



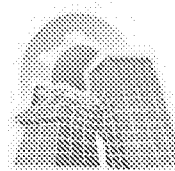
LAND NORTH OF HOOK LANE - PAGHAM



Energy Statement

6th December 2021

ARUN DISTRICT COUNCIL P/177/21/DOC
SEC/4055/ES-3702/-



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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6th December 2021

Report type:

Planning Condition Discharge: Supporting Document

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1.0 Introduction

- 1.1 This Energy Statement has been commissioned by Bellway Homes (the Applicant) and carried out by Southern Energy Consultants to respond to planning condition 26 of the outline planning consent (Ref: P/30/19/OUT, dated 2nd September 2019) for their development at Hook Lane, Pagham. In addition, a reserved matters application (Ref: P/132/20/RES) for the development received consent on 10th September 2021. The overall development is located within the Arun District Council authority boundary and includes the construction of up to 300 new dwellings of mixed type and tenure (30% affordable), a care home of up to 80 beds, D1 uses of up to 4,000 m², a primary school, new access provision, new pedestrian and cycle links, open space provision, landscaping, habitat creation, drainage and associated infrastructure works.
- 1.2 This Statement first details the contents of condition 26 and its underpinning policy, before, in subsequent Sections, proceeding to detail the Applicant's comprehensive response with respect to the 300 proposed dwellings.

Planning Condition 26

- 1.3 Planning Condition 26 states the following: *"At least 10% of the total predicted energy requirements for the development (taking into account energy efficiency measures) will be generated through renewable or low carbon energy generation on site. The Local Planning Authority will consider 'allowable solutions' where it is clearly demonstrated that the provision of on-site renewable or low carbon energy generation is unviable or unfeasible and where equivalent energy savings can be demonstrated. Details and a timetable of how this is to be achieved for the development hereby approved, including details of physical works on site, shall be submitted to and approved in writing by the Local Planning Authority before development of the dwellings hereby approved commences. The development shall be implemented in accordance with the approved details and timetable and will be retained as operational thereafter, unless otherwise agreed by the Local Planning Authority. "*
- 1.4 Condition 26 is justified through Policy ECC SP2 (Energy and Climate Change Mitigation) of Arun District Council's Local Plan (2018). This policy requires all major developments of 10 or more dwellings to incorporate decentralised, renewable and low carbon energy supply systems, which must be responsible for producing at least 10% of the total predicted energy requirements from renewable or low carbon energy generation on site. In addition, a Design Guide Supplementary Planning Document was adopted by Arun District Council in January 2021. Section K.01 reinforces

the 10% reduction target in Policy ECC SP2 and emphasises the importance of adhering to an energy hierarchy, whereby carbon dioxide emissions from new developments are reduced via energy efficiency measures prior to the introduction of renewable or low carbon energy generating technologies.

Summary of Requirements

- 1.5 This Statement will provide the Applicant's response to Policy ECC SP2, paying specific attention to the energy proposals for the site, which will utilise best practice energy efficiency techniques and renewable energy or low carbon technologies to reduce carbon dioxide emissions across the new development by at least 10% per annum.

Structure

- 1.6 Section 2 of this Statement calculates the baseline emissions for the development. These are the carbon dioxide emissions equivalent to the regulatory standard set by Part L1a of 2013 Building Regulations, encompassing the sources of space heating, hot water and fixed electrical items. Section 2 outlines the Applicant's best practice energy efficiency measures that will meet, and for most dwellings, exceed the emissions standard set by Part L1a. A feasibility study is then conducted to determine the most suitable renewable energy or low carbon technologies to deliver the sought-after 10% reduction in site-wide carbon dioxide emissions. In Section 3, a conclusion is provided, summarising projected emissions performance against the policy requirement for a 10% reduction in emissions to be delivered.

2.0 Building Design and Carbon Dioxide Emissions

Objectives of the energy strategy

- 2.1 All dwellings will be designed and built to meet or better the current emissions standard set by Part L1a of Building Regulations (2013) respectively. In order to meet this standard, all dwellings will incorporate enhanced energy efficiency measures. Standard Assessment Procedure (SAP) calculations, as required by Building Regulations, have been carried out by Southern Energy Consultants on all proposed dwelling types. This was carried out with the following aims in mind:

- (a) To first establish a regulatory baseline standard for carbon dioxide emissions in relation to the 300 proposed dwellings;

- (b) To appraise carbon dioxide emissions performance after energy efficiency measures in order to demonstrate the reduction in emissions delivered in comparison to the regulatory baseline standard;
- (c) To assess the residual emissions that must be offset through renewable or low carbon technologies to deliver a site-wide reduction of at least 10% compared to (a).

Carbon dioxide emissions baseline

- 2.2 A summary of the regulatory baseline calculation for the Hook Lane development is provided in Table 1:

Table 1: Baseline carbon dioxide emissions calculation for Hook Lane

Dwelling Type	Baseline Carbon Dioxide Emissions (KgCO ₂ /yr)	Number of Dwellings	Total Carbon Dioxide Emissions (KgCO ₂ /yr)
Private			
Slater	1,235	7	8,645
Cooper	1,244	22	27,368
Woodcarver	1,355	8	10,840
Coiner	1,396	25	34,900
Tailor	1,281	8	10,248
Thespian	1,579	6	9,474
Quilter	1,599	17	27,183
Tanner	1,625	4	6,500
Coppersmith	1,647	12	19,764
Blemmere	1,647	4	6,588
Framer	1,666	17	28,322
Mason	1,676	17	28,492
Sculptor	1,844	5	9,220
Bowyer	2,020	15	30,300
Goldsmith	2,185	14	30,590
Arkwright	2,240	23	51,520

Weaver	2,410	6	14,460
Sub-total		210	354,414
Affordable			
Souter	1,046	18	18,828
Glover	1,187	18	21,366
Baker	1,524	16	24,384
Romsey	1,765	12	21,180
Ploughwright	1,612	5	8,060
Tilman	1,596	15	23,940
Cartographer	1,729	6	10,374
Sub-total		90	128,132
TOTAL		300	482,546
Average per dwelling			1,608

Policy target

- 2.3 Based on the calculation in Table 1, site-wide carbon dioxide emissions are projected to be **482,546 kgCO₂/year**. Thus, in order to comply with the policy requirement to reduce site-wide emissions by at least 10%, this figure must be lowered by at least **48,255 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.
- 2.5 Table 2 overleaf illustrates the proposed U-values and the limiting area-weighted values set by Part L1a of 2013 Building Regulations.

Table 2: Insulation Enhancement Proposals

Thermal Element	Maximum Area-Weighted U-value (W/m ² K) Under 2013 Building Regulations	Proposed U-value (W/m ² K) Required to Meet 2013 Building Regulations Baseline	% Improvement on 2013 Allowable U-Value Standard
Main external walls	0.30	0.24	20.00
Roof (joists)	0.20	0.11	50.00
Ground floor	0.25	0.15	40.00
Windows	2.00	1.30	35.00

- 2.6 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):

Table 3: Fabric Enhancement Construction Specification

Construction Element	Delivered U-Value	Insulation Specification
Main external walls (houses)	0.24	302.5mm overall structural width comprising outer leaf of 102.5mm, 100mm cavity fully filled with blown mineral fibre insulation (thermal conductivity of 0.034 W/m ² K), and inner leaf of 100mm aerated block.
Party walls	0.00	Fully filled and sealed.
Roof (joists)	0.11	One layer of 100mm mineral wool insulation (thermal conductivity of 0.044 W/m ² K) laid between ceiling joists and one layer of 300mm mineral wool insulation (thermal conductivity of 0.044 W/m ² K) laid over to provide a total thickness of 400mm.
Ground floor	0.15	Beam and block construction to include 100mm insulation (thermal conductivity maximum of 0.022 W/m ² K) with 75mm screed topping.
Windows	1.30	Double-glazed windows with low 'e' soft coat glazing to specialist BFRC approved manufacturers design.

- 2.7 All insulating materials specified at the Hook Lane development will have an Ozone Depleting Potential of Zero and a Global Warming Potential of less than 5. It is intended that the development will utilise low Volatile Organic Compounds. These are usually solvents that have the capacity to rapidly evaporate. Once airborne they cause chemical or photochemical reactions in the atmosphere leading to the formation of smog containing, amongst other things, ground level ozone and can produce a number of physical problems such as eye and skin irritation, lung and breathing problems, headaches, nausea and muscle weakness. Preference will also be given to the specification of inert materials as they are non-toxic and easily re-used or recycled.
- 2.8 The performance standards and fabric measures detailed in Tables 2 and 3 will result in a reduced space heating requirement for the dwellings. The dwellings will also benefit from advanced heating controls through the installation of programmers, room thermostats, thermostatic radiator valves and dual zone controls. As such, it will be possible for future occupants to minimise the emissions associated with the heating operation of their home. The specified boiler for all dwellings will have a SEDBUK (2009) energy efficiency of at least 88.5% and are Class 5 for NOx emissions.
- 2.9 Air tightness standards will be improved by the Client adopting a mixture of Aircrete Product Association (APA) and Accredited Construction Details for non-repeating thermal bridges. These details incorporate an improvement over Building Regulations (2013) requirements by reducing air leakage loss and convective bypass of insulation. The Client will reduce each dwelling's design air permeability from 10 m³/hm² to not more than 5.01 m³/hm² to further reduce space heating requirements. It is not proposed to provide any mechanical cooling to the proposed dwellings. Instead it is the intention of the Client to reduce the need for active cooling as far as possible. This will be achieved through the specification of mainly non-mechanical measures such as good thermal insulation and an air tight build. Ventilation to the dwellings will be facilitated via the installation of highly efficient intermittent extract fans (System 1). In addition, the development will adopt a range of passive ventilation measures. Openable windows will help facilitate cross-ventilation, convective-ventilation and night purging.
- 2.10 All of the internal lighting throughout the development will be of the dedicated low energy type. External lighting will also be low energy and some will be controlled through PIR sensors or daylight cut-off devices.

Summary of outcomes after energy efficiency measures

- 2.11 Table 4 outlines the outcomes for carbon dioxide emissions and energy demand after the Applicant's adoption of the energy efficiency measures described in paragraphs 2.4 to 2.10. Emissions for each house type have been calculated by multiplying the Dwelling Emission Rate ($\text{kgCO}_2/\text{m}^2/\text{year}$) by its floor area, before these were aggregated according to the number of dwellings pertaining to each type and the overall site.

Outcome after best practice energy efficiency measures

- 2.5 Following the adoption of the measures above, site-wide emissions will be reduced from the baseline case of **482,546 $\text{kgCO}_2/\text{year}$** to **458,832 $\text{kgCO}_2/\text{year}$** , as set out in Table 4 below.

Table 4: Carbon dioxide emissions calculation for Hook Lane – after energy efficiency measures

Dwelling Type	Baseline Carbon Dioxide Emissions (KgCO_2/yr)	Number of Dwellings	Total Carbon Dioxide Emissions (KgCO_2/yr)
Private			
Slater	1,186	7	8,302
Cooper	1,188	22	26,136
Woodcarver	1,287	8	10,296
Coiner	1,326	25	33,150
Tailor	1,217	8	9,736
Thespian	1,579	6	9,474
Quilter	1,516	17	25,772
Tanner	1,542	4	6,168
Coppersmith	1,573	12	18,876
Blemmere	1,573	4	6,292
Framer	1,591	17	27,047
Mason	1,601	17	27,217
Sculptor	1,761	5	8,805
Bowyer	1,899	15	28,485
Goldsmith	2,054	14	28,756

Arkwright	2,106	23	48,438
Weaver	2,265	6	13,590
Sub-total		210	336,540
Affordable			
Souter	1,004	18	18,072
Glover	1,140	18	20,520
Baker	1,448	16	23,168
Romsey	1,683	12	20,196
Ploughwright	1,535	5	7,675
Tilman	1,519	15	22,785
Cartographer	1,646	6	9,876
Sub-total		90	122,292
TOTAL		300	458,832
Average per dwelling			1,529

2.12 The reduction against the baseline is **23,714 kgCO₂/year**, or **4.91%** in percentage terms. In order to deliver a reduction in site-wide emissions of at least **48,255 kgCO₂/year**, a further reduction of at least **24,541 kgCO₂/year** must now be delivered through either renewable energy or low carbon technologies.

Feasibility of renewable energy or low carbon technologies

2.13 The technologies to be evaluated in this Statement are as follows:

- District Heating / CHP
- Biomass
- Heat pumps (ground source and air source)
- Hydroelectric power
- Wind energy
- Solar thermal panels
- Solar photovoltaic panels

2.14 The Applicant has conducted a detailed review of the feasibility of installing Combined Heat and Power infrastructure (CHP) to serve the Hook Lane development. CHP is a form of district heating that generally uses gas to generate electricity for local consumption, reducing the need for grid electricity and its associated high carbon dioxide emissions. As the CHP system is close to the point of energy demand, it is possible to use the heat that is generated during the electricity generation process. While CHP would enable reductions in carbon dioxide emissions beyond the baseline case, the following reasons make it unsuited to this development:

- **Diversity and extent of heat demand** – CHP is best suited to developments where there is a diversity of energy demand. A mixed-use scheme built out in a single phase, or a very large residential scheme (>1,000 homes) will have extended periods of the day in which there is a continuous demand for heat. In these circumstances, the district heating network and CHP engine can operate consistently to generate electricity, with heat as a by-product. On a phased scheme such as this with no industrial demands, heat demand would be moderate and not continuous, especially during the working day, leading to an over-generation and subsequent dumping of heat.
- **Distributional heat losses** – thermal stores are a source of standing heat losses, as are even the best insulated distribution networks. When communal systems satisfy only a small and intermittent demand, these standing losses will represent a large part (>30%) of total demand. Carbon dioxide emissions savings gained within the dwellings through association with CHP may be considerably reduced by the additional heat losses associated with the network.
- **Plant room size and location** – to incorporate a central plant room would require a considerable amount of space. The most suitable location in terms of space would be one of the proposed areas of public open space, but the installation of such infrastructure would be in conflict with the Applicant's objective to deliver a vibrant and ecologically prosperous development with land uses suitable for children and young families. The noise emissions generated from plant infrastructure would also be high.
- **Minimised heat demands** – the Applicant's proposed energy strategy is based on the adoption of best practice standards for energy efficiency, an approach resulting in reduced space heating demands, which reduces the suitability of any district heating scheme.
- **Installed costs** – the installed cost of any CHP / district heating network benefit from economies of scale. However, pipe run costs remain approximately £1,000 per metre, and

total costs for CHP infrastructure across the site – predominantly from the plant room, CHP engine and pipe runs – would likely extend beyond £8 million for a scheme of this scale.

- **Running costs** – the fixed costs associated with the management and operation of a communal plant room would need to be shared by future occupants as part of an energy standing charge. The smaller the scheme, the greater the cost for the individual occupant, a particularly unfair situation in the light of the Applicant's commitment to provide 30% affordable housing. In addition, CHP engines impose additional running costs as contracts for maintenance and replacement costs are typically handled by specialist companies.
- **Absence of other local infrastructure** – there are no other CHP / district heating networks in the vicinity of the development with which to forge a connection to serve the development.

2.15 Biomass community heating is an alternative to conventional fossil fuel heating but, as per the reasons used against the installation of gas-fuelled CHP or district heating, should be discounted as an option at Hook Lane 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, especially the two bedroom houses. The management of fuel deliveries and ash dispersal is also complex, necessitating a dedicated operative as opposed to residents of the future dwellings at Hook Lane. 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 and ASHPs)

2.16 ASHPs are a potential technology that could be deployed but have not been considered by the Applicant for implementation across the site due to the potential for both noise and visually related impacts on the residents and surroundings. There is insufficient land available for sufficient boreholes to be drilled for GSHPs to represent a viable heating option for the apartments.

Hydroelectric power

2.17 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 Hook Lane development to facilitate a hydroelectric power installation.

Wind Turbines

- 2.18 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 Hook Lane development is 4.6m/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 and the rural surrounds. Furthermore, this technology could only generate significant reductions in carbon dioxide emissions for a small proportion of the 300 dwellings associated with the development.

Solar thermal and photovoltaic panels

- 2.19 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 some cases. This is because the smaller dwelling types, such as the various two bedroom houses, have very little space to accommodate a large hot water cylinder incorporating dedicated solar storage. In contrast, there are few constraints on the capacity for solar photovoltaic panels to deliver reductions in carbon dioxide emissions. For nearly all of the dwellings on the site, roof-space is available at no worse than a west-east orientation and there is sufficient roof-space available to accommodate up to 4-6 panels.

Impacts of strategy

- 2.20 Further SAP calculations have been undertaken which have verified that a total of 55 kWp of solar photovoltaic output is necessary for the Hook Lane development to deliver site-wide reductions in carbon dioxide emissions of at least 10%. This is equivalent to approximately 220 panels across the site. At this stage, the Applicant has not determined the location of panels, however, when

consulting with their solar engineer, preference will be given to maximising installations on roof-space of optimal, southerly orientation. Examples of the impact of providing installations of 0.50 kWp (2 panels) to plots 92 (Type Baker) and 107 (Type Mason) are provided in the Appendix to this Statement. Across the site, 55 kWp of solar photovoltaic output will reduce site-wide emissions by a further **24,750 kgCO₂/year**. As Table 4 depicts, in combination with the reductions in emissions of **23,714 kgCO₂/year** secured via best practice energy efficiency measures, the Applicant's proposed strategy is projected to deliver overall reductions of **48,464 kgCO₂/year**, which are equal to a **10.04%** decline compared to baseline emissions of **482,546 kgCO₂/year**.

Table 4: Emissions Reduction from Energy Efficiency Measures and Solar PV Installations – Hook Lane

	Emissions (kgCO ₂ /year)
Baseline	482,546
Reduction from energy efficiency measures	(23,714)
Reduction from 55 kWp solar PV output	(24,750)
Total reduction	(48,464)
Emissions after reductions	434,082
Overall percentage reduction from baseline	10.04

3. Conclusion

- 3.1 This Statement has set out the Applicant's energy strategy which has been developed to comply with the requirements of Policy ECC SP2 (Energy and Climate Change Mitigation) of Arun District Council's Local Plan (2018). These required the Applicant to deliver a 10% reduction in carbon dioxide emissions compared to the current standard set by Part L1a of Building Regulations.
- 3.2 The Applicant's priority was to minimise energy consumption at the point of demand through best practice fabric and energy efficiency measures, thus ensuring that reductions in emissions will persist over the lifetime of the development. The Applicant's strategy will be delivered through the installation of highly efficient fabric, ventilation and heating systems, together with the benefits of

passive solar gains and an air-tight build, all features which will help to lower the fuel bills of future occupants. In addition, 55 kWp of solar photovoltaic output will be installed to dwellings with optimal, south-facing roof-space. Overall, the Applicant's strategy of best practice energy efficiency measures and strategically located renewable energy installations will reduce carbon dioxide emissions by **10.04%** across the residential component of the Hook Lane development.

Appendix

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

Type Baker (Plot 92) with 0.5 kWp of solar PV output

Type Mason (Plot 107) with 0.5 kWp of solar PV output

FULL SAP CALCULATION PRINTOUT

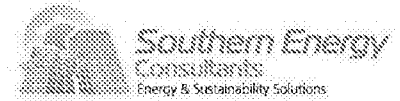
Calculation Type: New Build (As Designed)



Property Reference	SECH00092			Issued on Date	03/12/2021
Assessment Reference	001	Prop Type Ref	BA		
Property	Plot 92, Pagham, Bognor Regis, West Sussex, PO21				
SAP Rating	86 B	DER	15.53	TSE	18.80
Environmental	88 B	% DER<TER	17.40		
CO ₂ Emissions (t/year)	0.95	DFEE	48.49	TFEE	55.03
General Requirements Compliance	Pass	% DFEE<TFEE	11.88		
Assessor Details	Mr. Stephen Smith, Southern Energy Consultants Limited, Tel: [REDACTED]			Assessor ID	d168-0001
Client	Bellway Wessex				

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

DWELLING AS DESIGNED

Semi-Detached House, total floor area 81 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) 18.80 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.53 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)55.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)48.5 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.12 (max. 0.35)	OK
Openings	1.32 (max. 2.00)	1.50 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals: 5.00 (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

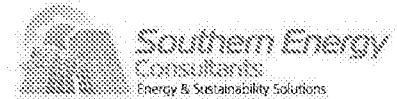
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading:
Average
Windows facing North East: 0.78 m², No overhang
Windows facing South East: 5.70 m², No overhang
Windows facing South West: 0.78 m², No overhang
Windows facing North West: 8.29 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.12 W/m²K
Floor U-value 0.11 W/m²K
Photovoltaic array 0.50 kW

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	40.6900 (1b)	x 2.4000 (2b)	= 97.6560 (1b) - (3b)
First floor	40.6000 (1c)	x 2.6500 (2c)	= 107.5900 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	81.2900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 205.2460 (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					4 * 10 = 40.0000 (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) =				40.0000 / (5) =	0.1949 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4449 (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) =		0.3782 (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	0.4821	0.4727	0.4632	0.4160	0.4065	0.3592	0.3592	0.3498	0.3782	0.4065	0.4254	0.4443 (22b)
Effective ac	0.6162	0.6117	0.6073	0.5865	0.5826	0.5645	0.5645	0.5612	0.5715	0.5826	0.5905	0.5987 (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 2 (Uw = 1.30)			15.5500	1.2357	19.2158		(27)
Opening Type 3			2.1200	1.5000	3.1800		(26a)
Heat Loss Floor 1			40.6900	0.1100	4.4759	75.0000	3051.7500 (28a)
Brick Faced	93.9300	17.6700	76.2600	0.2400	18.3024	60.0000	4575.6000 (29a)
Plane Roof	41.0600		41.0600	0.1100	4.5166	9.0000	369.5400 (30)
Flat Roof Kitchen/Diner	2.9200		2.9200	0.1200	0.3504	0.0000	0.0000 (31)
Total net area of external elements Aum(A, m ²)			178.6000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.0411		(33)
Party Wall 1			41.3500	0.0000	0.0000	45.0000	1860.7500 (32)
Internal Wall 2			163.5200			9.0000	1471.6800 (32c)
Internal Floor 1			41.0600			18.0000	739.0800 (32d)
Internal Ceiling 1			41.0600			18.0000	739.0800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	12807.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							157.5530 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.6215 (36)
Total fabric heat loss						(33) + (36) =	62.6626 (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	41.7382	41.4325	41.1328	39.7254	39.4621	38.2362	38.2362	38.0092	38.7084	39.4621	39.9948	40.5517 (38)
Average = Sum(39)m / 12 =	104.4008	104.0951	103.7954	102.3880	102.1247	100.8988	100.8988	100.6718	101.3710	102.1247	102.6574	103.2143 (39)
												102.3867 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2843	1.2805	1.2769	1.2595	1.2563	1.2412	1.2412	1.2384	1.2470	1.2563	1.2629	1.2697 (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												2.4869 (42)
Average daily hot water use (litres/day)												93.2634 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	102.5898	98.8593	95.1287	91.3982	87.6676	83.9371	83.9371	87.6676	91.3982	95.1287	98.8593	102.5898 (44)
Energy conte	152.1377	133.0606	137.3066	119.7072	114.8619	99.1171	91.8466	105.3953	106.6541	124.2950	135.6777	147.3372 (45)
Energy content (annual)										Total = Sum(45)m =		1467.3971 (45)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	22.8207	19.9591	20.5960	17.9561	17.2293	14.8676	13.7770	15.8093	15.9981	18.6443	20.3517	22.1006 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1217	12.7410	14.0700	13.5754	13.9982	13.5125	13.9416	13.9783	13.5468	14.0403	13.6347	14.1102 (61)
Total heat required for water heating calculated for each month	166.2594	145.8016	151.3767	133.2826	128.8602	112.6296	105.7882	119.3736	120.2008	138.3354	149.3124	161.4474 (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	166.2594	145.8016	151.3767	133.2826	128.8602	112.6296	105.7882	119.3736	120.2008	138.3354	149.3124	161.4474 (64)
Heat gains from water heating, kWh/month	54.1162	47.4279	49.1720	43.1965	41.6912	36.3346	34.0244	38.5385	38.8492	44.8382	48.5215	52.5172 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 1632.6678 (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	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.0461	17.8048	14.4798	10.9622	8.1943	6.9180	7.4752	9.7165	13.0415	16.5591	19.3269	20.6033 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	222.1155	224.4203	218.6122	206.2472	190.6387	175.9689	166.1686	163.8637	169.6719	182.0368	197.6454	212.3151 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344 (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)	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753 (71)
Water heating gains (Table 5)	72.7368	70.5772	66.0913	59.9951	56.0365	50.4647	45.7317	51.7991	53.9572	60.2664	67.3910	70.5876 (72)
Total internal gains	378.2017	376.1056	362.4866	340.5078	318.1728	296.6548	282.6787	288.6825	299.9738	322.1656	347.6665	366.8092 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W		
Northeast					0.7800	11.2829	0.4500	0.0000	0.7700	3.0494 (75)		
Southeast					5.7000	36.7938	0.4500	0.0000	0.7700	72.6697 (77)		
Southwest					0.7800	36.7938	0.4500	0.0000	0.7700	9.9443 (79)		
Northwest					8.2900	11.2829	0.4500	0.0000	0.7700	32.4101 (81)		
Solar gains	118.0734	212.9010	322.5855	452.1376	554.2952	571.3404	542.0716	462.6387	366.9423	243.7362	143.5697	99.6583 (83)
Total gains	496.2751	589.0065	685.0720	792.6453	872.4680	867.9952	824.7503	751.3212	666.9160	565.9018	491.2362	466.4676 (84)

