Energy Statement
FOR
62a Haverstock Hill, NW3 2BH

Prepared for:	Gridline Architecture	Prepared by:	Paul Parker Director - Sustainability
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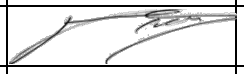
Client Reference: Job Reference: Location:	GLINE S00657 LB Camden

Issue/revision	Issue 1	Issue 2	Issue 3	
Remarks	Draft Issue	Draft Issue	Final issue (post planning comments)	
Date	19/4/16	25/4/16	02/06/16	
Prepared by	PP	PP	PP	
Signature				
Checked by	KP	KP	KP	

Contents

Executive summary

This energy statement describes the strategy used to reduce the overall carbon emissions within the development at 62a Haverstock Hill, NW3 2BH.

The development is a new build development of 3 dwellings in the London Borough of Camden.

The new build accommodation will be built to high standards of energy efficiency.

The energy strategy follows three main precepts:

- To reduce energy demand through energy efficient building fabric
- To use an efficient energy supply where possible
- To produce on-site generated energy

The report will show how each of these aspects is addressed by the proposed development.

The objective of this strategy is to achieve a 35% reduction in CO2 emissions as a result of energy efficiency, efficient supply and renewable technologies. The reduction is based on a comparison against Target Emission Rate (TER) and Design Emission Rate (DER) using SAP calculation tools.

The report shows that the development achieves a 36% CO2 reduction over the baseline building through energy efficiency improvements including low and zero carbon technologies, with a 19.5% reduction due to renewable energy technologies.

The renewable technology selected is roof mounted solar photovoltaic panels.

INTRODUCTION

This report will review the various options for provision of renewable energy technologies in relation to the new development at 62a Haverstock Hill, NW3 2BH.

This report will summarise the costs associated with installation. The report will be mindful of the end users requirements and the need to minimise maintenance and compare all options with a baseline scenario.

It is to be noted that all data is based on consumption from Part L calculations based on the planning drawings provided.

Development Details

Development type:	Residential
Site description:	Refurbishment /Change of use

Energy Hierarchy

There is an energy hierarchy whereby when developing a building, the first step is always to make the building as energy efficient as possible, as a cost effective means of reducing energy demand and as a result reducing the energy demand that is to be provided via the use of efficient supply and renewable energy sources.

It is recommended that as part of the scheme that the passive approach is fully investigated as a means of saving energy.

Part L of the building regulations aims to reduce carbon emissions from new buildings, this is achieved by improving the building fabric energy efficiency, for example provision of a structure which has been built to a very good standard of air tightness and improving the insulation levels; and heating system of the building itself.

The target in LB Camden is extended to a 35% reduction over the 2013 Target Emissions Rate (TER).

Note that this energy reduction is based on regulated energy demand which does not include electrical appliances etc. These are however included in the baseline energy calculation within this Energy Statement.

Renewable energy also aids in reducing the carbon emission of the buildings. The principal requirement for renewable provision under the terms of the LB Camden Guidance is that a 20% reduction of baseline CO2 emissions are achieved via the use of renewable energy technologies, and that this will contribute to the 35% target.

The scheme design should abide by the following energy hierarchy:

- Be lean - use less energy
- Be clean - Supply energy more efficiently, particularly through the use of decentralised energy.
- Be green - use renewable energy

Potential areas for consideration when seeking to improve the energy efficiency of buildings and thereby reducing CO2 emissions are:-

- Increased fabric insulation
- Reduced thermal bridging
- Improved air tightness
- Controlled ventilation
- Efficient heating and hot water systems
- Responsive heating and lighting controls
- Efficient lighting and fittings that do not permit the use of non-efficient lighting
- Efficient electrical appliances

1.0 Energy Supply

The baseline site demand shows what a building built to minimum building regs. standards would require in terms of energy. The proposed site demand is the energy demand of the site as proposed. The renewable energy component is also shown. The Baseline site demand and the proposed site demand have been calculated using SAP Part L assessment software.

	Heating	*Cooling*	*Electricity*	*Heating*	*Cooling*	*Electricity*
	kWh / yr	*kWh / yr*	*kWh / yr*	*% of site*	*% of site*	*% of site*
Baseline Site Demand	14,434	0	7,451	66%	0%	34%
Proposed Site Demand	14,270	0	7,451	66%	0%	34%
Low/Zero Carbon Technology Contribution	0	0	2,632	0%	0%	12%

Table 1-1. Total site energy demand and proportions provided by Efficient Supply and renewable Energy technologies.

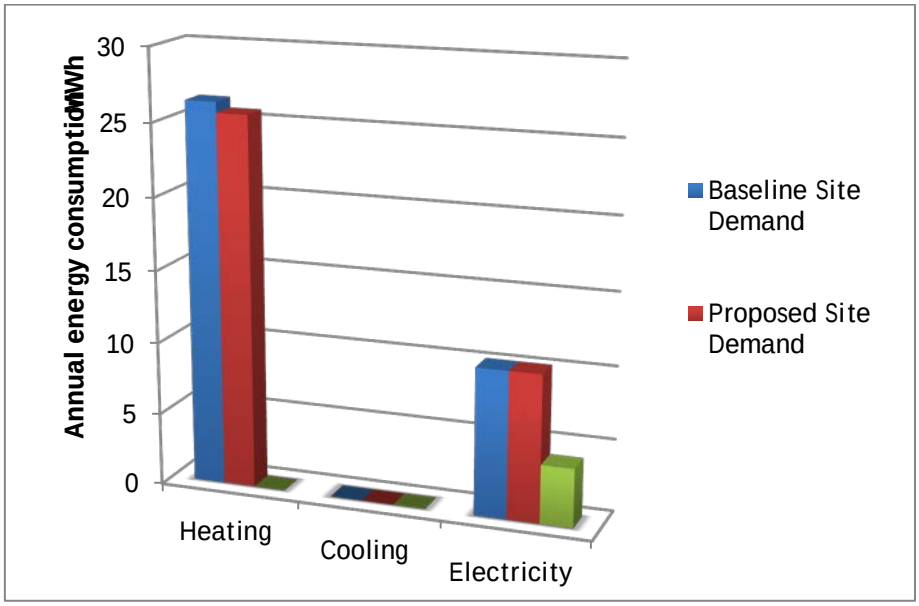


Figure 1-1. Proposed site energy supply breakdown

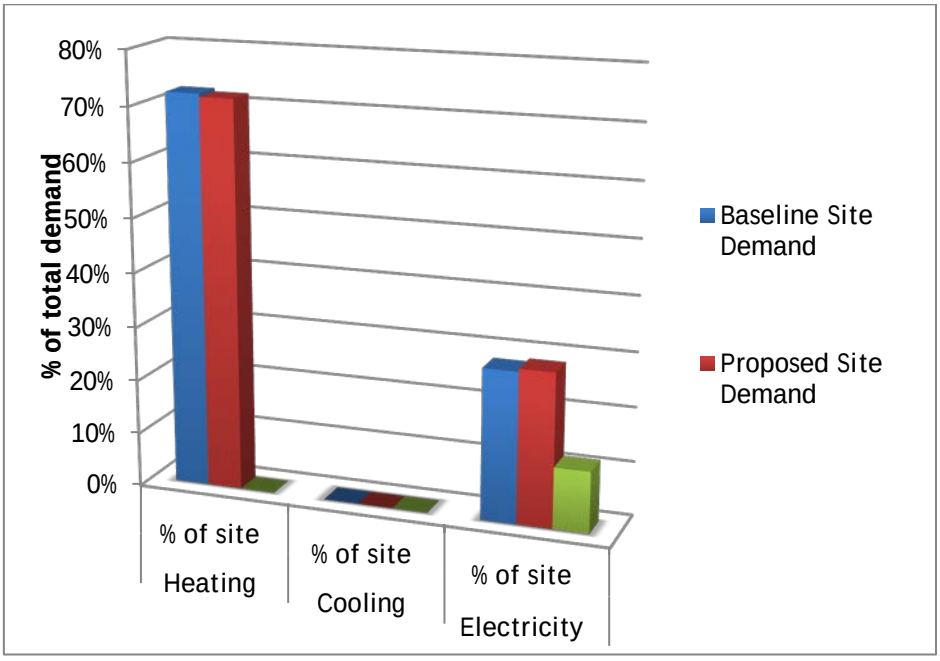


Figure 1-2. Proposed site energy supply breakdown as percentages.

1.1 CO2 Emissions

The table below shows both the CO_2 savings as a result of energy efficiency improvements, and through the use of renewable energy.

The TER and DER have been calculated using an average of the individual sample SAP's.

The contribution from renewable energy has not been included in the Energy Improvement Factor Calculation.

Table 1-2. Total site CO2 emissions and savings due to the inclusion of Efficient Supply and Renewable Energy technologies.

	TER	**DER**	**Improvement**
Energy Efficiency Improvement Factor:	19.56	12.61	**36%**

	kWh	CO2 (kg/yr)	CO2 (%)
Baseline Emissions	36,502	10,971	100%
Savings from energy efficiency	722	157	1%
Savings from Low/Zero Carbon Technology on baseline energy demand	4,060	2,107	19.5%
Contribution from Renewable Technologies			**19.5%**

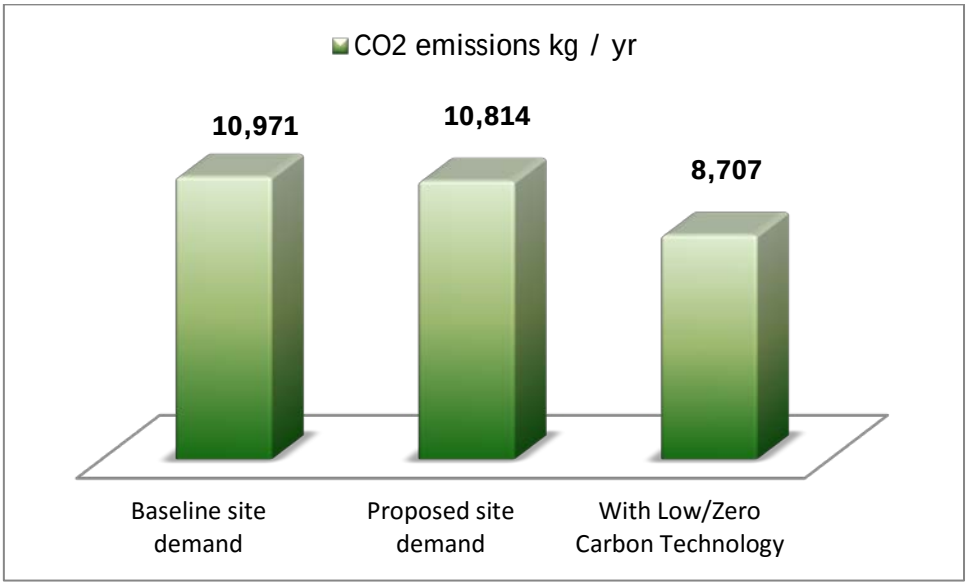


Figure 1-3. CO2 emissions from the site at each stage of analysis

2.0 Energy Demand

Table 2-1. Total site CO_2 emissions and savings by end use.

	Baseline scheme (see assumptions and benchmarks below		Proposed scheme (including energy efficient design and technology)		Change	
	kWh/yr	CO2(kg/yr)	kWh/yr	CO2(kg/yr)	kWh/yr	CO2(kg/yr)
Heating	26,347	5,692	25,625	5,535	722	157
Cooling	0	0	0	0	0	0
Electricity	10,155	5,279	10,155	5,279	0	0

Benchmarks have been calculated in the following way:

A representative sample of dwellings was modelled using a SAP 2012 (standard assessment procedure) calculation tool.

The resulting energy loads were extrapolated for the other dwellings of the same type, based on floor areas.

Auxiliary electricity demand (cooking and appliances) is estimated at 26.012 kWh/m2 as per BREDEM 12 recommendations.

All indicative SAP reports are available.

Table 2-3. Summary of Energy Efficiency for all site loads.

Inputs				
Load number			All	
Development description:			New build	
Number of loads				3.0
Building type:			Maisonettes	
Floor area (m2):				193.5
Loads - totals				
		Baseline	Proposed	Saving
Space heating	kWh / yr	18,731	18,827	-0.51%
	kg CO2/ yr	4,046	4,067	-0.52%
Hot water	kWh / yr	7,616	6,798	10.74%
	kg CO2/ yr	1,646	1,468	10.81%
Cooling	kWh / yr	0	0	0.00%
	kg CO2/ yr	0	0	0.00%
Lighting	kWh / yr	1,297	1,297	0.00%
	kg CO2/ yr	673	673	0.00%
Building Electrical	kWh / yr	225	225	0.00%
	kg CO2/ yr	117	117	0.00%
Auxiliary Electrical	kWh / yr	8,633	8,633	0.00%
	kg CO2/ yr	4,489	4,489	0.00%
CO2 emissions				
		Baseline	Proposed	Saving
Total CO2 emissions	kg CO2 / yr	10,971	10,814	157
CO2 saving	% CO2 reduction			1.43%
		TER	DER	Improvement
Energy Efficiency Improvement Factor:		19.56	12.61	**36 %**

3.0 Energy efficient design

3.1 Passive solar design

Glazing has been maximised on the south west façade. Other passive solar design issues are constrained by site specifics and dwelling orientation.

3.2 Lighting

Energy efficiency will be better than the sample benchmarks in practice, with the use of LED lighting.

3.3 Insulation

The development will exceed the Part L1A building regulations requirements in terms of the performance of the thermal elements.

The exact construction of the building elements is not yet known but the client has agreed to work to the minimum specifications below.

The infiltration and thermal performance will be to a high standard. The following table shows the proposed u-values.

- Walls 0.17
- Roof 0.10
- Ground floor 0.10
- Windows 1.2 (maximum)

3.4 Thermal Mass

Thermal mass will be relatively high with masonry and steel frame construction

3.5 Infiltration

The infiltration rate for the new build has been assumed to be close to best practice, 5.0 m^3 / ($h.m^2$) will be the maximum target.

The accepted advice on the matter is to 'build tight – ventilate right' in order to implement an effective ventilation strategy.

Better infiltration rates are achievable through good practice the Energy Saving Trust document: GPG 224 'Improving airtightness in dwellings' which is aimed at residential development and is a useful reference on achieving low infiltration rates.

3.6 Additional measures

All appliances will be specified to A or AAA energy standards. WC's and other fittings will be low flow/low flush for water conservation. The auxiliary energy load however is pre-determined by BREDEM12 (see 2.0 above) so this is not reflected in the energy calculations shown in this report.

4.0 Building Services

4.1 Space Heating

The heating load for the development is 18.8 MWh per year.

Gas central heating has been selected for space heating. The model selected is a condensing combi boiler, using underfloor heating with time and temperature zone control

4.2 Direct Hot Water

Direct hot water will be provided by the main heating system

4.3 Cooling

There will be no cooling

4.4 Ventilation

All areas are to be naturally ventilated with opening windows. WC's, Bathrooms and kitchens will have a mechanical exhaust.

5.0 Renewable Energy

5.1 Renewable Energy – Summary

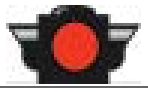
The following table lists all the systems analysed. Their contribution to the remainder of the site energy demands not met by Efficient Supply is expressed as a percentage.

Table 5-1. Summary of all Renewable Energy systems analysed showing energy outputs as a proportion of the site demands. The final column indicates if the system has been selected for inclusion on the site.

System type	Energy generated (% of proposed site demands)			Capital Cost £	Energy produced kWh/y	CO2 Saved kg CO2/yr)	CO2 Saved (% of proposed site demands)	Selected
	Heating	Cooling	Electricity					
Building Mounted Wind Turbines	0%	0%	0%	£0.00	0	0	0%	N
PV	0%	0%	40%	£6,500.00	4,060	2,107	19%	Y
Solar water heating (SWH)	0%	0%	0%	£0.00	0	0	0%	N
Solar water heating (SWH)	0%	0%	0%	£0.00	0	0	0%	N
Biomass heating systems	0%	0%	0%	£0.00	0	0	0%	N
Gas CHP	0%	0%	0%	£0.00	0	0	0%	N
Ground cooling	0%	0%	0%	£0.00	0	0	0%	N
Total (included systems)	0%	0%	40%	£6,500.00	4,060	2,107	19%	

5.2 Renewable Energy – Analysed Systems

Below is a brief overview of the available low or zero carbon technologies which are commonly used. A traffic light system is used to denote whether the systems are technically appropriate for the development.

Description	Traffic Light
Technology is technically and economically feasible with few barriers to implementation	
Technology is technically and economically feasible, but there are barriers to implementation	
Technology is technically or economically unfeasible and has been discounted	

Only those systems that are Amber or Green will be considered further.

N.B Micro hydro has not been considered as there is no potential at this site

5.2.1 Solar Photovoltaic (PV)

Solar photovoltaic (PV) systems use energy from the sun to convert solar radiation into electricity, which can be used directly to run appliances and lighting, sold to the national grid, or stored in batteries, in off-grid locations.

PV systems perform best in direct sunlight, but continue to perform well in reduced light conditions. Systems come in various forms including solar tiles, roof-integrated panels, and on-roof panels. PV systems are also available for cladding buildings and covering walkways.

A PV array would yield both energy and CO2 savings, while providing long term revenue via the feed in tariff, therefore a PV system is **recommended** for this site.

As an indication the feed-in tariff would be expected to provide around £172 p.a. (based on a tariff of 4.25p per kWh). In addition energy generated will displace an equivalent amount of purchased power at a rate of say £0.14 per kWh. This means the total benefit based on 4,060 kWh generated would be **£740** p.a.

At the time of writing this report, the estimated installed cost of a PV array is in the region of £2,500/KWp of array, so a peak power of 4.83 kW would come at a cost of around £12,075.

Description	
System number:	1
System name:	PV-system-1
Make and model number:	SunPower 345W, DS-X21 PV Panels
System description:	3 rows, mounted on the roof on stand-off frames, in landscape orientation. 1 row of 4 panels orientated SW, 1 row of 4 panels orientated SE, 1 row of 6 panels orientated S.
Number panels:	14

Inputs			
Installed Capital cost per m2:	556 £ / kWp		
System Lifetime:	25 Years		
PV technology:	Mono-si		
PV area:	21.7 m²		
Power capacity:	187 kWh / m²		
Panel efficiency:	4.83 kWp		
Weather data:	20%		
	London		
Outputs	Heating	Cooling	Electricity
Energy generated kWh (SAP 2012)			4,060
Proportion of total demand %			40 %

CO_2 saving	
Net CO_2 saving:	2,107 kg
CO_2 saving as a proportion of the site demand:	19.5%
Costs	
Total capital cost of systems:	£12,075

19.5

5.2.2 Wind Turbines

A wind turbine harnesses energy from the wind to produce electricity. The most common design is of three blades mounted on a horizontal axis (HAWT), which is free to rotate into the wind on a tall tower or mast. The blades drive a generator either directly or via a gearbox (generally for larger machines) to produce electricity. Wind turbines can be mounted on masts that are freestanding or tethered with wires, or on buildings. Vertical axis wind turbines (VAWT) can be up to 30% more efficient than HAWT's although the overall energy yield is lower than an 'equivalent' HAWT. The electricity can either link to the grid or, in the case of off-grid systems, charge batteries. Modern designs can be very quiet in operation.

The NOABL wind speed database gives a figure of 5.6 m/s at 25 m height for the area of the tallest part of the building, which could make a small wind turbine viable. However, in an urban infill situation such as this a wind turbine has no real practical application

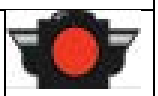
5.2.3 Combined Heat & Power (CHP)

Combined heat and power (CHP) is the on-site generation of electricity and the utilisation of the heat that is produced as a by-product of this generation.

This means that CHP systems achieve far higher fuel efficiency (around 85% on gross CV) than is possible at main line power stations (only 40% approximately). Operators with combined heat and power units as part of their plant mix can expect:

- Large savings by substituting grid electricity with their own supply.
- Compressed pay-back periods
- Reduced usage of relatively expensive back-up gas boilers.

Unfortunately current technology means that CHP is not economic for smaller developments.



5.2.5 Biomass heating system

Wood burning systems, unlike other renewable energy sources emit carbon dioxide. However, as the tree is growing, it absorbs the same amount of carbon dioxide as is released when burnt. As such, it does not add to the carbon dioxide in the atmosphere and is therefore deemed carbon neutral.

Biomass heating requires a greater level of user involvement than is deemed acceptable by the developer.

5.2.6 Solar thermal hot water systems

Solar panels, also known as “collectors”, can be fitted onto or integrated into a building’s roof. They use the sun’s energy to heat water, or a heat-transfer fluid, which passes through the panel.

The fluid is fed to a heat store (for example, a hot water tank) to provide part of the hot water demand for the building. Usually another heat source will be needed to supplement collectors in winter months.

It is not usually possible cover to the whole hot water demand with solar thermal, however between 40% and 60% could be achieved with a large scale installation.

The roof area available has been dedicated to solar PV which has a bigger carbon impact and a shorter payback period than solar thermal.

6.0 Conclusions

The scheme benefits from a number of energy efficiency measures, the most notable being:

- Levels of insulation exceeding building regulations minimums for new construction and refurbishment
- Low hot water use
- Good airtightness performance

It can therefore be demonstrated that the scheme follows the energy hierarchy set out in Energy Statement guidance notes provided by LB Camden, by using less energy, supplying energy efficiently and then using renewable energy.

The combination of high levels of insulation within the building and renewable technology were calculated using SAP 2012. These measures achieve a 36% reduction in Design Emissions Rate over Target Emission Rate. The LB Camden requirement is at present 35%.

The local authority has also set down a 20% target to be fulfilled with renewable energy technology. Through the use of Solar PV a reduction of 19.5% can be achieved.

The available roof area is fully maximised by solar photovoltaic panels which have been selected on the basis that they are the highest efficiency panels available on the market at present. Within the constraints of the site and the design this is the highest renewable energy contribution available. In the context of which it is considered that the energy conditions of the London Borough of Camden are satisfied by the proposed development.

7.0 Appendix I – DER/TER worksheets

Full SAP Calculation Printout

Property Reference: 000014
Survey Reference: 001

Issued on Date: 19.Apr.2016
Prop Type Ref: Maisonette A

Property: 62a, Haverstock Hill, LONDON, NW3 2BH

SAP Rating:	84 B	**CO2 Emissions (t/year):**	1.88	**DER:**	(SE) 18.78 Pass	**TER:**	18.81	**Percentage DER<TER:**	0.15 %
Environmental:	84 B	**General Requirements Compliance:**	Pass	**DFEE:**	57.42 Pass	**TFEE:**	66.01	**Percentage DFEE<TFEE:**	13.01 %

CfSH Results **Version:** **ENE1 Credits:** N/A **ENE2 Credits:** N/A **ENE7 Credits:** N/A **CfSH Level:** N/A

Surveyor: Paul Parker, Tel: 020 8099 6601 Surveyor ID: V556-0001
Address: New Road, West Molesey, KT8 1PX
Client:

Software Version: Elmhurst Energy Systems SAP2012 Calculator (Design System) version 3.05r04
SAP version: SAP 2012, Regs Region: England (Part L1A 2013), Calculation Type: New Build (As Designed)

CALCULATION DETAILS for survey reference no '001'
SAP2012 - 9.92 input data (DesignData) -


```
SAP2012 Input Data (Maisonette)     19/04/2016

FullRefNo:                    001

Regs Region:                  England
SAP Region:                   Thames Valley
Postcode:                     NW3 2BH
DwellingOrientation:          Unknown
Property Type:                Maisonette, Semi-Detached
Storeys:                      2
Date Built:                   2016
Sheltered Sides:              1
Sunlight Shade:               Average or unknown
Measurements                  Perimeter, Floor Area, Storey Height
    Basement:                36.56, 65.81, 3.67
    1st Storey:              25.02, 59.7, 3.85
Living Area:                  34.22 m2, fraction: 27.3%
Thermal Mass:                 Simple calculation
Thermal Mass Simple:          Low
Thermal MassValue:            100
External Walls                Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1               98.6, 121.95, 0, Other, SteelFrame, 0, 0.17, Gross
Basement wall                 108.74, 108.74, 17, SolidWallDensePlasterInsul, Solid, 0, 0.17, Gross
Party Walls                   Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1                  39.69, 70, PartyWallSinglePlaster, Solid, 0, 0
External Roofs                Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
    External Roof 1          4.6, 4.6, 9, Plasterboard, insulated flat roof, 0.1
Party Ceilings                Area, Kappa, Construction, Element
    Party Ceilings 1         59.7, 40, Precast concrete planks floor, screed, carpeted
Heat Loss Floors              Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
    Heat Loss Floor 1        65.81, 110, Slab on ground, screed over insulation, Basement Floor, 0, 0.1
Description                   Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
    Windows                  Manufacturer, Window, Double Low-E Soft 0.05, , , 0.63, , 0.7,
    Doors                    Manufacturer, Solid Door, , , , , , ,
Openings                      Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
    Opening 1                Window, External Wall 1, South West, , Light-coloured curtain or roller blind, 0, , 0, 0, 0, 18.20, 0
    Opening 2                Window, External Wall 1, North, , Light-coloured curtain or roller blind, 0, , 0, 0, 0, 3.26, 0
    Opening 3                Solid Door, External Wall 1, North West, , , , , 0, 0, 0, 1.89,
Conservatory:                 None
Draught Proofing:             100
Draught Lobby:                No
Thermal Bridges
    Bridging:                Calculate Bridges
    Y                        0.033
    List of Bridges          Junction with, Bridge Type, Source Type, Imported, Length, Psi, Adjusted, Result, Reference
    0.                       External wall, E1 Steel lintel with perforated steel base plate, Table K1 - Approved, Yes, 8.26, 0.5, 0.5, 4.13,
    1.                       External wall, E3 Sill, Table K1 - Approved, Yes, 7.36, 0.04, 0.04, 0.29,
    2.                       External wall, E4 Jamb, Table K1 - Approved, Yes, 37.6, 0.05, 0.05, 1.88,
    3.                       External wall, E6 Intermediate floor within a dwelling, Table K1 - Approved, Yes, 25.02, 0.07, 0.07, 1.75,
    4.                       External wall, E16 Corner (normal), Table K1 - Approved, No, 11.55, 0.09, 0.09, 1.04,
    5.                       External wall, E18 Party wall between dwellings, Table K1 - Approved, Yes, 15.04, 0.06, 0.06, 0.90,
Pressure Test:                True
Designed q50:                 5
AsBuilt q50:                  15
Property Tested:              False
Mechanical Ventilation        None
Chimneys MHS:                 0
Chimneys SHS:                 0
Chimneys Other:               0
Chimneys Total:               0
Open Flues MHS:               0
Open Flues SHS:               0
Open Flues Other:             0
Open Flues Total:             0
Intermittent Fans:            4
Passive Vents:                0
Flueless Gas Fires:           0
Cooling System                None
Light Fittings:               11
LEL Fittings:                 11
Percentage of LEL Fittings:   100
External Lights Fitted:       No
External LELs Fitted:         No
Electricity Tariff:           Standard
Main Heating 1
    Description
    Percentage               100
    Sedbuk ID                17117
    Fuel Type                Mains gas
```

MHS	Mains gas BGW Post 98 Combi condens. with auto ign.
SAP Code	104
Boiler Efficiency Type	Split Efficiences
Efficiency Winter	90.7
Efficiency Summer	91.2
Controls by PCDF	0
MHS Controls	CBI Time and temperature zone control
Boiler Interlock	Yes
Compensator	0
Delayed Start Stat	No
Ctrl SAP Code	2110
Flue Type	Balanced
Fan Assisted Flue	Yes
Pumped	Pump in heated space
Heat Pump Age	2013 or later
Heat Emitter	Underfloor
Flow Temperature	36° - 45°C
Under Floor Heating	Yes - Pipes in thin screed
Combi boiler type	Standard Combi
Combi keep hot type	Gas/Oil, time clock
Main Heating 2	None
Heating Systems Interaction	Each system heats separate parts of dwelling
Smoke Control Area	Unknown
Community Heating	None
Secondary Heating	None
Water Heating	
Type	MainHeating1
WHS	HWP From main heating 1
Low Water Usage	Yes
SAP Code	901
Showers in Property	Non-electric only
Hot Water Cylinder	None
Flue Gas Heat Recovery System	None
Waste Water Heat Recovery	none
PV Unit	None
Wind Turbine	None
Terrain Type:	Urban
Small Scale Hydro	None
Special Features	None