7. Mean internal temperature (heating season)

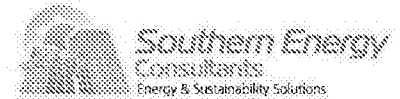
Temperature during heating periods in the living area from Table 9, Thl (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	34.0767	34.1768	34.2754	34.7466	34.8362	35.2594	35.2594	35.3389	35.0952	34.8362	34.6554	34.4684
alpha	3.2718	3.2785	3.2850	3.3164	3.3224	3.3506	3.3506	3.3559	3.3397	3.3224	3.3104	3.2979
util living area	0.9882	0.9787	0.9575	0.9042	0.8001	0.6463	0.5048	0.5633	0.7875	0.9383	0.9806	0.9903 (86)
MIT	19.0226	19.2634	19.6576	20.1708	20.6001	20.8648	20.9560	20.9364	20.7225	20.1560	19.5004	18.9854 (87)
Th 2	19.8532	19.8561	19.8590	19.8727	19.8752	19.8872	19.8872	19.8894	19.8826	19.8752	19.8700	19.8646 (88)
util rest of house	0.9855	0.9739	0.9475	0.8810	0.7514	0.5619	0.3906	0.4474	0.7177	0.9185	0.9754	0.9881 (89)
MIT 2	17.2307	17.5815	18.1514	18.8839	19.4580	19.7803	19.8648	19.8540	19.6316	18.8804	17.9372	17.1834 (90)
Living area fraction	17.6204	17.9473	18.4790	19.1638	19.7064	20.0162	20.1022	20.0894	19.8689	19.1578	18.2772	17.5753 (91)
Temperature adjustment												-0.1500
adjusted MIT	17.4704	17.7973	18.3290	19.0138	19.5564	19.8662	19.9522	19.9394	19.7189	19.0078	18.1272	17.4253 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9769	0.9612	0.9292	0.8588	0.7355	0.5602	0.3976	0.4530	0.7056	0.8978	0.9633	0.9807 (94)
Ext temp.	484.8234	566.1390	636.5440	680.7209	641.6649	486.2117	327.9491	340.3770	470.5745	508.0786	473.2070	457.4796 (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	1375.0008	1342.5469	1227.7921	1035.5323	802.3288	531.3489	338.2294	356.3180	569.5926	858.6428	1132.0250	1365.0402 (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	662.2920	521.7461	439.8886	255.4642	119.5339	0.0000	0.0000	0.0000	0.0000	260.8198	474.3490	675.2251 (98)
Space heating per m2												3409.3187 (98)
(98) / (4) = 41.9402 (99)												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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												3767.2030 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	662.2920	521.7461	439.8886	255.4642	119.5339	0.0000	0.0000	0.0000	0.0000	260.8198	474.3490	675.2251 (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)	731.8143	576.5151	486.0647	282.2809	132.0817	0.0000	0.0000	0.0000	0.0000	288.1987	524.1425	746.1051 (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	166.2594	145.8016	151.3767	133.2826	128.8602	112.6296	105.7882	119.3736	120.2008	138.3354	149.3124	161.4474 (64)
Efficiency of water heater (217)m	89.8392	89.7812	89.6586	89.3768	88.8112	87.3000	87.3000	87.3000	87.3000	89.3647	89.7127	89.8644 (217)
Fuel for water heating, kWh/month	185.0633	162.3965	168.8368	149.1244	145.0945	129.0144	121.1777	136.7395	137.6871	154.7986	166.4340	179.6567 (219)
Water heating fuel used												1836.0236 (219)
Annual totals kWh/year												
Space heating fuel - main system												3767.2030 (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)												354.0209 (232)
Energy saving/generation technologies (Appendices M,N and Q)												
PV Unit 0 (0.80 * 0.50 * 1029 * 0.80) =									-329.3397			-329.3397 (233)
Total delivered energy for all uses												5702.9077 (238)

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

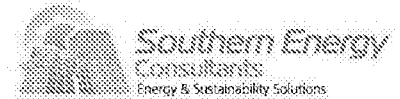
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3767.2030	0.2160	813.7158 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1836.0236	0.2160	396.5811 (264)
Space and water heating			1210.2969 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	354.0209	0.5190	183.7368 (268)
Energy saving/generation technologies			
PV Unit	-329.3397	0.5190	-170.9273 (269)
Total CO2, kg/year			1262.0315 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.5300 (273)

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

DER		15.5300 ZC1
Total Floor Area	TFA	81.2900
Assumed number of occupants	N	2.4869
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190
CO2 emissions from appliances, equation (L14)		16.1915 ZC2
CO2 emissions from cooking, equation (L16)		2.1981 ZC3
Total CO2 emissions		33.9197 ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000 ZC7
Net CO2 emissions		33.9197 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	40.6900 (1b)	x 2.4000 (2b)	= 97.6560 (1b) - (3b)
First floor	40.6000 (1c)	x 2.6500 (2c)	= 107.5900 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	81.2900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 205.2460 (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) = 0.1462 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3962 (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) =	0.3367 (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	0.4293	0.4209	0.4125	0.3704	0.3620	0.3199	0.3199	0.3115	0.3367	0.3620	0.3788	0.3957 (22b)
Effective ac	0.5922	0.5886	0.5851	0.5686	0.5655	0.5512	0.5512	0.5485	0.5567	0.5655	0.5718	0.5783 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Semi-glazed door			2.1200	1.2000	2.5440		(26a)
TER Opening Type (Uw = 1.40)			15.5500	1.3258	20.6155		(27)
Heat Loss Floor 1			40.6900	0.1300	5.2897		(28a)
Brick Faced	93.9300	17.6700	76.2600	0.1800	13.7268		(29a)
Plane Roof	41.0600		41.0600	0.1300	5.3378		(30)
Flat Roof Kitchen/Diner	2.9200		2.9200	0.1300	0.3796		(30)
Total net area of external elements Aum(A, m ²)			178.6000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.8934		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.8427 (36)
Total fabric heat loss						(33) + (36) =	58.7361 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	40.1083	39.8659	39.6283	38.5122	38.3034	37.3313	37.3313	37.1513	37.7058	38.3034	38.7258	39.1674 (38)
Heat transfer coeff	98.8444	98.6020	98.3644	97.2483	97.0395	96.0675	96.0675	95.8875	96.4419	97.0395	97.4619	97.9036 (39)
Average = Sum(39)m / 12 =												97.2473 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2159	1.2130	1.2100	1.1963	1.1937	1.1818	1.1818	1.1796	1.1864	1.1937	1.1989	1.2044 (40)
HLP (average)												1.1963 (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												2.4869 (42)
Average daily hot water use (litres/day)												93.2634 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	102.5898	98.8593	95.1287	91.3982	87.6676	83.9371	83.9371	87.6676	91.3982	95.1287	98.8593	102.5898 (44)
Energy conte	152.1377	133.0606	137.3066	119.7072	114.8619	99.1171	91.8466	105.3953	106.6541	124.2950	135.6777	147.3372 (45)
Energy content (annual)										Total = Sum(45)m =		1467.3971 (45)
Distribution loss (46)m = 0.15 x (45)m	22.8207	19.9591	20.5960	17.9561	17.2293	14.8676	13.7770	15.8093	15.9981	18.6443	20.3517	22.1006 (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

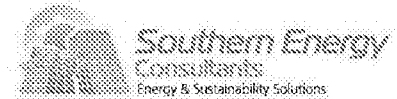
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 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	50.9589	45.5023	48.4765	45.0731	44.6745	41.3936	42.7734	44.6745	45.0731	48.4765	48.7525	50.9589 (61)
Total heat required for water heating calculated for each month	203.0966	178.5629	185.7832	164.7803	159.5364	140.5108	134.6200	150.0698	151.7271	172.7716	184.4302	198.2961 (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	203.0966	178.5629	185.7832	164.7803	159.5364	140.5108	134.6200	150.0698	151.7271	172.7716	184.4302	198.2961 (64)
Heat gains from water heating, kWh/month	63.3255	55.6182	57.7736	51.0709	49.3602	43.3049	41.2323	46.2126	46.7307	53.4472	57.3010	61.7294 (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	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.0461	17.8048	14.4798	10.9622	8.1943	6.9180	7.4752	9.7165	13.0415	16.5591	19.3269	20.6033 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	222.1155	224.4203	218.6122	206.2472	190.6387	175.9689	166.1686	163.8637	169.6719	182.0368	197.6454	212.3151 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344 (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)	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753 (71)
Water heating gains (Table 5)	85.1149	82.7652	77.6527	70.9318	66.3444	60.1456	55.4198	62.1136	64.9038	71.8377	79.5847	82.9696 (72)
Total internal gains	390.5798	388.2936	374.0479	351.4445	328.4807	306.3358	292.3668	298.9971	310.9204	333.7369	359.8602	379.1912 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d			Gains W
Northeast					0.7800	11.2829	0.6300	0.7000	0.7700			2.6896 (75)
Southeast					5.7000	36.7938	0.6300	0.7000	0.7700			64.0946 (77)
Southwest					0.7800	36.7938	0.6300	0.7000	0.7700			8.7708 (79)
Northwest					8.2900	11.2829	0.6300	0.7000	0.7700			28.5857 (81)
Solar gains	104.1408	187.7787	284.5204	398.7853	488.8884	503.9222	478.1071	408.0473	323.6431	214.9753	126.6285	87.8987 (83)
Total gains	494.7205	576.0722	658.5683	750.2298	817.3691	810.2580	770.4740	707.0444	634.5635	548.7122	486.4887	467.0899 (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	57.1114	57.2518	57.3901	58.0487	58.1736	58.7622	58.7622	58.8725	58.5341	58.1736	57.9215	57.6602
alpha	4.8074	4.8168	4.8260	4.8699	4.8782	4.9175	4.9175	4.9248	4.9023	4.8782	4.8614	4.8440
util living area	0.9979	0.9952	0.9869	0.9564	0.8682	0.7003	0.5353	0.5994	0.8497	0.9760	0.9956	0.9984 (86)
MIT	19.6791	19.8415	20.1128	20.4739	20.7790	20.9455	20.9882	20.9801	20.8551	20.4571	20.0033	19.6519 (87)
Th 2	19.9073	19.9096	19.9120	19.9230	19.9250	19.9346	19.9346	19.9364	19.9309	19.9250	19.9208	19.9165 (88)
util rest of house	0.9971	0.9935	0.9822	0.9398	0.8199	0.6063	0.4125	0.4728	0.7768	0.9638	0.9937	0.9978 (89)
MIT 2	18.1526	18.3912	18.7864	19.3073	19.7101	19.8989	19.9304	19.9283	19.8142	19.2937	18.6360	18.1193 (90)
Living area fraction									fLA = Living area / (4) =			0.2175 (91)
MIT	18.4846	18.7066	19.0749	19.5610	19.9426	20.1265	20.1604	20.1571	20.0406	19.5467	18.9334	18.4526 (92)
Temperature adjustment												0.0000
adjusted MIT	18.4846	18.7066	19.0749	19.5610	19.9426	20.1265	20.1604	20.1571	20.0406	19.5467	18.9334	18.4526 (93)

8. Space heating requirement

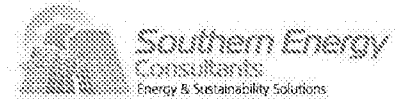
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9957	0.9908	0.9771	0.9327	0.8208	0.6245	0.4393	0.5003	0.7855	0.9579	0.9912	0.9967 (94)
Useful gains	492.5754	570.7584	643.4829	699.7654	670.8712	505.9836	338.5070	353.7527	498.4622	525.6239	482.2278	465.5382 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1402.0710	1361.3600	1236.9231	1036.7682	799.8546	530.9213	342.0428	360.2560	572.9221	868.1866	1153.3013	1395.3810 (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	676.6648	531.2843	441.5195	242.6420	95.9636	0.0000	0.0000	0.0000	0.0000	254.8667	483.1729	691.8030 (98)
Space heating												3417.9167 (98)
Space heating per m2										(98) / (4) =		42.0460 (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

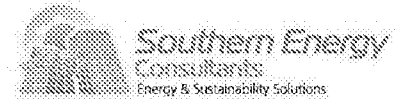
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												93.4000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												3659.4397 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	676.6648	531.2843	441.5195	242.6420	95.9636	0.0000	0.0000	0.0000	0.0000	254.8667	483.1729	691.8030 (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)	724.4805	568.8269	472.7189	259.7880	102.7448	0.0000	0.0000	0.0000	0.0000	272.8765	517.3157	740.6884 (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	203.0966	178.5629	185.7832	164.7803	159.5364	140.5108	134.6200	150.0698	151.7271	172.7716	184.4302	198.2961 (64)
Efficiency of water heater (217)m	87.8492	87.6275	87.1535	86.0239	83.8172	80.3000	80.3000	80.3000	80.3000	86.0284	87.3643	80.3000 (216)
Fuel for water heating, kWh/month	231.1878	203.7750	213.1678	191.5517	190.3384	174.9823	167.6463	186.8864	188.9503	200.8309	211.1047	225.5006 (219)
Water heating fuel used												2385.9225 (219)
Annual totals kWh/year												
Space heating fuel - main system												3659.4397 (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)												354.0209 (232)
Total delivered energy for all uses												6474.3831 (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	3659.4397	0.2160	790.4390 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2385.9225	0.2160	515.3593 (264)
Space and water heating			1305.7982 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	354.0209	0.5190	183.7368 (268)
Total CO2, kg/m2/year			1528.4601 (272)
Emissions per m2 for space and water heating			16.0635 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.2603 (272b)
Emissions per m2 for pumps and fans			0.4788 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.0635 * 1.00) + 2.2603 + 0.4788, rounded to 2 d.p.			18.8000 (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	40.6900 (1b)	x 2.4000 (2b)	= 97.6560 (1b) - (3b)
First floor	40.6000 (1c)	x 2.6500 (2c)	= 107.5900 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	81.2900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 205.2460 (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) = 0.1462 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3962 (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)	=	0.3367 (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	0.4293	0.4209	0.4125	0.3704	0.3620	0.3199	0.3199	0.3115	0.3367	0.3620	0.3788	0.3957 (22b)
Effective ac	0.5922	0.5886	0.5851	0.5686	0.5655	0.5512	0.5512	0.5485	0.5567	0.5655	0.5718	0.5783 (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 2 (Uw = 1.30)			15.5500	1.2357	19.2158		(27)
Opening Type 3			2.1200	1.5000	3.1800		(26a)
Heat Loss Floor 1			40.6900	0.1100	4.4759	75.0000	3051.7500 (28a)
Brick Faced	93.9300	17.6700	76.2600	0.2400	18.3024	60.0000	4575.6000 (29a)
Plane Roof	41.0600		41.0600	0.1100	4.5166	9.0000	369.5400 (30)
Flat Roof Kitchen/Diner	2.9200		2.9200	0.1200	0.3504	0.0000	0.0000 (31)
Total net area of external elements Aum(A, m ²)			178.6000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.0411		(33)
Party Wall 1			41.3500	0.0000	0.0000	45.0000	1860.7500 (32)
Internal Wall 2			163.5200			9.0000	1471.6800 (32c)
Internal Floor 1			41.0600			18.0000	739.0800 (32d)
Internal Ceiling 1			41.0600			9.0000	369.5400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	12437.9400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							153.0070 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.6215 (36)
Total fabric heat loss						(33) + (36) =	62.6626 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	40.1083	39.8659	39.6283	38.5122	38.3034	37.3313	37.3313	37.1513	37.7058	38.3034	38.7258	39.1674 (38)
Heat transfer coeff	102.7709	102.5285	102.2909	101.1748	100.9660	99.9939	99.9939	99.8139	100.3684	100.9660	101.3884	101.8300 (39)
Average = Sum(39)m / 12 =												101.1738 (39)
HLP	1.2642	1.2613	1.2583	1.2446	1.2420	1.2301	1.2301	1.2279	1.2347	1.2420	1.2472	1.2527 (40)
HLP (average)												1.2446 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

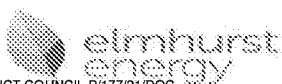
Assumed occupancy												2.4869 (42)
Average daily hot water use (litres/day)												93.2634 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.5898	98.8593	95.1287	91.3982	87.6676	83.9371	83.9371	87.6676	91.3982	95.1287	98.8593	102.5898 (44)
Energy conte	152.1377	133.0606	137.3066	119.7072	114.8619	99.1171	91.8466	105.3953	106.6541	124.2950	135.6777	147.3372 (45)
Energy content (annual)										Total = Sum(45)m =		1467.3971 (45)

Regs Region: England

Elmhurst Energy Systems

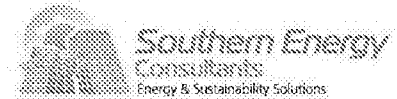
SAP2012 Calculator (Design

System) version 4.14r19



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	32.3293	28.2754	29.1777	25.4378	24.4082	21.0624	19.5174	22.3965	22.6640	26.4127	28.8315	31.3092 (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	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.0461	17.8048	14.4798	10.9622	8.1943	6.9180	7.4752	9.7165	13.0415	16.5591	19.3269	20.6033	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	222.1155	224.4203	218.6122	206.2472	190.6387	175.9689	166.1686	163.8637	169.6719	182.0368	197.6454	212.3151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	(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)	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	(71)
Water heating gains (Table 5)	43.4533	42.0765	39.2173	35.3303	32.8067	29.2533	26.2331	30.1028	31.4778	35.5009	40.0438	42.0822	(72)
Total internal gains	345.9181	344.6048	332.6125	312.8429	291.9430	272.4435	260.1800	263.9863	274.4944	294.4001	317.3193	335.3039	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	0.7800	11.2829	0.4500	0.0000	0.7700	3.0494 (75)
Southeast	5.7000	36.7938	0.4500	0.0000	0.7700	72.6697 (77)
Southwest	0.7800	36.7938	0.4500	0.0000	0.7700	9.9443 (79)
Northwest	8.2900	11.2829	0.4500	0.0000	0.7700	32.4101 (81)

Solar gains	118.0734	212.9010	322.5855	452.1376	554.2952	571.3404	542.0716	462.6387	366.9423	243.7362	143.5697	99.6583 (83)
Total gains	463.9916	557.5058	655.1980	764.9805	846.2382	843.7839	802.2516	726.6250	641.4366	538.1363	460.8890	434.9622 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	33.6183	33.6978	33.7761	34.1487	34.2193	34.5519	34.5519	34.6142	34.4230	34.2193	34.0767	33.9289
alpha	3.2412	3.2465	3.2517	3.2766	3.2813	3.3035	3.3035	3.3076	3.2949	3.2813	3.2718	3.2619
util living area	0.9894	0.9803	0.9596	0.9072	0.8046	0.6528	0.5116	0.5727	0.7957	0.9423	0.9825	0.9914 (86)
MIT	18.9661	19.2122	19.6154	20.1379	20.5800	20.8545	20.9518	20.9298	20.7030	20.1166	19.4458	18.9238 (87)
Th 2	19.8689	19.8713	19.8736	19.8845	19.8865	19.8960	19.8960	19.8978	19.8923	19.8865	19.8824	19.8781 (88)
util rest of house	0.9871	0.9759	0.9503	0.8851	0.7573	0.5696	0.3977	0.4574	0.7281	0.9240	0.9779	0.9895 (89)
MIT 2	18.0213	18.2669	18.6659	19.1783	19.5844	19.8162	19.8789	19.8704	19.7060	19.1700	18.5088	17.9859 (90)
Living area fraction									fLA = Living area /	(4) =		0.2175 (91)
MIT	18.2268	18.4725	18.8724	19.3870	19.8009	20.0420	20.1122	20.1008	19.9228	19.3759	18.7126	18.1899 (92)
Temperature adjustment												0.0000
adjusted MIT	18.2268	18.4725	18.8724	19.3870	19.8009	20.0420	20.1122	20.1008	19.9228	19.3759	18.7126	18.1899 (93)

8. Space heating requirement

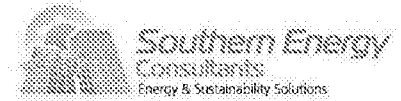
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9823	0.9686	0.9396	0.8732	0.7532	0.5815	0.4212	0.4802	0.7303	0.9133	0.9712	0.9854 (94)
Useful gains	455.7810	539.9965	615.6406	667.9575	637.4013	490.7024	337.9282	348.9037	468.4289	491.4779	447.6090	428.6186 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1431.2662	1391.5686	1265.5815	1061.0201	817.9197	544.1677	351.2000	369.3913	584.4290	886.0660	1177.3855	1424.5903 (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	725.7610	572.2565	483.5560	283.0051	134.3057	0.0000	0.0000	0.0000	0.0000	293.5736	525.4391	741.0029 (98)
Space heating												3758.8998 (98)
Space heating per m2										(98) / (4) =		46.2406 (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	939.9431	739.9552	758.5859	0.0000	0.0000	0.0000	0.0000 (100)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

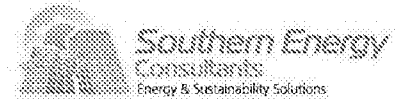


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8176	0.8752	0.8431	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	768.4703	647.6436	639.5778	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1079.1348	1028.6698	941.8591	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												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	223.6784	283.4834	224.8973	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												732.0592 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
Intermittency factor	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												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	55.9196	70.8709	56.2243	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												183.0148 (107)
Space cooling per m2												2.2514 (108)
Energy for space heating												46.2406 (99)
Energy for space cooling												2.2514 (108)
Total												48.4920 (109)
Dwelling Fabric Energy Efficiency (DFEE)												48.5 (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	40.6900 (1b)	x 2.4000 (2b)	= 97.6560 (1b) - (3b)
First floor	40.6000 (1c)	x 2.6500 (2c)	= 107.5900 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	81.2900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 205.2460 (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) = 0.1462 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3962 (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) =	0.3367 (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	0.4293	0.4209	0.4125	0.3704	0.3620	0.3199	0.3199	0.3115	0.3367	0.3620	0.3788	0.3957 (22b)
Effective ac	0.5922	0.5886	0.5851	0.5686	0.5655	0.5512	0.5512	0.5485	0.5567	0.5655	0.5718	0.5783 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Semi-glazed door			2.1200	1.2000	2.5440		(26a)
TER Opening Type (Uw = 1.40)			15.5500	1.3258	20.6155		(27)
Heat Loss Floor 1			40.6900	0.1300	5.2897		(28a)
Brick Faced	93.9300	17.6700	76.2600	0.1800	13.7268		(29a)
Plane Roof	41.0600		41.0600	0.1300	5.3378		(30)
Flat Roof Kitchen/Diner	2.9200		2.9200	0.1300	0.3796		(30)
Total net area of external elements Aum(A, m ²)			178.6000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.8934		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.8427 (36)
Total fabric heat loss						(33) + (36) =	58.7361 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	40.1083	39.8659	39.6283	38.5122	38.3034	37.3313	37.3313	37.1513	37.7058	38.3034	38.7258	39.1674 (38)
Heat transfer coeff	98.8444	98.6020	98.3644	97.2483	97.0395	96.0675	96.0675	95.8875	96.4419	97.0395	97.4619	97.9036 (39)
Average = Sum(39)m / 12 =												97.2473 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2159	1.2130	1.2100	1.1963	1.1937	1.1818	1.1818	1.1796	1.1864	1.1937	1.1989	1.2044 (40)
HLP (average)												1.1963 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