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

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DWELLING AS DESIGNED

Semi-Detached Maisonette, total floor area 126 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) 18.81 kg/m²
Dwelling 'CO2' Emission Rate (DERs)
DER (N):17.69
DER (NE):18.29
DER (E):18.73
DER (SE):18.78 (highest value)
DER (S):18.55
DER (SW):18.09
DER (W):17.58
DER (NW)17.36
Dwelling Carbon Dioxide Emission Rate (DER)(SE) 18.78 kg/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)66.0 kWh/m²
Dwelling Fabric Energy Efficiency (DFEEs)
DFEE (N):53.16
DFEE (NE):55.77
DFEE (E):57.42 (highest value)
DFEE (SE):57.41
DFEE (S):56.63
DFEE (SW):54.94
DFEE (W):52.77
DFEE (NW)51.65
Dwelling Fabric Energy Efficiency (DFEE)57.4 kWh/m²OK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.17 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.10 (max. 0.25)	0.10 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (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
Worcester Greenstar 25 Si Compact
Combi boiler
Efficiency: 89.8% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---

5 Cylinder insulation
Hot water storage No cylinder

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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

Orientation unspecified

Air change rate:	8.00 ach
Blinds/curtains:	Light-coloured curtain or roller blind, closed 0% of daylight hours

10 Key features

Party wall U-value	0.00 W/m²K
Roof U-value	0.10 W/m²K
Floor U-value	0.10 W/m²K
Thermal bridging y-value	0.033 W/m²K

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	65.8100 (1a)	x	3.6700 (2a)	=	241.5227	(1a) - (3a)
Ground floor	59.7000 (1b)	x	3.8500 (2b)	=	229.8450	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	125.5100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	471.3677	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0849	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3349	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3097	(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	0.3949	0.3872	0.3794	0.3407	0.3330	0.2943	0.2943	0.2865	0.3097	0.3330	0.3485	0.3640	(22b)
Effective ac	0.5780	0.5750	0.5720	0.5580	0.5554	0.5433	0.5433	0.5410	0.5480	0.5554	0.5607	0.5662	(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	
Windows (Uw = 1.20)			21.4600	1.1450	24.5725			(27)
Doors			1.8900	1.2000	2.2680			(26)
Heat Loss Floor 1			65.8100	0.1000	6.5810			(28)
External Wall 1	121.9500	23.3500	98.6000	0.1700	16.7620			(29a)
Basement wall	108.7400		108.7400	0.1700	18.4858			(29a)
External Roof 1	4.6000		4.6000	0.1000	0.4600			(30)
Total net area of external elements Aum(A, m2)			301.1000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.1293			(33)
Party Wall 1			39.6900	0.0000	0.0000			(32)
Party Ceilings 1			59.7000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.9977 (36)
Total fabric heat loss	(33) + (36) =	79.1270 (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	89.9060	89.4350	88.9733	86.8046	86.3989	84.5101	84.5101	84.1603	85.2376	86.3989	87.2197	88.0778	(38)
Heat transfer coeff	169.0330	168.5620	168.1003	165.9316	165.5259	163.6371	163.6371	163.2873	164.3646	165.5259	166.3467	167.2048	(39)
Average = Sum(39)m / 12 =												165.9297	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3468	1.3430	1.3393	1.3221	1.3188	1.3038	1.3038	1.3010	1.3096	1.3188	1.3254	1.3322	(40)
HLP (average)												1.3220	(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	2.8823 (42)
Average daily hot water use (litres/day)	102.6551 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.9206	108.8144	104.7082	100.6020	96.4958	92.3896	92.3896	96.4958	100.6020	104.7082	108.8144	112.9206	(44)
Energy conte	167.4579	146.4598	151.1334	131.7617	126.4285	109.0982	101.0955	116.0086	117.3941	136.8115	149.3405	162.1741	(45)
Energy content (annual)										Total = Sum(45)m =		1615.1638	(45)
Distribution loss (46)m = 0.15 x (45)m	25.1187	21.9690	22.6700	19.7643	18.9643	16.3647	15.1643	17.4013	17.6091	20.5217	22.4011	24.3261	(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	40.2940	36.3949	40.2872	38.9749	40.2562	38.9351	40.2190	40.2431	38.9562	40.2693	38.9854	40.2878	(61)
Total heat required for water heating calculated for each month	207.7519	182.8547	191.4206	170.7366	166.6847	148.0333	141.3145	156.2517	156.3503	177.0808	188.3258	202.4618	(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
207.7519 182.8547 191.4206 170.7366 166.6847 148.0333 141.3145 156.2517 156.3503 177.0808 188.3258 202.4618 (64)
Total per year (kWh/year) = Sum(64)m = 2089.2669 (64)
Heat gains from water heating, kWh/month
65.7533 57.7966 60.3237 53.5545 52.1015 46.0089 43.6690 48.6336 48.7726 55.5571 59.4020 63.9948 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
26.8413 23.8402 19.3881 14.6781 10.9720 9.2630 10.0090 13.0101 17.4622 22.1722 25.8783 27.5873 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
292.2233 295.2556 287.6142 271.3464 250.8113 231.5112 218.6175 215.5851 223.2266 239.4944 260.0295 279.3296 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
37.4116 37.4116 37.4116 37.4116 37.4116 37.4116 37.4116 37.4116 37.4116 37.4116 37.4116 37.4116 (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)
-115.2927 -115.2927 -115.2927 -115.2927 -115.2927 -115.2927 -115.2927 -115.2927 -115.2927 -115.2927 -115.2927 -115.2927 (71)
Water heating gains (Table 5)
88.3780 86.0069 81.0802 74.3812 70.0289 63.9013 58.6949 65.3678 67.7397 74.6736 82.5028 86.0145 (72)
Total internal gains
476.6773 474.3374 457.3173 429.6405 401.0470 373.9103 356.5562 363.1978 377.6633 405.5750 437.6454 462.1662 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	18.2000	10.6334	0.6300	0.7000	0.7700	59.1446	(74)
Southeast	3.2600	36.7938	0.6300	0.7000	0.7700	36.6576	(77)

Solar gains	95.8022	175.4699	277.4980	414.3604	534.1507	562.6040	528.8505	433.5415	323.4300	203.5567	116.8699	80.6771	(83)
Total gains	572.4796	649.8073	734.8152	844.0009	935.1977	936.5143	885.4067	796.7393	701.0932	609.1316	554.5152	542.8433	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	20.6255	20.6831	20.7399	21.0110	21.0625	21.3056	21.3056	21.3513	21.2113	21.0625	20.9586	20.8510	
alpha	2.3750	2.3789	2.3827	2.4007	2.4042	2.4204	2.4204	2.4234	2.4141	2.4042	2.3972	2.3901	
util living area	0.9819	0.9744	0.9592	0.9236	0.8550	0.7460	0.6316	0.6867	0.8517	0.9452	0.9750	0.9841	(86)
MIT	18.6279	18.8055	19.1519	19.6511	20.1425	20.5361	20.7264	20.6826	20.3459	19.7332	19.1054	18.6037	(87)
Th 2	19.8044	19.8073	19.8101	19.8236	19.8261	19.8379	19.8379	19.8401	19.8333	19.8261	19.8210	19.8157	(88)
util rest of house	0.9788	0.9700	0.9516	0.9079	0.8208	0.6757	0.5146	0.5773	0.8028	0.9310	0.9699	0.9814	(89)
MIT 2	16.6233	16.8836	17.3886	18.1163	18.8101	19.3429	19.5657	19.5270	19.1086	18.2449	17.3311	16.5950	(90)
Living area fraction									fLA = Living area / (4) =			0.2726	(91)
MIT	17.1699	17.4076	17.8693	18.5348	19.1734	19.6682	19.8822	19.8421	19.4460	18.6507	17.8148	17.1427	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.1699	17.4076	17.8693	18.5348	19.1734	19.6682	19.8822	19.8421	19.4460	18.6507	17.8148	17.1427	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9687	0.9571	0.9343	0.8851	0.7972	0.6635	0.5197	0.5775	0.7819	0.9111	0.9573	0.9723	(94)
Useful gains	554.5756	621.9450	686.5332	746.9847	745.5294	621.4089	460.1608	460.1061	548.2089	555.0093	530.8146	527.7844	(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	2175.4304	2108.3019	1911.1874	1598.7116	1237.0366	829.3495	537.0900	562.0541	878.6860	1332.5941	1782.3787	2164.0773	(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	1205.9160	998.8318	911.1427	613.2434	365.6813	0.0000	0.0000	0.0000	0.0000	578.5231	901.1262	1217.4019	(98)
Space heating												6791.8663	(98)
Space heating per m2											(98) / (4) =	54.1141	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 93.1000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 7295.2377 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1205.9160	998.8318	911.1427	613.2434	365.6813	0.0000	0.0000	0.0000	0.0000	578.5231	901.1262	1217.4019	(98)
Space heating efficiency (main heating system 1)	93.1000	93.1000	93.1000	93.1000	93.1000	0.0000	0.0000	0.0000	0.0000	93.1000	93.1000	93.1000	(210)
Space heating fuel (main heating system)	1295.2911	1072.8591	978.6710	658.6932	392.7834	0.0000	0.0000	0.0000	0.0000	621.3997	967.9121	1307.6282	(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												
	207.7519	182.8547	191.4206	170.7366	166.6847	148.0333	141.3145	156.2517	156.3503	177.0808	188.3258	202.4618 (64)
Efficiency of water heater												91.2000 (216)
(217)m	90.7731	90.7770	90.7864	90.8084	90.8560	91.2000	91.2000	91.2000	91.2000	90.8167	90.7860	90.7710 (217)
Fuel for water heating, kWh/month												
	228.8694	201.4329	210.8472	188.0185	183.4604	162.3173	154.9501	171.3286	171.4368	194.9870	207.4392	223.0469 (219)
Water heating fuel used												2298.1342 (219)
Annual totals kWh/year												
Space heating fuel - main system												7295.2377 (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)												474.0250 (232)
Total delivered energy for all uses												10142.3969 (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	7295.2377	0.2160	1575.7713	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2298.1342	0.2160	496.3970	(264)
Space and water heating			2072.1683	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	474.0250	0.5190	246.0190	(268)
Total CO2, kg/year			2357.1123	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.7800	(273)

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

DER		18.7800	ZC1
Total Floor Area	TFA	125.5100	
Assumed number of occupants	N	2.8823	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.7969	ZC2
CO2 emissions from cooking, equation (L16)		1.4993	ZC3
Total CO2 emissions		34.0762	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		34.0762	ZC8

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	65.8100 (1a)	x	3.6700 (2a)	=	241.5227 (1a) - (3a)	
Ground floor	59.7000 (1b)	x	3.8500 (2b)	=	229.8450 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	125.5100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	471.3677	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0849	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3349	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3097	(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	0.3949	0.3872	0.3794	0.3407	0.3330	0.2943	0.2943	0.2865	0.3097	0.3330	0.3485	0.3640	(22b)
Effective ac	0.5780	0.5750	0.5720	0.5580	0.5554	0.5433	0.5433	0.5410	0.5480	0.5554	0.5607	0.5662	(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			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.40)			21.4600	1.3258	28.4508			(27)
Heat Loss Floor 1			65.8100	0.1300	8.5553			(28)
External Wall 1	121.9500	23.3500	98.6000	0.1800	17.7480			(29a)
Basement wall	108.7400		108.7400	0.1800	19.5732			(29a)
External Roof 1	4.6000		4.6000	0.1300	0.5980			(30)
Total net area of external elements Aum(A, m2)			301.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		76.8153			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.6029	(36)
Total fabric heat loss					(33) + (36) =		81.4182	(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	89.9060	89.4350	88.9733	86.8046	86.3989	84.5101	84.5101	84.1603	85.2376	86.3989	87.2197	88.0778	(38)
Heat transfer coeff	171.3242	170.8531	170.3914	168.2228	167.8170	165.9282	165.9282	165.5785	166.6558	167.8170	168.6379	169.4960	(39)
Average = Sum(39)m / 12 =												168.2208	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3650	1.3613	1.3576	1.3403	1.3371	1.3220	1.3220	1.3192	1.3278	1.3371	1.3436	1.3505	(40)
HLP (average)												1.3403	(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		2.8823 (42)
Average daily hot water use (litres/day)		102.6551 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.9206	108.8144	104.7082	100.6020	96.4958	92.3896	92.3896	96.4958	100.6020	104.7082	108.8144	112.9206	(44)
Energy conte	167.4579	146.4598	151.1334	131.7617	126.4285	109.0982	101.0955	116.0086	117.3941	136.8115	149.3405	162.1741	(45)
Energy content (annual)										Total = Sum(45)m =		1615.1638	(45)
Distribution loss (46)m = 0.15 x (45)m	25.1187	21.9690	22.6700	19.7643	18.9643	16.3647	15.1643	17.4013	17.6091	20.5217	22.4011	24.3261	(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	50.9589	46.0274	50.9589	49.3151	49.1732	45.5620	47.0807	49.1732	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	218.4168	192.4872	202.0923	181.0768	175.6017	154.6602	148.1762	165.1818	166.7092	187.7704	198.6555	213.1330	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	218.4168	192.4872	202.0923	181.0768	175.6017	154.6602	148.1762	165.1818	166.7092	187.7704	198.6555	213.1330	(64)

Total per year (kWh/year) = Sum(64)m = 2203.9611 (64)

Heat gains from water heating, kWh/month

	68.4195	60.2047	62.9916	56.1395	54.3308	47.6656	45.3844	50.8662	51.3623	58.2296	61.9845	66.6626 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	26.8413	23.8402	19.3881	14.6781	10.9720	9.2630	10.0090	13.0101	17.4622	22.1722	25.8783	27.5873	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	292.2233	295.2556	287.6142	271.3464	250.8113	231.5112	218.6175	215.5851	223.2266	239.4944	260.0295	279.3296	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	(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)

	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	(71)

Water heating gains (Table 5)

	91.9617	89.5904	84.6661	77.9716	73.0252	66.2023	61.0006	68.3685	71.3365	78.2655	86.0895	89.6003	(72)

Total internal gains

	480.2610	477.9209	460.9032	433.2308	404.0433	376.2113	358.8619	366.1985	381.2601	409.1669	441.2321	465.7519	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.2600	10.6334	0.6300	0.7000	0.7700	10.5940	(74)
Southwest	18.2000	36.7938	0.6300	0.7000	0.7700	204.6531	(79)

Solar gains	215.2471	368.8456	511.3720	646.2476	736.3954	736.8587	707.9815	639.6632	557.8200	409.3770	258.1963	183.9721	(83)
Total gains	695.5081	846.7665	972.2752	1079.4784	1140.4387	1113.0699	1066.8434	1005.8617	939.0801	818.5439	699.4284	649.7240	(84)

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7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	50.8742	51.0144	51.1526	51.8121	51.9373	52.5286	52.5286	52.6395	52.2993	51.9373	51.6846	51.4229	
alpha	4.3916	4.4010	4.4102	4.4541	4.4625	4.5019	4.5019	4.5093	4.4866	4.4625	4.4456	4.4282	
util living area													
	0.9985	0.9961	0.9900	0.9712	0.9190	0.7985	0.6396	0.6903	0.8899	0.9816	0.9968	0.9989	(86)
MIT	19.4398	19.6257	19.9126	20.2862	20.6290	20.8744	20.9654	20.9511	20.7722	20.3185	19.8096	19.4128	(87)
Th 2	19.7903	19.7932	19.7960	19.8094	19.8119	19.8236	19.8236	19.8258	19.8191	19.8119	19.8068	19.8015	(88)
util rest of house													
	0.9979	0.9947	0.9862	0.9590	0.8812	0.7039	0.4899	0.5445	0.8238	0.9716	0.9953	0.9985	(89)
MIT 2	17.7234	17.9967	18.4161	18.9620	19.4342	19.7352	19.8107	19.8050	19.6285	19.0163	18.2753	17.6914	(90)
Living area fraction									fLA = Living area / (4) =			0.2726	(91)
MIT	18.1914	18.4408	18.8241	19.3230	19.7600	20.0458	20.1255	20.1175	19.9403	19.3714	18.6937	18.1608	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1914	18.4408	18.8241	19.3230	19.7600	20.0458	20.1255	20.1175	19.9403	19.3714	18.6937	18.1608	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9968	0.9924	0.9817	0.9523	0.8792	0.7242	0.5311	0.5842	0.8321	0.9663	0.9933	0.9976	(94)
Useful gains	693.2873	840.2994	954.5037	1028.0061	1002.6317	806.1328	566.6405	587.5881	781.3812	790.9381	694.7576	648.1823	(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													
	2379.9249	2313.4957	2099.9239	1753.3909	1352.6019	903.6078	584.9791	615.5412	973.3237	1471.9835	1955.1297	2366.2922	(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													
	1254.8583	989.9879	852.1927	522.2770	260.3778	0.0000	0.0000	0.0000	0.0000	506.6978	907.4679	1278.2737	(98)
Space heating												6572.1332	(98)
Space heating per m2											(98) / (4) =	52.3634	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 93.4000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 7036.5451 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1254.8583	989.9879	852.1927	522.2770	260.3778	0.0000	0.0000	0.0000	0.0000	506.6978	907.4679	1278.2737	(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)													
	1343.5314	1059.9443	912.4119	559.1831	278.7771	0.0000	0.0000	0.0000	0.0000	542.5029	971.5930	1368.6014	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating
Water heating requirement

218.4168	192.4872	202.0923	181.0768	175.6017	154.6602	148.1762	165.1818	166.7092	187.7704	198.6555	213.1330 (64)

Efficiency of water heater 80.3000 (216)

(217)m	88.7452	88.5862	88.2718	87.5645	86.0411	80.3000	80.3000	80.3000	80.3000	87.4268	88.4030	88.8038 (217)

Fuel for water heating, kWh/month

246.1169	217.2879	228.9433	206.7924	204.0904	192.6030	184.5283	205.7058	207.6079	214.7745	224.7157	240.0044 (219)

Water heating fuel used 2573.1705 (219)
Annual totals kWh/year
Space heating fuel - main system 7036.5451 (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) 474.0250 (232)
Total delivered energy for all uses 10158.7406 (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	7036.5451	0.2160	1519.8938 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2573.1705	0.2160	555.8048 (264)
Space and water heating			2075.6986 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	474.0250	0.5190	246.0190 (268)
Total CO2, kg/m2/year			2360.6425 (272)
Emissions per m2 for space and water heating			16.5381 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			1.9602 (272b)
Emissions per m2 for pumps and fans			0.3101 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.5381 * 1.00) + 1.9602 + 0.3101, rounded to 2 d.p.			18.8100 (273)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	65.8100 (1a)	x	3.6700 (2a)	=	241.5227 (1a) - (3a)	
Ground floor	59.7000 (1b)	x	3.8500 (2b)	=	229.8450 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	125.5100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	471.3677	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0849	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3349	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3097	(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	0.3949	0.3872	0.3794	0.3407	0.3330	0.2943	0.2943	0.2865	0.3097	0.3330	0.3485	0.3640	(22b)
Effective ac	0.5780	0.5750	0.5720	0.5580	0.5554	0.5433	0.5433	0.5410	0.5480	0.5554	0.5607	0.5662	(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	
Windows (Uw = 1.20)			21.4600	1.1450	24.5725			(27)
Doors			1.8900	1.2000	2.2680			(26)
Heat Loss Floor 1			65.8100	0.1000	6.5810			(28)
External Wall 1	121.9500	23.3500	98.6000	0.1700	16.7620			(29a)
Basement wall	108.7400		108.7400	0.1700	18.4858			(29a)
External Roof 1	4.6000		4.6000	0.1000	0.4600			(30)
Total net area of external elements Aum(A, m2)			301.1000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.1293			(33)
Party Wall 1			39.6900	0.0000	0.0000			(32)
Party Ceilings 1			59.7000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.9977 (36)
Total fabric heat loss	(33) + (36) =	79.1270 (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	89.9060	89.4350	88.9733	86.8046	86.3989	84.5101	84.5101	84.1603	85.2376	86.3989	87.2197	88.0778	(38)
Heat transfer coeff	169.0330	168.5620	168.1003	165.9316	165.5259	163.6371	163.6371	163.2873	164.3646	165.5259	166.3467	167.2048	(39)
Average = Sum(39)m / 12 =												165.9297	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3468	1.3430	1.3393	1.3221	1.3188	1.3038	1.3038	1.3010	1.3096	1.3188	1.3254	1.3322	(40)
HLP (average)												1.3220	(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	2.8823 (42)
Average daily hot water use (litres/day)	102.6551 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.9206	108.8144	104.7082	100.6020	96.4958	92.3896	92.3896	96.4958	100.6020	104.7082	108.8144	112.9206	(44)
Energy conte	167.4579	146.4598	151.1334	131.7617	126.4285	109.0982	101.0955	116.0086	117.3941	136.8115	149.3405	162.1741	(45)
Energy content (annual)										Total = Sum(45)m =		1615.1638	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.5848	31.1227	32.1158	27.9994	26.8661	23.1834	21.4828	24.6518	24.9462	29.0724	31.7348	34.4620	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.8413	23.8402	19.3881	14.6781	10.9720	9.2630	10.0090	13.0101	17.4622	22.1722	25.8783	27.5873	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	292.2233	295.2556	287.6142	271.3464	250.8113	231.5112	218.6175	215.5851	223.2266	239.4944	260.0295	279.3296	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	(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)													
	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	(71)
Water heating gains (Table 5)													
	47.8290	46.3135	43.1665	38.8880	36.1103	32.1991	28.8747	33.1342	34.6476	39.0759	44.0762	46.3199	(72)
Total internal gains													
	433.1283	431.6441	416.4035	391.1473	364.1284	339.2081	323.7361	327.9642	341.5711	366.9772	396.2187	419.4715	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
East	3.2600	19.6403	0.6300	0.7000	0.7700	19.5676 (76)
Northwest	18.2000	11.2829	0.6300	0.7000	0.7700	62.7575 (81)

Solar gains	82.3250	166.0230	293.1942	469.9196	620.7548	657.0098	616.5294	498.2878	353.7647	201.5346	103.3636	67.3423 (83)
Total gains	515.4534	597.6671	709.5977	861.0668	984.8832	996.2179	940.2655	826.2520	695.3358	568.5118	499.5823	486.8138 (84)

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7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	20.6255	20.6831	20.7399	21.0110	21.0625	21.3056	21.3056	21.3513	21.2113	21.0625	20.9586	20.8510	
alpha	2.3750	2.3789	2.3827	2.4007	2.4042	2.4204	2.4204	2.4234	2.4141	2.4042	2.3972	2.3901	
util living area													
	0.9855	0.9786	0.9619	0.9207	0.8425	0.7251	0.6087	0.6735	0.8537	0.9522	0.9800	0.9874	(86)
MIT	17.9152	18.1594	18.6558	19.3679	20.0457	20.5609	20.8004	20.7367	20.2709	19.4130	18.5542	17.8825	(87)
Th 2	19.8044	19.8073	19.8101	19.8236	19.8261	19.8379	19.8379	19.8401	19.8333	19.8261	19.8210	19.8157	(88)
util rest of house													
	0.9830	0.9748	0.9548	0.9045	0.8064	0.6528	0.4921	0.5633	0.8051	0.9396	0.9758	0.9853	(89)
MIT 2	16.9872	17.2320	17.7264	18.4349	19.0853	19.5584	19.7471	19.7098	19.3174	18.4907	17.6356	16.9619	(90)
Living area fraction									fLA = Living area / (4) =			0.2726	(91)
MIT	17.2402	17.4848	17.9798	18.6893	19.3472	19.8317	20.0343	19.9898	19.5774	18.7422	17.8860	17.2129	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.2402	17.4848	17.9798	18.6893	19.3472	19.8317	20.0343	19.9898	19.5774	18.7422	17.8860	17.2129	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9751	0.9642	0.9397	0.8842	0.7887	0.6523	0.5141	0.5796	0.7918	0.9234	0.9659	0.9782	(94)
Useful gains	502.6321	576.2846	666.7762	761.3875	776.7307	649.8743	483.4181	478.9345	550.5485	524.9422	482.5432	476.1987	(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													
	2187.3279	2121.3256	1929.7583	1624.3487	1265.8051	856.1044	561.9815	586.1664	900.2843	1347.7418	1794.2215	2175.8256	(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													
	1253.4137	1038.2676	939.6587	621.3321	363.8714	0.0000	0.0000	0.0000	0.0000	612.1629	944.4084	1264.5224	(98)
Space heating												7037.6371	(98)
Space heating per m2											(98) / (4) =	56.0723	(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	1538.1887	1210.9145	1240.9836	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6407	0.7084	0.6582	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	985.5923	857.8451	816.8327	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1281.6519	1213.6335	1082.6653	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	213.1630	264.7066	197.7794	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												675.6490	(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	53.2907	66.1766	49.4449	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												168.9122	(107)
Space cooling per m2												1.3458	(108)
Energy for space heating												56.0723	(99)
Energy for space cooling												1.3458	(108)
Total												57.4181	(109)
Dwelling Fabric Energy Efficiency (DFEE)												57.4	(109)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	65.8100 (1a)	x	3.6700 (2a)	=	241.5227 (1a) - (3a)	
Ground floor	59.7000 (1b)	x	3.8500 (2b)	=	229.8450 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	125.5100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	471.3677	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0849	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3349	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3097	(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	0.3949	0.3872	0.3794	0.3407	0.3330	0.2943	0.2943	0.2865	0.3097	0.3330	0.3485	0.3640	(22b)
Effective ac	0.5780	0.5750	0.5720	0.5580	0.5554	0.5433	0.5433	0.5410	0.5480	0.5554	0.5607	0.5662	(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			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.40)			21.4600	1.3258	28.4508			(27)
Heat Loss Floor 1			65.8100	0.1300	8.5553			(28)
External Wall 1	121.9500	23.3500	98.6000	0.1800	17.7480			(29a)
Basement wall	108.7400		108.7400	0.1800	19.5732			(29a)
External Roof 1	4.6000		4.6000	0.1300	0.5980			(30)
Total net area of external elements Aum(A, m2)			301.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		76.8153			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.6029	(36)
Total fabric heat loss					(33) + (36) =		81.4182	(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	89.9060	89.4350	88.9733	86.8046	86.3989	84.5101	84.5101	84.1603	85.2376	86.3989	87.2197	88.0778	(38)
Heat transfer coeff	171.3242	170.8531	170.3914	168.2228	167.8170	165.9282	165.9282	165.5785	166.6558	167.8170	168.6379	169.4960	(39)
Average = Sum(39)m / 12 =												168.2208	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3650	1.3613	1.3576	1.3403	1.3371	1.3220	1.3220	1.3192	1.3278	1.3371	1.3436	1.3505	(40)
HLP (average)												1.3403	(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		2.8823 (42)
Average daily hot water use (litres/day)		102.6551 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.9206	108.8144	104.7082	100.6020	96.4958	92.3896	92.3896	96.4958	100.6020	104.7082	108.8144	112.9206	(44)
Energy conte	167.4579	146.4598	151.1334	131.7617	126.4285	109.0982	101.0955	116.0086	117.3941	136.8115	149.3405	162.1741	(45)
Energy content (annual)										Total = Sum(45)m =		1615.1638	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.5848	31.1227	32.1158	27.9994	26.8661	23.1834	21.4828	24.6518	24.9462	29.0724	31.7348	34.4620	(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	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	144.1159	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	26.8413	23.8402	19.3881	14.6781	10.9720	9.2630	10.0090	13.0101	17.4622	22.1722	25.8783	27.5873	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	292.2233	295.2556	287.6142	271.3464	250.8113	231.5112	218.6175	215.5851	223.2266	239.4944	260.0295	279.3296	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	37.4116	(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)

	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	(71)

Water heating gains (Table 5)

	47.8290	46.3135	43.1665	38.8880	36.1103	32.1991	28.8747	33.1342	34.6476	39.0759	44.0762	46.3199	(72)

Total internal gains

	433.1283	431.6441	416.4035	391.1473	364.1284	339.2081	323.7361	327.9642	341.5711	366.9772	396.2187	419.4715	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.2600	10.6334	0.6300	0.7000	0.7700	10.5940	(74)
Southwest	18.2000	36.7938	0.6300	0.7000	0.7700	204.6531	(79)