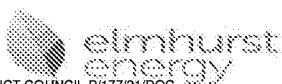
Assumed occupancy												2.4869 (42)
Average daily hot water use (litres/day)												93.2634 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	102.5898	98.8593	95.1287	91.3982	87.6676	83.9371	83.9371	87.6676	91.3982	95.1287	98.8593	102.5898 (44)
Energy conte	152.1377	133.0606	137.3066	119.7072	114.8619	99.1171	91.8466	105.3953	106.6541	124.2950	135.6777	147.3372 (45)
Energy content (annual)										Total = Sum(45)m =		1467.3971 (45)
Distribution loss (46)m = 0.15 x (45)m												
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 4.14r19



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET 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	32.3293	28.2754	29.1777	25.4378	24.4082	21.0624	19.5174	22.3965	22.6640	26.4127	28.8315	31.3092 (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	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	124.3441	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.0461	17.8048	14.4798	10.9622	8.1943	6.9180	7.4752	9.7165	13.0415	16.5591	19.3269	20.6033	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	222.1155	224.4203	218.6122	206.2472	190.6387	175.9689	166.1686	163.8637	169.6719	182.0368	197.6454	212.3151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	35.4344	(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)	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	(71)
Water heating gains (Table 5)	43.4533	42.0765	39.2173	35.3303	32.8067	29.2533	26.2331	30.1028	31.4778	35.5009	40.0438	42.0822	(72)
Total internal gains	345.9181	344.6048	332.6125	312.8429	291.9430	272.4435	260.1800	263.9863	274.4944	294.4001	317.3193	335.3039	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	0.7800	11.2829	0.6300	0.7000	0.7700	2.6896 (75)
Southeast	5.7000	36.7938	0.6300	0.7000	0.7700	64.0946 (77)
Southwest	0.7800	36.7938	0.6300	0.7000	0.7700	8.7708 (79)
Northwest	8.2900	11.2829	0.6300	0.7000	0.7700	28.5857 (81)

Solar gains	104.1408	187.7787	284.5204	398.7853	488.8884	503.9222	478.1071	408.0473	323.6431	214.9753	126.6285	87.8987	(83)
Total gains	450.0589	532.3835	617.1329	711.6282	780.8314	776.3657	738.2872	672.0336	598.1374	509.3754	443.9478	423.2025	(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	57.1114	57.2518	57.3901	58.0487	58.1736	58.7622	58.7622	58.8725	58.5341	58.1736	57.9215	57.6602	
alpha	4.8074	4.8168	4.8260	4.8699	4.8782	4.9175	4.9175	4.9248	4.9023	4.8782	4.8614	4.8440	
util living area	0.9986	0.9965	0.9900	0.9640	0.8839	0.7220	0.5562	0.6254	0.8716	0.9820	0.9970	0.9990	(86)
MIT	19.6286	19.7927	20.0682	20.4378	20.7567	20.9377	20.9861	20.9761	20.8346	20.4166	19.9556	19.6020	(87)
Th 2	19.9073	19.9096	19.9120	19.9230	19.9250	19.9346	19.9346	19.9364	19.9309	19.9250	19.9208	19.9165	(88)
util rest of house	0.9981	0.9953	0.9862	0.9498	0.8389	0.6283	0.4298	0.4958	0.8040	0.9726	0.9958	0.9986	(89)
MIT 2	18.6589	18.8244	19.0999	19.4692	19.7609	19.9062	19.9311	19.9296	19.8374	19.4557	18.9962	18.6397	(90)
Living area fraction									fLA = Living area / (4) =			0.2175	(91)
MIT	18.8698	19.0350	19.3105	19.6798	19.9775	20.1305	20.1606	20.1572	20.0543	19.6647	19.2049	18.8490	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8698	19.0350	19.3105	19.6798	19.9775	20.1305	20.1606	20.1572	20.0543	19.6647	19.2049	18.8490	(93)

8. Space heating requirement

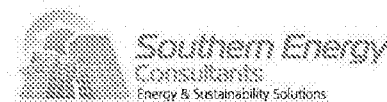
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	448.9038	529.1800	606.9277	673.0062	656.9959	502.2528	337.8365	352.3174	486.4093	493.8272	441.5477	422.3945	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1440.1461	1393.7429	1260.0935	1048.3213	803.2451	531.3058	342.0570	360.2706	574.2429	879.6298	1179.7625	1434.1896	(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	737.4843	580.9863	485.9554	270.2268	108.8094	0.0000	0.0000	0.0000	0.0000	287.0372	531.5147	752.7756	(98)
Space heating												3754.7896	(98)
Space heating per m2										(98) / (4) =		46.1901	(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	903.0343	710.8993	728.7448	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8705	0.9272	0.8984	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	786.1185	659.1630	654.7225	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1000.3344	953.9061	878.0510	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													

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

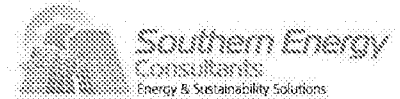


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	154.2354	219.2889	166.1564	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												539.6808 (104)
Cooled fraction									FC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	38.5589	54.8222	41.5391	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												134.9202 (107)
Space cooling per m2												1.6597 (108)
Energy for space heating												46.1901 (99)
Energy for space cooling												1.6597 (108)
Total												47.8498 (109)
Target Fabric Energy Efficiency (TFEE)												55.0 (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	40.6900 (1b)	x 2.4000 (2b)	= 97.6560 (1b) - (3b)
First floor	40.6000 (1c)	x 2.6500 (2c)	= 107.5900 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	81.2900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 205.2460 (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					4 * 10 = 40.0000 (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)					40.0000 / (5) = 0.1949 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4449 (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)	=	0.3782 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.6000	5.1000	4.8000	4.5000	4.7000	4.2000	4.4000	4.2000	4.4000	4.8000	4.9000	5.1000 (22)
Wind factor	1.4000	1.2750	1.2000	1.1250	1.1750	1.0500	1.1000	1.0500	1.1000	1.2000	1.2250	1.2750 (22a)
Adj infilt rate	0.5294	0.4821	0.4538	0.4254	0.4443	0.3971	0.4160	0.3971	0.4160	0.4538	0.4632	0.4821 (22b)
Effective ac	0.6401	0.6162	0.6030	0.5905	0.5987	0.5788	0.5865	0.5788	0.5865	0.6030	0.6073	0.6162 (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 2 (Uw = 1.30)			15.5500	1.2357	19.2158		(27)
Opening Type 3			2.1200	1.5000	3.1800		(26a)
Heat Loss Floor 1			40.6900	0.1100	4.4759	75.0000	3051.7500 (28a)
Brick Faced	93.9300	17.6700	76.2600	0.2400	18.3024	60.0000	4575.6000 (29a)
Plane Roof	41.0600		41.0600	0.1100	4.5166	9.0000	369.5400 (30)
Flat Roof Kitchen/Diner	2.9200		2.9200	0.1200	0.3504	0.0000	0.0000 (31)
Total net area of external elements Aum(A, m ²)			178.6000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.0411		(33)
Party Wall 1			41.3500	0.0000	0.0000	45.0000	1860.7500 (32)
Internal Wall 2			163.5200			9.0000	1471.6800 (32c)
Internal Floor 1			41.0600			18.0000	739.0800 (32d)
Internal Ceiling 1			41.0600			18.0000	739.0800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	12807.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							157.5530 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.6215 (36)
Total fabric heat loss						(33) + (36) =	62.6626 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	43.3575	41.7382	40.6392	39.9948	40.5517	39.2048	39.7254	39.2048	39.7254	40.6392	41.1328	41.7382 (38)
Heat transfer coeff	106.0201	104.4008	103.5018	102.6574	103.2143	101.8674	102.3880	101.8674	102.3880	103.5018	103.7954	104.4008 (39)
Average = Sum(39)m / 12 =												103.3336 (39)
HLP	1.3042	1.2843	1.2732	1.2629	1.2697	1.2531	1.2595	1.2531	1.2595	1.2732	1.2769	1.2843 (40)
HLP (average)												1.2712 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

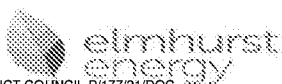
Assumed occupancy												2.4869 (42)
Average daily hot water use (litres/day)												93.2634 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.5898	98.8593	95.1287	91.3982	87.6676	83.9371	83.9371	87.6676	91.3982	95.1287	98.8593	102.5898 (44)
Energy conte	152.1377	133.0606	137.3066	119.7072	114.8619	99.1171	91.8466	105.3953	106.6541	124.2950	135.6777	147.3372 (45)
Energy content (annual)										Total = Sum(45)m =		1467.3971 (45)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	22.8207	19.9591	20.5960	17.9561	17.2293	14.8676	13.7770	15.8093	15.9981	18.6443	20.3517	22.1006 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1217	12.7410	14.0700	13.5754	13.9982	13.5125	13.9416	13.9783	13.5468	14.0403	13.6347	14.1102 (61)
Total heat required for water heating calculated for each month	166.2594	145.8016	151.3767	133.2826	128.8602	112.6296	105.7882	119.3736	120.2008	138.3354	149.3124	161.4474 (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	166.2594	145.8016	151.3767	133.2826	128.8602	112.6296	105.7882	119.3736	120.2008	138.3354	149.3124	161.4474 (64)
RHI water heating demand												
Heat gains from water heating, kWh/month	54.1162	47.4279	49.1720	43.1965	41.6912	36.3346	34.0244	38.5385	38.8492	44.8382	48.5215	52.5172 (65)
												1633 (64)
												0.0000 (63)
												Sum(63)m =
												1632.6678 (64)
												1633 (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
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	50.1153	44.5120	36.1996	27.4054	20.4859	17.2950	18.6879	24.2912	32.6036	41.3978	48.3173	51.5082 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	331.5156	334.9557	326.2868	307.8317	284.5354	262.6402	248.0128	244.5727	253.2417	271.6968	294.9931	316.8883 (68)
Pumps, fans	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082 (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)	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753 (71)
Total internal gains	72.7368	70.5772	66.0913	59.9951	56.0365	50.4647	45.7317	51.7991	53.9572	60.2664	67.3910	70.5876 (72)
	559.5136	555.1907	533.7235	500.3780	466.2036	435.5457	417.5782	425.8089	444.9483	478.5068	515.8472	544.1299 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
Northeast					0.7800	15.8975	0.4500	0.0000	0.7700		4.2966 (75)	
Southeast					5.7000	48.9171	0.4500	0.0000	0.7700		96.6137 (77)	
Southwest					0.7800	48.9171	0.4500	0.0000	0.7700		13.2208 (79)	
Northwest					8.2900	15.8975	0.4500	0.0000	0.7700		45.6653 (81)	
Solar gains	159.7964	241.5158	368.1132	539.6873	642.0082	711.2739	670.3929	573.5583	451.2689	298.2153	186.4811	130.7072 (83)
Total gains	719.3100	796.7065	901.8367	1040.0654	1108.2118	1146.8195	1087.9711	999.3671	896.2172	776.7221	702.3283	674.8370 (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	33.5562	34.0767	34.3727	34.6554	34.4684	34.9242	34.7466	34.9242	34.7466	34.3727	34.0767	34.0767
alpha	3.2371	3.2718	3.2915	3.3104	3.2979	3.3283	3.3164	3.3283	3.3164	3.2915	3.2850	3.2718
util living area	0.9580	0.9430	0.9010	0.8049	0.6502	0.4571	0.3238	0.3304	0.5625	0.8123	0.9274	0.9628 (86)
MIT	19.5515	19.7143	20.0747	20.5041	20.8172	20.9588	20.9903	20.9905	20.9226	20.6062	20.0605	19.5540 (87)
Th 2	19.8375	19.8532	19.8619	19.8700	19.8646	19.8777	19.8727	19.8777	19.8727	19.8619	19.8590	19.8532 (88)
util rest of house	0.9485	0.9307	0.8799	0.7657	0.5839	0.3704	0.2221	0.2208	0.4639	0.7596	0.9082	0.9542 (89)
MIT 2	17.9839	18.2243	18.7356	19.3184	19.6982	19.8522	19.8696	19.8750	19.8221	19.4632	18.7261	17.9987 (90)
Living area fraction	18.3249	18.5483	19.0268	19.5762	19.9416	20.0929	20.1134	20.1176	20.0615	19.7118	19.0164	18.3370 (91)
MIT	18.3249	18.5483	19.0268	19.5762	19.9416	20.0929	20.1134	20.1176	20.0615	19.7118	19.0164	18.3370 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.1749	18.3983	18.8768	19.4262	19.7916	19.9429	19.9634	19.9676	19.9115	19.5618	18.8664	18.1870 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9300	0.9101	0.8573	0.7480	0.5793	0.3756	0.2304	0.2298	0.4675	0.7432	0.8864	0.9368 (94)
Ext temp.	668.9227	725.0949	773.1008	777.9556	641.9664	430.8004	250.6962	229.6399	418.9899	577.2239	622.5570	632.1969 (95)
Heat loss rate W	5.8000	6.0000	7.5000	9.8000	12.9000	15.6000	17.5000	17.7000	15.6000	12.5000	9.0000	6.0000 (96)
Month fracti	1311.9848	1294.3975	1177.5234	988.2043	711.3071	442.3988	252.2190	230.9984	441.4415	730.9136	1024.0839	1272.3297 (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)
RHI space heating demand	478.4382	382.5713	300.8905	151.3790	51.5894	0.0000	0.0000	0.0000	0.0000	114.3451	289.0994	476.2588 (98)
												2244.5717 (98)
												2245 (98)

FULL SAP CALCULATION PRINTOUT

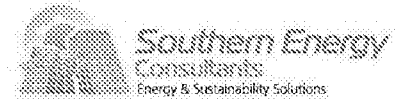
Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

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	40.6900 (1b)	x 2.4000 (2b)	= 97.6560 (1b) - (3b)
First floor	40.6000 (1c)	x 2.6500 (2c)	= 107.5900 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	81.2900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 205.2460 (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					4 * 10 = 40.0000 (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) =				40.0000 / (5) =	0.1949 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4449 (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) =		0.3782 (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	0.4821	0.4727	0.4632	0.4160	0.4065	0.3592	0.3592	0.3498	0.3782	0.4065	0.4254	0.4443 (22b)
Effective ac	0.6162	0.6117	0.6073	0.5865	0.5826	0.5645	0.5645	0.5612	0.5715	0.5826	0.5905	0.5987 (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 2 (Uw = 1.30)			15.5500	1.2357	19.2158		(27)
Opening Type 3			2.1200	1.5000	3.1800		(26a)
Heat Loss Floor 1			40.6900	0.1100	4.4759	75.0000	3051.7500 (28a)
Brick Faced	93.9300	17.6700	76.2600	0.2400	18.3024	60.0000	4575.6000 (29a)
Plane Roof	41.0600		41.0600	0.1100	4.5166	9.0000	369.5400 (30)
Flat Roof Kitchen/Diner	2.9200		2.9200	0.1200	0.3504	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m ²)			178.6000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.0411		(33)
Party Wall 1			41.3500	0.0000	0.0000	45.0000	1860.7500 (32)
Internal Wall 2			163.5200			9.0000	1471.6800 (32c)
Internal Floor 1			41.0600			18.0000	739.0800 (32d)
Internal Ceiling 1			41.0600			18.0000	739.0800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	12807.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							157.5530 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.6215 (36)
Total fabric heat loss						(33) + (36) =	62.6626 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	41.7382	41.4325	41.1328	39.7254	39.4621	38.2362	38.2362	38.0092	38.7084	39.4621	39.9948	40.5517 (38)
Heat transfer coeff	104.4008	104.0951	103.7954	102.3880	102.1247	100.8988	100.8988	100.6718	101.3710	102.1247	102.6574	103.2143 (39)
Average = Sum(39)m / 12 =												102.3867 (39)
HLP	1.2843	1.2805	1.2769	1.2595	1.2563	1.2412	1.2412	1.2384	1.2470	1.2563	1.2629	1.2697 (40)
HLP (average)												1.2595 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

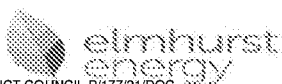
Assumed occupancy												2.4869 (42)
Average daily hot water use (litres/day)												93.2634 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	102.5898	98.8593	95.1287	91.3982	87.6676	83.9371	83.9371	87.6676	91.3982	95.1287	98.8593	102.5898 (44)
Energy conte	152.1377	133.0606	137.3066	119.7072	114.8619	99.1171	91.8466	105.3953	106.6541	124.2950	135.6777	147.3372 (45)
Energy content (annual)										Total = Sum(45)m =		1467.3971 (45)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	22.8207	19.9591	20.5960	17.9561	17.2293	14.8676	13.7770	15.8093	15.9981	18.6443	20.3517	22.1006 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1217	12.7410	14.0700	13.5754	13.9982	13.5125	13.9416	13.9783	13.5468	14.0403	13.6347	14.1102 (61)
Total heat required for water heating calculated for each month	166.2594	145.8016	151.3767	133.2826	128.8602	112.6296	105.7882	119.3736	120.2008	138.3354	149.3124	161.4474 (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	166.2594	145.8016	151.3767	133.2826	128.8602	112.6296	105.7882	119.3736	120.2008	138.3354	149.3124	161.4474 (64)
Heat gains from water heating, kWh/month	54.1162	47.4279	49.1720	43.1965	41.6912	36.3346	34.0244	38.5385	38.8492	44.8382	48.5215	52.5172 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 1632.6678 (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	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	50.1153	44.5120	36.1996	27.4054	20.4859	17.2950	18.6879	24.2912	32.6036	41.3978	48.3173	51.5082 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	331.5156	334.9557	326.2868	307.8317	284.5354	262.6402	248.0128	244.5727	253.2417	271.6968	294.9931	316.8883 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082 (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)	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753 (71)
Water heating gains (Table 5)	72.7368	70.5772	66.0913	59.9951	56.0365	50.4647	45.7317	51.7991	53.9572	60.2664	67.3910	70.5876 (72)
Total internal gains	559.5136	555.1907	533.7235	500.3780	466.2036	435.5457	417.5782	425.8089	444.9483	478.5068	515.8472	544.1299 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
Northeast				0.7800	11.2829		0.4500		0.0000		0.7700		3.0494 (75)
Southeast				5.7000	36.7938		0.4500		0.0000		0.7700		72.6697 (77)
Southwest				0.7800	36.7938		0.4500		0.0000		0.7700		9.9443 (79)
Northwest				8.2900	11.2829		0.4500		0.0000		0.7700		32.4101 (81)
Solar gains	118.0734	212.9010	322.5855	452.1376	554.2952	571.3404	542.0716	462.6387	366.9423	243.7362	143.5697	99.6583	(83)
Total gains	677.5870	768.0917	856.3090	952.5156	1020.4988	1006.8861	959.6498	888.4475	811.8905	722.2430	659.4169	643.7882	(84)

7. Mean internal temperature (heating season)

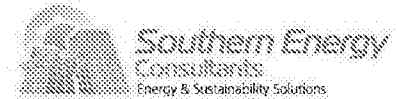
Temperature during heating periods in the living area from Table 9, Thl (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	34.0767	34.1768	34.2754	34.7466	34.8362	35.2594	35.2594	35.3389	35.0952	34.8362	34.6554	34.4684
alpha	3.2718	3.2785	3.2850	3.3164	3.3224	3.3506	3.3506	3.3559	3.3397	3.3224	3.3104	3.2979
util living area	0.9717	0.9565	0.9258	0.8575	0.7403	0.5806	0.4432	0.4915	0.7093	0.8905	0.9567	0.9757 (86)
MIT	19.2878	19.5133	19.8739	20.3298	20.6913	20.9025	20.9702	20.9578	20.8031	20.3342	19.7370	19.2486 (87)
Th 2	19.8532	19.8561	19.8590	19.8727	19.8752	19.8872	19.8872	19.8894	19.8826	19.8752	19.8700	19.8646 (88)
util rest of house	0.9658	0.9475	0.9101	0.8273	0.6865	0.4982	0.3391	0.3846	0.6326	0.8602	0.9461	0.9706 (89)
MIT 2	17.6127	17.9380	18.4528	19.0925	19.5625	19.8127	19.8726	19.8669	19.7133	19.1166	18.2736	17.5636 (90)
Living area fraction									fLA = Living area / (4) =			0.2175 (91)
MIT	17.9770	18.2806	18.7619	19.3616	19.8080	20.0497	20.1113	20.1042	19.9503	19.3815	18.5918	17.9300 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8270	18.1306	18.6119	19.2116	19.6580	19.8997	19.9613	19.9542	19.8003	19.2315	18.4418	17.7800 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9508	0.9289	0.8881	0.8062	0.6749	0.4992	0.3463	0.3911	0.6263	0.8386	0.9277	0.9569 (94)
Ext temp.	644.2518	713.5180	760.4776	767.9102	688.6852	502.6043	332.3578	347.5109	508.4852	605.6723	611.7637	616.0582 (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	1412.2335	1377.2434	1257.1590	1055.7840	812.7090	534.7370	339.1532	357.8058	577.8467	881.4847	1164.3244	1401.6548 (97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000 (97a)
Space heating	571.3784	446.0235	369.5309	207.2692	92.2738	0.0000	0.0000	0.0000	0.0000	205.2044	397.8437	584.4839 (98)
Space heating per m2												2874.0077 (98)
(98) / (4) = 35.3550 (99)												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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												3175.6991 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	571.3784	446.0235	369.5309	207.2692	92.2738	0.0000	0.0000	0.0000	0.0000	205.2044	397.8437	584.4839 (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)	631.3573	492.8436	408.3215	229.0267	101.9600	0.0000	0.0000	0.0000	0.0000	226.7452	439.6063	645.8385 (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	166.2594	145.8016	151.3767	133.2826	128.8602	112.6296	105.7882	119.3736	120.2008	138.3354	149.3124	161.4474 (64)
Efficiency of water heater (217)m	89.7584	89.6901	89.5461	89.2201	88.6074	87.3000	87.3000	87.3000	87.3000	89.1836	89.6037	89.7877 (217)
Fuel for water heating, kWh/month	185.2298	162.5616	169.0488	149.3864	145.4283	129.0144	121.1777	136.7395	137.6871	155.1129	166.6364	179.8102 (219)
Water heating fuel used												1837.8332 (219)
Annual totals kWh/year												
Space heating fuel - main system												3175.6991 (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)												354.0209 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 0.50 * 1029 * 0.80) =												-329.3397 (233)
Total delivered energy for all uses												5113.2135 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3175.6991	3.4800	110.5143 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1837.8332	3.4800	63.9566 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	354.0209	13.1900	46.6954 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-329.3397	13.1900	-43.4399 (252)
Total energy cost			307.6189 (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] = 1.0230 (257)
SAP value	85.7286
SAP rating (Section 12)	86 (258)
SAP band	B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3175.6991	0.2160	685.9510 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1837.8332	0.2160	396.9720 (264)
Space and water heating			1082.9230 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	354.0209	0.5190	183.7368 (268)
Energy saving/generation technologies			
PV Unit	-329.3397	0.5190	-170.9273 (269)
Total kg/year			1134.6575 (272)
CO2 emissions per m2			13.9600 (273)
EI value			87.9607
EI rating			88 (274)
EI band			B

Calculation of stars for heating and DHW

Regs Region: England

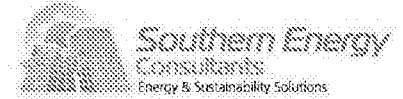
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

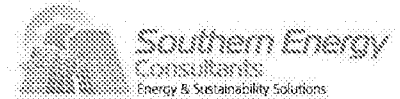


CALCULATION OF ENERGY RATINGS 09 Jan 2014

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	$3.48 / 0.8872 = 3.923$, stars = 4
Water heating environmental impact	$0.216 / 0.8872 = 0.2435$, stars = 4

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	40.6900 (1b)	x 2.4000 (2b)	= 97.6560 (1b) - (3b)
First floor	40.6000 (1c)	x 2.6500 (2c)	= 107.5900 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	81.2900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 205.2460 (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					4 * 10 = 40.0000 (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) =					40.0000 / (5) = 0.1949 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4449 (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) =	0.3782 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.6000	5.1000	4.8000	4.5000	4.7000	4.2000	4.4000	4.2000	4.4000	4.8000	4.9000	5.1000 (22)
Wind factor	1.4000	1.2750	1.2000	1.1250	1.1750	1.0500	1.1000	1.0500	1.1000	1.2000	1.2250	1.2750 (22a)
Adj infilt rate	0.5294	0.4821	0.4538	0.4254	0.4443	0.3971	0.4160	0.3971	0.4160	0.4538	0.4632	0.4821 (22b)
Effective ac	0.6401	0.6162	0.6030	0.5905	0.5987	0.5788	0.5865	0.5788	0.5865	0.6030	0.6073	0.6162 (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 2 (Uw = 1.30)			15.5500	1.2357	19.2158		(27)
Opening Type 3			2.1200	1.5000	3.1800		(26a)
Heat Loss Floor 1			40.6900	0.1100	4.4759	75.0000	3051.7500 (28a)
Brick Faced	93.9300	17.6700	76.2600	0.2400	18.3024	60.0000	4575.6000 (29a)
Plane Roof	41.0600		41.0600	0.1100	4.5166	9.0000	369.5400 (30)
Flat Roof Kitchen/Diner	2.9200		2.9200	0.1200	0.3504	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m ²)			178.6000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.0411		(33)
Party Wall 1			41.3500	0.0000	0.0000	45.0000	1860.7500 (32)
Internal Wall 2			163.5200			9.0000	1471.6800 (32c)
Internal Floor 1			41.0600			18.0000	739.0800 (32d)
Internal Ceiling 1			41.0600			18.0000	739.0800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	12807.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							157.5530 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.6215 (36)
Total fabric heat loss						(33) + (36) =	62.6626 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	43.3575	41.7382	40.6392	39.9948	40.5517	39.2048	39.7254	39.2048	39.7254	40.6392	41.1328	41.7382 (38)
Heat transfer coeff	106.0201	104.4008	103.5018	102.6574	103.2143	101.8674	102.3880	101.8674	102.3880	103.5018	103.7954	104.4008 (39)
Average = Sum(39)m / 12 =												103.3336 (39)
HLP	1.3042	1.2843	1.2732	1.2629	1.2697	1.2531	1.2595	1.2531	1.2595	1.2732	1.2769	1.2843 (40)
HLP (average)												1.2712 (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												2.4869 (42)
Average daily hot water use (litres/day)												93.2634 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.5898	98.8593	95.1287	91.3982	87.6676	83.9371	83.9371	87.6676	91.3982	95.1287	98.8593	102.5898 (44)
Energy conte	152.1377	133.0606	137.3066	119.7072	114.8619	99.1171	91.8466	105.3953	106.6541	124.2950	135.6777	147.3372 (45)
Energy content (annual)										Total = Sum(45)m =		1467.3971 (45)

Regs Region: England

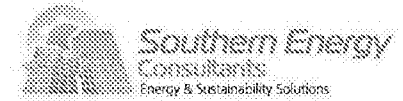
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Distribution loss (46)m = 0.15 x (45)m	22.8207	19.9591	20.5960	17.9561	17.2293	14.8676	13.7770	15.8093	15.9981	18.6443	20.3517	22.1006 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1217	12.7410	14.0700	13.5754	13.9982	13.5125	13.9416	13.9783	13.5468	14.0403	13.6347	14.1102 (61)
Total heat required for water heating calculated for each month	166.2594	145.8016	151.3767	133.2826	128.8602	112.6296	105.7882	119.3736	120.2008	138.3354	149.3124	161.4474 (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	166.2594	145.8016	151.3767	133.2826	128.8602	112.6296	105.7882	119.3736	120.2008	138.3354	149.3124	161.4474 (64)
Heat gains from water heating, kWh/month	54.1162	47.4279	49.1720	43.1965	41.6912	36.3346	34.0244	38.5385	38.8492	44.8382	48.5215	52.5172 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 1632.6678 (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	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	50.1153	44.5120	36.1996	27.4054	20.4859	17.2950	18.6879	24.2912	32.6036	41.3978	48.3173	51.5082 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	331.5156	334.9557	326.2868	307.8317	284.5354	262.6402	248.0128	244.5727	253.2417	271.6968	294.9931	316.8883 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082 (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)	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753 (71)
Water heating gains (Table 5)	72.7368	70.5772	66.0913	59.9951	56.0365	50.4647	45.7317	51.7991	53.9572	60.2664	67.3910	70.5876 (72)
Total internal gains	559.5136	555.1907	533.7235	500.3780	466.2036	435.5457	417.5782	425.8089	444.9483	478.5068	515.8472	544.1299 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	0.7800	15.8975	0.4500	0.0000	0.7700	4.2966 (75)
Southeast	5.7000	48.9171	0.4500	0.0000	0.7700	96.6137 (77)
Southwest	0.7800	48.9171	0.4500	0.0000	0.7700	13.2208 (79)
Northwest	8.2900	15.8975	0.4500	0.0000	0.7700	45.6653 (81)

Solar gains	159.7964	241.5158	368.1132	539.6873	642.0082	711.2739	670.3929	573.5583	451.2689	298.2153	186.4811	130.7072 (83)
Total gains	719.3100	796.7065	901.8367	1040.0654	1108.2118	1146.8195	1087.9711	999.3671	896.2172	776.7221	702.3283	674.8370 (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	33.5562	34.0767	34.3727	34.6554	34.4684	34.9242	34.7466	34.9242	34.7466	34.3727	34.2754	34.0767
alpha	3.2371	3.2718	3.2915	3.3104	3.2979	3.3283	3.3164	3.3283	3.3164	3.2915	3.2850	3.2718
util living area	0.9580	0.9430	0.9010	0.8049	0.6502	0.4571	0.3238	0.3304	0.5625	0.8123	0.9274	0.9628 (86)
MIT	19.5515	19.7143	20.0747	20.5041	20.8172	20.9588	20.9903	20.9905	20.9226	20.6062	20.0605	19.5540 (87)
Th 2	19.8375	19.8532	19.8619	19.8700	19.8646	19.8777	19.8727	19.8777	19.8727	19.8619	19.8590	19.8532 (88)
util rest of house	0.9485	0.9307	0.8799	0.7657	0.5839	0.3704	0.2221	0.2208	0.4639	0.7596	0.9082	0.9542 (89)
MIT 2	17.9839	18.2243	18.7356	19.3184	19.6982	19.8522	19.8696	19.8750	19.8221	19.4632	18.7261	17.9987 (90)
Living area fraction									fLA = Living area / (4) =			0.2175 (91)
MIT	18.3249	18.5483	19.0268	19.5762	19.9416	20.0929	20.1134	20.1176	20.0615	19.7118	19.0164	18.3370 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.1749	18.3983	18.8768	19.4262	19.7916	19.9429	19.9634	19.9676	19.9115	19.5618	18.8664	18.1870 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	668.9227	725.0949	773.1008	777.9556	641.9664	430.8004	250.6962	229.6399	418.9899	577.2239	622.5570	632.1969 (95)
Ext temp.	5.8000	6.0000	7.5000	9.8000	12.9000	15.6000	17.5000	17.7000	15.6000	12.5000	9.0000	6.0000 (96)
Heat loss rate W	1311.9848	1294.3975	1177.5234	988.2043	711.3071	442.3988	252.2190	230.9984	441.4415	730.9136	1024.0839	1272.3297 (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	478.4382	382.5713	300.8905	151.3790	51.5894	0.0000	0.0000	0.0000	0.0000	114.3451	289.0994	476.2588 (98)
Space heating												2244.5717 (98)
Space heating per m2												27.6119 (99)
(98) / (4) = 27.6119 (99)												

Regs Region: England

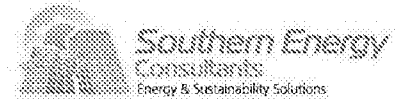
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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													2480.1898 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	478.4382	382.5713	300.8905	151.3790	51.5894	0.0000	0.0000	0.0000	0.0000	114.3451	289.0994	476.2588	(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)	528.6610	422.7307	332.4757	167.2697	57.0049	0.0000	0.0000	0.0000	0.0000	126.3482	319.4468	526.2528	(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	166.2594	145.8016	151.3767	133.2826	128.8602	112.6296	105.7882	119.3736	120.2008	138.3354	149.3124	161.4474	(64)
Efficiency of water heater (217)m	89.6525	89.5938	89.4031	88.9730	88.1915	87.3000	87.3000	87.3000	87.3000	88.7196	89.3841	89.6679	(216)
Fuel for water heating, kWh/month	185.4486	162.7363	169.3192	149.8012	146.1140	129.0144	121.1777	136.7395	137.6871	155.9242	167.0458	180.0504	(219)
Water heating fuel used													(219)
Annual totals kWh/year													
Space heating fuel - main system													2480.1898 (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)													354.0209 (232)
Energy saving/generation technologies (Appendices M,N and Q)													
PV Unit 0 (0.80 * 0.50 * 1252 * 0.80) =									-400.5426				-400.5426 (233)
Total delivered energy for all uses													4349.7266 (238)

10a. Fuel costs - using BEDF prices (485)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2480.1898	3.7400	92.7591 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1841.0585	3.7400	68.8556 (247)
Pumps and fans for heating	75.0000	19.1200	14.3400 (249)
Energy for lighting	354.0209	19.1200	67.6888 (250)
Additional standing charges			94.0000 (251)
Energy saving/generation technologies			
PV Unit	-400.5426	19.1200	-76.5837 (252)
Total energy cost			261.0597 (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	2480.1898	0.2160	535.7210 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1841.0585	0.2160	397.6686 (264)
Space and water heating			933.3896 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	354.0209	0.5190	183.7368 (268)
Energy saving/generation technologies			
PV Unit	-400.5426	0.5190	-207.8816 (269)
Total kg/year			948.1699 (272)

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

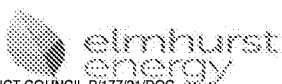
	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	2480.1898	1.2200	3025.8315 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1841.0585	1.2200	2246.0914 (264)
Space and water heating			5271.9229 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	354.0209	3.0700	1086.8441 (268)
Energy saving/generation technologies			
PV Unit	-400.5426	3.0700	-1229.6658 (269)
Primary energy kWh/year			5359.3512 (272)
Primary energy kWh/m2/year			65.9288 (273)

Regs Region: England

Elmhurst Energy Systems

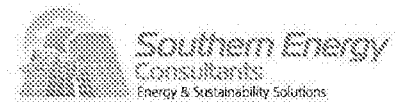
SAP2012 Calculator (Design

System) version 4.14r19



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 86
Current environmental impact rating: B 88

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 28	-189 kg (19.9%)

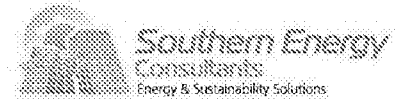
Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£28 2.32 kg/m²	B 87	B 90
Total Savings	£28 2.32 kg/m²		
Potential energy efficiency rating:		B 87	
Potential environmental impact rating:			B 90

Fuel prices for cost data on this page from database revision number 485 TEST (29 Oct 2021)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):			
	Current	Potential	Saving
Electricity	£82	£92	-£10
Mains gas	£256	£218	£37
Space heating	£201	£201	£0
Water heating	£69	£41	£28
Lighting	£68	£68	£0
Generated (PV)	-£77	-£77	£0
Total cost of fuels	£261	£233	£27
Total cost of uses	£261	£233	£28
Delivered energy	54 kWh/m²	42 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.8 tonnes	0.2 tonnes
CO2 emissions per m²	12 kg/m²	9 kg/m²	2 kg/m²
Primary energy	66 kWh/m²	53 kWh/m²	13 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	40.6900 (1b)	x 2.4000 (2b)	= 97.6560 (1b) - (3b)
First floor	40.6000 (1c)	x 2.6500 (2c)	= 107.5900 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	81.2900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 205.2460 (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					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1949 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4449 (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) =	0.3782 (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	0.4821	0.4727	0.4632	0.4160	0.4065	0.3592	0.3592	0.3498	0.3782	0.4065	0.4254	0.4443 (22b)
Effective ac	0.6162	0.6117	0.6073	0.5865	0.5826	0.5645	0.5645	0.5612	0.5715	0.5826	0.5905	0.5987 (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 2 (Uw = 1.30)			15.5500	1.2357	19.2158		(27)
Opening Type 3			2.1200	1.5000	3.1800		(26a)
Heat Loss Floor 1			40.6900	0.1100	4.4759	75.0000	3051.7500 (28a)
Brick Faced	93.9300	17.6700	76.2600	0.2400	18.3024	60.0000	4575.6000 (29a)
Plane Roof	41.0600		41.0600	0.1100	4.5166	9.0000	369.5400 (30)
Flat Roof Kitchen/Diner	2.9200		2.9200	0.1200	0.3504	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m ²)			178.6000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.0411		(33)
Party Wall 1			41.3500	0.0000	0.0000	45.0000	1860.7500 (32)
Internal Wall 2			163.5200			9.0000	1471.6800 (32c)
Internal Floor 1			41.0600			18.0000	739.0800 (32d)
Internal Ceiling 1			41.0600			18.0000	739.0800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	12807.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							157.5530 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.6215 (36)
Total fabric heat loss						(33) + (36) =	62.6626 (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	41.7382	41.4325	41.1328	39.7254	39.4621	38.2362	38.2362	38.0092	38.7084	39.4621	39.9948	40.5517 (38)
Average = Sum(39)m / 12 =	104.4008	104.0951	103.7954	102.3880	102.1247	100.8988	100.8988	100.6718	101.3710	102.1247	102.6574	103.2143 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2843	1.2805	1.2769	1.2595	1.2563	1.2412	1.2412	1.2384	1.2470	1.2563	1.2629	1.2697 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

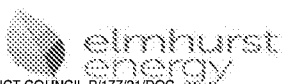
Assumed occupancy												2.4869 (42)
Average daily hot water use (litres/day)												93.2634 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	102.5898	98.8593	95.1287	91.3982	87.6676	83.9371	83.9371	87.6676	91.3982	95.1287	98.8593	102.5898 (44)
Energy content (annual)	152.1377	133.0606	137.3066	119.7072	114.8619	99.1171	91.8466	105.3953	106.6541	124.2950	135.6777	147.3372 (45)
Total = Sum(45)m =												1467.3971 (45)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	22.8207	19.9591	20.5960	17.9561	17.2293	14.8676	13.7770	15.8093	15.9981	18.6443	20.3517	22.1006 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1217	12.7410	14.0700	13.5754	13.9982	13.5125	13.9416	13.9783	13.5468	14.0403	13.6347	14.1102 (61)
Total heat required for water heating calculated for each month	166.2594	145.8016	151.3767	133.2826	128.8602	112.6296	105.7882	119.3736	120.2008	138.3354	149.3124	161.4474 (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												1.2359 (H8)
Utilisation factor												0.5547 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												93.2634 (H14)
Volume ratio Veff/V												0.8042 (H15)
Solar storage volume factor												0.9564 (H16)
Solar input	-24.5348	-40.9415	-69.7280	-93.4492	-115.4487	-113.5044	-112.0044	-97.8588	-76.6431	-52.3382	-29.1018	-846.0842 (H17)
Solar input (sum of months) = Sum (63)m =												-846.0842 (63)
Output from w/h	141.7246	104.8601	81.6487	39.8334	13.4115	0.0000	0.0000	21.5148	43.5577	85.9971	120.2107	140.9160 (64)
Total per year (kWh/year) = Sum (64)m =												793.6747 (64)
Heat gains from water heating, kWh/month	54.1162	47.4279	49.1720	43.1965	41.6912	36.3346	34.0244	38.5385	38.8492	44.8382	48.5215	52.5172 (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	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	50.1153	44.5120	36.1996	27.4054	20.4859	17.2950	18.6879	24.2912	32.6036	41.3978	48.3173	51.5082	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	331.5156	334.9557	326.2868	307.8317	284.5354	262.6402	248.0128	244.5727	253.2417	271.6968	294.9931	316.8883	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	(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)	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	(71)
Water heating gains (Table 5)	72.7368	70.5772	66.0913	59.9951	56.0365	50.4647	45.7317	51.7991	53.9572	60.2664	67.3910	70.5876	(72)
Total internal gains	559.5136	555.1907	533.7235	500.3780	466.2036	435.5457	417.5782	425.8089	444.9483	478.5068	515.8472	544.1299	(73)

6. Solar gains

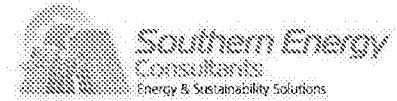
[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d	Gains W	
Northeast				0.7800	11.2829		0.4500		0.0000		0.7700	3.0494 (75)	
Southeast				5.7000	36.7938		0.4500		0.0000		0.7700	72.6697 (77)	
Southwest				0.7800	36.7938		0.4500		0.0000		0.7700	9.9443 (79)	
Northwest				8.2900	11.2829		0.4500		0.0000		0.7700	32.4101 (81)	
Solar gains	118.0734	212.9010	322.5855	452.1376	554.2952	571.3404	542.0716	462.6387	366.9423	243.7362	143.5697	99.6583	(83)
Total gains	677.5870	768.0917	856.3090	952.5156	1020.4988	1006.8861	959.6498	888.4475	811.8905	722.2430	659.4169	643.7882	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	34.0767	34.1768	34.2754	34.7466	34.8362	35.2594	35.2594	35.3389	35.0952	34.8362	34.6554	34.4684
alpha	3.2718	3.2785	3.2850	3.3164	3.3224	3.3506	3.3506	3.3559	3.3397	3.3224	3.3104	3.2979
util living area	0.9717	0.9565	0.9258	0.8575	0.7403	0.5806	0.4432	0.4915	0.7093	0.8905	0.9567	0.9757 (86)
MIT	19.2878	19.5133	19.8739	20.3298	20.6913	20.9025	20.9702	20.9578	20.8031	20.3342	19.7370	19.2486 (87)
Th 2	19.8532	19.8561	19.8590	19.8727	19.8752	19.8872	19.8872	19.8894	19.8826	19.8752	19.8700	19.8646 (88)
util rest of house	0.9658	0.9475	0.9101	0.8273	0.6865	0.4982	0.3391	0.3846	0.6326	0.8602	0.9461	0.9706 (89)
MIT 2	17.6127	17.9380	18.4528	19.0925	19.5625	19.8127	19.8726	19.8669	19.7133	19.1166	18.2736	17.5636 (90)
Living area fraction									fLA = Living area / (4) =			0.2175 (91)
MIT	17.9770	18.2806	18.7619	19.3616	19.8080	20.0497	20.1113	20.1042	19.9503	19.3815	18.5918	17.9300 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8270	18.1306	18.6119	19.2116	19.6580	19.8997	19.9613	19.9542	19.8003	19.2315	18.4418	17.7800 (93)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9508	0.9289	0.8881	0.8062	0.6749	0.4992	0.3463	0.3911	0.6263	0.8386	0.9277	0.9569	(94)
Useful gains	644.2518	713.5180	760.4776	767.9102	688.6852	502.6043	332.3578	347.5109	508.4852	605.6723	611.7637	616.0582	(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	1412.2335	1377.2434	1257.1590	1055.7840	812.7090	534.7370	339.1532	357.8058	577.8467	881.4847	1164.3244	1401.6548	(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	571.3784	446.0235	369.5309	207.2692	92.2738	0.0000	0.0000	0.0000	0.0000	205.2044	397.8437	584.4839	(98)
Space heating												2874.0077	(98)
Space heating per m2											(98) / (4) =	35.3550	(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													3175.6991	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	571.3784	446.0235	369.5309	207.2692	92.2738	0.0000	0.0000	0.0000	0.0000	205.2044	397.8437	584.4839	(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)	631.3573	492.8436	408.3215	229.0267	101.9600	0.0000	0.0000	0.0000	0.0000	226.7452	439.6063	645.8385	(211)	
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)	
Water heating														
Water heating requirement	141.7246	104.8601	81.6487	39.8334	13.4115	0.0000	0.0000	21.5148	43.5577	85.9971	120.2107	140.9160	(64)	
Efficiency of water heater	89.8455	89.8729	89.9036	89.9684	90.0810	87.3000	87.3000	87.3000	87.3000	89.5308	89.7367	89.8601	(217)	
Fuel for water heating, kWh/month	157.7426	116.6760	90.8180	44.2749	14.8883	0.0000	0.0000	24.6447	49.8943	96.0531	133.9593	156.8170	(219)	
Water heating fuel used												885.7681	(219)	
Annual totals kWh/year														
Space heating fuel - main system													3175.6991	(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)													354.0209	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV Unit 0 (0.80 * 0.50 * 1029 * 0.80) =										-329.3397			-329.3397	(233)
Total delivered energy for all uses													4211.1484	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3175.6991	3.4800	110.5143 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	885.7681	3.4800	30.8247 (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	354.0209	13.1900	46.6954 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-329.3397	13.1900	-43.4399 (252)
Total energy cost			281.0820 (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] =	0.9348 (257)
SAP value		86.9597
SAP rating (Section 12)		87 (258)
SAP band		B

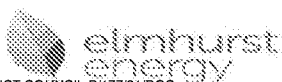
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

Regs Region: England

Elmhurst Energy Systems

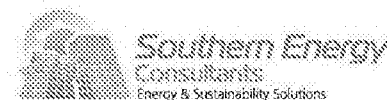
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

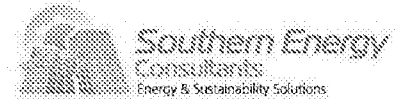


CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3175.6991	0.2160	685.9510 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	885.7681	0.2160	191.3259 (264)
Space and water heating			877.2769 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	354.0209	0.5190	183.7368 (268)
Energy saving/generation technologies			
PV Unit	-329.3397	0.5190	-170.9273 (269)
Total kg/year			954.9614 (272)
CO2 emissions per m2			11.7500 (273)
EI value			89.8674
EI rating			90 (274)
EI band			B

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	40.6900 (1b)	x 2.4000 (2b)	= 97.6560 (1b) - (3b)
First floor	40.6000 (1c)	x 2.6500 (2c)	= 107.5900 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	81.2900		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	205.2460 (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					4 * 10 = 40.0000 (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) =				40.0000 / (5) =	0.1949 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4449 (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) =		0.3782 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.6000	5.1000	4.8000	4.5000	4.7000	4.2000	4.4000	4.2000	4.4000	4.8000	4.9000	5.1000 (22)
Wind factor	1.4000	1.2750	1.2000	1.1250	1.1750	1.0500	1.1000	1.0500	1.1000	1.2000	1.2250	1.2750 (22a)
Adj infilt rate	0.5294	0.4821	0.4538	0.4254	0.4443	0.3971	0.4160	0.3971	0.4160	0.4538	0.4632	0.4821 (22b)
Effective ac	0.6401	0.6162	0.6030	0.5905	0.5987	0.5788	0.5865	0.5788	0.5865	0.6030	0.6073	0.6162 (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 2 (Uw = 1.30)			15.5500	1.2357	19.2158		(27)
Opening Type 3			2.1200	1.5000	3.1800		(26a)
Heat Loss Floor 1			40.6900	0.1100	4.4759	75.0000	3051.7500 (28a)
Brick Faced	93.9300	17.6700	76.2600	0.2400	18.3024	60.0000	4575.6000 (29a)
Plane Roof	41.0600		41.0600	0.1100	4.5166	9.0000	369.5400 (30)
Flat Roof Kitchen/Diner	2.9200		2.9200	0.1200	0.3504	0.0000	0.0000 (31)
Total net area of external elements Aum(A, m ²)			178.6000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.0411		(33)
Party Wall 1			41.3500	0.0000	0.0000	45.0000	1860.7500 (32)
Internal Wall 2			163.5200			9.0000	1471.6800 (32c)
Internal Floor 1			41.0600			18.0000	739.0800 (32d)
Internal Ceiling 1			41.0600			18.0000	739.0800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	12807.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							157.5530 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.6215 (36)
Total fabric heat loss						(33) + (36) =	62.6626 (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	43.3575	41.7382	40.6392	39.9948	40.5517	39.2048	39.7254	39.2048	39.7254	40.6392	41.1328	41.7382 (38)
Average = Sum(39)m / 12 =	106.0201	104.4008	103.5018	102.6574	103.2143	101.8674	102.3880	101.8674	102.3880	103.5018	103.7954	104.4008 (39)
												103.3336 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3042	1.2843	1.2732	1.2629	1.2697	1.2531	1.2595	1.2531	1.2595	1.2732	1.2769	1.2843 (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												2.4869 (42)
Average daily hot water use (litres/day)												93.2634 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	102.5898	98.8593	95.1287	91.3982	87.6676	83.9371	83.9371	87.6676	91.3982	95.1287	98.8593	102.5898 (44)
Energy content (annual)	152.1377	133.0606	137.3066	119.7072	114.8619	99.1171	91.8466	105.3953	106.6541	124.2950	135.6777	147.3372 (45)
										Total = Sum(45)m =		1467.3971 (45)