Solar gains	215.2471	368.8456	511.3720	646.2476	736.3954	736.8587	707.9815	639.6632	557.8200	409.3770	258.1963	183.9721	(83)
Total gains	648.3754	800.4897	927.7755	1037.3948	1100.5238	1076.0668	1031.7176	967.6274	899.3912	776.3543	654.4150	603.4436	(84)

7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	50.8742	51.0144	51.1526	51.8121	51.9373	52.5286	52.5286	52.6395	52.2993	51.9373	51.6846	51.4229	
alpha	4.3916	4.4010	4.4102	4.4541	4.4625	4.5019	4.5019	4.5093	4.4866	4.4625	4.4456	4.4282	
util living area													
	0.9989	0.9969	0.9916	0.9750	0.9272	0.8128	0.6564	0.7094	0.9023	0.9849	0.9975	0.9992	(86)
MIT	19.4061	19.5930	19.8820	20.2594	20.6090	20.8641	20.9616	20.9454	20.7547	20.2904	19.7776	19.3796	(87)
Th 2	19.7903	19.7932	19.7960	19.8094	19.8119	19.8236	19.8236	19.8258	19.8191	19.8119	19.8068	19.8015	(88)
util rest of house													
	0.9984	0.9958	0.9884	0.9641	0.8921	0.7204	0.5051	0.5632	0.8406	0.9764	0.9964	0.9989	(89)
MIT 2	18.3454	18.5340	18.8237	19.2055	19.5372	19.7572	19.8136	19.8096	19.6763	19.2418	18.7293	18.3276	(90)
Living area fraction										fLA = Living area / (4) =		0.2726	(91)
MIT	18.6346	18.8228	19.1122	19.4929	19.8294	20.0590	20.1266	20.1193	19.9703	19.5277	19.0151	18.6145	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6346	18.8228	19.1122	19.4929	19.8294	20.0590	20.1266	20.1193	19.9703	19.5277	19.0151	18.6145	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9979	0.9945	0.9859	0.9604	0.8927	0.7416	0.5472	0.6035	0.8504	0.9736	0.9954	0.9985	(94)
Useful gains	646.9982	796.0763	914.6588	996.3023	982.4279	798.0228	564.5396	584.0108	764.8141	755.8911	651.3967	602.5139	(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													
	2455.8685	2378.7456	2149.0159	1781.9593	1364.2596	905.8044	585.1683	615.8323	978.3201	1498.2169	2009.3402	2443.1918	(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													
	1345.7995	1063.5538	918.3617	565.6731	284.0828	0.0000	0.0000	0.0000	0.0000	552.2904	977.7194	1369.4643	(98)
Space heating												7076.9450	(98)
Space heating per m2											(98) / (4) =	56.3855	(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	1559.7254	1227.8690	1258.3963	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7632	0.8467	0.8150	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1190.4132	1039.6250	1025.6526	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1374.9817	1320.5256	1247.9093	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	132.8894	208.9901	165.3590	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												507.2384	(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	33.2223	52.2475	41.3397	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												126.8096	(107)
Space cooling per m2												1.0104	(108)
Energy for space heating												56.3855	(99)
Energy for space cooling												1.0104	(108)
Total												57.3959	(109)
Target Fabric Energy Efficiency (TFEE)												66.0	(109)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	65.8100 (1a)	x	3.6700 (2a)	=	241.5227 (1a) - (3a)	
Ground floor	59.7000 (1b)	x	3.8500 (2b)	=	229.8450 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	125.5100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	471.3677	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0849	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3349	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3097	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.6000	4.5000	4.4000	4.1000	4.1000	3.7000	3.8000	3.7000	3.7000	4.0000	3.9000	4.3000	(22)
Wind factor	1.1500	1.1250	1.1000	1.0250	1.0250	0.9250	0.9500	0.9250	0.9250	1.0000	0.9750	1.0750	(22a)
Adj infilt rate	0.3562	0.3485	0.3407	0.3175	0.3175	0.2865	0.2943	0.2865	0.2865	0.3097	0.3020	0.3330	(22b)
Effective ac	0.5634	0.5607	0.5580	0.5504	0.5504	0.5410	0.5433	0.5410	0.5410	0.5480	0.5456	0.5554	(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	
Windows (Uw = 1.20)			21.4600	1.1450	24.5725			(27)
Doors			1.8900	1.2000	2.2680			(26)
Heat Loss Floor 1			65.8100	0.1000	6.5810			(28)
External Wall 1	121.9500	23.3500	98.6000	0.1700	16.7620			(29a)
Basement wall	108.7400		108.7400	0.1700	18.4858			(29a)
External Roof 1	4.6000		4.6000	0.1000	0.4600			(30)
Total net area of external elements Aum(A, m2)			301.1000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.1293			(33)
Party Wall 1			39.6900	0.0000	0.0000			(32)
Party Ceilings 1			59.7000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.9977 (36)
Total fabric heat loss	(33) + (36) =	79.1270 (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	87.6441	87.2197	86.8046	85.6154	85.6154	84.1603	84.5101	84.1603	84.1603	85.2376	84.8692	86.3989	(38)
Heat transfer coeff	166.7711	166.3467	165.9316	164.7424	164.7424	163.2873	163.6371	163.2873	163.2873	164.3646	163.9962	165.5259	(39)
Average = Sum(39)m / 12 =												164.6600	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3287	1.3254	1.3221	1.3126	1.3126	1.3010	1.3038	1.3010	1.3010	1.3096	1.3066	1.3188	(40)
HLP (average)												1.3119	(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	2.8823 (42)
Average daily hot water use (litres/day)	102.6551 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.9206	108.8144	104.7082	100.6020	96.4958	92.3896	92.3896	96.4958	100.6020	104.7082	108.8144	112.9206	(44)
Energy conte	167.4579	146.4598	151.1334	131.7617	126.4285	109.0982	101.0955	116.0086	117.3941	136.8115	149.3405	162.1741	(45)
Energy content (annual)										Total = Sum(45)m =		1615.1638	(45)
Distribution loss (46)m = 0.15 x (45)m	25.1187	21.9690	22.6700	19.7643	18.9643	16.3647	15.1643	17.4013	17.6091	20.5217	22.4011	24.3261	(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	40.2940	36.3949	40.2872	38.9749	40.2562	38.9351	40.2190	40.2431	38.9562	40.2693	38.9854	40.2878	(61)
Total heat required for water heating calculated for each month	207.7519	182.8547	191.4206	170.7366	166.6847	148.0333	141.3145	156.2517	156.3503	177.0808	188.3258	202.4618	(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

	207.7519	182.8547	191.4206	170.7366	166.6847	148.0333	141.3145	156.2517	156.3503	177.0808	188.3258	202.4618 (64)

Total per year (kWh/year) = Sum(64)m = 2089.2669 (64)

RHI water heating demand 2089 (64)

Heat gains from water heating, kWh/month

	65.7533	57.7966	60.3237	53.5545	52.1015	46.0089	43.6690	48.6336	48.7726	55.5571	59.4020	63.9948 (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	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	67.1031	59.6004	48.4703	36.6951	27.4300	23.1576	25.0226	32.5253	43.6554	55.4306	64.6957	68.9681	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	436.1541	440.6800	429.2749	404.9946	374.3452	345.5391	326.2948	321.7689	333.1740	357.4543	388.1037	416.9099	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	55.1762	55.1762	55.1762	55.1762	55.1762	55.1762	55.1762	55.1762	55.1762	55.1762	55.1762	55.1762	(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)

	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	(71)

Water heating gains (Table 5)

	88.3780	86.0069	81.0802	74.3812	70.0289	63.9013	58.6949	65.3678	67.7397	74.6736	82.5028	86.0145	(72)

Total internal gains

	707.4579	702.1099	674.6480	631.8936	587.6268	548.4206	525.8349	535.4846	560.3918	603.3810	651.1248	687.7151	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.2600	11.5821	0.6300	0.7000	0.7700	11.5392	(74)
Southwest	18.2000	39.1209	0.6300	0.7000	0.7700	217.5967	(79)

Solar gains	229.1359	352.5800	491.8203	644.9983	718.8223	769.5731	736.8587	680.0626	590.1337	427.6389	283.8255	192.2933	(83)
Total gains	936.5937	1054.6899	1166.4682	1276.8919	1306.4491	1317.9937	1262.6936	1215.5472	1150.5255	1031.0200	934.9503	880.0084	(84)

7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	20.9052	20.9586	21.0110	21.1627	21.1627	21.3513	21.3056	21.3513	21.3513	21.2113	21.2590	21.0625	
alpha	2.3937	2.3972	2.4007	2.4108	2.4108	2.4234	2.4204	2.4234	2.4234	2.4141	2.4173	2.4042	
util living area	0.9441	0.9254	0.8848	0.8127	0.6963	0.5045	0.3315	0.3644	0.6162	0.8241	0.9162	0.9504	(86)
MIT	19.1282	19.3092	19.7049	20.1396	20.5264	20.7855	20.8659	20.8585	20.6977	20.2355	19.6311	19.0945	(87)
Th 2	19.8184	19.8210	19.8236	19.8310	19.8310	19.8401	19.8379	19.8401	19.8401	19.8333	19.8356	19.8261	(88)
util rest of house	0.9351	0.9135	0.8653	0.7790	0.6356	0.4031	0.1961	0.2284	0.5257	0.7847	0.9004	0.9423	(89)
MIT 2	17.3546	17.6152	18.1813	18.7922	19.3050	19.6087	19.6699	19.6687	19.5240	18.9377	18.0919	17.3117	(90)
Living area fraction									fLA = Living area / (4) =			0.2726	(91)
MIT	17.8381	18.0770	18.5967	19.1596	19.6380	19.9296	19.9960	19.9931	19.8440	19.2915	18.5115	17.7978	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8381	18.0770	18.5967	19.1596	19.6380	19.9296	19.9960	19.9931	19.8440	19.2915	18.5115	17.7978	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9148	0.8906	0.8401	0.7561	0.6243	0.4115	0.2154	0.2474	0.5260	0.7626	0.8770	0.9233	(94)
Useful gains	856.8369	939.3092	979.9187	965.4387	815.6036	542.3892	271.9572	300.6898	605.1923	786.2367	819.9884	812.5099	(95)
Ext temp.	5.2000	5.7000	7.7000	10.2000	13.3000	16.3000	18.3000	18.1000	15.5000	11.9000	8.2000	5.2000	(96)
Heat loss rate W	2107.6759	2058.8785	1808.1116	1476.0198	1044.1382	592.6649	277.5207	309.1157	709.3167	1214.9038	1691.0518	2085.2559	(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	930.6242	752.3506	616.1755	367.6184	170.0297	0.0000	0.0000	0.0000	0.0000	318.9283	627.1656	946.9230	(98)

Space heating 4729.8154 (98)

RHI space heating demand 4730 (98)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	65.8100 (1a)	x	3.6700 (2a)	=	241.5227 (1a) - (3a)	
Ground floor	59.7000 (1b)	x	3.8500 (2b)	=	229.8450 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	125.5100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	471.3677	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0849	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3349	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3097	(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	0.3949	0.3872	0.3794	0.3407	0.3330	0.2943	0.2943	0.2865	0.3097	0.3330	0.3485	0.3640	(22b)
Effective ac	0.5780	0.5750	0.5720	0.5580	0.5554	0.5433	0.5433	0.5410	0.5480	0.5554	0.5607	0.5662	(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	
Windows (Uw = 1.20)			21.4600	1.1450	24.5725			(27)
Doors			1.8900	1.2000	2.2680			(26)
Heat Loss Floor 1			65.8100	0.1000	6.5810			(28)
External Wall 1	121.9500	23.3500	98.6000	0.1700	16.7620			(29a)
Basement wall	108.7400		108.7400	0.1700	18.4858			(29a)
External Roof 1	4.6000		4.6000	0.1000	0.4600			(30)
Total net area of external elements Aum(A, m2)			301.1000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.1293			(33)
Party Wall 1			39.6900	0.0000	0.0000			(32)
Party Ceilings 1			59.7000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.9977 (36)
Total fabric heat loss	(33) + (36) =	79.1270 (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	89.9060	89.4350	88.9733	86.8046	86.3989	84.5101	84.5101	84.1603	85.2376	86.3989	87.2197	88.0778	(38)
Heat transfer coeff	169.0330	168.5620	168.1003	165.9316	165.5259	163.6371	163.6371	163.2873	164.3646	165.5259	166.3467	167.2048	(39)
Average = Sum(39)m / 12 =												165.9297	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3468	1.3430	1.3393	1.3221	1.3188	1.3038	1.3038	1.3010	1.3096	1.3188	1.3254	1.3322	(40)
HLP (average)												1.3220	(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	2.8823 (42)
Average daily hot water use (litres/day)	102.6551 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.9206	108.8144	104.7082	100.6020	96.4958	92.3896	92.3896	96.4958	100.6020	104.7082	108.8144	112.9206	(44)
Energy conte	167.4579	146.4598	151.1334	131.7617	126.4285	109.0982	101.0955	116.0086	117.3941	136.8115	149.3405	162.1741	(45)
Energy content (annual)										Total = Sum(45)m =		1615.1638	(45)
Distribution loss (46)m = 0.15 x (45)m	25.1187	21.9690	22.6700	19.7643	18.9643	16.3647	15.1643	17.4013	17.6091	20.5217	22.4011	24.3261	(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	40.2940	36.3949	40.2872	38.9749	40.2562	38.9351	40.2190	40.2431	38.9562	40.2693	38.9854	40.2878	(61)
Total heat required for water heating calculated for each month	207.7519	182.8547	191.4206	170.7366	166.6847	148.0333	141.3145	156.2517	156.3503	177.0808	188.3258	202.4618	(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
207.7519 182.8547 191.4206 170.7366 166.6847 148.0333 141.3145 156.2517 156.3503 177.0808 188.3258 202.4618 (64)
Total per year (kWh/year) = Sum(64)m = 2089.2669 (64)
Heat gains from water heating, kWh/month
65.7533 57.7966 60.3237 53.5545 52.1015 46.0089 43.6690 48.6336 48.7726 55.5571 59.4020 63.9948 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.1031	59.6004	48.4703	36.6951	27.4300	23.1576	25.0226	32.5253	43.6554	55.4306	64.6957	68.9681	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	436.1541	440.6800	429.2749	404.9946	374.3452	345.5391	326.2948	321.7689	333.1740	357.4543	388.1037	416.9099	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.1762	55.1762	55.1762	55.1762	55.1762	55.1762	55.1762	55.1762	55.1762	55.1762	55.1762	55.1762	(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)													
	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	-115.2927	(71)
Water heating gains (Table 5)													
	88.3780	86.0069	81.0802	74.3812	70.0289	63.9013	58.6949	65.3678	67.7397	74.6736	82.5028	86.0145	(72)
Total internal gains													
	707.4579	702.1099	674.6480	631.8936	587.6268	548.4206	525.8349	535.4846	560.3918	603.3810	651.1248	687.7151	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.2600	10.6334	0.6300	0.7000	0.7700	10.5940	(74)
Southwest	18.2000	36.7938	0.6300	0.7000	0.7700	204.6531	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	215.2471	368.8456	511.3720	646.2476	736.3954	736.8587	707.9815	639.6632	557.8200	409.3770	258.1963	183.9721	(83)
Total gains	922.7050	1070.9555	1186.0200	1278.1412	1324.0222	1285.2792	1233.8164	1175.1478	1118.2118	1012.7581	909.3211	871.6872	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	20.6255	20.6831	20.7399	21.0110	21.0625	21.3056	21.3056	21.3513	21.2113	21.0625	20.9586	20.8510	
alpha	2.3750	2.3789	2.3827	2.4007	2.4042	2.4204	2.4204	2.4234	2.4141	2.4042	2.3972	2.3901	
util living area													
	0.9516	0.9307	0.8989	0.8434	0.7574	0.6323	0.5051	0.5397	0.7121	0.8624	0.9324	0.9571	(86)
MIT	18.9436	19.1693	19.5138	19.9518	20.3475	20.6517	20.7914	20.7710	20.5473	20.0333	19.4146	18.9050	(87)
Th 2	19.8044	19.8073	19.8101	19.8236	19.8261	19.8379	19.8379	19.8401	19.8333	19.8261	19.8210	19.8157	(88)
util rest of house													
	0.9441	0.9201	0.8827	0.8167	0.7118	0.5558	0.3959	0.4327	0.6445	0.8334	0.9202	0.9504	(89)
MIT 2	17.0782	17.4039	17.8988	18.5259	19.0683	19.4639	19.6145	19.5992	19.3426	18.6539	17.7717	17.0300	(90)
Living area fraction									fLA = Living area / (4) =			0.2726	(91)
MIT	17.5868	17.8853	18.3391	18.9147	19.4171	19.7878	19.9354	19.9187	19.6711	19.0300	18.2196	17.5412	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.5868	17.8853	18.3391	18.9147	19.4171	19.7878	19.9354	19.9187	19.6711	19.0300	18.2196	17.5412	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9250	0.8976	0.8576	0.7918	0.6935	0.5521	0.4059	0.4406	0.6337	0.8089	0.8982	0.9327	(94)
Useful gains	853.5409	961.2822	1017.0766	1012.0046	918.1740	709.5710	500.7547	517.8083	708.6427	819.2464	816.7627	813.0541	(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													
	2245.9081	2188.8214	1990.1600	1661.7490	1277.3727	848.9084	545.7908	574.5521	915.6861	1395.3836	1849.7113	2230.7135	(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													
	1035.9211	824.9064	723.9741	467.8160	267.2438	0.0000	0.0000	0.0000	0.0000	428.6461	743.7230	1054.7386	(98)
Space heating												5546.9690	(98)
Space heating per m2											(98) / (4) =	44.1954	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 93.1000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 5958.0763 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1035.9211	824.9064	723.9741	467.8160	267.2438	0.0000	0.0000	0.0000	0.0000	428.6461	743.7230	1054.7386	(98)
Space heating efficiency (main heating system 1)													
	93.1000	93.1000	93.1000	93.1000	93.1000	0.0000	0.0000	0.0000	0.0000	93.1000	93.1000	93.1000	(210)
Space heating fuel (main heating system)													
	1112.6973	886.0434	777.6306	502.4876	287.0503	0.0000	0.0000	0.0000	0.0000	460.4147	798.8432	1132.9094	(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

	207.7519	182.8547	191.4206	170.7366	166.6847	148.0333	141.3145	156.2517	156.3503	177.0808	188.3258	202.4618 (64)

Efficiency of water heater 91.2000 (216)

(217)m	90.7831	90.7903	90.8041	90.8332	90.8914	91.2000	91.2000	91.2000	91.2000	90.8456	90.8006	90.7802 (217)

Fuel for water heating, kWh/month

	228.8441	201.4033	210.8061	187.9673	183.3888	162.3173	154.9501	171.3286	171.4368	194.9250	207.4060	223.0243 (219)

Water heating fuel used 2297.7978 (219)
Annual totals kWh/year
Space heating fuel - main system 5958.0763 (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) 474.0250 (232)
Total delivered energy for all uses 8804.8990 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5958.0763	3.4800	207.3411 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2297.7978	3.4800	79.9634 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	474.0250	13.1900	62.5239 (250)
Additional standing charges			120.0000 (251)
Total energy cost			479.7208 (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] = 1.1816 (257)
SAP value 83.5160
SAP rating (Section 12) 84 (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	5958.0763	0.2160	1286.9445 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2297.7978	0.2160	496.3243 (264)
Space and water heating			1783.2688 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	474.0250	0.5190	246.0190 (268)
Total kg/year			2068.2127 (272)
CO2 emissions per m2			16.4800 (273)
EI value			83.7464
EI rating			84 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency 3.48 × (1 + 0.29 × 0.25) / 0.9070 = 4.115, stars = 4
Main heating environmental impact 0.216 × (1 + 0.29 × 0.25) / 0.9070 = 0.2554, stars = 4
Water heating energy efficiency 3.48 / 0.9094 = 3.827, stars = 4
Water heating environmental impact 0.216 / 0.9094 = 0.2375, stars = 4

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	65.8100 (1a)	x	3.6700 (2a)	=	241.5227 (1a) - (3a)	
Ground floor	59.7000 (1b)	x	3.8500 (2b)	=	229.8450 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	125.5100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	471.3677	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0849	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3349	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3097	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.6000	4.5000	4.4000	4.1000	4.1000	3.7000	3.8000	3.7000	3.7000	4.0000	3.9000	4.3000	(22)
Wind factor	1.1500	1.1250	1.1000	1.0250	1.0250	0.9250	0.9500	0.9250	0.9250	1.0000	0.9750	1.0750	(22a)
Adj infilt rate	0.3562	0.3485	0.3407	0.3175	0.3175	0.2865	0.2943	0.2865	0.2865	0.3097	0.3020	0.3330	(22b)
Effective ac	0.5634	0.5607	0.5580	0.5504	0.5504	0.5410	0.5433	0.5410	0.5410	0.5480	0.5456	0.5554	(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	
Windows (Uw = 1.20)			21.4600	1.1450	24.5725			(27)
Doors			1.8900	1.2000	2.2680			(26)
Heat Loss Floor 1			65.8100	0.1000	6.5810			(28)
External Wall 1	121.9500	23.3500	98.6000	0.1700	16.7620			(29a)
Basement wall	108.7400		108.7400	0.1700	18.4858			(29a)
External Roof 1	4.6000		4.6000	0.1000	0.4600			(30)
Total net area of external elements Aum(A, m2)			301.1000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.1293			(33)
Party Wall 1			39.6900	0.0000	0.0000			(32)
Party Ceilings 1			59.7000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.9977 (36)
Total fabric heat loss	(33) + (36) =	79.1270 (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	87.6441	87.2197	86.8046	85.6154	85.6154	84.1603	84.5101	84.1603	84.1603	85.2376	84.8692	86.3989	(38)
Heat transfer coeff	166.7711	166.3467	165.9316	164.7424	164.7424	163.2873	163.6371	163.2873	163.2873	164.3646	163.9962	165.5259	(39)
Average = Sum(39)m / 12 =												164.6600	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3287	1.3254	1.3221	1.3126	1.3126	1.3010	1.3038	1.3010	1.3010	1.3096	1.3066	1.3188	(40)
HLP (average)												1.3119	(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	2.8823 (42)
Average daily hot water use (litres/day)	102.6551 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.9206	108.8144	104.7082	100.6020	96.4958	92.3896	92.3896	96.4958	100.6020	104.7082	108.8144	112.9206	(44)
Energy conte	167.4579	146.4598	151.1334	131.7617	126.4285	109.0982	101.0955	116.0086	117.3941	136.8115	149.3405	162.1741	(45)
Energy content (annual)										Total = Sum(45)m =		1615.1638	(45)
Distribution loss (46)m = 0.15 x (45)m	25.1187	21.9690	22.6700	19.7643	18.9643	16.3647	15.1643	17.4013	17.6091	20.5217	22.4011	24.3261	(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	40.2940	36.3949	40.2872	38.9749	40.2562	38.9351	40.2190	40.2431	38.9562	40.2693	38.9854	40.2878	(61)
Total heat required for water heating calculated for each month	207.7519	182.8547	191.4206	170.7366	166.6847	148.0333	141.3145	156.2517	156.3503	177.0808	188.3258	202.4618	(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
207.7519 182.8547 191.4206 170.7366 166.6847 148.0333 141.3145 156.2517 156.3503 177.0808 188.3258 202.4618 (64)
Total per year (kWh/year) = Sum(64)m = 2089.2669 (64)
Heat gains from water heating, kWh/month
65.7533 57.7966 60.3237 53.5545 52.1015 46.0089 43.6690 48.6336 48.7726 55.5571 59.4020 63.9948 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	172.9391	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
67.1031 59.6004 48.4703 36.6951 27.4300 23.1576 25.0226 32.5253 43.6554 55.4306 64.6957 68.9681 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
436.1541 440.6800 429.2749 404.9946 374.3452 345.5391 326.2948 321.7689 333.1740 357.4543 388.1037 416.9099 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
55.1762 55.1762 55.1762 55.1762 55.1762 55.1762 55.1762 55.1762 55.1762 55.1762 55.1762 55.1762 (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)
-115.2927 -115.2927 -115.2927 -115.2927 -115.2927 -115.2927 -115.2927 -115.2927 -115.2927 -115.2927 -115.2927 -115.2927 (71)
Water heating gains (Table 5)
88.3780 86.0069 81.0802 74.3812 70.0289 63.9013 58.6949 65.3678 67.7397 74.6736 82.5028 86.0145 (72)
Total internal gains
707.4579 702.1099 674.6480 631.8936 587.6268 548.4206 525.8349 535.4846 560.3918 603.3810 651.1248 687.7151 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.2600	11.5821	0.6300	0.7000	0.7700	11.5392	(74)
Southwest	18.2000	39.1209	0.6300	0.7000	0.7700	217.5967	(79)

Solar gains	229.1359	352.5800	491.8203	644.9983	718.8223	769.5731	736.8587	680.0626	590.1337	427.6389	283.8255	192.2933	(83)
Total gains	936.5937	1054.6899	1166.4682	1276.8919	1306.4491	1317.9937	1262.6936	1215.5472	1150.5255	1031.0200	934.9503	880.0084	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	20.9052	20.9586	21.0110	21.1627	21.1627	21.3513	21.3056	21.3513	21.3513	21.2113	21.2590	21.0625	
alpha	2.3937	2.3972	2.4007	2.4108	2.4108	2.4234	2.4204	2.4234	2.4234	2.4141	2.4173	2.4042	
util living area	0.9441	0.9254	0.8848	0.8127	0.6963	0.5045	0.3315	0.3644	0.6162	0.8241	0.9162	0.9504	(86)
MIT	19.1282	19.3092	19.7049	20.1396	20.5264	20.7855	20.8659	20.8585	20.6977	20.2355	19.6311	19.0945	(87)
Th 2	19.8184	19.8210	19.8236	19.8310	19.8310	19.8401	19.8379	19.8401	19.8401	19.8333	19.8356	19.8261	(88)
util rest of house	0.9351	0.9135	0.8653	0.7790	0.6356	0.4031	0.1961	0.2284	0.5257	0.7847	0.9004	0.9423	(89)
MIT 2	17.3546	17.6152	18.1813	18.7922	19.3050	19.6087	19.6699	19.6687	19.5240	18.9377	18.0919	17.3117	(90)
Living area fraction									fLA = Living area / (4) =			0.2726	(91)
MIT	17.8381	18.0770	18.5967	19.1596	19.6380	19.9296	19.9960	19.9931	19.8440	19.2915	18.5115	17.7978	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8381	18.0770	18.5967	19.1596	19.6380	19.9296	19.9960	19.9931	19.8440	19.2915	18.5115	17.7978	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9148	0.8906	0.8401	0.7561	0.6243	0.4115	0.2154	0.2474	0.5260	0.7626	0.8770	0.9233	(94)
Useful gains	856.8369	939.3092	979.9187	965.4387	815.6036	542.3892	271.9572	300.6898	605.1923	786.2367	819.9884	812.5099	(95)
Ext temp.	5.2000	5.7000	7.7000	10.2000	13.3000	16.3000	18.3000	18.1000	15.5000	11.9000	8.2000	5.2000	(96)
Heat loss rate W	2107.6759	2058.8785	1808.1116	1476.0198	1044.1382	592.6649	277.5207	309.1157	709.3167	1214.9038	1691.0518	2085.2559	(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	930.6242	752.3506	616.1755	367.6184	170.0297	0.0000	0.0000	0.0000	0.0000	318.9283	627.1656	946.9230	(98)

Space heating 4729.8154 (98)
Space heating per m2 (98) / (4) = 37.6848 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 93.1000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 5080.3603 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	930.6242	752.3506	616.1755	367.6184	170.0297	0.0000	0.0000	0.0000	0.0000	318.9283	627.1656	946.9230	(98)
Space heating efficiency (main heating system 1)	93.1000	93.1000	93.1000	93.1000	93.1000	0.0000	0.0000	0.0000	0.0000	93.1000	93.1000	93.1000	(210)
Space heating fuel (main heating system)	999.5964	808.1102	661.8426	394.8641	182.6313	0.0000	0.0000	0.0000	0.0000	342.5653	673.6473	1017.1032	(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

	207.7519	182.8547	191.4206	170.7366	166.6847	148.0333	141.3145	156.2517	156.3503	177.0808	188.3258	202.4618 (64)
Efficiency of water heater												91.2000 (216)
(217)m	90.7908	90.7973	90.8180	90.8580	90.9468	91.2000	91.2000	91.2000	91.2000	90.8779	90.8150	90.7877 (217)
Fuel for water heating, kWh/month												
	228.8247	201.3878	210.7738	187.9159	183.2771	162.3173	154.9501	171.3286	171.4368	194.8558	207.3731	223.0059 (219)

Water heating fuel used	2297.4468 (219)
Annual totals kWh/year	
Space heating fuel - main system	5080.3603 (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)	474.0250 (232)
Total delivered energy for all uses	7926.8321 (238)

10a. Fuel costs - using BEDF prices (391)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5080.3603	4.3200	219.4716 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2297.4468	4.3200	99.2497 (247)
Pumps and fans for heating	75.0000	15.3200	11.4900 (249)
Energy for lighting	474.0250	15.3200	72.6206 (250)
Additional standing charges			95.0000 (251)
Total energy cost			497.8319 (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	5080.3603	0.2160	1097.3578 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2297.4468	0.2160	496.2485 (264)
Space and water heating			1593.6063 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	474.0250	0.5190	246.0190 (268)
Total kg/year			1878.5503 (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	5080.3603	1.2200	6198.0396 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2297.4468	1.2200	2802.8851 (264)
Space and water heating			9000.9247 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	474.0250	3.0700	1455.2566 (268)
Primary energy kWh/year			10686.4313 (272)
Primary energy kWh/m2/year			85.1441 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 84

(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	Not applicable
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Not applicable
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
(none)			

	Typical annual savings	Energy efficiency	Environmental impact
Recommended measures			
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: B 84
Potential environmental impact rating: B 84

Fuel prices for cost data on this page from database revision number 391 TEST (01 Apr 2016)
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	£84	£84	£0
Mains gas	£414	£414	£0
Space heating	£326	£326	£0
Water heating	£99	£99	£0
Lighting	£73	£73	£0
Total cost of fuels	£498	£498	£0
Total cost of uses	£498	£498	£0
Delivered energy	63 kWh/m²	63 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.9 tonnes	1.9 tonnes	0.0 tonnes
CO2 emissions per m²	15 kg/m²	15 kg/m²	0 kg/m²
Primary energy	85 kWh/m²	85 kWh/m²	0 kWh/m²

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

No improvements selected / applicable

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

No improvements selected / applicable

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

Overheating Calculation Input Data

Dwelling type	SemiDetached Maisonette
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	Unknown
Overshading	Average or unknown
Thermal mass parameter	100.0
Night ventilation	No
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	1244.41 (P1)
Transmission heat loss coefficient	79.13 (37)
Summer heat loss coefficient	1323.54 (P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	0.000	0.00	0.000	0.000 (P8)
South West	0.000	0.00	0.000	0.000 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	3.2600	98.8453	0.6300	0.7000	0.0000	0.0000
South West	18.2000	112.2060	0.6300	0.7000	0.0000	0.0000
total:						844.5819

	Jun	Jul	Aug	
Solar gains	880	845	814	(P3)
Internal gains	545	523	532	
Total summer gains	1426	1367	1346	(P5)
Summer gain/loss ratio	1.08	1.03	1.02	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	18.38	20.23	20.12	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	

Assessment of likelihood of high internal temperature: Not significant

Full SAP Calculation Printout

Property Reference: 000015
Survey Reference: 001

Issued on Date: 19.Apr.2016
Prop Type Ref: Maisonette B

Property: 62a, Haverstock Hill, LONDON, NW3 2BH

SAP Rating:	84 B	**CO2 Emissions (t/year):**	1.51	**DER:**	(NE) 17.73 Pass	**TER:**	18.72	**Percentage DER<TER:**	5.31 %
Environmental:	85 B	**General Requirements Compliance:**	Pass	**DFEE:**	50.54 Pass	**TFEE:**	60.32	**Percentage DFEE<TFEE:**	16.22 %

CfSH Results **Version:** **ENE1 Credits:** N/A **ENE2 Credits:** N/A **ENE7 Credits:** N/A **CfSH Level:** N/A

Surveyor: Paul Parker, Tel: 020 8099 6601 Surveyor ID: V556-0001
Address: New Road, West Molesey, KT8 1PX
Client:

Software Version: Elmhurst Energy Systems SAP2012 Calculator (Design System) version 3.05r04
SAP version: SAP 2012, Regs Region: England (Part L1A 2013), Calculation Type: New Build (As Designed)

CALCULATION DETAILS for survey reference no '001'
SAP2012 - 9.92 input data (DesignData) -


```
SAP2012 Input Data (Maisonette)     19/04/2016

FullRefNo:                    001

Regs Region:                  England
SAP Region:                   Thames Valley
Postcode:                     NW3 2BH
DwellingOrientation:          Unknown
Property Type:                Maisonette, End-Terrace
Storeys:                      3
Date Built:                   2016
Sheltered Sides:              1
Sunlight Shade:               Average or unknown
Measurements                  Perimeter, Floor Area, Storey Height
    1st Storey:              3.18, 2.73, 3.85
    2nd Storey:              27.2, 67.45, 3
    3rd Storey:              17.83, 30.83, 3.12
Living Area:                  34.94 m2, fraction: 34.6%
Thermal Mass:                 Simple calculation
Thermal Mass Simple:          Low
Thermal MassValue:            100
External Walls                Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1               121.93, 149.47, 0, Other, SteelFrame, 0, 0.17, Calculate
Party Walls                   Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1                  39.69, 70, PartyWallSinglePlaster, Solid, 0, 0
External Roofs                Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
    External Roof 1          66.48, 67.45, 9, Plasterboard, insulated flat roof, 0.1
Heat Loss Floors              Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
Party Floors                  Area, Kappa, Construction, Element
    Party Floor 1            67.45, 40
Description                   Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
    Windows                  Manufacturer, Window, Double Low-E Soft 0.05, , , 0.63, , 0.7,
    Doors                    Manufacturer, Solid Door, , , , , , ,
    Rooflight                Manufacturer, Roof Window, Double Low-E Soft 0.05, , , 0.63, , 0.7,
Openings                      Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
    Opening 1                Window, External Wall 1, North West, , Light-coloured curtain or roller blind, 0, , 0, 0, 0, 3.35, 0
    Opening 2                Window, External Wall 1, North, , Light-coloured curtain or roller blind, 0, , 0, 0, 0, 12.61, 0
    Opening 3                Solid Door, External Wall 1, North West, , , , , 0, 0, 0, 1.93,
    Opening 4                Window, External Wall 1, South West, , Light-coloured curtain or roller blind, 0, , 0, 0, 0, 6.30, 0
    Opening 5                Window, External Wall 1, South East, , Light-coloured curtain or roller blind, 0, , 0, 0, 0, 3.35, 0
    Opening 6                Roof Window, External Roof 1, Horizontal, 0, None, , , 0, 0, 0, 0.97,
Conservatory:                 None
Draught Proofing:             100
Draught Lobby:                Yes
Thermal Bridges
    Bridging:                Calculate Bridges
    Y                        0.046
    List of Bridges          Junction with, Bridge Type, Source Type, Imported, Length, Psi, Adjusted, Result, Reference
    0.                       External wall, E1 Steel lintel with perforated steel base plate, Table K1 - Approved, Yes, 8.26, 0.5, 0.5, 4.13,
    1.                       External wall, E3 Sill, Table K1 - Approved, Yes, 7.36, 0.04, 0.04, 0.29,
    2.                       External wall, E4 Jamb, Table K1 - Approved, Yes, 37.6, 0.05, 0.05, 1.88,
    3.                       External wall, E6 Intermediate floor within a dwelling, Table K1 - Approved, Yes, 25.02, 0.07, 0.07, 1.75,
    4.                       External wall, E16 Corner (normal), Table K1 - Approved, No, 11.55, 0.09, 0.09, 1.04,
    5.                       External wall, E18 Party wall between dwellings, Table K1 - Approved, Yes, 15.04, 0.06, 0.06, 0.90,
Pressure Test:                True
Designed q50:                 5
AsBuilt q50:                  15
Property Tested:              False
Mechanical Ventilation        None
Chimneys MHS:                 0
Chimneys SHS:                 0
Chimneys Other:               0
Chimneys Total:               0
Open Flues MHS:               0
Open Flues SHS:               0
Open Flues Other:             0
Open Flues Total:             0
Intermittent Fans:            3
Passive Vents:                0
Flueless Gas Fires:           0
Cooling System                None
Light Fittings:               11
LEL Fittings:                 11
Percentage of LEL Fittings:   100
External Lights Fitted:       No
External LELs Fitted:         No
Electricity Tariff:           Standard
Main Heating 1
    Description
```

Percentage	100
Sedbuk ID	17117
Fuel Type	Mains gas
MHS	Mains gas BGW Post 98 Combi condens. with auto ign.
SAP Code	104
Boiler Efficiency Type	Split Efficiences
Efficiency Winter	90.7
Efficiency Summer	91.2
Controls by PCDF	0
MHS Controls	CBI Time and temperature zone control
Boiler Interlock	Yes
Compensator	0
Delayed Start Stat	No
Ctrl SAP Code	2110
Flue Type	Balanced
Fan Assisted Flue	Yes
Pumped	Pump in heated space
Heat Pump Age	2013 or later
Heat Emitter	Underfloor
Flow Temperature	36° - 45°C
Under Floor Heating	Yes - Pipes in thin screed
Combi boiler type	Standard Combi
Combi keep hot type	Gas/Oil, time clock
Main Heating 2	None
Heating Systems Interaction	Each system heats separate parts of dwelling
Smoke Control Area	Unknown
Community Heating	None
Secondary Heating	None
Water Heating	
Type	MainHeating1
WHS	HWP From main heating 1
Low Water Usage	Yes
SAP Code	901
Showers in Property	Non-electric only
Hot Water Cylinder	None
Flue Gas Heat Recovery System	None
Waste Water Heat Recovery	none
PV Unit	None
Wind Turbine	None
Terrain Type:	Urban
Small Scale Hydro	None
Special Features	None

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

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DWELLING AS DESIGNED

End-Terrace Maisonette, total floor area 101 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) 18.72 kg/m²
Dwelling 'CO2' Emission Rate (DERs)
DER (N):17.63
DER (NE):17.73 (highest value)
DER (E):17.58
DER (SE):17.17
DER (S):16.84
DER (SW):16.87
DER (W):17.15
DER (NW)17.42
Dwelling Carbon Dioxide Emission Rate (DER)(NE) 17.73 kg/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)60.3 kWh/m²
Dwelling Fabric Energy Efficiency (DFEEs)
DFEE (N):49.95
DFEE (NE):50.54 (highest value)
DFEE (E):50.16
DFEE (SE):48.39
DFEE (S):46.93
DFEE (SW):47.23
DFEE (W):48.50
DFEE (NW)49.36
Dwelling Fabric Energy Efficiency (DFEE)50.5 kWh/m²OK

---

2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.17 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (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

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Worcester Greenstar 25 Si Compact
Combi boiler
Efficiency: 89.8% 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

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7 Low energy lights

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

---

8 Mechanical ventilation

Not applicable

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9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based on:		
Overshading:	Average	
Orientation unspecified		
Air change rate:	8.00 ach	
Blinds/curtains:	Light-coloured curtain or roller blind, closed 0% of daylight hours	

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10 Key features

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	2.7300 (1b)	x	3.8500 (2b)	=	10.5105 (1b) - (3b)	
First floor	67.4500 (1c)	x	3.0000 (2c)	=	202.3500 (1c) - (3c)	
Second floor	30.8300 (1d)	x	3.1200 (2d)	=	96.1896 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	101.0100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		309.0501 (5)	

2. Ventilation rate

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

		Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0971 (8)
Pressure test		Yes
Measured/design q50		5.0000
Infiltration rate		0.3471 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3210 (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	0.4093	0.4013	0.3933	0.3531	0.3451	0.3050	0.3050	0.2970	0.3210	0.3451	0.3612	0.3772	(22b)
Effective ac	0.5838	0.5805	0.5773	0.5624	0.5596	0.5465	0.5465	0.5441	0.5515	0.5596	0.5652	0.5711	(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	
Windows (Uw = 1.20)			25.6100	1.1450	29.3244			(27)
Doors			1.9300	1.2000	2.3160			(26)
Rooflight (Uw = 1.20)			0.9700	1.1450	1.1107			(27a)
External Wall 1	149.4700	27.5400	121.9300	0.1700	20.7281			(29a)
External Roof 1	67.4500	0.9700	66.4800	0.1000	6.6480			(30)
Total net area of external elements Aum(A, m2)			216.9200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.1272			(33)
Party Wall 1			39.6900	0.0000	0.0000			(32)
Party Floor 1			67.4500					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.9977 (36)
Total fabric heat loss	(33) + (36) =	70.1249 (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	59.5371	59.2054	58.8802	57.3527	57.0669	55.7366	55.7366	55.4902	56.2490	57.0669	57.6451	58.2495	(38)
Heat transfer coeff	129.6621	129.3303	129.0051	127.4776	127.1919	125.8615	125.8615	125.6151	126.3739	127.1919	127.7700	128.3744	(39)
Average = Sum(39)m / 12 =												127.4763	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2837	1.2804	1.2772	1.2620	1.2592	1.2460	1.2460	1.2436	1.2511	1.2592	1.2649	1.2709	(40)
HLP (average)												1.2620	(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	2.7487 (42)
Average daily hot water use (litres/day)	99.4812 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.4293	105.4500	101.4708	97.4915	93.5123	89.5331	89.5331	93.5123	97.4915	101.4708	105.4500	109.4293	(44)
Energy conte	162.2805	141.9315	146.4606	127.6879	122.5196	105.7251	97.9699	112.4218	113.7645	132.5816	144.7232	157.1600	(45)
Energy content (annual)										Total = Sum(45)m =		1565.2262	(45)
Distribution loss (46)m = 0.15 x (45)m	24.3421	21.2897	21.9691	19.1532	18.3779	15.8588	14.6955	16.8633	17.0647	19.8872	21.7085	23.5740	(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	40.2936	36.3942	40.2861	38.9659	40.2465	38.9272	40.2116	40.2342	38.9483	40.2682	38.9846	40.2874	(61)
Total heat required for water heating calculated for each month	202.5740	178.3258	186.7467	166.6539	162.7661	144.6523	138.1815	152.6561	152.7128	172.8498	183.7078	197.4473	(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
202.5740 178.3258 186.7467 166.6539 162.7661 144.6523 138.1815 152.6561 152.7128 172.8498 183.7078 197.4473 (64)
Total per year (kWh/year) = Sum(64)m = 2039.2741 (64)
Heat gains from water heating, kWh/month
64.0316 56.2908 58.7697 52.1977 50.7994 44.8854 42.6279 47.4388 47.5638 54.1504 57.8666 62.3275 (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	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
22.9965 20.4252 16.6109 12.5755 9.4004 7.9362 8.5753 11.1465 14.9609 18.9962 22.1714 23.6356 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
257.9503 260.6270 253.8818 239.5220 221.3953 204.3587 192.9773 190.3006 197.0458 211.4056 229.5323 246.5689 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
36.7434 36.7434 36.7434 36.7434 36.7434 36.7434 36.7434 36.7434 36.7434 36.7434 36.7434 36.7434 (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)
-109.9472 -109.9472 -109.9472 -109.9472 -109.9472 -109.9472 -109.9472 -109.9472 -109.9472 -109.9472 -109.9472 -109.9472 (71)
Water heating gains (Table 5)
86.0640 83.7661 78.9915 72.4968 68.2788 62.3408 57.2955 63.7619 66.0608 72.7828 80.3703 83.7736 (72)
Total internal gains
434.2410 432.0485 416.7144 391.8246 366.3046 341.8660 326.0784 332.4392 345.2977 370.4149 399.3042 421.2082 (73)

---
6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.3500	10.6334	0.6300	0.7000	0.7700	10.8865	(74)
Northeast	12.6100	11.2829	0.6300	0.7000	0.7700	43.4820	(75)
South	3.3500	46.7521	0.6300	0.7000	0.7700	47.8649	(78)
West	6.3000	19.6403	0.6300	0.7000	0.7700	37.8146	(80)
Horizontal	0.9700	26.0000	0.6300	0.7000	1.0000	10.0098	(82)

Solar gains	150.0578	282.4669	453.4554	666.9515	837.7901	870.2657	823.0948	690.6654	527.0861	330.6667	184.7329	125.1266	(83)
Total gains	584.2989	714.5155	870.1699	1058.7761	1204.0947	1212.1317	1149.1732	1023.1046	872.3838	701.0816	584.0371	546.3348	(84)

---
7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	21.6396	21.6951	21.7498	22.0104	22.0599	22.2930	22.2930	22.3367	22.2026	22.0599	21.9600	21.8566	
alpha	2.4426	2.4463	2.4500	2.4674	2.4707	2.4862	2.4862	2.4891	2.4802	2.4707	2.4640	2.4571	
util living area	0.9699	0.9508	0.9117	0.8299	0.7055	0.5583	0.4378	0.4961	0.7125	0.8899	0.9557	0.9742	(86)
MIT	18.8636	19.1100	19.5220	20.0439	20.4655	20.7269	20.8272	20.8022	20.5711	19.9983	19.3377	18.8228	(87)
Th 2	19.8537	19.8562	19.8588	19.8707	19.8729	19.8834	19.8834	19.8853	19.8793	19.8729	19.8684	19.8637	(88)
util rest of house	0.9651	0.9430	0.8975	0.8025	0.6579	0.4851	0.3410	0.3967	0.6470	0.8657	0.9474	0.9700	(89)
MIT 2	16.9954	17.3528	17.9450	18.6852	19.2512	19.5809	19.6853	19.6676	19.4097	18.6425	17.6948	16.9426	(90)
Living area fraction									fLA = Living area / (4) =			0.3459	(91)
MIT	17.6416	17.9606	18.4905	19.1552	19.6712	19.9773	20.0803	20.0601	19.8114	19.1115	18.2631	17.5930	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6416	17.9606	18.4905	19.1552	19.6712	19.9773	20.0803	20.0601	19.8114	19.1115	18.2631	17.5930	(93)

---
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9521	0.9259	0.8761	0.7821	0.6485	0.4917	0.3590	0.4134	0.6425	0.8453	0.9315	0.9584	(94)
Useful gains	556.3285	661.5382	762.3672	828.0978	780.8335	596.0083	412.5084	422.9289	560.5112	592.6209	544.0088	523.6185	(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	1729.8990	1689.1330	1546.8385	1307.3084	1013.8741	676.7936	438.0341	459.7581	721.7781	1082.5881	1426.3123	1719.3174	(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	873.1364	690.5437	583.6466	345.0316	173.3822	0.0000	0.0000	0.0000	0.0000	364.5356	635.2585	889.5999	(98)
Space heating												4555.1346	(98)
Space heating per m2											(98) / (4) =	45.0959	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 93.1000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 4892.7332 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	873.1364	690.5437	583.6466	345.0316	173.3822	0.0000	0.0000	0.0000	0.0000	364.5356	635.2585	889.5999	(98)
Space heating efficiency (main heating system 1)	93.1000	93.1000	93.1000	93.1000	93.1000	0.0000	0.0000	0.0000	0.0000	93.1000	93.1000	93.1000	(210)

Space heating fuel (main heating system)

937.8479	741.7226	626.9029	370.6032	186.2322	0.0000	0.0000	0.0000	0.0000	391.5528	682.3400	955.5316 (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

202.5740	178.3258	186.7467	166.6539	162.7661	144.6523	138.1815	152.6561	152.7128	172.8498	183.7078	197.4473 (64)

Efficiency of water heater 91.2000 (216)

(217)m 90.7937	90.8022	90.8207	90.8622	90.9414	91.2000	91.2000	91.2000	91.2000	90.8602	90.8117	90.7904 (217)

Fuel for water heating, kWh/month

223.1145	196.3893	205.6213	183.4138	178.9791	158.6099	151.5148	167.3860	167.4482	190.2371	202.2953	217.4760 (219)

Water heating fuel used 2242.4854 (219)

Annual totals kWh/year

Space heating fuel - main system 4892.7332 (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) 406.1246 (232)

Total delivered energy for all uses 7616.3433 (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	4892.7332	0.2160	1056.8304	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2242.4854	0.2160	484.3769	(264)
Space and water heating			1541.2072	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	406.1246	0.5190	210.7787	(268)
Total CO2, kg/year			1790.9109	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.7300	(273)

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

DER		17.7300	ZC1
Total Floor Area	TFA	101.0100	
Assumed number of occupants	N	2.7487	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.1328	ZC2
CO2 emissions from cooking, equation (L16)		1.8312	ZC3
Total CO2 emissions		34.6939	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		34.6939	ZC8

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	2.7300 (1b)	x	3.8500 (2b)	=	10.5105 (1b) - (3b)	
First floor	67.4500 (1c)	x	3.0000 (2c)	=	202.3500 (1c) - (3c)	
Second floor	30.8300 (1d)	x	3.1200 (2d)	=	96.1896 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	101.0100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	309.0501	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1294	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3794	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3510	(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	0.4475	0.4387	0.4299	0.3861	0.3773	0.3334	0.3334	0.3246	0.3510	0.3773	0.3948	0.4124	(22b)
Effective ac	0.6001	0.5962	0.5924	0.5745	0.5712	0.5556	0.5556	0.5527	0.5616	0.5712	0.5780	0.5850	(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			1.9300	1.0000	1.9300			(26)
TER Opening Type (Uw = 1.40)			22.4700	1.3258	29.7898			(27)
TER Room Window (Uw = 1.70)			0.8500	1.5918	1.3530			(27a)
External Wall 1	149.4700	24.4000	125.0700	0.1800	22.5126			(29a)
External Roof 1	67.4500	0.8500	66.6000	0.1300	8.6580			(30)
Total net area of external elements Aum(A, m2)			216.9200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		64.2434			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.6029	(36)
Total fabric heat loss					(33) + (36) =		68.8463	(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	61.2045	60.8080	60.4193	58.5938	58.2522	56.6622	56.6622	56.3678	57.2747	58.2522	58.9432	59.6655	(38)
Heat transfer coeff	130.0507	129.6542	129.2656	127.4400	127.0985	125.5085	125.5085	125.2141	126.1209	127.0985	127.7894	128.5118	(39)
Average = Sum(39)m / 12 =												127.4384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2875	1.2836	1.2797	1.2617	1.2583	1.2425	1.2425	1.2396	1.2486	1.2583	1.2651	1.2723	(40)
HLP (average)												1.2616	(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		2.7487 (42)
Average daily hot water use (litres/day)		99.4812 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.4293	105.4500	101.4708	97.4915	93.5123	89.5331	89.5331	93.5123	97.4915	101.4708	105.4500	109.4293	(44)
Energy conte	162.2805	141.9315	146.4606	127.6879	122.5196	105.7251	97.9699	112.4218	113.7645	132.5816	144.7232	157.1600	(45)
Energy content (annual)										Total = Sum(45)m =		1565.2262	(45)
Distribution loss (46)m = 0.15 x (45)m	24.3421	21.2897	21.9691	19.1532	18.3779	15.8588	14.6955	16.8633	17.0647	19.8872	21.7085	23.5740	(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	50.9589	46.0274	50.9589	48.0780	47.6528	44.1533	45.6251	47.6528	48.0780	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	213.2394	187.9589	197.4195	175.7660	170.1725	149.8784	143.5949	160.0747	161.8425	183.5405	194.0382	208.1189	(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	213.2394	187.9589	197.4195	175.7660	170.1725	149.8784	143.5949	160.0747	161.8425	183.5405	194.0382	208.1189	(64)

Total per year (kWh/year) = Sum(64)m = 2145.6444 (64)

Heat gains from water heating, kWh/month

	66.6980	58.6991	61.4379	54.4757	52.6510	46.1919	43.9812	49.2935	49.8462	56.8231	60.4492	64.9954 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	22.9965	20.4252	16.6109	12.5755	9.4004	7.9362	8.5753	11.1465	14.9609	18.9962	22.1714	23.6356	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	257.9503	260.6270	253.8818	239.5220	221.3953	204.3587	192.9773	190.3006	197.0458	211.4056	229.5323	246.5689	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	(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)

	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	(71)

Water heating gains (Table 5)

	89.6478	87.3498	82.5778	75.6608	70.7674	64.1554	59.1146	66.2547	69.2308	76.3751	83.9572	87.3594	(72)

Total internal gains

	437.8248	435.6323	420.3007	394.9885	368.7933	343.6806	327.8974	334.9320	348.4677	374.0072	402.8912	424.7941	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	11.0600	10.6334	0.6300	0.7000	0.7700	35.9417	(74)
Southeast	2.9400	36.7938	0.6300	0.7000	0.7700	33.0593	(77)
Southwest	5.5300	36.7938	0.6300	0.7000	0.7700	62.1830	(79)
Northwest	2.9400	11.2829	0.6300	0.7000	0.7700	10.1377	(81)
Horizontal	0.8500	26.0000	0.6300	0.7000	1.0000	8.7715	(82)

Solar gains	150.0933	269.7729	408.2553	574.1745	707.4580	731.1667	692.8885	588.6983	464.7806	308.5488	182.3061	126.8341	(83)
Total gains	587.9181	705.4052	828.5561	969.1630	1076.2513	1074.8473	1020.7859	923.6303	813.2484	682.5560	585.1973	551.6282	(84)

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7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.9373	54.1022	54.2649	55.0422	55.1901	55.8893	55.8893	56.0207	55.6179	55.1901	54.8917	54.5832	
alpha	4.5958	4.6068	4.6177	4.6695	4.6793	4.7260	4.7260	4.7347	4.7079	4.6793	4.6594	4.6389	
util living area	0.9982	0.9955	0.9870	0.9542	0.8602	0.6886	0.5270	0.5967	0.8515	0.9775	0.9962	0.9987	(86)
MIT	19.5623	19.7427	20.0403	20.4376	20.7664	20.9423	20.9869	20.9773	20.8377	20.4031	19.9133	19.5374	(87)
Th 2	19.8506	19.8537	19.8567	19.8710	19.8737	19.8861	19.8861	19.8884	19.8813	19.8737	19.8683	19.8626	(88)
util rest of house	0.9976	0.9939	0.9822	0.9366	0.8090	0.5915	0.4007	0.4656	0.7770	0.9658	0.9946	0.9982	(89)
MIT 2	17.9431	18.2083	18.6424	19.2165	19.6491	19.8490	19.8816	19.8794	19.7512	19.1800	18.4683	17.9148	(90)
Living area fraction									fLA = Living area / (4) =			0.3459	(91)
MIT	18.5032	18.7391	19.1260	19.6389	20.0356	20.2272	20.2639	20.2592	20.1270	19.6031	18.9681	18.4761	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5032	18.7391	19.1260	19.6389	20.0356	20.2272	20.2639	20.2592	20.1270	19.6031	18.9681	18.4761	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9965	0.9917	0.9780	0.9322	0.8174	0.6230	0.4447	0.5113	0.7958	0.9620	0.9927	0.9973	(94)
Useful gains	585.8352	699.5708	810.3268	903.4088	879.7027	669.6702	453.9561	472.2302	647.2148	656.6321	580.9263	550.1634	(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	1847.1330	1794.2919	1632.1037	1368.5628	1059.4427	706.2568	459.8507	483.2226	760.1327	1144.2760	1516.6185	1834.6443	(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	938.4056	735.6526	611.4021	334.9109	133.7265	0.0000	0.0000	0.0000	0.0000	362.8070	673.6984	955.6538	(98)
Space heating												4746.2569	(98)
Space heating per m2											(98) / (4) =	46.9880	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 93.4000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 5081.6455 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	938.4056	735.6526	611.4021	334.9109	133.7265	0.0000	0.0000	0.0000	0.0000	362.8070	673.6984	955.6538	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	1004.7169	787.6366	654.6060	358.5770	143.1762	0.0000	0.0000	0.0000	0.0000	388.4444	721.3045	1023.1839	(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

213.2394	187.9589	197.4195	175.7660	170.1725	149.8784	143.5949	160.0747	161.8425	183.5405	194.0382	208.1189 (64)

Efficiency of water heater 80.3000 (216)