Regs Region: England

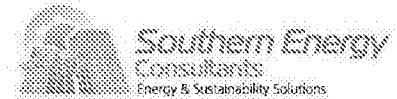
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Distribution loss (46)m = 0.15 x (45)m	22.8207	19.9591	20.5960	17.9561	17.2293	14.8676	13.7770	15.8093	15.9981	18.6443	20.3517	22.1006 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1217	12.7410	14.0700	13.5754	13.9982	13.5125	13.9416	13.9783	13.5468	14.0403	13.6347	14.1102 (61)
Total heat required for water heating calculated for each month	166.2594	145.8016	151.3767	133.2826	128.8602	112.6296	105.7882	119.3736	120.2008	138.3354	149.3124	161.4474 (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												1306.9326 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2195.6468 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.4963 (H8)
Utilisation factor												0.4874 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												93.2634 (H14)
Volume ratio Veff/V												0.8042 (H15)
Solar storage volume factor												0.9564 (H16)
Solar input												-900.0259 (H17)
Solar input	-29.4481	-41.0536	-69.8957	-97.3806	-116.4388	-123.0076	-120.5900	-105.7653	-82.5709	-56.4806	-33.4961	-23.8986 (63)
Solar input (sum of months) = Sum (63)m =												-900.0259 (63)
Output from w/h	136.8112	104.7479	81.4809	35.9020	12.4214	0.0000	0.0000	13.6084	37.6299	81.8548	115.8164	137.5488 (64)
Total per year (kWh/year) = Sum (64)m =												757.8217 (64)
Heat gains from water heating, kWh/month	54.1162	47.4279	49.1720	43.1965	41.6912	36.3346	34.0244	38.5385	38.8492	44.8382	48.5215	52.5172 (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	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	149.2129	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	50.1153	44.5120	36.1996	27.4054	20.4859	17.2950	18.6879	24.2912	32.6036	41.3978	48.3173	51.5082	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	331.5156	334.9557	326.2868	307.8317	284.5354	262.6402	248.0128	244.5727	253.2417	271.6968	294.9931	316.8883	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	52.4082	(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)	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	-99.4753	(71)
Water heating gains (Table 5)	72.7368	70.5772	66.0913	59.9951	56.0365	50.4647	45.7317	51.7991	53.9572	60.2664	67.3910	70.5876	(72)
Total internal gains	559.5136	555.1907	533.7235	500.3780	466.2036	435.5457	417.5782	425.8089	444.9483	478.5068	515.8472	544.1299	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d	Gains W
Northeast					0.7800	15.8975	0.4500	0.0000			0.7700	4.2966 (75)
Southeast					5.7000	48.9171	0.4500	0.0000			0.7700	96.6137 (77)
Southwest					0.7800	48.9171	0.4500	0.0000			0.7700	13.2208 (79)
Northwest					8.2900	15.8975	0.4500	0.0000			0.7700	45.6653 (81)

Solar gains	159.7964	241.5158	368.1132	539.6873	642.0082	711.2739	670.3929	573.5583	451.2689	298.2153	186.4811	130.7072 (83)
Total gains	719.3100	796.7065	901.8367	1040.0654	1108.2118	1146.8195	1087.9711	999.3671	896.2172	776.7221	702.3283	674.8370 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)	
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5562	34.0767	34.3727	34.6554	34.4684	34.9242	34.7466	34.9242	34.7466	34.3727	34.2754	34.0767	
alpha	3.2371	3.2718	3.2915	3.3104	3.2979	3.3283	3.3164	3.3283	3.3164	3.2915	3.2850	3.2718	
util living area	0.9580	0.9430	0.9010	0.8049	0.6502	0.4571	0.3238	0.3304	0.5625	0.8123	0.9274	0.9628 (86)	
MIT	19.5515	19.7143	20.0747	20.5041	20.8172	20.9588	20.9903	20.9905	20.9226	20.6062	20.0605	19.5540 (87)	
Th 2	19.8375	19.8532	19.8619	19.8700	19.8646	19.8777	19.8727	19.8777	19.8727	19.8619	19.8590	19.8532 (88)	
util rest of house	0.9485	0.9307	0.8799	0.7657	0.5839	0.3704	0.2221	0.2208	0.4639	0.7596	0.9082	0.9542 (89)	
MIT 2	17.9839	18.2243	18.7356	19.3184	19.6982	19.8522	19.8696	19.8750	19.8221	19.4632	18.7261	17.9987 (90)	
Living area fraction									fLA = Living area / (4) =				0.2175 (91)
MIT	18.3249	18.5483	19.0268	19.5762	19.9416	20.0929	20.1134	20.1176	20.0615	19.7118	19.0164	18.3370 (92)	
Temperature adjustment												-0.1500	
adjusted MIT	18.1749	18.3983	18.8768	19.4262	19.7916	19.9429	19.9634	19.9676	19.9115	19.5618	18.8664	18.1870 (93)	

Regs Region: England

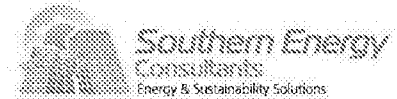
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FULL SAP CALCULATION PRINTOUT

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

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9300	0.9101	0.8573	0.7480	0.5793	0.3756	0.2304	0.2298	0.4675	0.7432	0.8864	0.9368	(94)
Useful gains	668.9227	725.0949	773.1008	777.9556	641.9664	430.8004	250.6962	229.6399	418.9899	577.2239	622.5570	632.1969	(95)
Ext temp.	5.8000	6.0000	7.5000	9.8000	12.9000	15.6000	17.5000	17.7000	15.6000	12.5000	9.0000	6.0000	(96)
Heat loss rate W													
Month fracti	1311.9848	1294.3975	1177.5234	988.2043	711.3071	442.3988	252.2190	230.9984	441.4415	730.9136	1024.0839	1272.3297	(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	478.4382	382.5713	300.8905	151.3790	51.5894	0.0000	0.0000	0.0000	0.0000	114.3451	289.0994	476.2588	(98)
Space heating per m2												2244.5717	(98)
												(98) / (4) =	27.6119 (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													2480.1898 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	478.4382	382.5713	300.8905	151.3790	51.5894	0.0000	0.0000	0.0000	0.0000	114.3451	289.0994	476.2588	(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)	528.6610	422.7307	332.4757	167.2697	57.0049	0.0000	0.0000	0.0000	0.0000	126.3482	319.4468	526.2528	(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	136.8112	104.7479	81.4809	35.9020	12.4214	0.0000	0.0000	13.6084	37.6299	81.8548	115.8164	137.5488	(64)
Efficiency of water heater	89.7683	89.7925	89.7986	89.8685	89.8608	87.3000	87.3000	87.3000	87.3000	89.1369	89.5610	89.7627	(217)
Fuel for water heating, kWh/month	152.4048	116.6555	90.7374	39.9495	13.8229	0.0000	0.0000	15.5880	43.1042	91.8304	129.3156	153.2361	(219)
Water heating fuel used												846.6445	(219)
Annual totals kWh/year													
Space heating fuel - main system												2480.1898	(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)													354.0209 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.50 * 1252 * 0.80) =									-400.5426			-400.5426	(233)
Total delivered energy for all uses												3405.3125	(238)

10a. Fuel costs - using BEDF prices (485)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2480.1898	3.7400	92.7591 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	846.6445	3.7400	31.6645 (247)
Pumps and fans for heating	75.0000	19.1200	14.3400 (249)
Pump for solar water heating	50.0000	19.1200	9.5600 (249)
Energy for lighting	354.0209	19.1200	67.6888 (250)
Additional standing charges			94.0000 (251)
Energy saving/generation technologies			
PV Unit	-400.5426	19.1200	-76.5837 (252)
Total energy cost			233.4286 (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	2480.1898	0.2160	535.7210 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	846.6445	0.2160	182.8752 (264)
Space and water heating			718.5962 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	354.0209	0.5190	183.7368 (268)
Energy saving/generation technologies			
PV Unit	-400.5426	0.5190	-207.8816 (269)

Regs Region: England

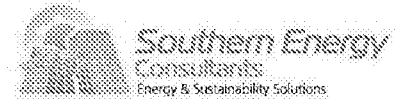
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Total kg/year 759.3264 (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	2480.1898	1.2200	3025.8315 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	846.6445	1.2200	1032.9063 (264)
Space and water heating			4058.7378 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	354.0209	3.0700	1086.8441 (268)
Energy saving/generation technologies			
PV Unit	-400.5426	3.0700	-1229.6658 (269)
Primary energy kWh/year			4299.6661 (272)
Primary energy kWh/m2/year			52.8929 (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	Thames Valley
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	157.6 (calculated from construction elements)
Night ventilation	Yes
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	270.92 (P1)
Transmission heat loss coefficient	62.66 (37)
Summer heat loss coefficient	333.59 (P2)

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

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

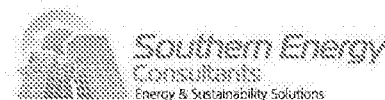
[Jul]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	0.7800	98.8453	0.4500	0.0000	0.9000	31.2252
South East	5.7000	119.9223	0.4500	0.0000	0.9000	276.8407
South West	0.7800	119.9223	0.4500	0.0000	0.9000	37.8835
North West	8.2900	98.8453	0.4500	0.0000	0.9000	331.8681

total: 677.8175

	Jun	Jul	Aug	
Solar gains	722	678	591	(P4)
Internal gains	433	415	423	
Total summer gains	1155	1092	1013	(P5)
Summer gain/loss ratio	3.46	3.27	3.04	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 157.6)	0.90	0.90	0.90	
Threshold temperature	20.36	22.07	21.74	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	
Assessment of likelihood of high internal temperature:	Medium			

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Property Reference	SECH00107			Issued on Date	03/12/2021
Assessment Reference	001	Prop Type Ref	MA		
Property	Plot 107, Pagham, Bognor Regis, West Sussex, PO21				
SAP Rating	86 B	88B	15.25	T81	18.25
Environmental	88 B	% DER<TER	16.42		
CO ₂ Emissions (t/year)	1.08	DPEE	48.60	T8EE	57.42
General Requirements Compliance	Pass	% DPEE<T8EE	15.37		
Assessor Details	Mr. Stephen Smith, Southern Energy Consultants Limited, Tel: [REDACTED] [REDACTED]			Assessor ID	d168-0001
Client	Bellway Wessex				

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

DWELLING AS DESIGNED

Detached House, total floor area 98 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) 18.25 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.25 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 57.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE) 48.6 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.50 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals: 5.00 (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

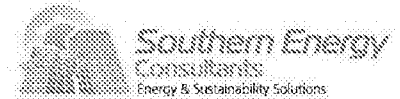
Overheating risk (Thames Valley): Not significant OK
Based on:
Overshading: Average
Windows facing North: 13.35 m², No overhang
Windows facing East: 1.89 m², No overhang
Windows facing South: 9.95 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Thermal bridging y-value 0.025 W/m²K
Photovoltaic array 0.50 kW

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	51.9700 (1b)	x 2.3500 (2b)	= 122.1295 (1b) - (3b)
First floor	46.3900 (1c)	x 2.6500 (2c)	= 122.9335 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.3600		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	245.0630 (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					5 * 10 = 50.0000 (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) =					50.0000 / (5) = 0.2040 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4540 (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) =	0.3859 (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	0.4921	0.4824	0.4728	0.4245	0.4149	0.3666	0.3666	0.3570	0.3859	0.4149	0.4342	0.4535 (22b)
Effective ac	0.6211	0.6164	0.6118	0.5901	0.5861	0.5672	0.5672	0.5637	0.5745	0.5861	0.5942	0.6028 (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	1.5000	2.9250		(26)					
Opening Type 2 (Uw = 1.30)			25.1900	1.2357	31.1283		(27)					
Heat Loss Floor 1			51.9700	0.1500	7.7955		(28a)					
External Wall 1	144.8800	27.1400	117.7400	0.2400	28.2576		(29a)					
External Roof 1	51.9700		51.9700	0.1100	5.7167		(30)					
Total net area of external elements Aum(A, m2)			248.8200				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		75.8231		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.1647 (36)					
Total fabric heat loss						(33) + (36) =	81.9878 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 50.2255	Feb 49.8453	Mar 49.4727	Apr 47.7225	May 47.3950	Jun 45.8706	Jul 45.8706	Aug 45.5883	Sep 46.4578	Oct 47.3950	Nov 48.0575	Dec 48.7500 (38)
Heat transfer coeff	132.2133	131.8332	131.4605	129.7103	129.3828	127.8584	127.8584	127.5761	128.4456	129.3828	130.0453	130.7378 (39)
Average = Sum(39)m / 12 =												129.7087 (39)
HLP	Jan 1.3442	Feb 1.3403	Mar 1.3365	Apr 1.3187	May 1.3154	Jun 1.2999	Jul 1.2999	Aug 1.2970	Sep 1.3059	Oct 1.3154	Nov 1.3221	Dec 1.3292 (40)
HLP (average)												1.3187 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

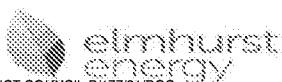
Assumed occupancy												2.7238 (42)
Average daily hot water use (litres/day)												98.8906 (43)
Daily hot water use	108.7797	104.8241	100.8685	96.9128	92.9572	89.0016	89.0016	92.9572	96.9128	100.8685	104.8241	108.7797 (44)
Energy conte	161.3172	141.0890	145.5912	126.9300	121.7923	105.0975	97.3883	111.7545	113.0892	131.7946	143.8641	156.2271 (45)
Energy content (annual)										Total = Sum(45)m =		1555.9348 (45)
Distribution loss (46)m = 0.15 x (45)m	24.1976	21.1634	21.8387	19.0395	18.2688	15.7646	14.6082	16.7632	16.9634	19.7692	21.5796	23.4341 (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 4.14r19



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1437	12.7639	14.1060	13.6080	14.0283	13.5373	13.9646	14.0059	13.5758	14.0729	13.6581	14.1315 (61)
Total heat required for water heating calculated for each month												
	175.4609	153.8529	159.6972	140.5380	135.8206	118.6348	111.3529	125.7604	126.6650	145.8674	157.5221	170.3586 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
	Solar input (sum of months) = Sum(63)m =											0.0000 (63)
Output from w/h	175.4609	153.8529	159.6972	140.5380	135.8206	118.6348	111.3529	125.7604	126.6650	145.8674	157.5221	170.3586 (64)
	Total per year (kWh/year) = Sum(64)m =											1721.5308 (64)
Heat gains from water heating, kWh/month												
	57.1739	50.1031	51.9356	45.6062	44.0030	38.3292	35.8728	40.6598	40.9961	47.3399	51.2493	55.4784 (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	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	22.6130	20.0847	16.3339	12.3658	9.2436	7.8038	8.4323	10.9607	14.7114	18.6795	21.8017	23.2415 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	253.6489	256.2810	249.6482	235.5278	217.7034	200.9510	189.7593	187.1272	193.7600	207.8804	225.7048	242.4572 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191 (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)												
	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527 (71)
Water heating gains (Table 5)												
	76.8466	74.5581	69.8059	63.3420	59.1438	53.2351	48.2161	54.6503	56.9390	63.6289	71.1796	74.5677 (72)
Total internal gains												
	419.9657	417.7810	402.6453	378.0929	352.9481	328.8471	313.2650	319.5955	332.2677	357.0460	385.5433	407.1236 (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					13.3500	10.6334	0.7200	0.7000			0.7700	49.5812 (74)
East					1.8900	19.6403	0.7200	0.7000			0.7700	12.9650 (76)
South					9.9500	46.7521	0.7200	0.7000			0.7700	162.4754 (78)
Solar gains	225.0216	386.2073	541.7303	702.6278	822.2447	833.5592	796.3274	703.2859	596.2394	429.8907	269.9194	192.3888 (83)
Total gains	644.9873	803.9884	944.3756	1080.7207	1175.1928	1162.4063	1109.5923	1022.8814	928.5070	786.9367	655.4627	599.5125 (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	51.6631	51.8121	51.9590	52.6601	52.7934	53.4228	53.4228	53.5410	53.1786	52.7934	52.5244	52.2462
alpha	4.4442	4.4541	4.4639	4.5107	4.5196	4.5615	4.5615	4.5694	4.5452	4.5196	4.5016	4.4831
util living area	0.9970	0.9917	0.9776	0.9336	0.8284	0.6550	0.4955	0.5535	0.8001	0.9612	0.9934	0.9978 (86)
MIT	19.5568	19.7771	20.0923	20.4808	20.7870	20.9471	20.9881	20.9808	20.8669	20.4539	19.9293	19.5223 (87)
Th 2	19.8064	19.8094	19.8123	19.8262	19.8288	19.8409	19.8409	19.8432	19.8362	19.8288	19.8235	19.8180 (88)
util rest of house	0.9960	0.9889	0.9696	0.9099	0.7707	0.5557	0.3708	0.4242	0.7143	0.9424	0.9906	0.9971 (89)
MIT 2	17.9049	18.2273	18.6839	19.2374	19.6305	19.8081	19.8369	19.8359	19.7362	19.2146	18.4603	17.8623 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.2223	18.5251	18.9545	19.4763	19.8527	20.0269	20.0581	20.0559	19.9534	19.4528	18.7426	18.1813 (92)
Temperature adjustment												
adjusted MIT	18.0723	18.3751	18.8045	19.3263	19.7027	19.8769	19.9081	19.9059	19.8034	19.3028	18.5926	18.0313 (93)

8. Space heating requirement

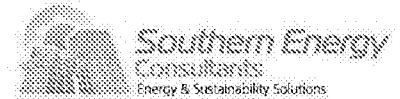
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9936	0.9838	0.9602	0.8970	0.7635	0.5590	0.3783	0.4316	0.7115	0.9308	0.9861	0.9953 (94)
Useful gains	640.8376	790.9336	906.8168	969.4266	897.2436	649.8180	419.7421	441.4664	660.6009	732.4664	646.3614	596.6653 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1820.8875	1776.4671	1617.5544	1352.4040	1035.4162	674.6992	422.9729	447.2693	732.5815	1125.9865	1494.5586	1808.2737 (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	877.9571	662.2785	528.7888	275.7438	102.8004	0.0000	0.0000	0.0000	0.0000	292.7790	610.7020	901.4366 (98)
Space heating												
Space heating per m2	(98) / (4) =											
	43.2339 (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												4698.8798 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	877.9571	662.2785	528.7888	275.7438	102.8004	0.0000	0.0000	0.0000	0.0000	292.7790	610.7020	901.4366 (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)	970.1184	731.7995	584.2970	304.6893	113.5916	0.0000	0.0000	0.0000	0.0000	323.5127	674.8088	996.0626 (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	175.4609	153.8529	159.6972	140.5380	135.8206	118.6348	111.3529	125.7604	126.6650	145.8674	157.5221	170.3586 (64)
Efficiency of water heater (217)m	89.9508	89.8789	89.7370	89.3938	88.6504	87.3000	87.3000	87.3000	87.3000	89.4102	89.8249	87.3000 (216)
Fuel for water heating, kWh/month	195.0631	171.1779	177.9613	157.2123	153.2092	135.8932	127.5520	144.0554	145.0917	163.1441	175.3658	189.3382 (219)
Water heating fuel used												1935.0644 (219)
Annual totals kWh/year												
Space heating fuel - main system												4698.8798 (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)												399.3523 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 0.50 * 1080 * 0.80) =												-345.4479 (233)
Total delivered energy for all uses												6762.8487 (238)

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

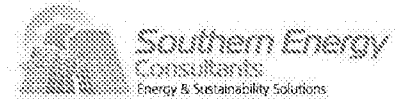
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4698.8798	0.2160	1014.9580 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1935.0644	0.2160	417.9739 (264)
Space and water heating			1432.9320 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	399.3523	0.5190	207.2639 (268)
Energy saving/generation technologies			
PV Unit	-345.4479	0.5190	-179.2874 (269)
Total CO2, kg/year			1499.8334 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.2500 (273)

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

DER		15.2500 ZC1
Total Floor Area	TFA	98.3600
Assumed number of occupants	N	2.7238
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190
CO2 emissions from appliances, equation (L14)		15.2813 ZC2
CO2 emissions from cooking, equation (L16)		1.8745 ZC3
Total CO2 emissions		32.4058 ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000 ZC7
Net CO2 emissions		32.4058 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	51.9700 (1b)	x 2.3500 (2b)	= 122.1295 (1b) - (3b)
First floor	46.3900 (1c)	x 2.6500 (2c)	= 122.9335 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.3600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 245.0630 (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) = 0.1224 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3724 (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) =	0.3166 (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	0.4036	0.3957	0.3878	0.3482	0.3403	0.3007	0.3007	0.2928	0.3166	0.3403	0.3561	0.3720 (22b)
Effective ac	0.5814	0.5783	0.5752	0.5606	0.5579	0.5452	0.5452	0.5429	0.5501	0.5579	0.5634	0.5692 (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)			22.6400	1.3258	30.0152		(27)					
Heat Loss Floor 1			51.9700	0.1300	6.7561		(28a)					
External Wall 1	144.8800	24.5900	120.2900	0.1800	21.6522		(29a)					
External Roof 1	51.9700		51.9700	0.1300	6.7561		(30)					
Total net area of external elements Aum(A, m2)			248.8200				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.1296		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.9455 (36)					
Total fabric heat loss						(33) + (36) =	79.0751 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	47.0223	46.7665	46.5158	45.3382	45.1179	44.0922	44.0922	43.9023	44.4873	45.1179	45.5636	46.0296 (38)
Heat transfer coeff	126.0973	125.8416	125.5908	124.4133	124.1929	123.1673	123.1673	122.9774	123.5624	124.1929	124.6386	125.1046 (39)
Average = Sum(39)m / 12 =												124.4122 (39)
HLP	Jan 1.2820	Feb 1.2794	Mar 1.2768	Apr 1.2649	May 1.2626	Jun 1.2522	Jul 1.2522	Aug 1.2503	Sep 1.2562	Oct 1.2626	Nov 1.2672	Dec 1.2719 (40)
HLP (average)												1.2649 (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												2.7238 (42)
Average daily hot water use (litres/day)												98.8906 (43)
Daily hot water use	108.7797	104.8241	100.8685	96.9128	92.9572	89.0016	89.0016	92.9572	96.9128	100.8685	104.8241	108.7797 (44)
Energy conte	161.3172	141.0890	145.5912	126.9300	121.7923	105.0975	97.3883	111.7545	113.0892	131.7946	143.8641	156.2271 (45)
Energy content (annual)										Total = Sum(45)m =		1555.9348 (45)
Distribution loss (46)m = 0.15 x (45)m	24.1976	21.1634	21.8387	19.0395	18.2688	15.7646	14.6082	16.7632	16.9634	19.7692	21.5796	23.4341 (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

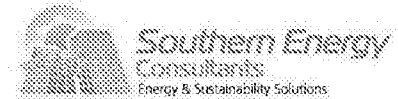
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Total heat required for water heating calculated for each month	50.9589	46.0274	50.9589	47.7926	47.3700	43.8912	45.3542	47.3700	47.7926	50.9589	49.3151	50.9589 (61)
Solar input	212.2761	187.1164	196.5501	174.7226	169.1623	148.9887	142.7425	159.1245	160.8818	182.7535	193.1791	207.1860 (62)
Output from w/h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Heat gains from water heating, kWh/month	212.2761	187.1164	196.5501	174.7226	169.1623	148.9887	142.7425	159.1245	160.8818	182.7535	193.1791	207.1860 (64)
	66.3777	58.4189	61.1488	54.1524	52.3384	45.9177	43.7202	49.0009	49.5503	56.5614	60.1636	64.6852 (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	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.6130	20.0847	16.3339	12.3658	9.2436	7.8038	8.4323	10.9607	14.7114	18.6795	21.8017	23.2415	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	253.6489	256.2810	249.6482	235.5278	217.7034	200.9510	189.7593	187.1272	193.7600	207.8804	225.7048	242.4572	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	(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)	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	(71)
Water heating gains (Table 5)	89.2173	86.9330	82.1893	75.2116	70.3474	63.7746	58.7637	65.8614	68.8199	76.0234	83.5605	86.9425	(72)
Total internal gains	432.3364	430.1558	415.0286	389.9625	364.1516	339.3867	323.8126	330.8065	344.1485	369.4405	397.9242	419.4984	(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					12.0000	10.6334	0.6300	0.7000			0.7700			38.9964 (74)
East					1.7000	19.6403	0.6300	0.7000			0.7700			10.2039 (76)
South					8.9400	46.7521	0.6300	0.7000			0.7700			127.7351 (78)
Solar gains	176.9354	303.6824	425.9879	552.5316	646.6141	655.5190	626.2367	553.0563	468.8586	338.0355	212.2399	151.2754	(83)	
Total gains	609.2719	733.8382	841.0165	942.4942	1010.7657	994.9057	950.0492	883.8628	813.0071	707.4760	610.1641	570.7739	(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	54.1689	54.2790	54.3874	54.9022	54.9996	55.4575	55.4575	55.5432	55.2802	54.9996	54.8029	54.5988	
alpha	4.6113	4.6186	4.6258	4.6601	4.6666	4.6972	4.6972	4.7029	4.6853	4.6666	4.6535	4.6399	
util living area	0.9977	0.9941	0.9847	0.9546	0.8737	0.7173	0.5521	0.6094	0.8431	0.9718	0.9949	0.9983	(86)
MIT	19.6033	19.7906	20.0734	20.4335	20.7456	20.9300	20.9837	20.9746	20.8435	20.4348	19.9479	19.5690	(87)
Th 2	19.8550	19.8570	19.8590	19.8684	19.8702	19.8785	19.8785	19.8800	19.8753	19.8702	19.8666	19.8629	(88)
util rest of house	0.9969	0.9921	0.9791	0.9371	0.8251	0.6198	0.4206	0.4758	0.7665	0.9576	0.9928	0.9977	(89)
MIT 2	18.0058	18.2801	18.6913	19.2090	19.6226	19.8325	19.8727	19.8698	19.7512	19.2209	18.5174	17.9612	(90)
Living area fraction										fLA = Living area / (4) =		0.1922	(91)
MIT	18.3127	18.5703	18.9568	19.4443	19.8384	20.0434	20.0862	20.0821	19.9611	19.4542	18.7922	18.2701	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3127	18.5703	18.9568	19.4443	19.8384	20.0434	20.0862	20.0821	19.9611	19.4542	18.7922	18.2701	(93)