(217)m 88.3426	88.1438	87.7074	86.6489	84.4519	80.3000	80.3000	80.3000	80.3000	86.7351	87.9270	88.4114 (217)

Fuel for water heating, kWh/month

241.3778	213.2412	225.0889	202.8484	201.5021	186.6481	178.8231	199.3458	201.5474	211.6104	220.6811	235.3984 (219)

Water heating fuel used 2518.1126 (219)
Annual totals kWh/year
Space heating fuel - main system 5081.6455 (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) 406.1246 (232)
Total delivered energy for all uses 8080.8827 (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	5081.6455	0.2160	1097.6354 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2518.1126	0.2160	543.9123 (264)
Space and water heating			1641.5478 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	406.1246	0.5190	210.7787 (268)
Total CO2, kg/m2/year			1891.2514 (272)
Emissions per m2 for space and water heating			16.2513 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.0867 (272b)
Emissions per m2 for pumps and fans			0.3854 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.2513 * 1.00) + 2.0867 + 0.3854, rounded to 2 d.p.			18.7200 (273)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	2.7300 (1b)	x	3.8500 (2b)	=	10.5105 (1b) - (3b)	
First floor	67.4500 (1c)	x	3.0000 (2c)	=	202.3500 (1c) - (3c)	
Second floor	30.8300 (1d)	x	3.1200 (2d)	=	96.1896 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	101.0100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		309.0501 (5)	

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1294	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3794	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3510	(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	0.4475	0.4387	0.4299	0.3861	0.3773	0.3334	0.3334	0.3246	0.3510	0.3773	0.3948	0.4124	(22b)
Effective ac	0.6001	0.5962	0.5924	0.5745	0.5712	0.5556	0.5556	0.5527	0.5616	0.5712	0.5780	0.5850	(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	
Windows (Uw = 1.20)			25.6100	1.1450	29.3244			(27)
Doors			1.9300	1.2000	2.3160			(26)
Rooflight (Uw = 1.20)			0.9700	1.1450	1.1107			(27a)
External Wall 1	149.4700	27.5400	121.9300	0.1700	20.7281			(29a)
External Roof 1	67.4500	0.9700	66.4800	0.1000	6.6480			(30)
Total net area of external elements Aum(A, m2)			216.9200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.1272			(33)
Party Wall 1			39.6900	0.0000	0.0000			(32)
Party Floor 1			67.4500					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.9977 (36)
Total fabric heat loss	(33) + (36) =	70.1249 (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	61.2045	60.8080	60.4193	58.5938	58.2522	56.6622	56.6622	56.3678	57.2747	58.2522	58.9432	59.6655	(38)
Heat transfer coeff	131.3294	130.9329	130.5442	128.7187	128.3771	126.7872	126.7872	126.4927	127.3996	128.3771	129.0681	129.7904	(39)
Average = Sum(39)m / 12 =												128.7170	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3002	1.2962	1.2924	1.2743	1.2709	1.2552	1.2552	1.2523	1.2613	1.2709	1.2778	1.2849	(40)
HLP (average)												1.2743	(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	2.7487 (42)
Average daily hot water use (litres/day)	99.4812 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.4293	105.4500	101.4708	97.4915	93.5123	89.5331	89.5331	93.5123	97.4915	101.4708	105.4500	109.4293	(44)
Energy conte	162.2805	141.9315	146.4606	127.6879	122.5196	105.7251	97.9699	112.4218	113.7645	132.5816	144.7232	157.1600	(45)
Energy content (annual)										Total = Sum(45)m =		1565.2262	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.4846	30.1605	31.1229	27.1337	26.0354	22.4666	20.8186	23.8896	24.1750	28.1736	30.7537	33.3965	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	22.9965	20.4252	16.6109	12.5755	9.4004	7.9362	8.5753	11.1465	14.9609	18.9962	22.1714	23.6356	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	257.9503	260.6270	253.8818	239.5220	221.3953	204.3587	192.9773	190.3006	197.0458	211.4056	229.5323	246.5689	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	(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)

	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	(71)

Water heating gains (Table 5)

	46.3503	44.8816	41.8318	37.6857	34.9938	31.2036	27.9820	32.1097	33.5763	37.8677	42.7134	44.8878	(72)
Total internal gains													
	391.5272	390.1641	376.5548	354.0134	330.0197	307.7287	293.7648	297.7871	309.8132	332.4998	358.6474	379.3224	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.3500	10.6334	0.6300	0.7000	0.7700	10.8865	(74)
Northeast	12.6100	11.2829	0.6300	0.7000	0.7700	43.4820	(75)
South	3.3500	46.7521	0.6300	0.7000	0.7700	47.8649	(78)
West	6.3000	19.6403	0.6300	0.7000	0.7700	37.8146	(80)
Horizontal	0.9700	26.0000	0.6300	0.7000	1.0000	10.0098	(82)

Solar gains	150.0578	282.4669	453.4554	666.9515	837.7901	870.2657	823.0948	690.6654	527.0861	330.6667	184.7329	125.1266	(83)
Total gains	541.5851	672.6310	830.0102	1020.9649	1167.8097	1177.9944	1116.8596	988.4525	836.8993	663.1665	543.3803	504.4490	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	21.3649	21.4296	21.4934	21.7982	21.8562	22.1303	22.1303	22.1818	22.0239	21.8562	21.7392	21.6182	
alpha	2.4243	2.4286	2.4329	2.4532	2.4571	2.4754	2.4754	2.4788	2.4683	2.4571	2.4493	2.4412	
util living area													
	0.9744	0.9567	0.9197	0.8407	0.7185	0.5715	0.4502	0.5113	0.7289	0.9010	0.9620	0.9783	(86)
MIT	18.2000	18.5346	19.0961	19.8145	20.3977	20.7642	20.9061	20.8694	20.5419	19.7479	18.8467	18.1495	(87)
Th 2	19.8407	19.8438	19.8468	19.8610	19.8637	19.8761	19.8761	19.8784	19.8713	19.8637	19.8583	19.8527	(88)
util rest of house													
	0.9702	0.9496	0.9065	0.8142	0.6714	0.4976	0.3510	0.4098	0.6643	0.8785	0.9547	0.9747	(89)
MIT 2	17.2928	17.6252	18.1782	18.8782	19.4155	19.7348	19.8363	19.8187	19.5659	18.8339	17.9479	17.2507	(90)
Living area fraction										fLA = Living area / (4) =		0.3459	(91)
MIT	17.6066	17.9398	18.4957	19.2021	19.7553	20.0908	20.2064	20.1822	19.9035	19.1500	18.2588	17.5616	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6066	17.9398	18.4957	19.2021	19.7553	20.0908	20.2064	20.1822	19.9035	19.1500	18.2588	17.5616	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9589	0.9342	0.8869	0.7963	0.6664	0.5126	0.3816	0.4391	0.6664	0.8609	0.9407	0.9647	(94)
Useful gains	519.3467	628.3745	736.1364	812.9551	778.2176	603.8854	426.2465	434.0029	557.6990	570.8947	511.1804	486.6418	(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													
	1747.5466	1707.3369	1565.9672	1326.0668	1034.1122	696.1691	457.2432	478.4177	739.3657	1097.6289	1440.2443	1734.2095	(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													
	913.7807	725.0627	617.3941	369.4405	190.3856	0.0000	0.0000	0.0000	0.0000	391.8902	668.9260	928.1904	(98)
Space heating												4805.0702	(98)
Space heating per m2											(98) / (4) =	47.5702	(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	1191.7992	938.2249	961.3446	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7824	0.8363	0.7989	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	932.4537	784.6322	768.0465	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1469.4654	1396.4346	1250.2876	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	386.6485	455.1810	358.7874	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1200.6168	(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	96.6621	113.7952	89.6968	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												300.1542	(107)
Space cooling per m2												2.9715	(108)
Energy for space heating												47.5702	(99)
Energy for space cooling												2.9715	(108)
Total												50.5418	(109)
Dwelling Fabric Energy Efficiency (DFEE)												50.5	(109)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	2.7300 (1b)	x	3.8500 (2b)	=	10.5105 (1b) - (3b)	
First floor	67.4500 (1c)	x	3.0000 (2c)	=	202.3500 (1c) - (3c)	
Second floor	30.8300 (1d)	x	3.1200 (2d)	=	96.1896 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	101.0100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	309.0501 (5)	

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1294	(8)
Pressure test			Yes	
Measured/design q50			5.0000	
Infiltration rate			0.3794	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3510	(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	0.4475	0.4387	0.4299	0.3861	0.3773	0.3334	0.3334	0.3246	0.3510	0.3773	0.3948	0.4124	(22b)
Effective ac	0.6001	0.5962	0.5924	0.5745	0.5712	0.5556	0.5556	0.5527	0.5616	0.5712	0.5780	0.5850	(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			1.9300	1.0000	1.9300			(26)
TER Opening Type (Uw = 1.40)			22.4700	1.3258	29.7898			(27)
TER Room Window (Uw = 1.70)			0.8500	1.5918	1.3530			(27a)
External Wall 1	149.4700	24.4000	125.0700	0.1800	22.5126			(29a)
External Roof 1	67.4500	0.8500	66.6000	0.1300	8.6580			(30)
Total net area of external elements Aum(A, m2)			216.9200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		64.2434			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.6029	(36)
Total fabric heat loss					(33) + (36) =		68.8463	(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	61.2045	60.8080	60.4193	58.5938	58.2522	56.6622	56.6622	56.3678	57.2747	58.2522	58.9432	59.6655	(38)
Heat transfer coeff	130.0507	129.6542	129.2656	127.4400	127.0985	125.5085	125.5085	125.2141	126.1209	127.0985	127.7894	128.5118	(39)
Average = Sum(39)m / 12 =												127.4384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2875	1.2836	1.2797	1.2617	1.2583	1.2425	1.2425	1.2396	1.2486	1.2583	1.2651	1.2723	(40)
HLP (average)												1.2616	(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												2.7487	(42)
Average daily hot water use (litres/day)												99.4812	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.4293	105.4500	101.4708	97.4915	93.5123	89.5331	89.5331	93.5123	97.4915	101.4708	105.4500	109.4293	(44)
Energy conte	162.2805	141.9315	146.4606	127.6879	122.5196	105.7251	97.9699	112.4218	113.7645	132.5816	144.7232	157.1600	(45)
Energy content (annual)										Total = Sum(45)m =		1565.2262	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.4846	30.1605	31.1229	27.1337	26.0354	22.4666	20.8186	23.8896	24.1750	28.1736	30.7537	33.3965	(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	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	137.4340	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	22.9965	20.4252	16.6109	12.5755	9.4004	7.9362	8.5753	11.1465	14.9609	18.9962	22.1714	23.6356	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	257.9503	260.6270	253.8818	239.5220	221.3953	204.3587	192.9773	190.3006	197.0458	211.4056	229.5323	246.5689	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	36.7434	(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)

	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	(71)

Water heating gains (Table 5)

	46.3503	44.8816	41.8318	37.6857	34.9938	31.2036	27.9820	32.1097	33.5763	37.8677	42.7134	44.8878	(72)

Total internal gains

	391.5272	390.1641	376.5548	354.0134	330.0197	307.7287	293.7648	297.7871	309.8132	332.4998	358.6474	379.3224	(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	11.0600	10.6334	0.6300	0.7000	0.7700	35.9417	(74)
Southeast	2.9400	36.7938	0.6300	0.7000	0.7700	33.0593	(77)
Southwest	5.5300	36.7938	0.6300	0.7000	0.7700	62.1830	(79)
Northwest	2.9400	11.2829	0.6300	0.7000	0.7700	10.1377	(81)
Horizontal	0.8500	26.0000	0.6300	0.7000	1.0000	8.7715	(82)

Solar gains	150.0933	269.7729	408.2553	574.1745	707.4580	731.1667	692.8885	588.6983	464.7806	308.5488	182.3061	126.8341	(83)
Total gains	541.6206	659.9370	784.8101	928.1879	1037.4777	1038.8954	986.6533	886.4853	774.5938	641.0486	540.9535	506.1565	(84)

7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.9373	54.1022	54.2649	55.0422	55.1901	55.8893	55.8893	56.0207	55.6179	55.1901	54.8917	54.5832	
alpha	4.5958	4.6068	4.6177	4.6695	4.6793	4.7260	4.7260	4.7347	4.7079	4.6793	4.6594	4.6389	
util living area	0.9987	0.9966	0.9895	0.9606	0.8731	0.7057	0.5432	0.6175	0.8691	0.9823	0.9973	0.9991	(86)
MIT	19.5207	19.7022	20.0029	20.4073	20.7481	20.9359	20.9851	20.9738	20.8201	20.3689	19.8737	19.4963	(87)
Th 2	19.8506	19.8537	19.8567	19.8710	19.8737	19.8861	19.8861	19.8884	19.8813	19.8737	19.8683	19.8626	(88)
util rest of house	0.9983	0.9954	0.9855	0.9450	0.8245	0.6086	0.4140	0.4838	0.7990	0.9728	0.9961	0.9988	(89)
MIT 2	18.5067	18.6901	18.9910	19.3962	19.7064	19.8576	19.8825	19.8812	19.7806	19.3675	18.8731	18.4917	(90)
Living area fraction									fLA = Living area / (4) =			0.3459	(91)
MIT	18.8574	19.0402	19.3410	19.7460	20.0667	20.2306	20.2639	20.2592	20.1402	19.7139	19.2192	18.8392	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8574	19.0402	19.3410	19.7460	20.0667	20.2306	20.2639	20.2592	20.1402	19.7139	19.2192	18.8392	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9942	0.9832	0.9429	0.8339	0.6407	0.4592	0.5306	0.8179	0.9710	0.9951	0.9983	(94)
Useful gains	540.3906	656.1097	771.5960	875.1494	865.1865	665.5859	453.1139	470.3987	633.5090	622.4375	538.3281	505.3181	(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	1893.2036	1833.3410	1659.9022	1382.2092	1063.3968	706.6880	459.8555	483.2201	761.7909	1158.3662	1548.7038	1881.3100	(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	1006.4929	791.0994	660.8998	365.0831	147.4685	0.0000	0.0000	0.0000	0.0000	398.7309	727.4705	1023.7380	(98)
Space heating												5120.9831	(98)
Space heating per m2											(98) / (4) =	50.6978	(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	1179.7800	928.7629	951.6269	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8652	0.9220	0.8890	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1020.7267	856.2766	845.9771	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1308.4904	1245.7651	1132.3677	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	207.1899	289.7795	213.0746	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												710.0439	(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	51.7975	72.4449	53.2687	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												177.5110	(107)
Space cooling per m2												1.7574	(108)
Energy for space heating												50.6978	(99)
Energy for space cooling												1.7574	(108)
Total												52.4551	(109)
Target Fabric Energy Efficiency (TFEE)												60.3	(109)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	2.7300 (1b)	x	3.8500 (2b)	=	10.5105 (1b)	- (3b)
First floor	67.4500 (1c)	x	3.0000 (2c)	=	202.3500 (1c)	- (3c)
Second floor	30.8300 (1d)	x	3.1200 (2d)	=	96.1896 (1d)	- (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	101.0100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	309.0501	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0971	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3471	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3210	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.6000	4.5000	4.4000	4.1000	4.1000	3.7000	3.8000	3.7000	3.7000	4.0000	3.9000	4.3000	(22)
Wind factor	1.1500	1.1250	1.1000	1.0250	1.0250	0.9250	0.9500	0.9250	0.9250	1.0000	0.9750	1.0750	(22a)
Adj infilt rate	0.3692	0.3612	0.3531	0.3291	0.3291	0.2970	0.3050	0.2970	0.2970	0.3210	0.3130	0.3451	(22b)
Effective ac	0.5682	0.5652	0.5624	0.5541	0.5541	0.5441	0.5465	0.5441	0.5441	0.5515	0.5490	0.5596	(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	
Windows (Uw = 1.20)			25.6100	1.1450	29.3244			(27)
Doors			1.9300	1.2000	2.3160			(26)
Rooflight (Uw = 1.20)			0.9700	1.1450	1.1107			(27a)
External Wall 1	149.4700	27.5400	121.9300	0.1700	20.7281			(29a)
External Roof 1	67.4500	0.9700	66.4800	0.1000	6.6480			(30)
Total net area of external elements Aum(A, m2)			216.9200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.1272			(33)
Party Wall 1			39.6900	0.0000	0.0000			(32)
Party Floor 1			67.4500					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.9977 (36)
Total fabric heat loss	(33) + (36) =	70.1249 (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	57.9440	57.6451	57.3527	56.5151	56.5151	55.4902	55.7366	55.4902	55.4902	56.2490	55.9895	57.0669	(38)
Heat transfer coeff	128.0689	127.7700	127.4776	126.6400	126.6400	125.6151	125.8615	125.6151	125.6151	126.3739	126.1144	127.1919	(39)
Average = Sum(39)m / 12 =												126.5820	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2679	1.2649	1.2620	1.2537	1.2537	1.2436	1.2460	1.2436	1.2436	1.2511	1.2485	1.2592	(40)
HLP (average)												1.2532	(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	2.7487 (42)
Average daily hot water use (litres/day)	99.4812 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.4293	105.4500	101.4708	97.4915	93.5123	89.5331	89.5331	93.5123	97.4915	101.4708	105.4500	109.4293	(44)
Energy conte	162.2805	141.9315	146.4606	127.6879	122.5196	105.7251	97.9699	112.4218	113.7645	132.5816	144.7232	157.1600	(45)
Energy content (annual)										Total = Sum(45)m =		1565.2262	(45)
Distribution loss (46)m = 0.15 x (45)m	24.3421	21.2897	21.9691	19.1532	18.3779	15.8588	14.6955	16.8633	17.0647	19.8872	21.7085	23.5740	(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	40.2936	36.3942	40.2861	38.9659	40.2465	38.9272	40.2116	40.2342	38.9483	40.2682	38.9846	40.2874	(61)
Total heat required for water heating calculated for each month	202.5740	178.3258	186.7467	166.6539	162.7661	144.6523	138.1815	152.6561	152.7128	172.8498	183.7078	197.4473	(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

	202.5740	178.3258	186.7467	166.6539	162.7661	144.6523	138.1815	152.6561	152.7128	172.8498	183.7078	197.4473 (64)

Total per year (kWh/year) = Sum(64)m = 2039.2741 (64)

RHI water heating demand 2039 (64)

Heat gains from water heating, kWh/month

	64.0316	56.2908	58.7697	52.1977	50.7994	44.8854	42.6279	47.4388	47.5638	54.1504	57.8666	62.3275 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	57.4911	51.0631	41.5273	31.4389	23.5009	19.8405	21.4383	27.8663	37.4021	47.4906	55.4285	59.0890 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	385.0005	388.9956	378.9280	357.4955	330.4407	305.0130	288.0258	284.0307	294.0982	315.5308	342.5856	368.0132 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	54.2408	54.2408	54.2408	54.2408	54.2408	54.2408	54.2408	54.2408	54.2408	54.2408	54.2408	54.2408 (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)

	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472 (71)

Water heating gains (Table 5)

	86.0640	83.7661	78.9915	72.4968	68.2788	62.3408	57.2955	63.7619	66.0608	72.7828	80.3703	83.7736 (72)

Total internal gains

	640.7700	636.0391	611.6613	573.6455	534.4348	499.4087	478.9740	487.8733	509.7755	548.0186	590.5988	623.0902 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	12.6100	11.5821	0.6300	0.7000	0.7700	44.6347	(74)
Southeast	3.3500	39.1209	0.6300	0.7000	0.7700	40.0521	(77)
Southwest	6.3000	39.1209	0.6300	0.7000	0.7700	75.3219	(79)
Northwest	3.3500	12.4928	0.6300	0.7000	0.7700	12.7901	(81)
Horizontal	0.9700	29.0000	0.6300	0.7000	1.0000	11.1648	(82)

Solar gains	183.9637	297.8860	455.1962	664.5949	798.8382	881.7502	833.3915	725.2322	570.4159	372.9065	230.9575	152.4961	(83)
Total gains	824.7337	933.9251	1066.8574	1238.2404	1333.2730	1381.1589	1312.3655	1213.1055	1080.1914	920.9252	821.5563	775.5862	(84)

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7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	21.9088	21.9600	22.0104	22.1560	22.1560	22.3367	22.2930	22.3367	22.3367	22.2026	22.2483	22.0599	
alpha	2.4606	2.4640	2.4674	2.4771	2.4771	2.4891	2.4862	2.4891	2.4891	2.4802	2.4832	2.4707	
util living area	0.9319	0.9083	0.8521	0.7469	0.5948	0.3963	0.2522	0.2896	0.5436	0.7867	0.8986	0.9393	(86)
MIT	19.2918	19.4796	19.8873	20.3248	20.6588	20.8372	20.8809	20.8758	20.7592	20.3467	19.7684	19.2542	(87)
Th 2	19.8661	19.8684	19.8707	19.8773	19.8773	19.8853	19.8834	19.8853	19.8853	19.8793	19.8814	19.8729	(88)
util rest of house	0.9214	0.8946	0.8295	0.7087	0.5339	0.3123	0.1507	0.1826	0.4583	0.7442	0.8806	0.9299	(89)
MIT 2	17.6191	17.8878	18.4651	19.0663	19.4919	19.6919	19.7226	19.7225	19.6226	19.1148	18.3149	17.5706	(90)
Living area fraction									fLA = Living area / (4) =			0.3459	(91)
MIT	18.1977	18.4384	18.9570	19.5016	19.8955	20.0880	20.1233	20.1214	20.0158	19.5410	18.8177	18.1529	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1977	18.4384	18.9570	19.5016	19.8955	20.0880	20.1233	20.1214	20.0158	19.5410	18.8177	18.1529	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9017	0.8730	0.8078	0.6944	0.5350	0.3282	0.1730	0.2059	0.4690	0.7293	0.8595	0.9112	(94)
Useful gains	743.6836	815.3306	861.7869	859.8515	713.3074	453.3053	226.9980	249.8118	506.6357	671.6667	706.1145	706.7379	(95)
Ext temp.	5.2000	5.7000	7.7000	10.2000	13.3000	16.3000	18.3000	18.1000	15.5000	11.9000	8.2000	5.2000	(96)
Heat loss rate W	1664.6038	1627.5861	1435.0197	1177.9566	835.2564	475.8353	229.4838	253.9230	567.2508	965.6174	1339.0461	1647.5081	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	685.1646	545.8357	426.4853	229.0357	90.7300	0.0000	0.0000	0.0000	0.0000	218.6993	455.7107	699.9331	(98)

Space heating 3351.5943 (98)

RHI space heating demand 3352 (98)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)
Ground floor	2.7300 (1b)	x	3.8500 (2b)	=	10.5105 (1b) - (3b)
First floor	67.4500 (1c)	x	3.0000 (2c)	=	202.3500 (1c) - (3c)
Second floor	30.8300 (1d)	x	3.1200 (2d)	=	96.1896 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	101.0100				(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		309.0501 (5)

2. Ventilation rate

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

		Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0971 (8)
Pressure test		Yes
Measured/design q50		5.0000
Infiltration rate		0.3471 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3210 (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	0.4093	0.4013	0.3933	0.3531	0.3451	0.3050	0.3050	0.2970	0.3210	0.3451	0.3612	0.3772	(22b)
Effective ac	0.5838	0.5805	0.5773	0.5624	0.5596	0.5465	0.5465	0.5441	0.5515	0.5596	0.5652	0.5711	(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	
Windows (Uw = 1.20)			25.6100	1.1450	29.3244			(27)
Doors			1.9300	1.2000	2.3160			(26)
Rooflight (Uw = 1.20)			0.9700	1.1450	1.1107			(27a)
External Wall 1	149.4700	27.5400	121.9300	0.1700	20.7281			(29a)
External Roof 1	67.4500	0.9700	66.4800	0.1000	6.6480			(30)
Total net area of external elements Aum(A, m2)			216.9200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.1272			(33)
Party Wall 1			39.6900	0.0000	0.0000			(32)
Party Floor 1			67.4500					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.9977 (36)
Total fabric heat loss (33) + (36) =	70.1249 (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	59.5371	59.2054	58.8802	57.3527	57.0669	55.7366	55.7366	55.4902	56.2490	57.0669	57.6451	58.2495	(38)
Heat transfer coeff	129.6621	129.3303	129.0051	127.4776	127.1919	125.8615	125.8615	125.6151	126.3739	127.1919	127.7700	128.3744	(39)
Average = Sum(39)m / 12 =												127.4763	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2837	1.2804	1.2772	1.2620	1.2592	1.2460	1.2460	1.2436	1.2511	1.2592	1.2649	1.2709	(40)
HLP (average)												1.2620	(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	2.7487 (42)
Average daily hot water use (litres/day)	99.4812 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.4293	105.4500	101.4708	97.4915	93.5123	89.5331	89.5331	93.5123	97.4915	101.4708	105.4500	109.4293	(44)
Energy conte	162.2805	141.9315	146.4606	127.6879	122.5196	105.7251	97.9699	112.4218	113.7645	132.5816	144.7232	157.1600	(45)
Energy content (annual)										Total = Sum(45)m =		1565.2262	(45)
Distribution loss (46)m = 0.15 x (45)m	24.3421	21.2897	21.9691	19.1532	18.3779	15.8588	14.6955	16.8633	17.0647	19.8872	21.7085	23.5740	(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	40.2936	36.3942	40.2861	38.9659	40.2465	38.9272	40.2116	40.2342	38.9483	40.2682	38.9846	40.2874	(61)
Total heat required for water heating calculated for each month	202.5740	178.3258	186.7467	166.6539	162.7661	144.6523	138.1815	152.6561	152.7128	172.8498	183.7078	197.4473	(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
202.5740 178.3258 186.7467 166.6539 162.7661 144.6523 138.1815 152.6561 152.7128 172.8498 183.7078 197.4473 (64)
Total per year (kWh/year) = Sum(64)m = 2039.2741 (64)
Heat gains from water heating, kWh/month
64.0316 56.2908 58.7697 52.1977 50.7994 44.8854 42.6279 47.4388 47.5638 54.1504 57.8666 62.3275 (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	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
57.4911 51.0631 41.5273 31.4389 23.5009 19.8405 21.4383 27.8663 37.4021 47.4906 55.4285 59.0890 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
385.0005 388.9956 378.9280 357.4955 330.4407 305.0130 288.0258 284.0307 294.0982 315.5308 342.5856 368.0132 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
54.2408 54.2408 54.2408 54.2408 54.2408 54.2408 54.2408 54.2408 54.2408 54.2408 54.2408 54.2408 (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)
-109.9472 -109.9472 -109.9472 -109.9472 -109.9472 -109.9472 -109.9472 -109.9472 -109.9472 -109.9472 -109.9472 -109.9472 (71)
Water heating gains (Table 5)
86.0640 83.7661 78.9915 72.4968 68.2788 62.3408 57.2955 63.7619 66.0608 72.7828 80.3703 83.7736 (72)
Total internal gains
640.7700 636.0391 611.6613 573.6455 534.4348 499.4087 478.9740 487.8733 509.7755 548.0186 590.5988 623.0902 (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	12.6100	10.6334	0.6300	0.7000	0.7700	40.9788	(74)
Southeast	3.3500	36.7938	0.6300	0.7000	0.7700	37.6697	(77)
Southwest	6.3000	36.7938	0.6300	0.7000	0.7700	70.8414	(79)
Northwest	3.3500	11.2829	0.6300	0.7000	0.7700	11.5515	(81)
Horizontal	0.9700	26.0000	0.6300	0.7000	1.0000	10.0098	(82)

Solar gains	171.0512	307.4501	465.2938	654.4240	806.3593	833.3915	789.7579	670.9868	529.7266	351.6472	207.7634	144.5432	(83)
Total gains	811.8212	943.4892	1076.9551	1228.0695	1340.7940	1332.8002	1268.7320	1158.8600	1039.5022	899.6658	798.3622	767.6334	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	21.6396	21.6951	21.7498	22.0104	22.0599	22.2930	22.2930	22.3367	22.2026	22.0599	21.9600	21.8566	
alpha	2.4426	2.4463	2.4500	2.4674	2.4707	2.4862	2.4862	2.4891	2.4802	2.4707	2.4640	2.4571	
util living area	0.9411	0.9156	0.8711	0.7874	0.6660	0.5217	0.4033	0.4501	0.6477	0.8327	0.9181	0.9476	(86)
MIT	19.1137	19.3443	19.7060	20.1566	20.5211	20.7508	20.8383	20.8202	20.6374	20.1584	19.5607	19.0713	(87)
Th 2	19.8537	19.8562	19.8588	19.8707	19.8729	19.8834	19.8834	19.8853	19.8793	19.8729	19.8684	19.8637	(88)
util rest of house	0.9323	0.9034	0.8523	0.7562	0.6169	0.4502	0.3119	0.3562	0.5795	0.8006	0.9042	0.9398	(89)
MIT 2	17.3538	17.6847	18.1998	18.8330	19.3167	19.6035	19.6927	19.6807	19.4810	18.8546	18.0097	17.2997	(90)
Living area fraction									fLA = Living area / (4) =			0.3459	(91)
MIT	17.9625	18.2588	18.7208	19.2909	19.7333	20.0004	20.0890	20.0748	19.8810	19.3056	18.5462	17.9125	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9625	18.2588	18.7208	19.2909	19.7333	20.0004	20.0890	20.0748	19.8810	19.3056	18.5462	17.9125	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9136	0.8820	0.8297	0.7380	0.6103	0.4582	0.3295	0.3731	0.5796	0.7814	0.8835	0.9222	(94)
Useful gains	741.6560	832.1550	893.5484	906.3027	818.2909	610.6641	418.0693	432.3416	602.4981	703.0142	705.3555	707.9157	(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	1771.5129	1727.6923	1576.5462	1324.6013	1021.7711	679.7029	439.1256	461.6146	730.5667	1107.2757	1462.4838	1760.3362	(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	766.2136	601.8011	508.1504	301.1750	151.3892	0.0000	0.0000	0.0000	0.0000	300.7705	545.1324	783.0008	(98)
Space heating												3957.6328	(98)
Space heating per m2											(98) / (4) =	39.1806	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 93.1000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 4250.9483 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	766.2136	601.8011	508.1504	301.1750	151.3892	0.0000	0.0000	0.0000	0.0000	300.7705	545.1324	783.0008	(98)
Space heating efficiency (main heating system 1)	93.1000	93.1000	93.1000	93.1000	93.1000	0.0000	0.0000	0.0000	0.0000	93.1000	93.1000	93.1000	(210)

Space heating fuel (main heating system)

823.0006	646.4029	545.8113	323.4962	162.6092	0.0000	0.0000	0.0000	0.0000	323.0618	585.5342	841.0320 (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

202.5740	178.3258	186.7467	166.6539	162.7661	144.6523	138.1815	152.6561	152.7128	172.8498	183.7078	197.4473 (64)

Efficiency of water heater 91.2000 (216)

(217)m 90.8041	90.8138	90.8338	90.8775	90.9584	91.2000	91.2000	91.2000	91.2000	90.8818	90.8255	90.8003 (217)

Fuel for water heating, kWh/month

223.0891	196.3641	205.5916	183.3830	178.9457	158.6099	151.5148	167.3860	167.4482	190.1918	202.2645	217.4524 (219)

Water heating fuel used 2242.2414 (219)

Annual totals kWh/year

Space heating fuel - main system 4250.9483 (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) 406.1246 (232)

Total delivered energy for all uses 6974.3143 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4250.9483	3.4800	147.9330 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2242.2414	3.4800	78.0300 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	406.1246	13.1900	53.5678 (250)
Additional standing charges			120.0000 (251)
Total energy cost			409.4233 (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] = 1.1777 (257)

SAP value 83.5709

SAP rating (Section 12) 84 (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	4250.9483	0.2160	918.2048 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2242.2414	0.2160	484.3241 (264)
Space and water heating			1402.5290 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	406.1246	0.5190	210.7787 (268)
Total kg/year			1652.2326 (272)
CO2 emissions per m2			16.3600 (273)
EI value			84.8367
EI rating			85 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency 3.48 × (1 + 0.29 × 0.25) / 0.9070 = 4.115, stars = 4

Main heating environmental impact 0.216 × (1 + 0.29 × 0.25) / 0.9070 = 0.2554, stars = 4

Water heating energy efficiency 3.48 / 0.9097 = 3.826, stars = 4

Water heating environmental impact 0.216 / 0.9097 = 0.2375, stars = 4

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	2.7300 (1b)	x	3.8500 (2b)	=	10.5105 (1b) - (3b)	
First floor	67.4500 (1c)	x	3.0000 (2c)	=	202.3500 (1c) - (3c)	
Second floor	30.8300 (1d)	x	3.1200 (2d)	=	96.1896 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	101.0100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		309.0501 (5)	

2. Ventilation rate

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

		Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0971 (8)
Pressure test		Yes
Measured/design q50		5.0000
Infiltration rate		0.3471 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3210 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.6000	4.5000	4.4000	4.1000	4.1000	3.7000	3.8000	3.7000	3.7000	4.0000	3.9000	4.3000	(22)
Wind factor	1.1500	1.1250	1.1000	1.0250	1.0250	0.9250	0.9500	0.9250	0.9250	1.0000	0.9750	1.0750	(22a)
Adj infilt rate	0.3692	0.3612	0.3531	0.3291	0.3291	0.2970	0.3050	0.2970	0.2970	0.3210	0.3130	0.3451	(22b)
Effective ac	0.5682	0.5652	0.5624	0.5541	0.5541	0.5441	0.5465	0.5441	0.5441	0.5515	0.5490	0.5596	(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	
Windows (Uw = 1.20)			25.6100	1.1450	29.3244			(27)
Doors			1.9300	1.2000	2.3160			(26)
Rooflight (Uw = 1.20)			0.9700	1.1450	1.1107			(27a)
External Wall 1	149.4700	27.5400	121.9300	0.1700	20.7281			(29a)
External Roof 1	67.4500	0.9700	66.4800	0.1000	6.6480			(30)
Total net area of external elements Aum(A, m2)			216.9200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.1272			(33)
Party Wall 1			39.6900	0.0000	0.0000			(32)
Party Floor 1			67.4500					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.9977 (36)
Total fabric heat loss	(33) + (36) =	70.1249 (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	57.9440	57.6451	57.3527	56.5151	56.5151	55.4902	55.7366	55.4902	55.4902	56.2490	55.9895	57.0669	(38)
Heat transfer coeff	128.0689	127.7700	127.4776	126.6400	126.6400	125.6151	125.8615	125.6151	125.6151	126.3739	126.1144	127.1919	(39)
Average = Sum(39)m / 12 =												126.5820	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2679	1.2649	1.2620	1.2537	1.2537	1.2436	1.2460	1.2436	1.2436	1.2511	1.2485	1.2592	(40)
HLP (average)												1.2532	(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	2.7487 (42)
Average daily hot water use (litres/day)	99.4812 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.4293	105.4500	101.4708	97.4915	93.5123	89.5331	89.5331	93.5123	97.4915	101.4708	105.4500	109.4293	(44)
Energy conte	162.2805	141.9315	146.4606	127.6879	122.5196	105.7251	97.9699	112.4218	113.7645	132.5816	144.7232	157.1600	(45)
Energy content (annual)										Total = Sum(45)m =		1565.2262	(45)
Distribution loss (46)m = 0.15 x (45)m	24.3421	21.2897	21.9691	19.1532	18.3779	15.8588	14.6955	16.8633	17.0647	19.8872	21.7085	23.5740	(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	40.2936	36.3942	40.2861	38.9659	40.2465	38.9272	40.2116	40.2342	38.9483	40.2682	38.9846	40.2874	(61)
Total heat required for water heating calculated for each month	202.5740	178.3258	186.7467	166.6539	162.7661	144.6523	138.1815	152.6561	152.7128	172.8498	183.7078	197.4473	(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

	202.5740	178.3258	186.7467	166.6539	162.7661	144.6523	138.1815	152.6561	152.7128	172.8498	183.7078	197.4473 (64)

Total per year (kWh/year) = Sum(64)m = 2039.2741 (64)

Heat gains from water heating, kWh/month

	64.0316	56.2908	58.7697	52.1977	50.7994	44.8854	42.6279	47.4388	47.5638	54.1504	57.8666	62.3275 (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	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	164.9209	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	57.4911	51.0631	41.5273	31.4389	23.5009	19.8405	21.4383	27.8663	37.4021	47.4906	55.4285	59.0890 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	385.0005	388.9956	378.9280	357.4955	330.4407	305.0130	288.0258	284.0307	294.0982	315.5308	342.5856	368.0132 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	54.2408	54.2408	54.2408	54.2408	54.2408	54.2408	54.2408	54.2408	54.2408	54.2408	54.2408	54.2408 (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)

	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472	-109.9472 (71)

Water heating gains (Table 5)

	86.0640	83.7661	78.9915	72.4968	68.2788	62.3408	57.2955	63.7619	66.0608	72.7828	80.3703	83.7736 (72)

Total internal gains

	640.7700	636.0391	611.6613	573.6455	534.4348	499.4087	478.9740	487.8733	509.7755	548.0186	590.5988	623.0902 (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	12.6100	11.5821	0.6300	0.7000	0.7700	44.6347	(74)
Southeast	3.3500	39.1209	0.6300	0.7000	0.7700	40.0521	(77)
Southwest	6.3000	39.1209	0.6300	0.7000	0.7700	75.3219	(79)
Northwest	3.3500	12.4928	0.6300	0.7000	0.7700	12.7901	(81)
Horizontal	0.9700	29.0000	0.6300	0.7000	1.0000	11.1648	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	183.9637	297.8860	455.1962	664.5949	798.8382	881.7502	833.3915	725.2322	570.4159	372.9065	230.9575	152.4961	(83)
Total gains	824.7337	933.9251	1066.8574	1238.2404	1333.2730	1381.1589	1312.3655	1213.1055	1080.1914	920.9252	821.5563	775.5862	(84)

7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	21.9088	21.9600	22.0104	22.1560	22.1560	22.3367	22.2930	22.3367	22.3367	22.2026	22.2483	22.0599	
alpha	2.4606	2.4640	2.4674	2.4771	2.4771	2.4891	2.4862	2.4891	2.4891	2.4802	2.4832	2.4707	
util living area	0.9319	0.9083	0.8521	0.7469	0.5948	0.3963	0.2522	0.2896	0.5436	0.7867	0.8986	0.9393	(86)
MIT	19.2918	19.4796	19.8873	20.3248	20.6588	20.8372	20.8809	20.8758	20.7592	20.3467	19.7684	19.2542	(87)
Th 2	19.8661	19.8684	19.8707	19.8773	19.8773	19.8853	19.8834	19.8853	19.8853	19.8793	19.8814	19.8729	(88)
util rest of house	0.9214	0.8946	0.8295	0.7087	0.5339	0.3123	0.1507	0.1826	0.4583	0.7442	0.8806	0.9299	(89)
MIT 2	17.6191	17.8878	18.4651	19.0663	19.4919	19.6919	19.7226	19.7225	19.6226	19.1148	18.3149	17.5706	(90)

Living area fraction fLA = Living area / (4) = 0.3459 (91)

MIT	18.1977	18.4384	18.9570	19.5016	19.8955	20.0880	20.1233	20.1214	20.0158	19.5410	18.8177	18.1529	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1977	18.4384	18.9570	19.5016	19.8955	20.0880	20.1233	20.1214	20.0158	19.5410	18.8177	18.1529	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9017	0.8730	0.8078	0.6944	0.5350	0.3282	0.1730	0.2059	0.4690	0.7293	0.8595	0.9112	(94)
Useful gains	743.6836	815.3306	861.7869	859.8515	713.3074	453.3053	226.9980	249.8118	506.6357	671.6667	706.1145	706.7379	(95)
Ext temp.	5.2000	5.7000	7.7000	10.2000	13.3000	16.3000	18.3000	18.1000	15.5000	11.9000	8.2000	5.2000	(96)
Heat loss rate W	1664.6038	1627.5861	1435.0197	1177.9566	835.2564	475.8353	229.4838	253.9230	567.2508	965.6174	1339.0461	1647.5081	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	685.1646	545.8357	426.4853	229.0357	90.7300	0.0000	0.0000	0.0000	0.0000	218.6993	455.7107	699.9331	(98)

Space heating 3351.5943 (98)

Space heating per m2 (98) / (4) = 33.1808 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	93.1000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	3599.9939 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	685.1646	545.8357	426.4853	229.0357	90.7300	0.0000	0.0000	0.0000	0.0000	218.6993	455.7107	699.9331	(98)
Space heating efficiency (main heating system 1)	93.1000	93.1000	93.1000	93.1000	93.1000	0.0000	0.0000	0.0000	0.0000	93.1000	93.1000	93.1000	(210)

Space heating fuel (main heating system)

735.9448	586.2897	458.0937	246.0104	97.4544	0.0000	0.0000	0.0000	0.0000	234.9080	489.4852	751.8078 (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

202.5740	178.3258	186.7467	166.6539	162.7661	144.6523	138.1815	152.6561	152.7128	172.8498	183.7078	197.4473 (64)

Efficiency of water heater 91.2000 (216)

(217)m 90.8136	90.8226	90.8517	90.9099	91.0204	91.2000	91.2000	91.2000	91.2000	90.9200	90.8431	90.8095 (217)

Fuel for water heating, kWh/month

223.0657	196.3451	205.5512	183.3176	178.8238	158.6099	151.5148	167.3860	167.4482	190.1119	202.2254	217.4302 (219)

Water heating fuel used 2241.8298 (219)

Annual totals kWh/year

Space heating fuel - main system 3599.9939 (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) 406.1246 (232)

Total delivered energy for all uses 6322.9484 (238)

10a. Fuel costs - using BEDF prices (391)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3599.9939	4.3200	155.5197 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2241.8298	4.3200	96.8470 (247)
Pumps and fans for heating	75.0000	15.3200	11.4900 (249)
Energy for lighting	406.1246	15.3200	62.2183 (250)
Additional standing charges			95.0000 (251)
Total energy cost			421.0751 (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	3599.9939	0.2160	777.5987 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2241.8298	0.2160	484.2352 (264)
Space and water heating			1261.8339 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	406.1246	0.5190	210.7787 (268)
Total kg/year			1511.5376 (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	3599.9939	1.2200	4391.9926 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2241.8298	1.2200	2735.0324 (264)
Space and water heating			7127.0250 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	406.1246	3.0700	1246.8026 (268)
Primary energy kWh/year			8604.0776 (272)
Primary energy kWh/m2/year			85.1805 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 84

Current environmental impact rating: B 85

(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	Not applicable
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Not applicable
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
(none)			

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: B 84
Potential environmental impact rating: B 85

Fuel prices for cost data on this page from database revision number 391 TEST (01 Apr 2016)
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	£74	£74	£0
Mains gas	£347	£347	£0
Space heating	£262	£262	£0
Water heating	£97	£97	£0
Lighting	£62	£62	£0
Total cost of fuels	£421	£421	£0
Total cost of uses	£421	£421	£0
Delivered energy	63 kWh/m²	63 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.5 tonnes	1.5 tonnes	0.0 tonnes
CO2 emissions per m²	15 kg/m²	15 kg/m²	0 kg/m²
Primary energy	85 kWh/m²	85 kWh/m²	0 kWh/m²

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

No improvements selected / applicable

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

No improvements selected / applicable

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

Overheating Calculation Input Data

Dwelling type	EndTerrace Maisonette
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	Unknown
Overshading	Average or unknown
Thermal mass parameter	100.0
Night ventilation	No
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	815.89 (P1)
Transmission heat loss coefficient	70.12 (37)
Summer heat loss coefficient	886.02 (P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	0.000	0.00	0.000	0.000 (P8)
South East	0.000	0.00	0.000	0.000 (P8)
South West	0.000	0.00	0.000	0.000 (P8)
North West	0.000	0.00	0.000	0.000 (P8)
Horizontal	1.000	1.00	1.000	1.000 (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	12.6100	98.8453	0.6300	0.7000	0.0000	0.0000
South East	3.3500	117.5071	0.6300	0.7000	0.0000	0.0000
South West	6.3000	112.2060	0.6300	0.7000	0.0000	0.0000
North West	3.3500	117.5071	0.6300	0.7000	0.0000	445.2404
Horizontal	0.9700	203.0000	0.6300	0.7000	1.0000	78.1536
total:						1057.1355

	Jun	Jul	Aug	
Solar gains	1124	1057	927	(P3)
Internal gains	496	476	485	
Total summer gains	1621	1533	1412	(P5)
Summer gain/loss ratio	1.83	1.73	1.59	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	19.13	20.93	20.69	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

Full SAP Calculation Printout

Property Reference: 000016
Survey Reference: 001

Issued on Date: 19.Apr.2016
Prop Type Ref: Maisonette C

Property: 62a, Haverstock Hill, LONDON, NW3 2BH

SAP Rating:	82 B	**CO2 Emissions (t/year):**	1.81	**DER:**	(NW) 20.66 Pass	**TER:**	21.15	**Percentage DER<TER:**	2.33 %
Environmental:	82 B	**General Requirements Compliance:**	Pass	**DFEE:**	64.02 Pass	**TFEE:**	75.07	**Percentage DFEE<TFEE:**	14.73 %

CfSH Results **Version:** **ENE1 Credits:** N/A **ENE2 Credits:** N/A **ENE7 Credits:** N/A **CfSH Level:** N/A

Surveyor: Paul Parker, Tel: 020 8099 6601 Surveyor ID: V556-0001
Address: New Road, West Molesey, KT8 1PX
Client:

Software Version: Elmhurst Energy Systems SAP2012 Calculator (Design System) version 3.05r04
SAP version: SAP 2012, Regs Region: England (Part L1A 2013), Calculation Type: New Build (As Designed)

CALCULATION DETAILS for survey reference no '001'
SAP2012 - 9.92 input data (DesignData) -


```
SAP2012 Input Data (Maisonette)     19/04/2016

FullRefNo:                    001

Regs Region:                  England
SAP Region:                   Thames Valley
Postcode:                     NW3 2BH
DwellingOrientation:          Unknown
Property Type:                Maisonette, Semi-Detached
Storeys:                      3
Date Built:                   2016
Sheltered Sides:              1
Sunlight Shade:               Average or unknown
Measurements                  Perimeter, Floor Area, Storey Height
    Basement:                30.78, 41.82, 2.8
    1st Storey:              29.05, 36.7, 3.7
    2nd Storey:              24.78, 26.86, 3.12
Living Area:                  22.24 m2, fraction: 21.1%
Thermal Mass:                 Simple calculation
Thermal Mass Simple:          Low
Thermal MassValue:            100
External Walls                Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1               120.09, 150.15, 0, Other, SteelFrame, 0, 0.17, Gross
Basement wall                 98.61, 98.61, 17, SolidWallDensePlasterInsul, Solid, 0, 0.17, Gross
Party Walls                   Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1                  39.69, 70, PartyWallSinglePlaster, Solid, 0, 0
External Roofs                Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
    External Roof 1          42.53, 43.5, 9, Plasterboard, insulated flat roof, 0.1
Party Ceilings                Area, Kappa, Construction, Element
    Party Ceilings 1         59.7, 40, Precast concrete planks floor, screed, carpeted
Heat Loss Floors              Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
    Heat Loss Floor 1        41.82, 110, Slab on ground, screed over insulation, Basement Floor, 0, 0.1
Description                   Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
    Windows                  Manufacturer, Window, Double Low-E Soft 0.05, , , 0.63, , 0.7,
    Doors                    Manufacturer, Solid Door, , , , , , ,
    Rooflight                Manufacturer, Roof Window, Double Low-E Soft 0.05, , , 0.63, , 0.7,
Openings                      Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
    Opening 1                Window, External Wall 1, East, , Light-coloured curtain or roller blind, 0, , 0, 0, 0, 20.80, 0
    Opening 2                Window, External Wall 1, North, , Light-coloured curtain or roller blind, 0, , 0, 0, 0, 7.37, 0
    Opening 3                Solid Door, External Wall 1, North East, , , , , 0, 0, 0, 1.89,
    Opening 4                Roof Window, External Roof 1, Horizontal, 0, None, , , 0, 0, 0, 0.97,
Conservatory:                 None
Draught Proofing:             100
Draught Lobby:                Yes
Thermal Bridges
    Bridging:                Calculate Bridges
    Y                        0.057
    List of Bridges          Junction with, Bridge Type, Source Type, Imported, Length, Psi, Adjusted, Result, Reference
    0.                       External wall, E1 Steel lintel with perforated steel base plate, Table K1 - Approved, Yes, 12.36, 0.5, 0.5, 6.18,
    1.                       External wall, E3 Sill, Table K1 - Approved, Yes, 11.46, 0.04, 0.04, 0.46,
    2.                       External wall, E4 Jamb, Table K1 - Approved, Yes, 28.36, 0.05, 0.05, 1.42,
    3.                       External wall, E5 Ground floor (normal), Table K1 - Approved, Yes, 30.78, 0.16, 0.16, 4.92,
    4.                       External wall, E6 Intermediate floor within a dwelling, Table K1 - Approved, Yes, 53.83, 0.07, 0.07, 3.77,
    5.                       External wall, E16 Corner (normal), Table K1 - Approved, No, 11.1, 0.09, 0.09, 1.00,
    6.                       External wall, E18 Party wall between dwellings, Table K1 - Approved, Yes, 19.24, 0.06, 0.06, 1.15,
Pressure Test:                True
Designed q50:                 5
AsBuilt q50:                  15
Property Tested:              False
Mechanical Ventilation        None
Chimneys MHS:                 0
Chimneys SHS:                 0
Chimneys Other:               0
Chimneys Total:               0
Open Flues MHS:               0
Open Flues SHS:               0
Open Flues Other:             0
Open Flues Total:             0
Intermittent Fans:            4
Passive Vents:                0
Flueless Gas Fires:           0
Cooling System                None
Light Fittings:               11
LEL Fittings:                 11
Percentage of LEL Fittings:   100
External Lights Fitted:       No
External LELs Fitted:         No
Electricity Tariff:           Standard
Main Heating 1
```

Description	
Percentage	100
Sedbuk ID	17117
Fuel Type	Mains gas
MHS	Mains gas BGW Post 98 Combi condens. with auto ign.
SAP Code	104
Boiler Efficiency Type	Split Efficiences
Efficiency Winter	90.7
Efficiency Summer	91.2
Controls by PCDF	0
MHS Controls	CBI Time and temperature zone control
Boiler Interlock	Yes
Compensator	0
Delayed Start Stat	No
Ctrl SAP Code	2110
Flue Type	Balanced
Fan Assisted Flue	Yes
Pumped	Pump in heated space
Heat Pump Age	2013 or later
Heat Emitter	Underfloor
Flow Temperature	36° - 45°C
Under Floor Heating	Yes - Pipes in thin screed
Combi boiler type	Standard Combi
Combi keep hot type	Gas/Oil, time clock
Main Heating 2	None
Heating Systems Interaction	Each system heats separate parts of dwelling
Smoke Control Area	Unknown
Community Heating	None
Secondary Heating	None
Water Heating	
Type	MainHeating1
WHS	HWP From main heating 1
Low Water Usage	Yes
SAP Code	901
Showers in Property	Non-electric only
Hot Water Cylinder	None
Flue Gas Heat Recovery System	None
Waste Water Heat Recovery	none
PV Unit	None
Wind Turbine	None
Terrain Type:	Urban
Small Scale Hydro	None
Special Features	None

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

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DWELLING AS DESIGNED

Semi-Detached Maisonette, total floor area 105 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) 21.15 kg/m²
Dwelling 'CO2' Emission Rate (DERs)
DER (N):20.10
DER (NE):19.30
DER (E):18.74
DER (SE):18.86
DER (S):19.43
DER (SW):20.15
DER (W):20.62
DER (NW)20.66 (highest value)
Dwelling Carbon Dioxide Emission Rate (DER)(NW) 20.66 kg/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)75.1 kWh/m²
Dwelling Fabric Energy Efficiency (DFEEs)
DFEE (N):61.91
DFEE (NE):58.60
DFEE (E):56.19
DFEE (SE):56.88
DFEE (S):59.27
DFEE (SW):62.00
DFEE (W):63.62
DFEE (NW)64.02 (highest value)
Dwelling Fabric Energy Efficiency (DFEE)64.0 kWh/m²OK

---

2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.17 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.10 (max. 0.25)	0.10 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (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
Worcester Greenstar 25 Si Compact
Combi boiler
Efficiency: 89.8% 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):	Slight	OK

Based on:

Overshading:	Average
Orientation unspecified	
Air change rate:	8.00 ach
Blinds/curtains:	Light-coloured curtain or roller blind, closed 0% of daylight hours

---

10 Key features

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	41.8200 (1a)	x	2.8000 (2a)	=	117.0960 (1a) - (3a)	
Ground floor	36.7000 (1b)	x	3.7000 (2b)	=	135.7900 (1b) - (3b)	
First floor	26.8600 (1c)	x	3.1200 (2c)	=	83.8032 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.3800				(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	336.6892 (5)	

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans							4 * 10 =	40.0000 (7a)
Number of passive vents							0 * 10 =	0.0000 (7b)
Number of flueless gas fires							0 * 40 =	0.0000 (7c)

		Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1188 (8)
Pressure test		Yes
Measured/design q50		5.0000
Infiltration rate		0.3688 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3411 (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	0.4350	0.4264	0.4179	0.3753	0.3667	0.3241	0.3241	0.3156	0.3411	0.3667	0.3838	0.4008	(22b)
Effective ac	0.5946	0.5909	0.5873	0.5704	0.5672	0.5525	0.5525	0.5498	0.5582	0.5672	0.5736	0.5803	(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	
Windows (Uw = 1.20)			28.1700	1.1450	32.2557			(27)
Doors			1.8900	1.2000	2.2680			(26)
Rooflight (Uw = 1.20)			0.9700	1.1450	1.1107			(27a)
Heat Loss Floor 1			41.8200	0.1000	4.1820			(28)
External Wall 1	150.1500	30.0600	120.0900	0.1700	20.4153			(29a)
Basement wall	98.6100		98.6100	0.1700	16.7637			(29a)
External Roof 1	43.5000	0.9700	42.5300	0.1000	4.2530			(30)
Total net area of external elements Aum(A, m2)			334.0800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		81.2484			(33)
Party Wall 1			39.6900	0.0000	0.0000			(32)
Party Ceilings 1			59.7000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	18.9027 (36)
Total fabric heat loss (33) + (36) =	100.1511 (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	66.0638	65.6557	65.2557	63.3767	63.0252	61.3886	61.3886	61.0856	62.0190	63.0252	63.7363	64.4799	(38)
Heat transfer coeff	166.2150	165.8068	165.4068	163.5278	163.1763	161.5397	161.5397	161.2367	162.1701	163.1763	163.8875	164.6310	(39)

Average = Sum(39)m / 12 = 163.5261 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5773	1.5734	1.5696	1.5518	1.5485	1.5329	1.5329	1.5301	1.5389	1.5485	1.5552	1.5623	(40)
HLP (average)												1.5518	(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	2.7841 (42)
Average daily hot water use (litres/day)	100.3215 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.3536	106.3407	102.3279	98.3150	94.3022	90.2893	90.2893	94.3022	98.3150	102.3279	106.3407	110.3536	(44)
Energy conte	163.6512	143.1304	147.6977	128.7665	123.5545	106.6181	98.7974	113.3714	114.7254	133.7014	145.9456	158.4874	(45)
Energy content (annual)										Total = Sum(45)m =		1578.4471	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5477	21.4696	22.1547	19.3150	18.5332	15.9927	14.8196	17.0057	17.2088	20.0552	21.8918	23.7731	(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	40.2937	36.3944	40.2864	38.9687	40.2490	38.9292	40.2135	40.2366	38.9507	40.2685	38.9849	40.2875	(61)
Total heat required for water heating calculated for each month	203.9449	179.5248	187.9842	167.7351	163.8035	145.5474	139.0109	153.6080	153.6762	173.9700	184.9304	198.7750	(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	203.9449	179.5248	187.9842	167.7351	163.8035	145.5474	139.0109	153.6080	153.6762	173.9700	184.9304	198.7750	(64)
Total per year (kWh/year) = Sum(64)m =												2052.5104	(64)
Heat gains from water heating, kWh/month	64.4874	56.6895	59.1811	52.5570	51.1441	45.1828	42.9035	47.7551	47.8839	54.5229	58.2731	62.7690	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.6021	20.9632	17.0484	12.9067	9.6479	8.1452	8.8012	11.4401	15.3549	19.4965	22.7553	24.2580	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	264.7435	267.4907	260.5678	245.8298	227.2258	209.7406	198.0594	195.3122	202.2350	216.9730	235.5771	253.0623	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	(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)													
	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	(71)
Water heating gains (Table 5)													
	86.6767	84.3593	79.5445	72.9959	68.7421	62.7539	57.6660	64.1870	66.5054	73.2834	80.9349	84.3669	(72)
Total internal gains													
	442.7831	440.5741	424.9216	399.4933	373.3767	348.4006	332.2875	338.7002	351.8562	377.5139	407.0282	429.4481	(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	20.8000	11.2829	0.6300	0.7000	0.7700	71.7228	(75)
Northwest	7.3700	11.2829	0.6300	0.7000	0.7700	25.4133	(81)
Horizontal	0.9700	26.0000	0.6300	0.7000	1.0000	10.0098	(82)