8. Space heating requirement

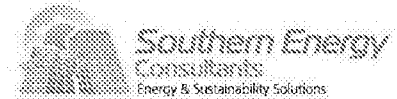
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9952	0.9887	0.9730	0.9287	0.8235	0.6354	0.4460	0.5013	0.7733	0.9504	0.9898	0.9964	(94)
Ext temp.	606.3210	725.5432	818.3007	875.3238	832.3801	632.1616	423.6764	443.0936	628.7354	672.3735	603.9481	568.6962	(95)
Heat loss rate 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	1766.9686	1720.2947	1564.4654	1311.8554	1010.7312	670.4435	429.3824	452.8151	724.2071	1099.6237	1457.3045	1760.2383	(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	863.5218	668.4730	555.1466	314.3028	132.6932	0.0000	0.0000	0.0000	0.0000	317.8741	614.4166	886.5074	(98)
Space heating per m2												4352.9354	(98)
												44.2551	(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

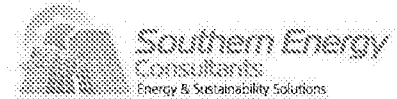
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												93.4000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												4660.5305 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	863.5218	668.4730	555.1466	314.3028	132.6932	0.0000	0.0000	0.0000	0.0000	317.8741	614.4166	886.5074 (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)	924.5416	715.7099	594.3753	336.5126	142.0698	0.0000	0.0000	0.0000	0.0000	340.3363	657.8336	949.1514 (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	212.2761	187.1164	196.5501	174.7226	169.1623	148.9887	142.7425	159.1245	160.8818	182.7535	193.1791	207.1860 (64)
Efficiency of water heater (217)m	88.2107	87.9799	87.5216	86.5122	84.4475	80.3000	80.3000	80.3000	80.3000	86.4315	87.7596	80.3000 (216)
Fuel for water heating, kWh/month	240.6465	212.6809	224.5733	201.9629	200.3164	185.5401	177.7615	198.1625	200.3510	211.4432	220.1230	234.6489 (219)
Water heating fuel used												2508.2102 (219)
Annual totals kWh/year												
Space heating fuel - main system												4660.5305 (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)												399.3523 (232)
Total delivered energy for all uses												7643.0930 (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	4660.5305	0.2160	1006.6746 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2508.2102	0.2160	541.7734 (264)
Space and water heating			1548.4480 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	399.3523	0.5190	207.2639 (268)
Total CO2, kg/m2/year			1794.6368 (272)
Emissions per m2 for space and water heating			15.7427 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.1072 (272b)
Emissions per m2 for pumps and fans			0.3957 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.7427 * 1.00) + 2.1072 + 0.3957, rounded to 2 d.p.			18.2500 (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	51.9700 (1b)	x 2.3500 (2b)	= 122.1295 (1b) - (3b)
First floor	46.3900 (1c)	x 2.6500 (2c)	= 122.9335 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.3600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 245.0630 (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) = 0.1224 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3724 (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) =	0.3166 (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	0.4036	0.3957	0.3878	0.3482	0.3403	0.3007	0.3007	0.2928	0.3166	0.3403	0.3561	0.3720 (22b)
Effective ac	0.5814	0.5783	0.5752	0.5606	0.5579	0.5452	0.5452	0.5429	0.5501	0.5579	0.5634	0.5692 (25)

3. Heat losses and heat loss parameter

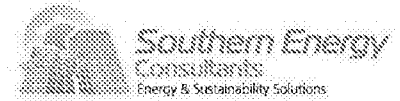
Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
Opening Type 1			1.9500	1.5000	2.9250		(26)					
Opening Type 2 (Uw = 1.30)			25.1900	1.2357	31.1283		(27)					
Heat Loss Floor 1			51.9700	0.1500	7.7955		(28a)					
External Wall 1	144.8800	27.1400	117.7400	0.2400	28.2576		(29a)					
External Roof 1	51.9700		51.9700	0.1100	5.7167		(30)					
Total net area of external elements Aum(A, m2)			248.8200				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		75.8231		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.1647 (36)					
Total fabric heat loss					(33) + (36) =		81.9878 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	47.0223	46.7665	46.5158	45.3382	45.1179	44.0922	44.0922	43.9023	44.4873	45.1179	45.5636	46.0296 (38)
Heat transfer coeff	129.0101	128.7543	128.5036	127.3260	127.1057	126.0801	126.0801	125.8901	126.4751	127.1057	127.5514	128.0174 (39)
Average = Sum(39)m / 12 =												127.3250 (39)
HLP	Jan 1.3116	Feb 1.3090	Mar 1.3065	Apr 1.2945	May 1.2922	Jun 1.2818	Jul 1.2818	Aug 1.2799	Sep 1.2858	Oct 1.2922	Nov 1.2968	Dec 1.3015 (40)
HLP (average)												1.2945 (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												2.7238 (42)
Average daily hot water use (litres/day)												98.8906 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.7797	104.8241	100.8685	96.9128	92.9572	89.0016	89.0016	92.9572	96.9128	100.8685	104.8241	108.7797 (44)
Energy conte	161.3172	141.0890	145.5912	126.9300	121.7923	105.0975	97.3883	111.7545	113.0892	131.7946	143.8641	156.2271 (45)
Energy content (annual)												Total = Sum(45)m = 1555.9348 (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												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF 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)
	34.2799	29.9814	30.9381	26.9726	25.8809	22.3332	20.6950	23.7478	24.0315	28.0063	30.5711	33.1982 (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	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.6130	20.0847	16.3339	12.3658	9.2436	7.8038	8.4323	10.9607	14.7114	18.6795	21.8017	23.2415	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	253.6489	256.2810	249.6482	235.5278	217.7034	200.9510	189.7593	187.1272	193.7600	207.8804	225.7048	242.4572	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	(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)	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	(71)
Water heating gains (Table 5)	46.0751	44.6152	41.5835	37.4620	34.7861	31.0184	27.8159	31.9191	33.3770	37.6429	42.4599	44.6213	(72)
Total internal gains	386.1942	384.8381	371.4229	349.2129	325.5904	303.6304	289.8648	293.8643	305.7056	328.0600	353.8236	374.1772	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	13.3500	10.6334	0.7200	0.7200	0.7000	0.7700	49.5812 (74)
East	1.8900	19.6403	0.7200	0.7200	0.7000	0.7700	12.9650 (76)
South	9.9500	46.7521	0.7200	0.7200	0.7000	0.7700	162.4754 (78)

Solar gains	225.0216	386.2073	541.7303	702.6278	822.2447	833.5592	796.3274	703.2859	596.2394	429.8907	269.9194	192.3888 (83)
Total gains	611.2158	771.0454	913.1532	1051.8407	1147.8351	1137.1896	1086.1922	997.1502	901.9450	757.9507	623.7430	566.5661 (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	52.9459	53.0511	53.1546	53.6462	53.7392	54.1763	54.1763	54.2581	54.0071	53.7392	53.5514	53.3565	
alpha	4.5297	4.5367	4.5436	4.5764	4.5826	4.6118	4.6118	4.6172	4.6005	4.5826	4.5701	4.5571	
util living area	0.9976	0.9929	0.9796	0.9372	0.8327	0.6600	0.4992	0.5600	0.8076	0.9651	0.9945	0.9983	(86)
MIT	19.5673	19.7868	20.1007	20.4838	20.7894	20.9474	20.9883	20.9807	20.8656	20.4505	19.9281	19.5272	(87)
Th 2	19.8317	19.8338	19.8358	19.8452	19.8469	19.8551	19.8551	19.8566	19.8519	19.8469	19.8434	19.8396	(88)
util rest of house	0.9968	0.9905	0.9724	0.9145	0.7762	0.5615	0.3752	0.4310	0.7237	0.9479	0.9922	0.9977	(89)
MIT 2	18.5383	18.7582	19.0692	19.4436	19.7124	19.8327	19.8524	19.8516	19.7823	19.4217	18.9073	18.5045	(90)
Living area fraction									fLA = Living area / (4) =			0.1922	(91)
MIT	18.7360	18.9559	19.2674	19.6434	19.9193	20.0469	20.0707	20.0685	19.9904	19.6194	19.1035	18.7010	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7360	18.9559	19.2674	19.6434	19.9193	20.0469	20.0707	20.0685	19.9904	19.6194	19.1035	18.7010	(93)

8. Space heating requirement

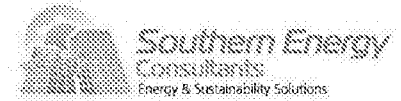
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9957	0.9879	0.9678	0.9097	0.7802	0.5791	0.3992	0.4559	0.7352	0.9435	0.9902	0.9969	(94)
Ext temp.	608.5702	761.7389	883.7545	956.8767	895.5551	658.5022	433.6128	454.6444	663.1363	715.1402	617.5993	564.8004	(95)
Ext temp.	4.3000	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	1862.3946	1809.7518	1640.6561	1367.9200	1044.7221	686.7417	437.5833	461.8342	744.9933	1146.4176	1531.0581	1856.3852	(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	932.8454	704.2647	563.1348	295.9512	110.9803	0.0000	0.0000	0.0000	0.0000	320.8704	657.6904	960.9391	(98)
Space heating												4546.6761	(98)
Space heating per m2												46.2248	(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	1185.1527	932.9925	956.7650	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8902	0.9389	0.9161	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1054.9690	875.9497	876.4581	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1433.2878	1371.4349	1269.1807	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	272.3895	368.6409	292.1856	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												933.2160	(104)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

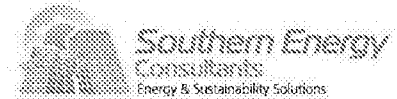


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	68.0974	92.1602	73.0464	0.0000	0.0000	0.0000 (107)
Space cooling											233.3040 (107)
Space cooling per m2											2.3719 (108)
Energy for space heating											46.2248 (99)
Energy for space cooling											2.3719 (108)
Total											48.5968 (109)
Dwelling Fabric Energy Efficiency (DFEE)											48.6 (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	51.9700 (1b)	x 2.3500 (2b)	= 122.1295 (1b) - (3b)
First floor	46.3900 (1c)	x 2.6500 (2c)	= 122.9335 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.3600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 245.0630 (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) = 0.1224 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3724 (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) =	0.3166 (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	0.4036	0.3957	0.3878	0.3482	0.3403	0.3007	0.3007	0.2928	0.3166	0.3403	0.3561	0.3720 (22b)
Effective ac	0.5814	0.5783	0.5752	0.5606	0.5579	0.5452	0.5452	0.5429	0.5501	0.5579	0.5634	0.5692 (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)			22.6400	1.3258	30.0152		(27)					
Heat Loss Floor 1			51.9700	0.1300	6.7561		(28a)					
External Wall 1	144.8800	24.5900	120.2900	0.1800	21.6522		(29a)					
External Roof 1	51.9700		51.9700	0.1300	6.7561		(30)					
Total net area of external elements Aum(A, m2)			248.8200				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.1296		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.9455 (36)					
Total fabric heat loss						(33) + (36) =	79.0751 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	47.0223	46.7665	46.5158	45.3382	45.1179	44.0922	44.0922	43.9023	44.4873	45.1179	45.5636	46.0296 (38)
Heat transfer coeff	126.0973	125.8416	125.5908	124.4133	124.1929	123.1673	123.1673	122.9774	123.5624	124.1929	124.6386	125.1046 (39)
Average = Sum(39)m / 12 =												124.4122 (39)
HLP	Jan 1.2820	Feb 1.2794	Mar 1.2768	Apr 1.2649	May 1.2626	Jun 1.2522	Jul 1.2522	Aug 1.2503	Sep 1.2562	Oct 1.2626	Nov 1.2672	Dec 1.2719 (40)
HLP (average)												1.2649 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

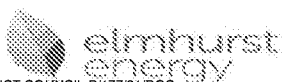
Assumed occupancy												2.7238 (42)
Average daily hot water use (litres/day)												98.8906 (43)
Daily hot water use	108.7797	104.8241	100.8685	96.9128	92.9572	89.0016	89.0016	92.9572	96.9128	100.8685	104.8241	108.7797 (44)
Energy conte	161.3172	141.0890	145.5912	126.9300	121.7923	105.0975	97.3883	111.7545	113.0892	131.7946	143.8641	156.2271 (45)
Energy content (annual)										Total = Sum(45)m =		1555.9348 (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

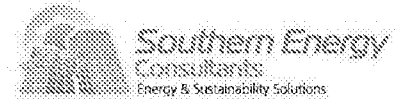
SAP2012 Calculator (Design

System) version 4.14r19



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)
	34.2799	29.9814	30.9381	26.9726	25.8809	22.3332	20.6950	23.7478	24.0315	28.0063	30.5711	33.1982 (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	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.6130	20.0847	16.3339	12.3658	9.2436	7.8038	8.4323	10.9607	14.7114	18.6795	21.8017	23.2415 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	253.6489	256.2810	249.6482	235.5278	217.7034	200.9510	189.7593	187.1272	193.7600	207.8804	225.7048	242.4572 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191 (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)	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527 (71)
Water heating gains (Table 5)	46.0751	44.6152	41.5835	37.4620	34.7861	31.0184	27.8159	31.9191	33.3770	37.6429	42.4599	44.6213 (72)
Total internal gains	386.1942	384.8381	371.4229	349.2129	325.5904	303.6304	289.8648	293.8643	305.7056	328.0600	353.8236	374.1772 (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				12.0000	10.6334	0.6300	0.7000	0.7700	38.9964 (74)			
East				1.7000	19.6403	0.6300	0.7000	0.7700	10.2039 (76)			
South				8.9400	46.7521	0.6300	0.7000	0.7700	127.7351 (78)			
Solar gains	176.9354	303.6824	425.9879	552.5316	646.6141	655.5190	626.2367	553.0563	468.8586	338.0355	212.2399	151.2754 (83)
Total gains	563.1297	688.5205	797.4108	901.7445	972.2044	959.1495	916.1014	846.9205	774.5643	666.0955	566.0635	525.4527 (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	54.1689	54.2790	54.3874	54.9022	54.9996	55.4575	55.4575	55.5432	55.2802	54.9996	54.8029	54.5988
alpha	4.6113	4.6186	4.6258	4.6601	4.6666	4.6972	4.6972	4.7029	4.6853	4.6666	4.6535	4.6399
util living area	0.9983	0.9955	0.9876	0.9611	0.8864	0.7353	0.5700	0.6310	0.8612	0.9774	0.9963	0.9988 (86)
MIT	19.5607	19.7494	20.0354	20.4026	20.7256	20.9222	20.9814	20.9707	20.8262	20.4007	19.9076	19.5270 (87)
Th 2	19.8550	19.8570	19.8590	19.8684	19.8702	19.8785	19.8785	19.8800	19.8753	19.8702	19.8666	19.8629 (88)
util rest of house	0.9977	0.9939	0.9829	0.9456	0.8407	0.6384	0.4355	0.4950	0.7887	0.9657	0.9947	0.9984 (89)
MIT 2	18.5500	18.7396	19.0247	19.3897	19.6855	19.8430	19.8739	19.8718	19.7791	19.3949	18.9055	18.5226 (90)
Living area fraction									fLA = Living area / (4) =			0.1922 (91)
MIT	18.7442	18.9336	19.2189	19.5843	19.8854	20.0504	20.0867	20.0830	19.9803	19.5881	19.0980	18.7156 (92)
Temperature adjustment												0.0000
adjusted MIT	18.7442	18.9336	19.2189	19.5843	19.8854	20.0504	20.0867	20.0830	19.9803	19.5881	19.0980	18.7156 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9969	0.9921	0.9795	0.9407	0.8414	0.6547	0.4616	0.5213	0.7968	0.9617	0.9932	0.9977 (94)
Ext temp.	561.3927	683.0733	781.0268	848.2563	818.0006	627.9295	422.8655	441.4981	617.1497	640.5872	562.2196	524.2679 (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	1821.3750	1766.0105	1597.3793	1329.2672	1016.5678	671.3053	429.4498	452.9202	726.5842	1116.2622	1495.4184	1815.9675 (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	937.4268	727.7338	607.3663	346.3278	147.7340	0.0000	0.0000	0.0000	0.0000	353.9022	671.9031	961.0246 (98)
Space heating												4753.4185 (98)
Space heating per m2										(98) / (4) =		48.3267 (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	1157.7726	911.4380	934.6279	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8470	0.9105	0.8826	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	980.5926	829.8677	824.9386	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1225.1889	1172.6275	1093.5876	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	176.1093	255.0133	199.8748	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												630.9974 (104)

Regs Region: England

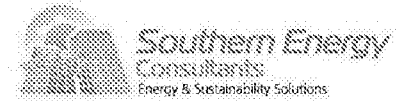
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

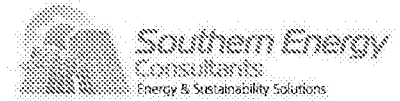


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	44.0273	63.7533	49.9687	0.0000	0.0000	0.0000 (107)
Space cooling											157.7494 (107)
Space cooling per m2											1.6038 (108)
Energy for space heating											48.3267 (99)
Energy for space cooling											1.6038 (108)
Total											49.9305 (109)
Target Fabric Energy Efficiency (TFEE)											57.4 (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	51.9700 (1b)	x 2.3500 (2b)	= 122.1295 (1b) - (3b)
First floor	46.3900 (1c)	x 2.6500 (2c)	= 122.9335 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.3600		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) = 245.0630 (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					5 * 10 = 50.0000 (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) =					50.0000 / (5) = 0.2040 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4540 (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) =	0.3859 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.6000	5.1000	4.8000	4.5000	4.7000	4.2000	4.4000	4.2000	4.4000	4.8000	4.9000	5.1000 (22)
Wind factor	1.4000	1.2750	1.2000	1.1250	1.1750	1.0500	1.1000	1.0500	1.1000	1.2000	1.2250	1.2750 (22a)
Adj infilt rate	0.5403	0.4921	0.4631	0.4342	0.4535	0.4052	0.4245	0.4052	0.4245	0.4631	0.4728	0.4921 (22b)
Effective ac	0.6460	0.6211	0.6072	0.5942	0.6028	0.5821	0.5901	0.5821	0.5901	0.6072	0.6118	0.6211 (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	1.5000	2.9250		(26)					
Opening Type 2 (Uw = 1.30)			25.1900	1.2357	31.1283		(27)					
Heat Loss Floor 1			51.9700	0.1500	7.7955		(28a)					
External Wall 1	144.8800	27.1400	117.7400	0.2400	28.2576		(29a)					
External Roof 1	51.9700		51.9700	0.1100	5.7167		(30)					
Total net area of external elements Aum(A, m2)			248.8200				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	75.8231		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.1647 (36)					
Total fabric heat loss					(33) + (36) =		81.9878 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	52.2392	50.2255	49.1076	48.0575	48.7500	47.0751	47.7225	47.0751	47.7225	49.1076	49.4727	50.2255 (38)
Heat transfer coeff	134.2271	132.2133	131.0954	130.0453	130.7378	129.0629	129.7103	129.0629	129.7103	131.0954	131.4605	132.2133 (39)
Average = Sum(39)m / 12 =												130.8862 (39)
HLP	Jan 1.3647	Feb 1.3442	Mar 1.3328	Apr 1.3221	May 1.3292	Jun 1.3121	Jul 1.3187	Aug 1.3121	Sep 1.3187	Oct 1.3328	Nov 1.3365	Dec 1.3442 (40)
HLP (average)												1.3307 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

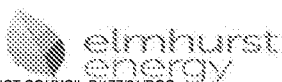
Assumed occupancy												2.7238 (42)
Average daily hot water use (litres/day)												98.8906 (43)
Daily hot water use	108.7797	104.8241	100.8685	96.9128	92.9572	89.0016	89.0016	92.9572	96.9128	100.8685	104.8241	108.7797 (44)
Energy conte	161.3172	141.0890	145.5912	126.9300	121.7923	105.0975	97.3883	111.7545	113.0892	131.7946	143.8641	156.2271 (45)
Energy content (annual)										Total = Sum(45)m =		1555.9348 (45)
Distribution loss (46)m = 0.15 x (45)m	24.1976	21.1634	21.8387	19.0395	18.2688	15.7646	14.6082	16.7632	16.9634	19.7692	21.5796	23.4341 (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

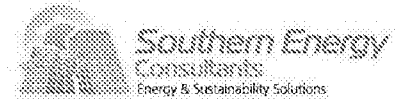
SAP2012 Calculator (Design

System) version 4.14r19



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1437	12.7639	14.1060	13.6080	14.0283	13.5373	13.9646	14.0059	13.5758	14.0729	13.6581	14.1315 (61)
Total heat required for water heating calculated for each month												
	175.4609	153.8529	159.6972	140.5380	135.8206	118.6348	111.3529	125.7604	126.6650	145.8674	157.5221	170.3586 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)
Output from w/h	175.4609	153.8529	159.6972	140.5380	135.8206	118.6348	111.3529	125.7604	126.6650	145.8674	157.5221	170.3586 (64)
								Total per year (kWh/year) = Sum(64)m =				1721.5308 (64)
RHI water heating demand												1722 (64)
Heat gains from water heating, kWh/month												
	57.1739	50.1031	51.9356	45.6062	44.0030	38.3292	35.8728	40.6598	40.9961	47.3399	51.2493	55.4784 (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	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	56.5325	50.2116	40.8348	30.9146	23.1090	19.5096	21.0808	27.4017	36.7784	46.6987	54.5043	58.1037 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	378.5804	382.5089	372.6093	351.5341	324.9305	299.9268	283.2229	279.2944	289.1940	310.2692	336.8728	361.8764 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667 (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)												
	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527 (71)
Water heating gains (Table 5)												
	76.8466	74.5581	69.8059	63.3420	59.1438	53.2351	48.2161	54.6503	56.9390	63.6289	71.1796	74.5677 (72)
Total internal gains	623.5025	618.8217	594.7930	557.3337	518.7264	484.2145	464.0628	472.8894	494.4546	532.1398	574.0997	606.0909 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	FF	Access factor Table 6d	Gains W
North	13.3500	14.6401	0.7200		0.7000	0.7700	68.2635 (74)
East	1.8900	27.3735	0.7200		0.7000	0.7700	18.0699 (76)
South	9.9500	61.3950	0.7200		0.7000	0.7700	213.3633 (78)

Solar gains	299.6966	430.1429	606.4965	825.7524	942.0684	1028.8248	975.4420	860.1272	720.0665	516.0421	344.7554	248.5231 (83)
Total gains	923.1992	1048.9646	1201.2895	1383.0861	1460.7948	1513.0394	1439.5048	1333.0166	1214.5211	1048.1820	918.8551	854.6140 (84)