Solar gains	107.1460	218.5131	393.1942	642.7889	860.3272	915.3933	857.0647	685.6978	478.3519	267.0433	134.9272	87.4111	(83)
Total gains	549.9291	659.0872	818.1158	1042.2822	1233.7039	1263.7939	1189.3522	1024.3980	830.2082	644.5572	541.9554	516.8593	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	17.6111	17.6544	17.6971	17.9005	17.9390	18.1208	18.1208	18.1548	18.0503	17.9390	17.8612	17.7805	
alpha	2.1741	2.1770	2.1798	2.1934	2.1959	2.2081	2.2081	2.2103	2.2034	2.1959	2.1907	2.1854	
util living area	0.9761	0.9637	0.9347	0.8668	0.7548	0.6169	0.5021	0.5724	0.7828	0.9225	0.9669	0.9791	(86)
MIT	18.3975	18.6217	19.0640	19.6782	20.2233	20.5937	20.7516	20.7047	20.3533	19.6467	18.9225	18.3637	(87)
Th 2	19.6300	19.6329	19.6357	19.6489	19.6514	19.6629	19.6629	19.6650	19.6584	19.6514	19.6464	19.6411	(88)
util rest of house	0.9718	0.9572	0.9224	0.8406	0.7042	0.5311	0.3787	0.4489	0.7156	0.9018	0.9598	0.9753	(89)
MIT 2	16.1923	16.5180	17.1563	18.0325	18.7735	19.2452	19.4133	19.3789	18.9778	18.0106	16.9648	16.1487	(90)
Living area fraction									fLA = Living area / (4) =			0.2110	(91)
MIT	16.6577	16.9620	17.5589	18.3799	19.0795	19.5298	19.6958	19.6587	19.2681	18.3559	17.3779	16.6162	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.6577	16.9620	17.5589	18.3799	19.0795	19.5298	19.6958	19.6587	19.2681	18.3559	17.3779	16.6162	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9576	0.9384	0.8963	0.8091	0.6787	0.5213	0.3821	0.4482	0.6911	0.8739	0.9419	0.9625	(94)
Useful gains	526.6250	618.4611	733.2755	843.3035	837.3576	658.8716	454.4715	459.1469	573.7392	563.2686	510.4598	497.4812	(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	2054.0301	1999.9639	1829.2170	1550.2202	1204.1556	796.3636	500.0911	525.4284	838.1096	1265.5828	1684.4258	2044.0856	(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	1136.3894	928.3698	815.3805	508.9800	272.8978	0.0000	0.0000	0.0000	0.0000	522.5218	845.2556	1150.6737	(98)
Space heating												6180.4685	(98)
Space heating per m2											(98) / (4) =	58.6493	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.1000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6638.5269	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1136.3894	928.3698	815.3805	508.9800	272.8978	0.0000	0.0000	0.0000	0.0000	522.5218	845.2556	1150.6737	(98)
Space heating efficiency (main heating system 1)	93.1000	93.1000	93.1000	93.1000	93.1000	0.0000	0.0000	0.0000	0.0000	93.1000	93.1000	93.1000	(210)

Space heating fuel (main heating system)

1220.6116	997.1749	875.8115	546.7025	293.1233	0.0000	0.0000	0.0000	0.0000	561.2479	907.9007	1235.9546 (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

203.9449	179.5248	187.9842	167.7351	163.8035	145.5474	139.0109	153.6080	153.6762	173.9700	184.9304	198.7750 (64)

Efficiency of water heater 91.2000 (216)

(217)m	90.7757	90.7806	90.7933	90.8234	90.8869	91.2000	91.2000	91.2000	91.2000	90.8244	90.7894	90.7733 (217)

Fuel for water heating, kWh/month

224.6690	197.7567	207.0464	184.6827	180.2279	159.5914	152.4242	168.4298	168.5046	191.5455	203.6918	218.9795 (219)

Water heating fuel used 2257.5495 (219)

Annual totals kWh/year

Space heating fuel - main system 6638.5269 (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) 416.8200 (232)

Total delivered energy for all uses 9387.8963 (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	6638.5269	0.2160	1433.9218	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2257.5495	0.2160	487.6307	(264)
Space and water heating			1921.5525	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.8200	0.5190	216.3296	(268)
Total CO2, kg/year			2176.8071	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			20.6600	(273)

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

DER		20.6600	ZC1
Total Floor Area	TFA	105.3800	
Assumed number of occupants	N	2.7841	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.8872	ZC2
CO2 emissions from cooking, equation (L16)		1.7633	ZC3
Total CO2 emissions		37.3105	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		37.3105	ZC8

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	41.8200 (1a)	x	2.8000 (2a)	=	117.0960 (1a) - (3a)	
Ground floor	36.7000 (1b)	x	3.7000 (2b)	=	135.7900 (1b) - (3b)	
First floor	26.8600 (1c)	x	3.1200 (2c)	=	83.8032 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.3800				(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		336.6892 (5)	

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans							4 * 10 =	40.0000 (7a)
Number of passive vents							0 * 10 =	0.0000 (7b)
Number of flueless gas fires							0 * 40 =	0.0000 (7c)

		Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1188 (8)
Pressure test		Yes
Measured/design q50		5.0000
Infiltration rate		0.3688 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3411 (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	0.4350	0.4264	0.4179	0.3753	0.3667	0.3241	0.3241	0.3156	0.3411	0.3667	0.3838	0.4008	(22b)
Effective ac	0.5946	0.5909	0.5873	0.5704	0.5672	0.5525	0.5525	0.5498	0.5582	0.5672	0.5736	0.5803	(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			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.40)			23.6300	1.3258	31.3277			(27)
TER Room Window (Uw = 1.70)			0.8100	1.5918	1.2893			(27a)
Heat Loss Floor 1			41.8200	0.1300	5.4366			(28)
External Wall 1	150.1500	25.5200	124.6300	0.1800	22.4334			(29a)
Basement wall	98.6100		98.6100	0.1800	17.7498			(29a)
External Roof 1	43.5000	0.8100	42.6900	0.1300	5.5497			(30)
Total net area of external elements Aum(A, m2)			334.0800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		85.6765			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.6872	(36)
Total fabric heat loss					(33) + (36) =		95.3637	(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	66.0638	65.6557	65.2557	63.3767	63.0252	61.3886	61.3886	61.0856	62.0190	63.0252	63.7363	64.4799	(38)
Heat transfer coeff	161.4275	161.0194	160.6194	158.7404	158.3888	156.7523	156.7523	156.4493	157.3827	158.3888	159.1000	159.8435	(39)
Average = Sum(39)m / 12 =												158.7387	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5319	1.5280	1.5242	1.5064	1.5030	1.4875	1.4875	1.4846	1.4935	1.5030	1.5098	1.5168	(40)
HLP (average)												1.5063	(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		2.7841 (42)
Average daily hot water use (litres/day)		100.3215 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.3536	106.3407	102.3279	98.3150	94.3022	90.2893	90.2893	94.3022	98.3150	102.3279	106.3407	110.3536	(44)
Energy conte	163.6512	143.1304	147.6977	128.7665	123.5545	106.6181	98.7974	113.3714	114.7254	133.7014	145.9456	158.4874	(45)
Energy content (annual)										Total = Sum(45)m =		1578.4471	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5477	21.4696	22.1547	19.3150	18.5332	15.9927	14.8196	17.0057	17.2088	20.0552	21.8918	23.7731	(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	50.9589	46.0274	50.9589	48.4841	48.0554	44.5262	46.0104	48.0554	48.4841	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	214.6101	189.1578	198.6566	177.2506	171.6098	151.1444	144.8078	161.4268	163.2096	184.6603	195.2606	209.4464	(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
214.6101 189.1578 198.6566 177.2506 171.6098 151.1444 144.8078 161.4268 163.2096 184.6603 195.2606 209.4464 (64)
Total per year (kWh/year) = Sum(64)m = 2161.2408 (64)
Heat gains from water heating, kWh/month
67.1538 59.0977 61.8492 54.9359 53.0957 46.5821 44.3527 49.7098 50.2672 57.1955 60.8557 65.4368 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.6021	20.9632	17.0484	12.9067	9.6479	8.1452	8.8012	11.4401	15.3549	19.4965	22.7553	24.2580	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	264.7435	267.4907	260.5678	245.8298	227.2258	209.7406	198.0594	195.3122	202.2350	216.9730	235.5771	253.0623	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	(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)													
	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	(71)
Water heating gains (Table 5)													
	90.2604	87.9430	83.1307	76.2998	71.3652	64.6973	59.6139	66.8143	69.8156	76.8756	84.5218	87.9527	(72)
Total internal gains													
	446.3669	444.1578	428.5078	402.7973	375.9998	350.3440	334.2354	341.3275	355.1664	381.1061	410.6151	433.0340	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.1800	10.6334	0.6300	0.7000	0.7700	20.0832	(74)
East	17.4500	19.6403	0.6300	0.7000	0.7700	104.7405	(76)
Horizontal	0.8100	26.0000	0.6300	0.7000	1.0000	8.3587	(82)

Solar gains	133.1824	260.6350	433.5121	645.1032	805.9580	832.7633	789.5903	667.2729	507.8308	310.0293	165.9834	109.6271	(83)
Total gains	579.5492	704.7927	862.0199	1047.9005	1181.9578	1183.1073	1123.8256	1008.6004	862.9972	691.1354	576.5985	542.6610	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	45.3334	45.4483	45.5615	46.1008	46.2031	46.6855	46.6855	46.7759	46.4985	46.2031	45.9966	45.7826	
alpha	4.0222	4.0299	4.0374	4.0734	4.0802	4.1124	4.1124	4.1184	4.0999	4.0802	4.0664	4.0522	
util living area													
	0.9984	0.9962	0.9885	0.9596	0.8805	0.7331	0.5790	0.6516	0.8841	0.9830	0.9969	0.9988	(86)
MIT	19.2358	19.4238	19.7678	20.2341	20.6380	20.8859	20.9673	20.9475	20.7291	20.1896	19.6311	19.2094	(87)
Th 2	19.6637	19.6666	19.6694	19.6827	19.6852	19.6969	19.6969	19.6991	19.6924	19.6852	19.6802	19.6749	(88)
util rest of house													
	0.9978	0.9948	0.9840	0.9427	0.8294	0.6249	0.4241	0.4954	0.8117	0.9733	0.9955	0.9983	(89)
MIT 2	17.3426	17.6190	18.1211	18.7955	19.3363	19.6236	19.6860	19.6788	19.4717	18.7454	17.9314	17.3112	(90)
Living area fraction									fLA = Living area / (4) =			0.2110	(91)
MIT	17.7422	17.9999	18.4686	19.0991	19.6110	19.8900	19.9564	19.9465	19.7371	19.0502	18.2901	17.7118	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7422	17.9999	18.4686	19.0991	19.6110	19.8900	19.9564	19.9465	19.7371	19.0502	18.2901	17.7118	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9964	0.9919	0.9780	0.9326	0.8259	0.6428	0.4569	0.5280	0.8149	0.9662	0.9931	0.9972	(94)
Useful gains	577.4476	699.1090	843.0307	977.2971	976.1486	760.5462	513.5216	532.5028	703.2272	667.7831	572.6056	541.1529	(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													
	2169.9346	2109.3435	1922.3916	1619.0147	1253.0171	829.2152	526.1241	554.8518	887.1827	1338.4103	1780.3486	2159.7781	(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													
	1184.8103	947.6776	803.0445	462.0366	205.9901	0.0000	0.0000	0.0000	0.0000	498.9466	869.5749	1204.2572	(98)
Space heating												6176.3379	(98)
Space heating per m2											(98) / (4) =	58.6102	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 93.4000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 6612.7815 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1184.8103	947.6776	803.0445	462.0366	205.9901	0.0000	0.0000	0.0000	0.0000	498.9466	869.5749	1204.2572	(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)													
	1268.5335	1014.6441	859.7907	494.6859	220.5462	0.0000	0.0000	0.0000	0.0000	534.2041	931.0224	1289.3546	(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

214.6101	189.1578	198.6566	177.2506	171.6098	151.1444	144.8078	161.4268	163.2096	184.6603	195.2606	209.4464 (64)

Efficiency of water heater 80.3000 (216)

(217)m 88.6893	88.5469	88.1999	87.3537	85.5119	80.3000	80.3000	80.3000	80.3000	87.4295	88.3620	88.7462 (217)

Fuel for water heating, kWh/month

241.9798	213.6245	225.2345	202.9115	200.6854	188.2246	180.3335	201.0296	203.2498	211.2106	220.9781	236.0059 (219)

Water heating fuel used 2525.4676 (219)
Annual totals kWh/year
Space heating fuel - main system 6612.7815 (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) 416.8200 (232)
Total delivered energy for all uses 9630.0691 (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	6612.7815	0.2160	1428.3608 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2525.4676	0.2160	545.5010 (264)
Space and water heating			1973.8618 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	416.8200	0.5190	216.3296 (268)
Total CO2, kg/m2/year			2229.1164 (272)
Emissions per m2 for space and water heating			18.7309 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.0529 (272b)
Emissions per m2 for pumps and fans			0.3694 (272c)
Target Carbon Dioxide Emission Rate (TER) = (18.7309 * 1.00) + 2.0529 + 0.3694, rounded to 2 d.p.			21.1500 (273)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	41.8200 (1a)	x	2.8000 (2a)	=	117.0960 (1a) - (3a)	
Ground floor	36.7000 (1b)	x	3.7000 (2b)	=	135.7900 (1b) - (3b)	
First floor	26.8600 (1c)	x	3.1200 (2c)	=	83.8032 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.3800				(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	336.6892 (5)	

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1188	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3688	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3411	(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	0.4350	0.4264	0.4179	0.3753	0.3667	0.3241	0.3241	0.3156	0.3411	0.3667	0.3838	0.4008	(22b)
Effective ac	0.5946	0.5909	0.5873	0.5704	0.5672	0.5525	0.5525	0.5498	0.5582	0.5672	0.5736	0.5803	(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	
Windows (Uw = 1.20)			28.1700	1.1450	32.2557			(27)
Doors			1.8900	1.2000	2.2680			(26)
Rooflight (Uw = 1.20)			0.9700	1.1450	1.1107			(27a)
Heat Loss Floor 1			41.8200	0.1000	4.1820			(28)
External Wall 1	150.1500	30.0600	120.0900	0.1700	20.4153			(29a)
Basement wall	98.6100		98.6100	0.1700	16.7637			(29a)
External Roof 1	43.5000	0.9700	42.5300	0.1000	4.2530			(30)
Total net area of external elements Aum(A, m2)			334.0800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		81.2484			(33)
Party Wall 1			39.6900	0.0000	0.0000			(32)
Party Ceilings 1			59.7000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		18.9027 (36)
Total fabric heat loss	(33) + (36) =	100.1511 (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	66.0638	65.6557	65.2557	63.3767	63.0252	61.3886	61.3886	61.0856	62.0190	63.0252	63.7363	64.4799	(38)
Heat transfer coeff	166.2150	165.8068	165.4068	163.5278	163.1763	161.5397	161.5397	161.2367	162.1701	163.1763	163.8875	164.6310	(39)

Average = Sum(39)m / 12 = 163.5261 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5773	1.5734	1.5696	1.5518	1.5485	1.5329	1.5329	1.5301	1.5389	1.5485	1.5552	1.5623	(40)
HLP (average)												1.5518	(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	2.7841 (42)
Average daily hot water use (litres/day)	100.3215 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.3536	106.3407	102.3279	98.3150	94.3022	90.2893	90.2893	94.3022	98.3150	102.3279	106.3407	110.3536	(44)
Energy conte	163.6512	143.1304	147.6977	128.7665	123.5545	106.6181	98.7974	113.3714	114.7254	133.7014	145.9456	158.4874	(45)
Energy content (annual)										Total = Sum(45)m =		1578.4471	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.7759	30.4152	31.3858	27.3629	26.2553	22.6564	20.9944	24.0914	24.3792	28.4116	31.0134	33.6786	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	23.6021	20.9632	17.0484	12.9067	9.6479	8.1452	8.8012	11.4401	15.3549	19.4965	22.7553	24.2580	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	264.7435	267.4907	260.5678	245.8298	227.2258	209.7406	198.0594	195.3122	202.2350	216.9730	235.5771	253.0623	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	(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)

	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	(71)

Water heating gains (Table 5)

	46.7418	45.2607	42.1852	38.0040	35.2894	31.4672	28.2183	32.3810	33.8599	38.1876	43.0742	45.2669	(72)

Total internal gains

	399.8482	398.4755	384.5623	361.5015	336.9240	314.1138	299.8398	303.8941	316.2108	339.4180	366.1675	387.3482	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	20.8000	11.2829	0.6300	0.7000	0.7700	71.7228	(75)
Northwest	7.3700	11.2829	0.6300	0.7000	0.7700	25.4133	(81)
Horizontal	0.9700	26.0000	0.6300	0.7000	1.0000	10.0098	(82)

Solar gains	107.1460	218.5131	393.1942	642.7889	860.3272	915.3933	857.0647	685.6978	478.3519	267.0433	134.9272	87.4111	(83)
Total gains	506.9942	616.9886	777.7565	1004.2904	1197.2512	1229.5071	1156.9045	989.5919	794.5627	606.4614	501.0948	474.7593	(84)

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7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	17.6111	17.6544	17.6971	17.9005	17.9390	18.1208	18.1208	18.1548	18.0503	17.9390	17.8612	17.7805	
alpha	2.1741	2.1770	2.1798	2.1934	2.1959	2.2081	2.2081	2.2103	2.2034	2.1959	2.1907	2.1854	
util living area													
	0.9796	0.9680	0.9403	0.8743	0.7639	0.6269	0.5121	0.5851	0.7953	0.9303	0.9715	0.9823	(86)
MIT	17.6343	17.9363	18.5325	19.3621	20.1018	20.6062	20.8230	20.7563	20.2723	19.3124	18.3371	17.5889	(87)
Th 2	19.6300	19.6329	19.6357	19.6489	19.6514	19.6629	19.6629	19.6650	19.6584	19.6514	19.6464	19.6411	(88)
util rest of house													
	0.9759	0.9621	0.9289	0.8492	0.7142	0.5411	0.3875	0.4609	0.7300	0.9114	0.9653	0.9791	(89)
MIT 2	16.5979	16.8989	17.4890	18.3022	18.9924	19.4345	19.5934	19.5597	19.1783	18.2745	17.3086	16.5596	(90)
Living area fraction									fLA = Living area / (4) =			0.2110	(91)
MIT	16.8166	17.1179	17.7093	18.5259	19.2265	19.6818	19.8529	19.8122	19.4092	18.4936	17.5257	16.7768	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.8166	17.1179	17.7093	18.5259	19.2265	19.6818	19.8529	19.8122	19.4092	18.4936	17.5257	16.7768	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9645	0.9465	0.9067	0.8227	0.6958	0.5425	0.4071	0.4764	0.7150	0.8888	0.9509	0.9689	(94)
Useful gains	488.9805	583.9835	705.2173	826.2296	833.0614	666.9767	470.9242	471.4815	568.0834	539.0041	476.4994	459.9824	(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													
	2080.4471	2025.8064	1854.0876	1574.0992	1228.1529	820.9168	525.4685	550.1733	860.9892	1288.0401	1708.6394	2070.5374	(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													
	1184.0512	968.9050	854.7595	538.4661	293.9481	0.0000	0.0000	0.0000	0.0000	557.2828	887.1408	1198.2530	(98)
Space heating												6482.8062	(98)
Space heating per m2											(98) / (4) =	61.5184	(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	1518.4736	1195.3941	1225.3988	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6913	0.7508	0.6964	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1049.7626	897.4469	853.3533	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1531.9858	1445.4811	1253.9216	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	347.2007	407.7374	298.0228	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1052.9609	(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	86.8002	101.9344	74.5057	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												263.2402	(107)
Space cooling per m2												2.4980	(108)
Energy for space heating												61.5184	(99)
Energy for space cooling												2.4980	(108)
Total												64.0164	(109)
Dwelling Fabric Energy Efficiency (DFEE)												64.0	(109)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	41.8200 (1a)	x	2.8000 (2a)	=	117.0960 (1a) - (3a)	
Ground floor	36.7000 (1b)	x	3.7000 (2b)	=	135.7900 (1b) - (3b)	
First floor	26.8600 (1c)	x	3.1200 (2c)	=	83.8032 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.3800				(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		336.6892 (5)	

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans							4 * 10 =	40.0000 (7a)
Number of passive vents							0 * 10 =	0.0000 (7b)
Number of flueless gas fires							0 * 40 =	0.0000 (7c)

		Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1188 (8)
Pressure test		Yes
Measured/design q50		5.0000
Infiltration rate		0.3688 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3411 (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	0.4350	0.4264	0.4179	0.3753	0.3667	0.3241	0.3241	0.3156	0.3411	0.3667	0.3838	0.4008	(22b)
Effective ac	0.5946	0.5909	0.5873	0.5704	0.5672	0.5525	0.5525	0.5498	0.5582	0.5672	0.5736	0.5803	(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			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.40)			23.6300	1.3258	31.3277			(27)
TER Room Window (Uw = 1.70)			0.8100	1.5918	1.2893			(27a)
Heat Loss Floor 1			41.8200	0.1300	5.4366			(28)
External Wall 1	150.1500	25.5200	124.6300	0.1800	22.4334			(29a)
Basement wall	98.6100		98.6100	0.1800	17.7498			(29a)
External Roof 1	43.5000	0.8100	42.6900	0.1300	5.5497			(30)
Total net area of external elements Aum(A, m2)			334.0800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		85.6765			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.6872	(36)
Total fabric heat loss					(33) + (36) =		95.3637	(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	66.0638	65.6557	65.2557	63.3767	63.0252	61.3886	61.3886	61.0856	62.0190	63.0252	63.7363	64.4799	(38)
Heat transfer coeff	161.4275	161.0194	160.6194	158.7404	158.3888	156.7523	156.7523	156.4493	157.3827	158.3888	159.1000	159.8435	(39)
Average = Sum(39)m / 12 =												158.7387	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5319	1.5280	1.5242	1.5064	1.5030	1.4875	1.4875	1.4846	1.4935	1.5030	1.5098	1.5168	(40)
HLP (average)												1.5063	(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		2.7841 (42)
Average daily hot water use (litres/day)		100.3215 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.3536	106.3407	102.3279	98.3150	94.3022	90.2893	90.2893	94.3022	98.3150	102.3279	106.3407	110.3536	(44)
Energy conte	163.6512	143.1304	147.6977	128.7665	123.5545	106.6181	98.7974	113.3714	114.7254	133.7014	145.9456	158.4874	(45)
Energy content (annual)										Total = Sum(45)m =		1578.4471	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.7759	30.4152	31.3858	27.3629	26.2553	22.6564	20.9944	24.0914	24.3792	28.4116	31.0134	33.6786	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	139.2031	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	23.6021	20.9632	17.0484	12.9067	9.6479	8.1452	8.8012	11.4401	15.3549	19.4965	22.7553	24.2580	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	264.7435	267.4907	260.5678	245.8298	227.2258	209.7406	198.0594	195.3122	202.2350	216.9730	235.5771	253.0623	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	36.9203	(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)

	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	(71)

Water heating gains (Table 5)

	46.7418	45.2607	42.1852	38.0040	35.2894	31.4672	28.2183	32.3810	33.8599	38.1876	43.0742	45.2669	(72)
Total internal gains													
	399.8482	398.4755	384.5623	361.5015	336.9240	314.1138	299.8398	303.8941	316.2108	339.4180	366.1675	387.3482	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.1800	10.6334	0.6300	0.7000	0.7700	20.0832	(74)
East	17.4500	19.6403	0.6300	0.7000	0.7700	104.7405	(76)
Horizontal	0.8100	26.0000	0.6300	0.7000	1.0000	8.3587	(82)

Solar gains	133.1824	260.6350	433.5121	645.1032	805.9580	832.7633	789.5903	667.2729	507.8308	310.0293	165.9834	109.6271	(83)
Total gains	533.0306	659.1104	818.0744	1006.6047	1142.8820	1146.8771	1089.4301	971.1670	824.0415	649.4473	532.1509	496.9752	(84)

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7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	45.3334	45.4483	45.5615	46.1008	46.2031	46.6855	46.6855	46.7759	46.4985	46.2031	45.9966	45.7826	
alpha	4.0222	4.0299	4.0374	4.0734	4.0802	4.1124	4.1124	4.1184	4.0999	4.0802	4.0664	4.0522	
util living area													
	0.9988	0.9970	0.9905	0.9644	0.8902	0.7472	0.5939	0.6698	0.8970	0.9863	0.9977	0.9991	(86)
MIT	19.1973	19.3864	19.7329	20.2050	20.6184	20.8772	20.9641	20.9419	20.7091	20.1570	19.5944	19.1715	(87)
Th 2	19.6637	19.6666	19.6694	19.6827	19.6852	19.6969	19.6969	19.6991	19.6924	19.6852	19.6802	19.6749	(88)
util rest of house													
	0.9984	0.9959	0.9866	0.9492	0.8416	0.6399	0.4366	0.5123	0.8295	0.9783	0.9966	0.9988	(89)
MIT 2	18.0405	18.2313	18.5780	19.0499	19.4316	19.6423	19.6886	19.6834	19.5275	19.0123	18.4497	18.0232	(90)
Living area fraction									fLA = Living area / (4) =			0.2110	(91)
MIT	18.2847	18.4751	18.8217	19.2936	19.6821	19.9029	19.9578	19.9490	19.7769	19.2539	18.6913	18.2655	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2847	18.4751	18.8217	19.2936	19.6821	19.9029	19.9578	19.9490	19.7769	19.2539	18.6913	18.2655	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9944	0.9832	0.9433	0.8415	0.6590	0.4703	0.5458	0.8350	0.9744	0.9954	0.9983	(94)
Useful gains	531.8042	655.4297	804.3592	949.5088	961.6972	755.8003	512.3455	530.0177	688.0699	632.8522	529.7296	496.1206	(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													
	2257.5104	2185.8540	1979.1065	1649.8916	1264.2694	831.2408	526.3444	555.2391	893.4385	1370.6747	1844.1730	2248.2810	(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													
	1283.9255	1028.4451	874.0120	504.2756	225.1137	0.0000	0.0000	0.0000	0.0000	548.9399	946.3992	1303.6073	(98)
Space heating												6714.7184	(98)
Space heating per m2											(98) / (4) =	63.7191	(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	1473.4718	1159.9671	1189.0143	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7943	0.8647	0.8193	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1170.4435	1003.0291	974.1513	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1437.5496	1368.6412	1234.0693	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	192.3164	272.0154	193.3790	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												657.7108	(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	48.0791	68.0039	48.3448	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												164.4277	(107)
Space cooling per m2												1.5603	(108)
Energy for space heating												63.7191	(99)
Energy for space cooling												1.5603	(108)
Total												65.2794	(109)
Target Fabric Energy Efficiency (TFEE)												75.1	(109)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	41.8200 (1a)	x	2.8000 (2a)	=	117.0960 (1a) - (3a)	
Ground floor	36.7000 (1b)	x	3.7000 (2b)	=	135.7900 (1b) - (3b)	
First floor	26.8600 (1c)	x	3.1200 (2c)	=	83.8032 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.3800				(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	336.6892 (5)	

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1188	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3688	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3411	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.6000	4.5000	4.4000	4.1000	4.1000	3.7000	3.8000	3.7000	3.7000	4.0000	3.9000	4.3000	(22)
Wind factor	1.1500	1.1250	1.1000	1.0250	1.0250	0.9250	0.9500	0.9250	0.9250	1.0000	0.9750	1.0750	(22a)
Adj infilt rate	0.3923	0.3838	0.3753	0.3497	0.3497	0.3156	0.3241	0.3156	0.3156	0.3411	0.3326	0.3667	(22b)
Effective ac	0.5770	0.5736	0.5704	0.5611	0.5611	0.5498	0.5525	0.5498	0.5498	0.5582	0.5553	0.5672	(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	
Windows (Uw = 1.20)			28.1700	1.1450	32.2557			(27)
Doors			1.8900	1.2000	2.2680			(26)
Rooflight (Uw = 1.20)			0.9700	1.1450	1.1107			(27a)
Heat Loss Floor 1			41.8200	0.1000	4.1820			(28)
External Wall 1	150.1500	30.0600	120.0900	0.1700	20.4153			(29a)
Basement wall	98.6100		98.6100	0.1700	16.7637			(29a)
External Roof 1	43.5000	0.9700	42.5300	0.1000	4.2530			(30)
Total net area of external elements Aum(A, m2)			334.0800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		81.2484			(33)
Party Wall 1			39.6900	0.0000	0.0000			(32)
Party Ceilings 1			59.7000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	18.9027 (36)
Total fabric heat loss (33) + (36) =	100.1511 (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	64.1041	63.7363	63.3767	62.3463	62.3463	61.0856	61.3886	61.0856	61.0856	62.0190	61.6998	63.0252	(38)
Heat transfer coeff	164.2552	163.8875	163.5278	162.4974	162.4974	161.2367	161.5397	161.2367	161.2367	162.1701	161.8509	163.1763	(39)

Average = Sum(39)m / 12 = 162.4260 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5587	1.5552	1.5518	1.5420	1.5420	1.5301	1.5329	1.5301	1.5301	1.5389	1.5359	1.5485	(40)
HLP (average)												1.5413	(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	2.7841 (42)
Average daily hot water use (litres/day)	100.3215 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.3536	106.3407	102.3279	98.3150	94.3022	90.2893	90.2893	94.3022	98.3150	102.3279	106.3407	110.3536	(44)
Energy conte	163.6512	143.1304	147.6977	128.7665	123.5545	106.6181	98.7974	113.3714	114.7254	133.7014	145.9456	158.4874	(45)
Energy content (annual)										Total = Sum(45)m =		1578.4471	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5477	21.4696	22.1547	19.3150	18.5332	15.9927	14.8196	17.0057	17.2088	20.0552	21.8918	23.7731	(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	40.2937	36.3944	40.2864	38.9687	40.2490	38.9292	40.2135	40.2366	38.9507	40.2685	38.9849	40.2875	(61)
Total heat required for water heating calculated for each month	203.9449	179.5248	187.9842	167.7351	163.8035	145.5474	139.0109	153.6080	153.6762	173.9700	184.9304	198.7750	(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													
	203.9449	179.5248	187.9842	167.7351	163.8035	145.5474	139.0109	153.6080	153.6762	173.9700	184.9304	198.7750	(64)
								Total per year (kWh/year) = Sum(64)m =				2052.5104	(64)
RHI water heating demand												2053	(64)
Heat gains from water heating, kWh/month													
	64.4874	56.6895	59.1811	52.5570	51.1441	45.1828	42.9035	47.7551	47.8839	54.5229	58.2731	62.7690	(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	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	59.0052	52.4079	42.6210	32.2668	24.1198	20.3630	22.0029	28.6002	38.3871	48.7413	56.8883	60.6451	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	395.1395	399.2398	388.9072	366.9102	339.1429	313.0456	295.6110	291.5107	301.8434	323.8403	351.6076	377.7049	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	(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)													
	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	(71)
Water heating gains (Table 5)													
	86.6767	84.3593	79.5445	72.9959	68.7421	62.7539	57.6660	64.1870	66.5054	73.2834	80.9349	84.3669	(72)
Total internal gains													
	653.9910	649.1767	624.2423	585.3425	545.1745	509.3322	488.4496	497.4676	519.9055	559.0347	602.6004	635.8866	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.3700	11.5821	0.6300	0.7000	0.7700	26.0871	(74)
East	20.8000	21.5869	0.6300	0.7000	0.7700	137.2228	(76)
Horizontal	0.9700	29.0000	0.6300	0.7000	1.0000	11.1648	(82)

Solar gains	174.4746	306.8060	512.0732	785.0486	952.4517	1049.5407	993.0794	862.3472	658.2003	398.6323	224.6269	140.9408	(83)
Total gains	828.4657	955.9827	1136.3155	1370.3911	1497.6262	1558.8729	1481.5289	1359.8148	1178.1059	957.6670	827.2273	776.8274	(84)

7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	17.8212	17.8612	17.9005	18.0140	18.0140	18.1548	18.1208	18.1548	18.1548	18.0503	18.0859	17.9390	
alpha	2.1881	2.1907	2.1934	2.2009	2.2009	2.2103	2.2081	2.2103	2.2103	2.2034	2.2057	2.1959	
util living area													
	0.9425	0.9216	0.8685	0.7676	0.6240	0.4298	0.2802	0.3218	0.5867	0.8194	0.9163	0.9487	(86)
MIT	18.8572	19.0647	19.5523	20.0916	20.5241	20.7807	20.8554	20.8456	20.6594	20.1045	19.4056	18.8214	(87)
Th 2	19.6438	19.6464	19.6489	19.6561	19.6561	19.6650	19.6629	19.6650	19.6650	19.6584	19.6607	19.6514	(88)
util rest of house													
	0.9325	0.9081	0.8451	0.7260	0.5538	0.3253	0.1467	0.1819	0.4853	0.7754	0.8991	0.9397	(89)
MIT 2	16.8609	17.1580	17.8498	18.5920	19.1459	19.4300	19.4815	19.4802	19.3244	18.6365	17.6613	16.8143	(90)
Living area fraction										fLA = Living area / (4) =		0.2110	(91)
MIT	17.2822	17.5604	18.2091	18.9085	19.4367	19.7151	19.7715	19.7684	19.6062	18.9463	18.0294	17.2379	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.2822	17.5604	18.2091	18.9085	19.4367	19.7151	19.7715	19.7684	19.6062	18.9463	18.0294	17.2379	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9082	0.8802	0.8135	0.6986	0.5410	0.3295	0.1581	0.1934	0.4803	0.7461	0.8707	0.9169	(94)
Useful gains	752.4088	841.4482	924.3891	957.2977	810.1824	513.6255	234.1809	262.9624	565.7985	714.5154	720.2311	712.2571	(95)
Ext temp.	5.2000	5.7000	7.7000	10.2000	13.3000	16.3000	18.3000	18.1000	15.5000	11.9000	8.2000	5.2000	(96)
Heat loss rate W													
	1984.5639	1943.7733	1718.5245	1415.1123	997.2028	550.6363	237.7015	269.0014	662.0664	1142.6995	1590.9008	1964.2944	(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													
	916.7233	740.7624	590.8367	329.6265	139.1432	0.0000	0.0000	0.0000	0.0000	318.5689	626.8822	931.5157	(98)
Space heating												4594.0590	(98)
RHI space heating demand												4594	(98)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	41.8200 (1a)	x	2.8000 (2a)	=	117.0960	(1a) - (3a)
Ground floor	36.7000 (1b)	x	3.7000 (2b)	=	135.7900	(1b) - (3b)
First floor	26.8600 (1c)	x	3.1200 (2c)	=	83.8032	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.3800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		336.6892	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1188	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3688	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3411	(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	0.4350	0.4264	0.4179	0.3753	0.3667	0.3241	0.3241	0.3156	0.3411	0.3667	0.3838	0.4008	(22b)
Effective ac	0.5946	0.5909	0.5873	0.5704	0.5672	0.5525	0.5525	0.5498	0.5582	0.5672	0.5736	0.5803	(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	
Windows (Uw = 1.20)			28.1700	1.1450	32.2557			(27)
Doors			1.8900	1.2000	2.2680			(26)
Rooflight (Uw = 1.20)			0.9700	1.1450	1.1107			(27a)
Heat Loss Floor 1			41.8200	0.1000	4.1820			(28)
External Wall 1	150.1500	30.0600	120.0900	0.1700	20.4153			(29a)
Basement wall	98.6100		98.6100	0.1700	16.7637			(29a)
External Roof 1	43.5000	0.9700	42.5300	0.1000	4.2530			(30)
Total net area of external elements Aum(A, m2)			334.0800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		81.2484			(33)
Party Wall 1			39.6900	0.0000	0.0000			(32)
Party Ceilings 1			59.7000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		18.9027 (36)
Total fabric heat loss	(33) + (36) =	100.1511 (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	66.0638	65.6557	65.2557	63.3767	63.0252	61.3886	61.3886	61.0856	62.0190	63.0252	63.7363	64.4799	(38)
Heat transfer coeff	166.2150	165.8068	165.4068	163.5278	163.1763	161.5397	161.5397	161.2367	162.1701	163.1763	163.8875	164.6310	(39)

Average = Sum(39)m / 12 = 163.5261 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5773	1.5734	1.5696	1.5518	1.5485	1.5329	1.5329	1.5301	1.5389	1.5485	1.5552	1.5623	(40)
HLP (average)												1.5518	(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	2.7841 (42)
Average daily hot water use (litres/day)	100.3215 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.3536	106.3407	102.3279	98.3150	94.3022	90.2893	90.2893	94.3022	98.3150	102.3279	106.3407	110.3536	(44)
Energy conte	163.6512	143.1304	147.6977	128.7665	123.5545	106.6181	98.7974	113.3714	114.7254	133.7014	145.9456	158.4874	(45)
Energy content (annual)										Total = Sum(45)m =		1578.4471	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5477	21.4696	22.1547	19.3150	18.5332	15.9927	14.8196	17.0057	17.2088	20.0552	21.8918	23.7731	(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	40.2937	36.3944	40.2864	38.9687	40.2490	38.9292	40.2135	40.2366	38.9507	40.2685	38.9849	40.2875	(61)
Total heat required for water heating calculated for each month	203.9449	179.5248	187.9842	167.7351	163.8035	145.5474	139.0109	153.6080	153.6762	173.9700	184.9304	198.7750	(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													
	203.9449	179.5248	187.9842	167.7351	163.8035	145.5474	139.0109	153.6080	153.6762	173.9700	184.9304	198.7750	(64)
								Total per year (kWh/year) = Sum(64)m =				2052.5104	(64)
Heat gains from water heating, kWh/month													
	64.4874	56.6895	59.1811	52.5570	51.1441	45.1828	42.9035	47.7551	47.8839	54.5229	58.2731	62.7690	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	59.0052	52.4079	42.6210	32.2668	24.1198	20.3630	22.0029	28.6002	38.3871	48.7413	56.8883	60.6451	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	395.1395	399.2398	388.9072	366.9102	339.1429	313.0456	295.6110	291.5107	301.8434	323.8403	351.6076	377.7049	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	(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)													
	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	(71)
Water heating gains (Table 5)													
	86.6767	84.3593	79.5445	72.9959	68.7421	62.7539	57.6660	64.1870	66.5054	73.2834	80.9349	84.3669	(72)
Total internal gains													
	653.9910	649.1767	624.2423	585.3425	545.1745	509.3322	488.4496	497.4676	519.9055	559.0347	602.6004	635.8866	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.3700	10.6334	0.6300	0.7000	0.7700	23.9503	(74)
East	20.8000	19.6403	0.6300	0.7000	0.7700	124.8483	(76)
Horizontal	0.9700	26.0000	0.6300	0.7000	1.0000	10.0098	(82)

Solar gains	158.8084	310.7896	516.9457	769.2768	961.1081	993.0794	941.5927	795.7192	605.5734	369.6921	197.9217	130.7201	(83)
Total gains	812.7994	959.9662	1141.1880	1354.6193	1506.2825	1502.4115	1430.0423	1293.1867	1125.4789	928.7269	800.5221	766.6067	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	17.6111	17.6544	17.6971	17.9005	17.9390	18.1208	18.1208	18.1548	18.0503	17.9390	17.8612	17.7805	
alpha	2.1741	2.1770	2.1798	2.1934	2.1959	2.2081	2.2081	2.2103	2.2034	2.1959	2.1907	2.1854	
util living area													
	0.9500	0.9281	0.8854	0.8043	0.6897	0.5535	0.4373	0.4875	0.6858	0.8590	0.9320	0.9555	(86)
MIT	18.6582	18.9053	19.3367	19.8858	20.3436	20.6521	20.7832	20.7542	20.4899	19.8737	19.1701	18.6156	(87)
Th 2	19.6300	19.6329	19.6357	19.6489	19.6514	19.6629	19.6629	19.6650	19.6584	19.6514	19.6464	19.6411	(88)
util rest of house													
	0.9417	0.9162	0.8661	0.7707	0.6345	0.4689	0.3235	0.3720	0.6088	0.8266	0.9187	0.9480	(89)
MIT 2	16.5660	16.9210	17.5355	18.3064	18.9155	19.2999	19.4334	19.4139	19.1270	18.3152	17.3156	16.5107	(90)
Living area fraction									fLA = Living area / (4) =			0.2110	(91)
MIT	17.0075	17.3398	17.9156	18.6397	19.2169	19.5853	19.7182	19.6968	19.4147	18.6441	17.7070	16.9550	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.0075	17.3398	17.9156	18.6397	19.2169	19.5853	19.7182	19.6968	19.4147	18.6441	17.7070	16.9550	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9189	0.8891	0.8347	0.7404	0.6142	0.4634	0.3286	0.3750	0.5924	0.7955	0.8922	0.9268	(94)
Useful gains	746.9157	853.5013	952.5039	1002.9807	925.1838	696.2751	469.9470	485.0033	666.7557	738.7987	714.2625	710.5233	(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													
	2112.1820	2062.5963	1888.2187	1592.7146	1226.5834	805.3190	503.7186	531.5591	861.8812	1312.6029	1738.3555	2099.8599	(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													
	1015.7581	812.5118	696.1718	424.6084	224.2413	0.0000	0.0000	0.0000	0.0000	426.9104	737.3469	1033.6665	(98)
Space heating												5371.2152	(98)
Space heating per m2											(98) / (4) =	50.9700	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.1000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5769.2967	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1015.7581	812.5118	696.1718	424.6084	224.2413	0.0000	0.0000	0.0000	0.0000	426.9104	737.3469	1033.6665	(98)
Space heating efficiency (main heating system 1)													
	93.1000	93.1000	93.1000	93.1000	93.1000	0.0000	0.0000	0.0000	0.0000	93.1000	93.1000	93.1000	(210)

Space heating fuel (main heating system)

1091.0399	872.7302	747.7678	456.0777	240.8607	0.0000	0.0000	0.0000	0.0000	458.5503	791.9946	1110.2755 (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

203.9449	179.5248	187.9842	167.7351	163.8035	145.5474	139.0109	153.6080	153.6762	173.9700	184.9304	198.7750 (64)

Efficiency of water heater 91.2000 (216)

(217)m 90.7832	90.7901	90.8058	90.8410	90.9104	91.2000	91.2000	91.2000	91.2000	90.8442	90.7998	90.7803 (217)

Fuel for water heating, kWh/month

224.6504	197.7362	207.0177	184.6469	180.1813	159.5914	152.4242	168.4298	168.5046	191.5037	203.6683	218.9627 (219)

Water heating fuel used 2257.3173 (219)

Annual totals kWh/year

Space heating fuel - main system 5769.2967 (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) 416.8200 (232)

Total delivered energy for all uses 8518.4339 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5769.2967	3.4800	200.7715 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2257.3173	3.4800	78.5546 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	416.8200	13.1900	54.9786 (250)
Additional standing charges			120.0000 (251)
Total energy cost			464.1972 (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] = 1.2965 (257)

SAP value 81.9143

SAP rating (Section 12) 82 (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	5769.2967	0.2160	1246.1681 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2257.3173	0.2160	487.5805 (264)
Space and water heating			1733.7486 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	416.8200	0.5190	216.3296 (268)
Total kg/year			1989.0032 (272)
CO2 emissions per m2			18.8700 (273)
EI value			82.2765
EI rating			82 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency 3.48 × (1 + 0.29 × 0.25) / 0.9070 = 4.115, stars = 4

Main heating environmental impact 0.216 × (1 + 0.29 × 0.25) / 0.9070 = 0.2554, stars = 4

Water heating energy efficiency 3.48 / 0.9095 = 3.826, stars = 4

Water heating environmental impact 0.216 / 0.9095 = 0.2375, stars = 4

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	41.8200 (1a)	x	2.8000 (2a)	=	117.0960 (1a) - (3a)	
Ground floor	36.7000 (1b)	x	3.7000 (2b)	=	135.7900 (1b) - (3b)	
First floor	26.8600 (1c)	x	3.1200 (2c)	=	83.8032 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.3800				(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	336.6892 (5)	

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1188	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3688	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3411	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.6000	4.5000	4.4000	4.1000	4.1000	3.7000	3.8000	3.7000	3.7000	4.0000	3.9000	4.3000	(22)
Wind factor	1.1500	1.1250	1.1000	1.0250	1.0250	0.9250	0.9500	0.9250	0.9250	1.0000	0.9750	1.0750	(22a)
Adj infilt rate	0.3923	0.3838	0.3753	0.3497	0.3497	0.3156	0.3241	0.3156	0.3156	0.3411	0.3326	0.3667	(22b)
Effective ac	0.5770	0.5736	0.5704	0.5611	0.5611	0.5498	0.5525	0.5498	0.5498	0.5582	0.5553	0.5672	(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	
Windows (Uw = 1.20)			28.1700	1.1450	32.2557			(27)
Doors			1.8900	1.2000	2.2680			(26)
Rooflight (Uw = 1.20)			0.9700	1.1450	1.1107			(27a)
Heat Loss Floor 1			41.8200	0.1000	4.1820			(28)
External Wall 1	150.1500	30.0600	120.0900	0.1700	20.4153			(29a)
Basement wall	98.6100		98.6100	0.1700	16.7637			(29a)
External Roof 1	43.5000	0.9700	42.5300	0.1000	4.2530			(30)
Total net area of external elements Aum(A, m2)			334.0800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		81.2484			(33)
Party Wall 1			39.6900	0.0000	0.0000			(32)
Party Ceilings 1			59.7000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	18.9027 (36)
Total fabric heat loss (33) + (36) =	100.1511 (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	64.1041	63.7363	63.3767	62.3463	62.3463	61.0856	61.3886	61.0856	61.0856	62.0190	61.6998	63.0252	(38)
Heat transfer coeff	164.2552	163.8875	163.5278	162.4974	162.4974	161.2367	161.5397	161.2367	161.2367	162.1701	161.8509	163.1763	(39)

Average = Sum(39)m / 12 = 162.4260 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5587	1.5552	1.5518	1.5420	1.5420	1.5301	1.5329	1.5301	1.5301	1.5389	1.5359	1.5485	(40)
HLP (average)												1.5413	(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	2.7841 (42)
Average daily hot water use (litres/day)	100.3215 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.3536	106.3407	102.3279	98.3150	94.3022	90.2893	90.2893	94.3022	98.3150	102.3279	106.3407	110.3536	(44)
Energy conte	163.6512	143.1304	147.6977	128.7665	123.5545	106.6181	98.7974	113.3714	114.7254	133.7014	145.9456	158.4874	(45)
Energy content (annual)										Total = Sum(45)m =		1578.4471	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5477	21.4696	22.1547	19.3150	18.5332	15.9927	14.8196	17.0057	17.2088	20.0552	21.8918	23.7731	(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	40.2937	36.3944	40.2864	38.9687	40.2490	38.9292	40.2135	40.2366	38.9507	40.2685	38.9849	40.2875	(61)
Total heat required for water heating calculated for each month	203.9449	179.5248	187.9842	167.7351	163.8035	145.5474	139.0109	153.6080	153.6762	173.9700	184.9304	198.7750	(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													
	203.9449	179.5248	187.9842	167.7351	163.8035	145.5474	139.0109	153.6080	153.6762	173.9700	184.9304	198.7750	(64)
									Total per year (kWh/year) = Sum(64)m =				2052.5104 (64)
Heat gains from water heating, kWh/month													
	64.4874	56.6895	59.1811	52.5570	51.1441	45.1828	42.9035	47.7551	47.8839	54.5229	58.2731	62.7690	(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	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	167.0437	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	59.0052	52.4079	42.6210	32.2668	24.1198	20.3630	22.0029	28.6002	38.3871	48.7413	56.8883	60.6451	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	395.1395	399.2398	388.9072	366.9102	339.1429	313.0456	295.6110	291.5107	301.8434	323.8403	351.6076	377.7049	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	54.4884	(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)													
	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	-111.3625	(71)
Water heating gains (Table 5)													
	86.6767	84.3593	79.5445	72.9959	68.7421	62.7539	57.6660	64.1870	66.5054	73.2834	80.9349	84.3669	(72)
Total internal gains													
	653.9910	649.1767	624.2423	585.3425	545.1745	509.3322	488.4496	497.4676	519.9055	559.0347	602.6004	635.8866	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.3700	11.5821	0.6300	0.7000	0.7700	26.0871	(74)
East	20.8000	21.5869	0.6300	0.7000	0.7700	137.2228	(76)
Horizontal	0.9700	29.0000	0.6300	0.7000	1.0000	11.1648	(82)

Solar gains	174.4746	306.8060	512.0732	785.0486	952.4517	1049.5407	993.0794	862.3472	658.2003	398.6323	224.6269	140.9408	(83)
Total gains	828.4657	955.9827	1136.3155	1370.3911	1497.6262	1558.8729	1481.5289	1359.8148	1178.1059	957.6670	827.2273	776.8274	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	17.8212	17.8612	17.9005	18.0140	18.0140	18.1548	18.1208	18.1548	18.1548	18.0503	18.0859	17.9390	
alpha	2.1881	2.1907	2.1934	2.2009	2.2009	2.2103	2.2081	2.2103	2.2103	2.2034	2.2057	2.1959	
util living area													
	0.9425	0.9216	0.8685	0.7676	0.6240	0.4298	0.2802	0.3218	0.5867	0.8194	0.9163	0.9487	(86)
MIT	18.8572	19.0647	19.5523	20.0916	20.5241	20.7807	20.8554	20.8456	20.6594	20.1045	19.4056	18.8214	(87)
Th 2	19.6438	19.6464	19.6489	19.6561	19.6561	19.6650	19.6629	19.6650	19.6650	19.6584	19.6607	19.6514	(88)
util rest of house													
	0.9325	0.9081	0.8451	0.7260	0.5538	0.3253	0.1467	0.1819	0.4853	0.7754	0.8991	0.9397	(89)
MIT 2	16.8609	17.1580	17.8498	18.5920	19.1459	19.4300	19.4815	19.4802	19.3244	18.6365	17.6613	16.8143	(90)
Living area fraction									fLA = Living area / (4) =			0.2110	(91)
MIT	17.2822	17.5604	18.2091	18.9085	19.4367	19.7151	19.7715	19.7684	19.6062	18.9463	18.0294	17.2379	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.2822	17.5604	18.2091	18.9085	19.4367	19.7151	19.7715	19.7684	19.6062	18.9463	18.0294	17.2379	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9082	0.8802	0.8135	0.6986	0.5410	0.3295	0.1581	0.1934	0.4803	0.7461	0.8707	0.9169	(94)
Useful gains	752.4088	841.4482	924.3891	957.2977	810.1824	513.6255	234.1809	262.9624	565.7985	714.5154	720.2311	712.2571	(95)
Ext temp.	5.2000	5.7000	7.7000	10.2000	13.3000	16.3000	18.3000	18.1000	15.5000	11.9000	8.2000	5.2000	(96)
Heat loss rate W													
	1984.5639	1943.7733	1718.5245	1415.1123	997.2028	550.6363	237.7015	269.0014	662.0664	1142.6995	1590.9008	1964.2944	(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													
	916.7233	740.7624	590.8367	329.6265	139.1432	0.0000	0.0000	0.0000	0.0000	318.5689	626.8822	931.5157	(98)
Space heating												4594.0590	(98)
Space heating per m2											(98) / (4) =	43.5952	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	93.1000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	4934.5425 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	916.7233	740.7624	590.8367	329.6265	139.1432	0.0000	0.0000	0.0000	0.0000	318.5689	626.8822	931.5157	(98)
Space heating efficiency (main heating system 1)													
	93.1000	93.1000	93.1000	93.1000	93.1000	0.0000	0.0000	0.0000	0.0000	93.1000	93.1000	93.1000	(210)

Space heating fuel (main heating system)
984.6652 795.6632 634.6259 354.0564 149.4556 0.0000 0.0000 0.0000 0.0000 342.1793 673.3428 1000.5540 (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
203.9449 179.5248 187.9842 167.7351 163.8035 145.5474 139.0109 153.6080 153.6762 173.9700 184.9304 198.7750 (64)
Efficiency of water heater 91.2000 (216)
(217)m 90.7906 90.7971 90.8202 90.8680 90.9697 91.2000 91.2000 91.2000 91.2000 90.8760 90.8134 90.7875 (217)
Fuel for water heating, kWh/month
224.6322 197.7209 206.9850 184.5921 180.0639 159.5914 152.4242 168.4298 168.5046 191.4367 203.6378 218.9452 (219)
Water heating fuel used 2256.9638 (219)
Annual totals kWh/year
Space heating fuel - main system 4934.5425 (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) 416.8200 (232)
Total delivered energy for all uses 7683.3263 (238)

10a. Fuel costs - using BEDF prices (391)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4934.5425	4.3200	213.1722 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2256.9638	4.3200	97.5008 (247)
Pumps and fans for heating	75.0000	15.3200	11.4900 (249)
Energy for lighting	416.8200	15.3200	63.8568 (250)
Additional standing charges			95.0000 (251)
Total energy cost			481.0199 (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	4934.5425	0.2160	1065.8612 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2256.9638	0.2160	487.5042 (264)
Space and water heating			1553.3654 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	416.8200	0.5190	216.3296 (268)
Total kg/year			1808.6199 (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	4934.5425	1.2200	6020.1418 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2256.9638	1.2200	2753.4959 (264)
Space and water heating			8773.6377 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	416.8200	3.0700	1279.6374 (268)
Primary energy kWh/year			10283.5251 (272)
Primary energy kWh/m2/year			97.5852 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 82
Current environmental impact rating: B 82

(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	Not applicable
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Not applicable
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
(none)			

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: B 82
Potential environmental impact rating: B 82

Fuel prices for cost data on this page from database revision number 391 TEST (01 Apr 2016)
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	£75	£75	£0
Mains gas	£406	£406	£0
Space heating	£320	£320	£0
Water heating	£98	£98	£0
Lighting	£64	£64	£0
Total cost of fuels	£481	£481	£0
Total cost of uses	£482	£482	£0
Delivered energy	73 kWh/m²	73 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.8 tonnes	1.8 tonnes	0.0 tonnes
CO2 emissions per m²	17 kg/m²	17 kg/m²	0 kg/m²
Primary energy	98 kWh/m²	98 kWh/m²	0 kWh/m²

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

No improvements selected / applicable

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

No improvements selected / applicable

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

Overheating Calculation Input Data

Dwelling type	SemiDetached Maisonette
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	Unknown
Overshading	Average or unknown
Thermal mass parameter	100.0
Night ventilation	No
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	888.86 (P1)
Transmission heat loss coefficient	100.15 (37)
Summer heat loss coefficient	989.01 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	0.000	None
East	0.000	0.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	0.000	0.00	0.000	0.000 (P8)
East	0.000	0.00	0.000	0.000 (P8)
Horizontal	1.000	1.00	1.000	1.000 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	7.3700	98.8453	0.6300	0.7000	0.0000	0.0000
East	20.8000	98.8453	0.6300	0.7000	0.0000	0.0000
Horizontal	0.9700	203.0000	0.6300	0.7000	1.0000	78.1536
total:						1072.7946

	Jun	Jul	Aug	
Solar gains	1157	1073	880	(P3)
Internal gains	506	485	494	
Total summer gains	1664	1558	1375	(P5)
Summer gain/loss ratio	1.68	1.58	1.39	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	18.98	20.78	20.49	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

Assessment of likelihood of high internal temperature: Slight