7. Mean internal temperature (heating season)

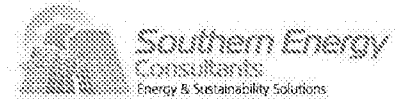
Temperature during heating periods in the living area from Table 9, Thl (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	50.8881	51.6631	52.1037	52.5244	52.2462	52.9242	52.6601	52.9242	52.6601	52.1037	51.9590	51.6631
alpha	4.3925	4.4442	4.4736	4.5016	4.4831	4.5283	4.5107	4.5283	4.5107	4.4736	4.4639	4.4442
util living area	0.9829	0.9713	0.9355	0.8387	0.6680	0.4531	0.3142	0.3183	0.5553	0.8414	0.9605	0.9864 (86)
MIT	19.9591	20.1107	20.4031	20.7255	20.9231	20.9894	20.9984	20.9985	20.9759	20.7853	20.3583	19.9485 (87)
Th 2	19.7905	19.8064	19.8152	19.8235	19.8180	19.8313	19.8262	19.8313	19.8262	19.8152	19.8123	19.8064 (88)
util rest of house	0.9770	0.9619	0.9149	0.7932	0.5895	0.3586	0.2095	0.2062	0.4444	0.7792	0.9444	0.9815 (89)
MIT 2	18.4771	18.7036	19.1177	19.5436	19.7594	19.8266	19.8259	19.8311	19.8148	19.6227	19.0636	18.4738 (90)
Living area fraction												
	fLA = Living area / (4) =											
MIT	18.7619	18.9740	19.3647	19.7707	19.9830	20.0501	20.0512	20.0554	20.0379	19.8461	19.3124	18.7571 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.6119	18.8240	19.2147	19.6207	19.8330	19.9001	19.9012	19.9054	19.8879	19.6961	19.1624	18.6071 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9688	0.9513	0.9018	0.7842	0.5906	0.3643	0.2162	0.2134	0.4505	0.7718	0.9325	0.9743 (94)
Useful gains	894.3725	997.8792	1083.3556	1084.6126	862.7293	551.2179	311.2166	284.4303	547.1622	809.0137	856.8708	832.6465 (95)
Ext temp.	5.8000	6.0000	7.5000	9.8000	12.9000	15.6000	17.5000	17.7000	15.6000	12.5000	9.0000	6.0000 (96)
Heat loss rate W												
	1719.6987	1695.5053	1535.7437	1277.1348	906.4115	554.9773	311.4614	284.6362	556.1821	943.3756	1335.9508	1666.8306 (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	614.0427	468.8047	336.5767	138.6159	32.4996	0.0000	0.0000	0.0000	0.0000	99.9652	344.9376	620.6330 (98)
Space heating												2656.0754 (98)
RHI space heating demand												2656 (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	51.9700 (1b)	x 2.3500 (2b)	= 122.1295 (1b) - (3b)
First floor	46.3900 (1c)	x 2.6500 (2c)	= 122.9335 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.3600		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	245.0630 (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					5 * 10 = 50.0000 (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) =					50.0000 / (5) = 0.2040 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4540 (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) =	0.3859 (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	0.4921	0.4824	0.4728	0.4245	0.4149	0.3666	0.3666	0.3570	0.3859	0.4149	0.4342	0.4535 (22b)
Effective ac	0.6211	0.6164	0.6118	0.5901	0.5861	0.5672	0.5672	0.5637	0.5745	0.5861	0.5942	0.6028 (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	1.5000	2.9250		(26)					
Opening Type 2 (Uw = 1.30)			25.1900	1.2357	31.1283		(27)					
Heat Loss Floor 1			51.9700	0.1500	7.7955		(28a)					
External Wall 1	144.8800	27.1400	117.7400	0.2400	28.2576		(29a)					
External Roof 1	51.9700		51.9700	0.1100	5.7167		(30)					
Total net area of external elements Aum(A, m2)			248.8200				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		75.8231		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.1647 (36)					
Total fabric heat loss						(33) + (36) =	81.9878 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 50.2255	Feb 49.8453	Mar 49.4727	Apr 47.7225	May 47.3950	Jun 45.8706	Jul 45.8706	Aug 45.5883	Sep 46.4578	Oct 47.3950	Nov 48.0575	Dec 48.7500 (38)
Heat transfer coeff	132.2133	131.8332	131.4605	129.7103	129.3828	127.8584	127.8584	127.5761	128.4456	129.3828	130.0453	130.7378 (39)
Average = Sum(39)m / 12 =												129.7087 (39)
HLP	Jan 1.3442	Feb 1.3403	Mar 1.3365	Apr 1.3187	May 1.3154	Jun 1.2999	Jul 1.2999	Aug 1.2970	Sep 1.3059	Oct 1.3154	Nov 1.3221	Dec 1.3292 (40)
HLP (average)												1.3187 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

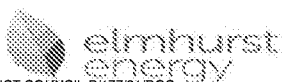
Assumed occupancy												2.7238 (42)
Average daily hot water use (litres/day)												98.8906 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	108.7797	104.8241	100.8685	96.9128	92.9572	89.0016	89.0016	92.9572	96.9128	100.8685	104.8241	108.7797 (44)
Energy conte	161.3172	141.0890	145.5912	126.9300	121.7923	105.0975	97.3883	111.7545	113.0892	131.7946	143.8641	156.2271 (45)
Energy content (annual)												Total = Sum(45)m = 1555.9348 (45)
Distribution loss (46)m = 0.15 x (45)m												
	24.1976	21.1634	21.8387	19.0395	18.2688	15.7646	14.6082	16.7632	16.9634	19.7692	21.5796	23.4341 (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 4.14r19



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1437	12.7639	14.1060	13.6080	14.0283	13.5373	13.9646	14.0059	13.5758	14.0729	13.6581	14.1315 (61)
Total heat required for water heating calculated for each month												
	175.4609	153.8529	159.6972	140.5380	135.8206	118.6348	111.3529	125.7604	126.6650	145.8674	157.5221	170.3586 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum (63)m =												
	0.0000	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												
	175.4609	153.8529	159.6972	140.5380	135.8206	118.6348	111.3529	125.7604	126.6650	145.8674	157.5221	170.3586 (64)
Total per year (kWh/year) = Sum (64)m =												
	57.1739	50.1031	51.9356	45.6062	44.0030	38.3292	35.8728	40.6598	40.9961	47.3399	51.2493	55.4784 (65)
Heat gains from water heating, kWh/month												
	57.1739	50.1031	51.9356	45.6062	44.0030	38.3292	35.8728	40.6598	40.9961	47.3399	51.2493	55.4784 (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	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	56.5325	50.2116	40.8348	30.9146	23.1090	19.5096	21.0808	27.4017	36.7784	46.6987	54.5043	58.1037 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	378.5804	382.5089	372.6093	351.5341	324.9305	299.9268	283.2229	279.2944	289.1940	310.2692	336.8728	361.8764 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667 (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)												
	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527 (71)
Water heating gains (Table 5)												
	76.8466	74.5581	69.8059	63.3420	59.1438	53.2351	48.2161	54.6503	56.9390	63.6289	71.1796	74.5677 (72)
Total internal gains												
	623.5025	618.8217	594.7930	557.3337	518.7264	484.2145	464.0628	472.8894	494.4546	532.1398	574.0997	606.0909 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	13.3500	10.6334	0.7200	0.7200	0.7000	0.7700	49.5812 (74)
East	1.8900	19.6403	0.7200	0.7200	0.7000	0.7700	12.9650 (76)
South	9.9500	46.7521	0.7200	0.7200	0.7000	0.7700	162.4754 (78)
Solar gains							
	225.0216	386.2073	541.7303	702.6278	822.2447	833.5592	796.3274
Total gains							
	848.5241	1005.0291	1136.5233	1259.9615	1340.9711	1317.7737	1260.3902

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	51.6631	51.8121	51.9590	52.6601	52.7934	53.4228	53.4228	53.5410	53.1786	52.7934	52.5244	52.2462
alpha	4.4442	4.4541	4.4639	4.5107	4.5196	4.5615	4.5615	4.5694	4.5452	4.5196	4.5016	4.4831
util living area												
	0.9912	0.9808	0.9573	0.8957	0.7719	0.5922	0.4400	0.4883	0.7258	0.9258	0.9824	0.9932 (86)
MIT												
	19.7394	19.9510	20.2445	20.5915	20.8441	20.9647	20.9926	20.9884	20.9122	20.5783	20.0942	19.7024 (87)
Th 2												
	19.8064	19.8094	19.8123	19.8262	19.8288	19.8409	19.8409	19.8432	19.8362	19.8288	19.8235	19.8180 (88)
util rest of house												
	0.9883	0.9747	0.9436	0.8631	0.7079	0.4968	0.3274	0.3709	0.6339	0.8949	0.9757	0.9909 (89)
MIT 2												
	18.1699	18.4768	18.8959	19.3789	19.6897	19.8199	19.8385	19.8390	19.7746	19.3766	18.6966	18.1243 (90)
Living area fraction												
	0.9883	0.9747	0.9436	0.8631	0.7079	0.4968	0.3274	0.3709	0.6339	0.8949	0.9757	0.9909 (89)
MIT												
	18.4715	18.7600	19.1550	19.6119	19.9115	20.0399	20.0603	20.0598	19.9932	19.6075	18.9652	18.4275 (92)
Temperature adjustment												
	-0.1500	-0.1500	-0.1500	-0.1500	-0.1500	-0.1500	-0.1500	-0.1500	-0.1500	-0.1500	-0.1500	-0.1500 (93)
adjusted MIT												
	18.3215	18.6100	19.0050	19.4619	19.7615	19.8899	19.9103	19.9098	19.8432	19.4575	18.8152	18.2775 (93)

8. Space heating requirement

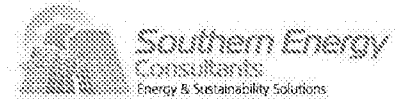
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9829	0.9661	0.9315	0.8510	0.7038	0.5010	0.3343	0.3778	0.6346	0.8825	0.9675	0.9865 (94)
Useful gains	834.0460	970.9669	1058.6315	1072.2739	943.7863	660.2528	421.3073	444.3942	692.1047	848.9613	816.5875	787.6696 (95)
Ext temp.	4.3000	4.9000	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												
	1853.8291	1807.4391	1643.9157	1369.9830	1043.0209	676.3567	423.2488	447.7708	737.6834	1146.0088	1523.5001	1840.4674 (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												
	758.7186	562.1093	435.4514	214.3506	73.8305	0.0000	0.0000	0.0000	0.0000	221.0033	508.9771	783.2815 (98)
Space heating												
	758.7186	562.1093	435.4514	214.3506	73.8305	0.0000	0.0000	0.0000	0.0000	221.0033	508.9771	783.2815 (98)
Space heating per m2												
	758.7186	562.1093	435.4514	214.3506	73.8305	0.0000	0.0000	0.0000	0.0000	221.0033	508.9771	783.2815 (98)
(98) / (4) =												
	36.1704	36.1704	36.1704	36.1704	36.1704	36.1704	36.1704	36.1704	36.1704	36.1704	36.1704	36.1704 (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													3931.1851 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	758.7186	562.1093	435.4514	214.3506	73.8305	0.0000	0.0000	0.0000	0.0000	221.0033	508.9771	783.2815	(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)	838.3631	621.1153	481.1618	236.8515	81.5807	0.0000	0.0000	0.0000	0.0000	244.2026	562.4057	865.5045	(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	175.4609	153.8529	159.6972	140.5380	135.8206	118.6348	111.3529	125.7604	126.6650	145.8674	157.5221	170.3586	(64)
Efficiency of water heater													87.3000 (216)
(217)m	89.8812	89.7927	89.6185	89.2051	88.4008	87.3000	87.3000	87.3000	87.3000	89.2000	89.7227	89.9113	(217)
Fuel for water heating, kWh/month													
	195.2142	171.3423	178.1966	157.5447	153.6419	135.8932	127.5520	144.0554	145.0917	163.5285	175.5655	189.4741	(219)
Water heating fuel used													1937.1002 (219)
Annual totals kWh/year													
Space heating fuel - main system													3931.1851 (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)													399.3523 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.50 * 1080 * 0.80) =										-345.4479			-345.4479 (233)
Total delivered energy for all uses													5997.1897 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3931.1851	3.4800	136.8052 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1937.1002	3.4800	67.4111 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	399.3523	13.1900	52.6746 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-345.4479	13.1900	-45.5646 (252)
Total energy cost			341.2188 (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] =	0.9997 (257)
SAP value	86.0547	
SAP rating (Section 12)	86	(258)
SAP band	B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3931.1851	0.2160	849.1360 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1937.1002	0.2160	418.4136 (264)
Space and water heating			1267.5496 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	399.3523	0.5190	207.2639 (268)
Energy saving/generation technologies			
PV Unit	-345.4479	0.5190	-179.2874 (269)
Total kg/year			1334.4510 (272)
CO2 emissions per m2			13.5700 (273)
EI value			87.5268
EI rating			88 (274)
EI band			B

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	$3.48 / 0.8874 = 3.921$, stars = 4
Water heating environmental impact	$0.216 / 0.8874 = 0.2434$, stars = 4

FULL SAP CALCULATION PRINTOUT

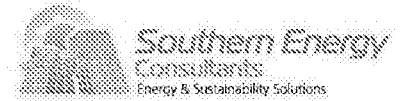
Calculation Type: New Build (As Designed)



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	51.9700 (1b)	x 2.3500 (2b)	= 122.1295 (1b) - (3b)
First floor	46.3900 (1c)	x 2.6500 (2c)	= 122.9335 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.3600		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	245.0630 (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					5 * 10 = 50.0000 (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) =					50.0000 / (5) = 0.2040 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4540 (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) =	0.3859 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.6000	5.1000	4.8000	4.5000	4.7000	4.2000	4.4000	4.2000	4.4000	4.8000	4.9000	5.1000 (22)
Wind factor	1.4000	1.2750	1.2000	1.1250	1.1750	1.0500	1.1000	1.0500	1.1000	1.2000	1.2250	1.2750 (22a)
Adj infilt rate	0.5403	0.4921	0.4631	0.4342	0.4535	0.4052	0.4245	0.4052	0.4245	0.4631	0.4728	0.4921 (22b)
Effective ac	0.6460	0.6211	0.6072	0.5942	0.6028	0.5821	0.5901	0.5821	0.5901	0.6072	0.6118	0.6211 (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	1.5000	2.9250		(26)					
Opening Type 2 (Uw = 1.30)			25.1900	1.2357	31.1283		(27)					
Heat Loss Floor 1			51.9700	0.1500	7.7955		(28a)					
External Wall 1	144.8800	27.1400	117.7400	0.2400	28.2576		(29a)					
External Roof 1	51.9700		51.9700	0.1100	5.7167		(30)					
Total net area of external elements Aum(A, m2)			248.8200				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	75.8231		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.1647 (36)					
Total fabric heat loss						(33) + (36) =	81.9878 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	52.2392	50.2255	49.1076	48.0575	48.7500	47.0751	47.7225	47.0751	47.7225	49.1076	49.4727	50.2255 (38)
Heat transfer coeff	134.2271	132.2133	131.0954	130.0453	130.7378	129.0629	129.7103	129.0629	129.7103	131.0954	131.4605	132.2133 (39)
Average = Sum(39)m / 12 =												130.8862 (39)
HLP	Jan 1.3647	Feb 1.3442	Mar 1.3328	Apr 1.3221	May 1.3292	Jun 1.3121	Jul 1.3187	Aug 1.3121	Sep 1.3187	Oct 1.3328	Nov 1.3365	Dec 1.3442 (40)
HLP (average)												1.3307 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

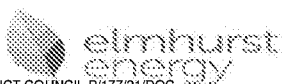
Assumed occupancy												2.7238 (42)
Average daily hot water use (litres/day)												98.8906 (43)
Daily hot water use	108.7797	104.8241	100.8685	96.9128	92.9572	89.0016	89.0016	92.9572	96.9128	100.8685	104.8241	108.7797 (44)
Energy conte	161.3172	141.0890	145.5912	126.9300	121.7923	105.0975	97.3883	111.7545	113.0892	131.7946	143.8641	156.2271 (45)
Energy content (annual)										Total = Sum(45)m =		1555.9348 (45)
Distribution loss (46)m = 0.15 x (45)m	24.1976	21.1634	21.8387	19.0395	18.2688	15.7646	14.6082	16.7632	16.9634	19.7692	21.5796	23.4341 (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

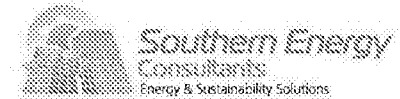
SAP2012 Calculator (Design

System) version 4.14r19



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1437	12.7639	14.1060	13.6080	14.0283	13.5373	13.9646	14.0059	13.5758	14.0729	13.6581	14.1315 (61)
Total heat required for water heating calculated for each month												
	175.4609	153.8529	159.6972	140.5380	135.8206	118.6348	111.3529	125.7604	126.6650	145.8674	157.5221	170.3586 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum (63)m =												
												0.0000 (63)
Output from w/h												
	175.4609	153.8529	159.6972	140.5380	135.8206	118.6348	111.3529	125.7604	126.6650	145.8674	157.5221	170.3586 (64)
Total per year (kWh/year) = Sum (64)m =												
												1721.5308 (64)
Heat gains from water heating, kWh/month												
	57.1739	50.1031	51.9356	45.6062	44.0030	38.3292	35.8728	40.6598	40.9961	47.3399	51.2493	55.4784 (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	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	56.5325	50.2116	40.8348	30.9146	23.1090	19.5096	21.0808	27.4017	36.7784	46.6987	54.5043	58.1037 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	378.5804	382.5089	372.6093	351.5341	324.9305	299.9268	283.2229	279.2944	289.1940	310.2692	336.8728	361.8764 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667 (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)												
	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527 (71)
Water heating gains (Table 5)												
	76.8466	74.5581	69.8059	63.3420	59.1438	53.2351	48.2161	54.6503	56.9390	63.6289	71.1796	74.5677 (72)
Total internal gains												
	623.5025	618.8217	594.7930	557.3337	518.7264	484.2145	464.0628	472.8894	494.4546	532.1398	574.0997	606.0909 (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					13.3500	14.6401	0.7200	0.7000	0.7700		68.2635 (74)	
East					1.8900	27.3735	0.7200	0.7000	0.7700		18.0699 (76)	
South					9.9500	61.3950	0.7200	0.7000	0.7700		213.3633 (78)	
Solar gains	299.6966	430.1429	606.4965	825.7524	942.0684	1028.8248	975.4420	860.1272	720.0665	516.0421	344.7554	248.5231 (83)
Total gains	923.1992	1048.9646	1201.2895	1383.0861	1460.7948	1513.0394	1439.5048	1333.0166	1214.5211	1048.1820	918.8551	854.6140 (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	50.8881	51.6631	52.1037	52.5244	52.2462	52.9242	52.6601	52.9242	52.6601	52.1037	51.9590	51.6631
alpha	4.3925	4.4442	4.4736	4.5016	4.4831	4.5283	4.5107	4.5283	4.5107	4.4736	4.4639	4.4442
util living area												
	0.9829	0.9713	0.9355	0.8387	0.6680	0.4531	0.3142	0.3183	0.5553	0.8414	0.9605	0.9864 (86)
MIT												
	19.9591	20.1107	20.4031	20.7255	20.9231	20.9894	20.9984	20.9985	20.9759	20.7853	20.3583	19.9485 (87)
Th 2												
	19.7905	19.8064	19.8152	19.8235	19.8180	19.8313	19.8262	19.8313	19.8262	19.8152	19.8123	19.8064 (88)
util rest of house												
	0.9770	0.9619	0.9149	0.7932	0.5895	0.3586	0.2095	0.2062	0.4444	0.7792	0.9444	0.9815 (89)
MIT 2												
	18.4771	18.7036	19.1177	19.5436	19.7594	19.8266	19.8259	19.8311	19.8148	19.6227	19.0636	18.4738 (90)
Living area fraction												
									fLA = Living area / (4) =			0.1922 (91)
MIT												
	18.7619	18.9740	19.3647	19.7707	19.9830	20.0501	20.0512	20.0554	20.0379	19.8461	19.3124	18.7571 (92)
Temperature adjustment												
												-0.1500
adjusted MIT												
	18.6119	18.8240	19.2147	19.6207	19.8330	19.9001	19.9012	19.9054	19.8879	19.6961	19.1624	18.6071 (93)

8. Space heating requirement

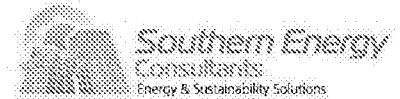
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9688	0.9513	0.9018	0.7842	0.5906	0.3643	0.2162	0.2134	0.4505	0.7718	0.9325	0.9743 (94)
Useful gains	894.3725	997.8792	1083.3556	1084.6126	862.7293	551.2179	311.2166	284.4303	547.1622	809.0137	856.8708	832.6465 (95)
Ext temp.	5.8000	6.0000	7.5000	9.8000	12.9000	15.6000	17.5000	17.7000	15.6000	12.5000	9.0000	6.0000 (96)
Heat loss rate W												
	1719.6987	1695.5053	1535.7437	1277.1348	906.4115	554.9773	311.4614	284.6362	556.1821	943.3756	1335.9508	1666.8306 (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												
	614.0427	468.8047	336.5767	138.6159	32.4996	0.0000	0.0000	0.0000	0.0000	99.9652	344.9376	620.6330 (98)
Space heating												
												2656.0754 (98)
Space heating per m2												
										(98) / (4) =		27.0036 (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													2934.8900 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	614.0427	468.8047	336.5767	138.6159	32.4996	0.0000	0.0000	0.0000	0.0000	99.9652	344.9376	620.6330	(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)	678.5002	518.0163	371.9080	153.1668	35.9111	0.0000	0.0000	0.0000	0.0000	110.4588	381.1465	685.7823	(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	175.4609	153.8529	159.6972	140.5380	135.8206	118.6348	111.3529	125.7604	126.6650	145.8674	157.5221	170.3586	(64)
Efficiency of water heater (217)m	89.7687	89.6877	89.4450	88.8602	87.9001	87.3000	87.3000	87.3000	87.3000	88.5735	89.4718	87.3000	(216)
Fuel for water heating, kWh/month	195.4588	171.5430	178.5424	158.1563	154.5170	135.8932	127.5520	144.0554	145.0917	164.6851	176.0578	189.7276	(219)
Water heating fuel used												1941.2802	(219)
Annual totals kWh/year													
Space heating fuel - main system												2934.8900	(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)												399.3523	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.50 * 1307 * 0.80) =										-418.2184		-418.2184	(233)
Total delivered energy for all uses												4932.3041	(238)

10a. Fuel costs - using BEDF prices (485)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2934.8900	3.7400	109.7649 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1941.2802	3.7400	72.6039 (247)
Pumps and fans for heating	75.0000	19.1200	14.3400 (249)
Energy for lighting	399.3523	19.1200	76.3562 (250)
Additional standing charges			94.0000 (251)
Energy saving/generation technologies			
PV Unit	-418.2184	19.1200	-79.9634 (252)
Total energy cost			287.1016 (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	2934.8900	0.2160	633.9362 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1941.2802	0.2160	419.3165 (264)
Space and water heating			1053.2528 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	399.3523	0.5190	207.2639 (268)
Energy saving/generation technologies			
PV Unit	-418.2184	0.5190	-217.0554 (269)
Total kg/year			1082.3863 (272)

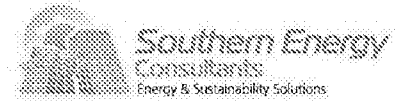
13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	2934.8900	1.2200	3580.5658 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1941.2802	1.2200	2368.3619 (264)
Space and water heating			5948.9277 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	399.3523	3.0700	1226.0117 (268)
Energy saving/generation technologies			
PV Unit	-418.2184	3.0700	-1283.9306 (269)
Primary energy kWh/year			6121.2588 (272)
Primary energy kWh/m2/year			62.2332 (273)

SAP 2012 EPC IMPROVEMENTS

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: B 86
Current environmental impact rating: B 88

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 29	-196 kg (18.1%)

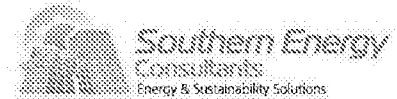
Recommended measures	Typical annual savings		Energy efficiency	Environmental impact
Solar water heating	£29	2.00 kg/m ²	B 87	B 89
Total Savings	£29	2.00 kg/m ²		
Potential energy efficiency rating:			B 87	
Potential environmental impact rating:				B 89

Fuel prices for cost data on this page from database revision number 485 TEST (29 Oct 2021)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):			
	Current	Potential	Saving
Electricity	£91	£100	-£10
Mains gas	£276	£238	£39
Space heating	£218	£218	£0
Water heating	£73	£44	£29
Lighting	£76	£76	£0
Generated (PV)	-£80	-£80	£0
Total cost of fuels	£287	£258	£29
Total cost of uses	£287	£258	£29
Delivered energy	50 kWh/m ²	40 kWh/m ²	10 kWh/m ²
Carbon dioxide emissions	1.1 tonnes	0.9 tonnes	0.2 tonnes
CO2 emissions per m ²	11 kg/m ²	9 kg/m ²	2 kg/m ²
Primary energy	62 kWh/m ²	51 kWh/m ²	11 kWh/m ²

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	51.9700 (1b)	x 2.3500 (2b)	= 122.1295 (1b) - (3b)
First floor	46.3900 (1c)	x 2.6500 (2c)	= 122.9335 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.3600		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	245.0630 (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					5 * 10 = 50.0000 (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) =				50.0000 / (5) =	0.2040 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4540 (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) =		0.3859 (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	0.4921	0.4824	0.4728	0.4245	0.4149	0.3666	0.3666	0.3570	0.3859	0.4149	0.4342	0.4535 (22b)
Effective ac	0.6211	0.6164	0.6118	0.5901	0.5861	0.5672	0.5672	0.5637	0.5745	0.5861	0.5942	0.6028 (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	1.5000	2.9250		(26)					
Opening Type 2 (Uw = 1.30)			25.1900	1.2357	31.1283		(27)					
Heat Loss Floor 1			51.9700	0.1500	7.7955		(28a)					
External Wall 1	144.8800	27.1400	117.7400	0.2400	28.2576		(29a)					
External Roof 1	51.9700		51.9700	0.1100	5.7167		(30)					
Total net area of external elements Aum(A, m2)			248.8200				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	75.8231		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.1647 (36)					
Total fabric heat loss						(33) + (36) =	81.9878 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 50.2255	Feb 49.8453	Mar 49.4727	Apr 47.7225	May 47.3950	Jun 45.8706	Jul 45.8706	Aug 45.5883	Sep 46.4578	Oct 47.3950	Nov 48.0575	Dec 48.7500 (38)
Heat transfer coeff	132.2133	131.8332	131.4605	129.7103	129.3828	127.8584	127.8584	127.5761	128.4456	129.3828	130.0453	130.7378 (39)
Average = Sum(39)m / 12 =												129.7087 (39)
HLP	Jan 1.3442	Feb 1.3403	Mar 1.3365	Apr 1.3187	May 1.3154	Jun 1.2999	Jul 1.2999	Aug 1.2970	Sep 1.3059	Oct 1.3154	Nov 1.3221	Dec 1.3292 (40)
HLP (average)												1.3187 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

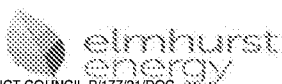
Assumed occupancy												2.7238 (42)
Average daily hot water use (litres/day)												98.8906 (43)
Daily hot water use	108.7797	104.8241	100.8685	96.9128	92.9572	89.0016	89.0016	92.9572	96.9128	100.8685	104.8241	108.7797 (44)
Energy conte	161.3172	141.0890	145.5912	126.9300	121.7923	105.0975	97.3883	111.7545	113.0892	131.7946	143.8641	156.2271 (45)
Energy content (annual)										Total = Sum(45)m =		1555.9348 (45)
Distribution loss (46)m = 0.15 x (45)m	24.1976	21.1634	21.8387	19.0395	18.2688	15.7646	14.6082	16.7632	16.9634	19.7692	21.5796	23.4341 (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

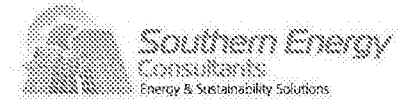
SAP2012 Calculator (Design

System) version 4.14r19



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Total heat required for water heating calculated for each month	14.1437	12.7639	14.1060	13.6080	14.0283	13.5373	13.9646	14.0059	13.5758	14.0729	13.6581	14.1315 (61)
Aperture area of solar collector	175.4609	153.8529	159.6972	140.5380	135.8206	118.6348	111.3529	125.7604	126.6650	145.8674	157.5221	170.3586 (62)
Zero-loss collector efficiency												3.0000 (H1)
Collector heat loss coefficient												0.7000 (H2)
Collector 2nd order heat loss coefficient												1.8000 (H3)
Collector effective heat loss coefficient												0.0050 (H3a)
Collector performance ratio												1.8063 (H3b)
Annual solar radiation per m2												2.5804 (H4)
Overshading factor												1079.5246 (H5)
Solar energy available												0.8000 (H6)
Adjustment factor for showers												1813.6014 (H7)
Solar-to-load ratio												1.0000 (H7a)
Utilisation factor												1.1656 (H8)
Collector performance factor												0.5760 (H9)
Dedicated solar storage volume												0.8793 (H10)
Effective solar volume												75.0000 (H11)
Daily hot water demand												75.0000 (H13)
Volume ratio Veff/V												98.8906 (H14)
Solar storage volume factor												0.7584 (H15)
Solar input												0.9447 (H16)
Solar input												-867.6785 (H17)
Solar input	-25.1609	-41.9864	-71.5076	-95.8343	-118.3952	-116.4014	-114.8631	-100.3564	-78.5992	-53.6740	-29.8445	-21.0554 (63)
Solar input (sum of months) = Sum(63)m =												-867.6785 (63)
Output from w/h	150.2999	111.8665	88.1896	44.7037	17.4254	2.2334	0.0000	25.4039	48.0658	92.1934	127.6776	149.3031 (64)
Heat gains from water heating, kWh/month	57.1739	50.1031	51.9356	45.6062	44.0030	38.3292	35.8728	40.6598	40.9961	47.3399	51.2493	55.4784 (65)
Total per year (kWh/year) = Sum(64)m =												857.3625 (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	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.5325	50.2116	40.8348	30.9146	23.1090	19.5096	21.0808	27.4017	36.7784	46.6987	54.5043	58.1037	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	378.5804	382.5089	372.6093	351.5341	324.9305	299.9268	283.2229	279.2944	289.1940	310.2692	336.8728	361.8764	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	(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)	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	(71)
Water heating gains (Table 5)	76.8466	74.5581	69.8059	63.3420	59.1438	53.2351	48.2161	54.6503	56.9390	63.6289	71.1796	74.5677	(72)
Total internal gains	623.5025	618.8217	594.7930	557.3337	518.7264	484.2145	464.0628	472.8894	494.4546	532.1398	574.0997	606.0909	(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					13.3500	10.6334	0.7200	0.7000			0.7700			49.5812 (74)
East					1.8900	19.6403	0.7200	0.7000			0.7700			12.9650 (76)
South					9.9500	46.7521	0.7200	0.7000			0.7700			162.4754 (78)
Solar gains	225.0216	386.2073	541.7303	702.6278	822.2447	833.5592	796.3274	703.2859	596.2394	429.8907	269.9194	192.3888	(83)	
Total gains	848.5241	1005.0291	1136.5233	1259.9615	1340.9711	1317.7737	1260.3902	1176.1753	1090.6939	962.0305	844.0191	798.4797	(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	51.6631	51.8121	51.9590	52.6601	52.7934	53.4228	53.4228	53.5410	53.1786	52.7934	52.5244	52.2462	
alpha	4.4442	4.4541	4.4639	4.5107	4.5196	4.5615	4.5615	4.5694	4.5452	4.5196	4.5016	4.4831	
util living area	0.9912	0.9808	0.9573	0.8957	0.7719	0.5922	0.4400	0.4883	0.7258	0.9258	0.9824	0.9932	(86)
MIT	19.7394	19.9510	20.2445	20.5915	20.8441	20.9647	20.9926	20.9884	20.9122	20.5783	20.0942	19.7024	(87)
Th 2	19.8064	19.8094	19.8123	19.8262	19.8288	19.8409	19.8409	19.8432	19.8362	19.8288	19.8235	19.8180	(88)
util rest of house	0.9883	0.9747	0.9436	0.8631	0.7079	0.4968	0.3274	0.3709	0.6339	0.8949	0.9757	0.9909	(89)
MIT 2	18.1699	18.4768	18.8959	19.3789	19.6897	19.8199	19.8385	19.8390	19.7746	19.3766	18.6966	18.1243	(90)
Living area fraction	18.4715	18.7600	19.1550	19.6119	19.9115	20.0399	20.0603	20.0598	fLA = Living area / (4) =	19.9932	19.6075	18.9652	0.1922 (91)
MIT	18.3215	18.6100	19.0050	19.4619	19.7615	19.8899	19.9103	19.9098	19.8432	19.4575	18.8152	-0.1500	
Temperature adjustment												18.2775	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9829	0.9661	0.9315	0.8510	0.7038	0.5010	0.3343	0.3778	0.6346	0.8825	0.9675	0.9865	(94)
	834.0460	970.9669	1058.6315	1072.2739	943.7863	660.2528	421.3073	444.3942	692.1047	848.9613	816.5875	787.6696	(95)

Regs Region: England

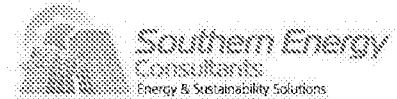
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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	1853.8291	1807.4391	1643.9157	1369.9830	1043.0209	676.3567	423.2488	447.7708	737.6834	1146.0088	1523.5001	1840.4674 (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	758.7186	562.1093	435.4514	214.3506	73.8305	0.0000	0.0000	0.0000	0.0000	221.0033	508.9771	783.2815 (98)
Space heating												3557.7225 (98)
Space heating per m2											(98) / (4) =	36.1704 (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												3931.1851 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	758.7186	562.1093	435.4514	214.3506	73.8305	0.0000	0.0000	0.0000	0.0000	221.0033	508.9771	783.2815 (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)	838.3631	621.1153	481.1618	236.8515	81.5807	0.0000	0.0000	0.0000	0.0000	244.2026	562.4057	865.5045 (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	150.2999	111.8665	88.1896	44.7037	17.4254	2.2334	0.0000	25.4039	48.0658	92.1934	127.6776	149.3031 (64)
Efficiency of water heater	89.9548	89.9527	89.9447	89.9311	89.8710	87.3000	87.3000	87.3000	87.3000	89.5339	89.8396	87.3000 (216)
Fuel for water heating, kWh/month	167.0838	124.3615	98.0486	49.7088	19.3893	2.5584	0.0000	29.0996	55.0582	102.9703	142.1173	165.9440 (219)
Water heating fuel used												956.3398 (219)
Annual totals kWh/year												
Space heating fuel - main system												3931.1851 (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)												399.3523 (232)
Energy saving/generation technologies (Appendices M, N and Q)												
PV Unit 0 (0.80 * 0.50 * 1080 * 0.80) =									-345.4479			-345.4479 (233)
Total delivered energy for all uses												5066.4294 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3931.1851	3.4800	136.8052 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	956.3398	3.4800	33.2806 (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	399.3523	13.1900	52.6746 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-345.4479	13.1900	-45.5646 (252)
Total energy cost			313.6834 (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] =	0.9190 (257)
SAP value		87.1800
SAP rating (Section 12)		87 (258)
SAP band		B

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

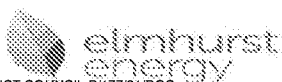
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3931.1851	0.2160	849.1360 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	956.3398	0.2160	206.5694 (264)
Space and water heating			1055.7054 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)

Regs Region: England

Elmhurst Energy Systems

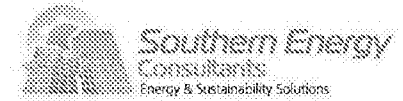
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Calculation Type: New Build (As Designed)

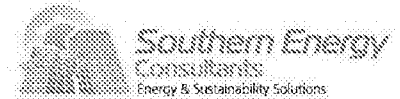


CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy for lighting	399.3523	0.5190	207.2639 (268)
Energy saving/generation technologies			
PV Unit	-345.4479	0.5190	-179.2874 (269)
Total kg/year			1148.5568 (272)
CO2 emissions per m2			11.6800 (273)
EI value			89.2643
EI rating			89 (274)
EI band			B

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	51.9700 (1b)	x 2.3500 (2b)	= 122.1295 (1b) - (3b)
First floor	46.3900 (1c)	x 2.6500 (2c)	= 122.9335 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.3600		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	245.0630 (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					5 * 10 = 50.0000 (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) =					50.0000 / (5) = 0.2040 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4540 (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) =		0.3859 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.6000	5.1000	4.8000	4.5000	4.7000	4.2000	4.4000	4.2000	4.4000	4.8000	4.9000	5.1000 (22)
Wind factor	1.4000	1.2750	1.2000	1.1250	1.1750	1.0500	1.1000	1.0500	1.1000	1.2000	1.2250	1.2750 (22a)
Adj infilt rate	0.5403	0.4921	0.4631	0.4342	0.4535	0.4052	0.4245	0.4052	0.4245	0.4631	0.4728	0.4921 (22b)
Effective ac	0.6460	0.6211	0.6072	0.5942	0.6028	0.5821	0.5901	0.5821	0.5901	0.6072	0.6118	0.6211 (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	1.5000	2.9250		(26)					
Opening Type 2 (Uw = 1.30)			25.1900	1.2357	31.1283		(27)					
Heat Loss Floor 1			51.9700	0.1500	7.7955		(28a)					
External Wall 1	144.8800	27.1400	117.7400	0.2400	28.2576		(29a)					
External Roof 1	51.9700		51.9700	0.1100	5.7167		(30)					
Total net area of external elements Aum(A, m2)			248.8200				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	75.8231		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.1647 (36)					
Total fabric heat loss						(33) + (36) =	81.9878 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	52.2392	50.2255	49.1076	48.0575	48.7500	47.0751	47.7225	47.0751	47.7225	49.1076	49.4727	50.2255 (38)
Heat transfer coeff	134.2271	132.2133	131.0954	130.0453	130.7378	129.0629	129.7103	129.0629	129.7103	131.0954	131.4605	132.2133 (39)
Average = Sum(39)m / 12 =												130.8862 (39)
HLP	Jan 1.3647	Feb 1.3442	Mar 1.3328	Apr 1.3221	May 1.3292	Jun 1.3121	Jul 1.3187	Aug 1.3121	Sep 1.3187	Oct 1.3328	Nov 1.3365	Dec 1.3442 (40)
HLP (average)												1.3307 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

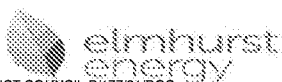
Assumed occupancy												2.7238 (42)
Average daily hot water use (litres/day)												98.8906 (43)
Daily hot water use	108.7797	104.8241	100.8685	96.9128	92.9572	89.0016	89.0016	92.9572	96.9128	100.8685	104.8241	108.7797 (44)
Energy conte	161.3172	141.0890	145.5912	126.9300	121.7923	105.0975	97.3883	111.7545	113.0892	131.7946	143.8641	156.2271 (45)
Energy content (annual)										Total = Sum(45)m =		1555.9348 (45)
Distribution loss (46)m = 0.15 x (45)m	24.1976	21.1634	21.8387	19.0395	18.2688	15.7646	14.6082	16.7632	16.9634	19.7692	21.5796	23.4341 (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

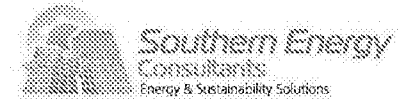
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CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Total heat required for water heating calculated for each month	14.1437	12.7639	14.1060	13.6080	14.0283	13.5373	13.9646	14.0059	13.5758	14.0729	13.6581	14.1315 (61)
Aperture area of solar collector	175.4609	153.8529	159.6972	140.5380	135.8206	118.6348	111.3529	125.7604	126.6650	145.8674	157.5221	170.3586 (62)
Zero-loss collector efficiency												3.0000 (H1)
Collector heat loss coefficient												0.7000 (H2)
Collector 2nd order heat loss coefficient												1.8000 (H3)
Collector effective heat loss coefficient												0.0050 (H3a)
Collector performance ratio												1.8063 (H3b)
Annual solar radiation per m2												2.5804 (H4)
Overshading factor												1306.9326 (H5)
Solar energy available												0.8000 (H6)
Adjustment factor for showers												2195.6468 (H7)
Solar-to-load ratio												1.0000 (H7a)
Utilisation factor												1.4111 (H8)
Collector performance factor												0.5077 (H9)
Dedicated solar storage volume												0.8793 (H10)
Effective solar volume												75.0000 (H11)
Daily hot water demand												75.0000 (H13)
Volume ratio Veff/V												98.8906 (H14)
Solar storage volume factor												0.7584 (H15)
Solar input												0.9447 (H16)
Solar input												-925.9464 (H17)
Solar input	-30.2962	-42.2360	-71.9087	-100.1851	-119.7922	-126.5502	-124.0629	-108.8113	-84.9489	-58.1072	-34.4607	-24.5869 (63)
Solar input (sum of months) = Sum(63)m =												-925.9464 (63)
Output from w/h												
Output from w/h	145.1646	111.6169	87.7885	40.3529	16.0284	0.0000	0.0000	16.9491	41.7161	87.7602	123.0614	145.7717 (64)
Total per year (kWh/year) = Sum(64)m =												816.2099 (64)
Heat gains from water heating, kWh/month												
Heat gains from water heating, kWh/month	57.1739	50.1031	51.9356	45.6062	44.0030	38.3292	35.8728	40.6598	40.9961	47.3399	51.2493	55.4784 (65)

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
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290	163.4290 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	56.5325	50.2116	40.8348	30.9146	23.1090	19.5096	21.0808	27.4017	36.7784	46.6987	54.5043	58.1037 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	378.5804	382.5089	372.6093	351.5341	324.9305	299.9268	283.2229	279.2944	289.1940	310.2692	336.8728	361.8764 (68)
Pumps, fans	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667	54.0667 (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)	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527 (71)
Total internal gains	76.8466	74.5581	69.8059	63.3420	59.1438	53.2351	48.2161	54.6503	56.9390	63.6289	71.1796	74.5677 (72)
Total internal gains	623.5025	618.8217	594.7930	557.3337	518.7264	484.2145	464.0628	472.8894	494.4546	532.1398	574.0997	606.0909 (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				13.3500	14.6401	0.7200	0.7000	0.7700	68.2635 (74)			
East				1.8900	27.3735	0.7200	0.7000	0.7700	18.0699 (76)			
South				9.9500	61.3950	0.7200	0.7000	0.7700	213.3633 (78)			
Solar gains	299.6966	430.1429	606.4965	825.7524	942.0684	1028.8248	975.4420	860.1272	720.0665	516.0421	344.7554	248.5231 (83)
Total gains	923.1992	1048.9646	1201.2895	1383.0861	1460.7948	1513.0394	1439.5048	1333.0166	1214.5211	1048.1820	918.8551	854.6140 (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)												
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	50.8881	51.6631	52.1037	52.5244	52.2462	52.9242	52.6601	52.9242	52.6601	52.1037	51.9590	51.6631
util living area	4.3925	4.4442	4.4736	4.5016	4.4831	4.5283	4.5107	4.5283	4.5107	4.4736	4.4639	4.4442
MIT	0.9829	0.9713	0.9355	0.8387	0.6680	0.4531	0.3142	0.3183	0.5553	0.8414	0.9605	0.9864 (86)
Th 2	19.9591	20.1107	20.4031	20.7255	20.9231	20.9894	20.9984	20.9985	20.9759	20.7853	20.3583	19.9485 (87)
util rest of house	19.7905	19.8064	19.8152	19.8235	19.8180	19.8313	19.8262	19.8313	19.8262	19.8152	19.8123	19.8064 (88)
MIT 2	0.9770	0.9619	0.9149	0.7932	0.5895	0.3586	0.2095	0.2062	0.4444	0.7792	0.9444	0.9815 (89)
Living area fraction	18.4771	18.7036	19.1177	19.5436	19.7594	19.8266	19.8259	19.8311	19.8148	19.6227	19.0636	18.4738 (90)
MIT	18.7619	18.9740	19.3647	19.7707	19.9830	20.0501	20.0512	20.0554	20.0379	19.8461	19.3124	18.7571 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.6119	18.8240	19.2147	19.6207	19.8330	19.9001	19.9012	19.9054	19.8879	19.6961	19.1624	18.6071 (93)

8. Space heating requirement

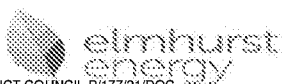
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9688	0.9513	0.9018	0.7842	0.5906	0.3643	0.2162	0.2134	0.4505	0.7718	0.9325	0.9743 (94)
Useful gains	894.3725	997.8792	1083.3556	1084.6126	862.7293	551.2179	311.2166	284.4303	547.1622	809.0137	856.8708	832.6465 (95)

Regs Region: England

Elmhurst Energy Systems

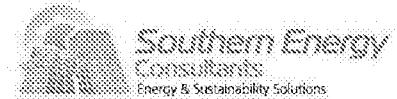
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System) version 4.14r19



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Ext temp.	5.8000	6.0000	7.5000	9.8000	12.9000	15.6000	17.5000	17.7000	15.6000	12.5000	9.0000	6.0000 (96)
Heat loss rate W	1719.6987	1695.5053	1535.7437	1277.1348	906.4115	554.9773	311.4614	284.6362	556.1821	943.3756	1335.9508	1666.8306 (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	614.0427	468.8047	336.5767	138.6159	32.4996	0.0000	0.0000	0.0000	0.0000	99.9652	344.9376	620.6330 (98)
Space heating												2656.0754 (98)
Space heating per m2										(98) / (4) =		27.0036 (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												2934.8900 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	614.0427	468.8047	336.5767	138.6159	32.4996	0.0000	0.0000	0.0000	0.0000	99.9652	344.9376	620.6330 (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)	678.5002	518.0163	371.9080	153.1668	35.9111	0.0000	0.0000	0.0000	0.0000	110.4588	381.1465	685.7823 (211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	145.1646	111.6169	87.7885	40.3529	16.0284	0.0000	0.0000	16.9491	41.7161	87.7602	123.0614	145.7717 (64)
Efficiency of water heater	89.8701	89.8665	89.8189	89.7582	89.4174	87.3000	87.3000	87.3000	87.3000	88.9753	89.6360	87.3000 (216)
Fuel for water heating, kWh/month	161.5271	124.2030	97.7394	44.9573	17.9254	0.0000	0.0000	19.4148	47.7848	98.6343	137.2901	162.1967 (219)
Water heating fuel used												911.6729 (219)
Annual totals kWh/year												
Space heating fuel - main system												2934.8900 (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)												399.3523 (232)
Energy saving/generation technologies (Appendices M, N and Q)												
PV Unit 0 (0.80 * 0.50 * 1307 * 0.80) =									-418.2184			-418.2184 (233)
Total delivered energy for all uses												3952.6968 (238)

10a. Fuel costs - using BEDF prices (485)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2934.8900	3.7400	109.7649 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	911.6729	3.7400	34.0966 (247)
Pumps and fans for heating	75.0000	19.1200	14.3400 (249)
Pump for solar water heating	50.0000	19.1200	9.5600 (249)
Energy for lighting	399.3523	19.1200	76.3562 (250)
Additional standing charges			94.0000 (251)
Energy saving/generation technologies			
PV Unit	-418.2184	19.1200	-79.9634 (252)
Total energy cost			258.1543 (255)

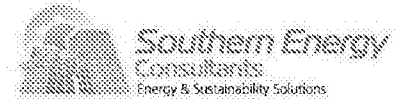
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2934.8900	0.2160	633.9362 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	911.6729	0.2160	196.9213 (264)
Space and water heating			830.8576 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	399.3523	0.5190	207.2639 (268)
Energy saving/generation technologies			
PV Unit	-418.2184	0.5190	-217.0554 (269)
Total kg/year			885.9411 (272)

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

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	2934.8900	1.2200	3580.5658 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	911.6729	1.2200	1112.2409 (264)
Space and water heating			4692.8067 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	399.3523	3.0700	1226.0117 (268)
Energy saving/generation technologies			
PV Unit	-418.2184	3.0700	-1283.9306 (269)
Primary energy kWh/year			5018.6378 (272)
Primary energy kWh/m2/year			51.0232 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South
Overshading	Average or unknown
Thermal mass parameter	250.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	646.97 (P1)
Transmission heat loss coefficient	81.99 (37)
Summer heat loss coefficient	728.95 (P2)

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

Solar shading	Z blinds	Solar access	Z overhangs	Z summer
Orientation				
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	13.3500	81.1852	0.7200	0.7000	0.9000	442.4595
East	1.8900	117.5071	0.7200	0.7000	0.9000	90.6654
South	9.9500	112.2060	0.7200	0.7000	0.9000	455.7794
total:						988.9043

	Jun	Jul	Aug	
Solar gains	1047	989	889	(P3)
Internal gains	481	461	470	
Total summer gains	1529	1450	1359	(P5)
Summer gain/loss ratio	2.10	1.99	1.86	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	18.35	20.14	19.91	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	
Assessment of likelihood of high internal temperature:	Not significant			

Regs Region: England

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SAP2012 Calculator (Design

System) version 4.14r19

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