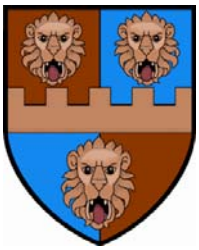

Premier Consultants Ltd

‘Notional’ and ‘As Proposed’ SAP 2009 CALCULATIONS FOR

TWO NEW FLATS

10-13 CHARLOTTE STREET,

LONDON, W1T 2LT

DESIGN BY

MSA LIMITED
70 HATTON GARDEN
LONDON, EC1N 8JT

14 Stanmoor, Abbeydale, Gloucester, GL4 5BT
Tel: 01452 503355, M: 07922041056
Company Number 5808356 VAT Registration Number 935 1234 41

SUMMARY

This report is in support of the planning application made by MSA Ltd. to the London Borough of Camden reference number 2011/3962/INVALID

The calculations have been prepared for flat 2 which is the larger of the two proposed units and which also has an exposed gable end and hence a larger area of fabric from which to loose heat. Unit 1 should, as a mid terraced unit use less energy for heating purposes.

The SAP version used is 2009 in order to demonstrate that compliance with the Building Regulations Part L will also be achievable should the development be granted planning permission.

Included in the appendix are the full SAP calculations 5648-0001-0366 which is for the base line calculation using a gas combi boiler, an air leakage rate of 3.8m^3/(h.m^2) @50pa and enhanced heating controls: a weather compensator controller with a delayed start thermostat. The second SAP document 5648-0001-0366-A includes the photovoltaic panels, but did not include air leakage testing. For this reason the model assumes a greater percentage of energy will be required to heat the unit as un wanted leakage may be occurring.

Compliance with the on site carbon reduction measures

The SAP 2009 calculations show that the predicted energy demands:

	Gas boiler	With PV panels	Reduction %
	Kg CO_2/yr	Kg CO_2/yr	
Space heating	597.92	789.59	
Water heating	407.85	407.22	
Total heating and water	1005.77	1196.81	Gas consumption
Pumps and extract fans	90.47	90.47	
Energy for lighting	137.12	137.12	
Total for pumps, fans and lighting	227.59	227.59	Electricity consumption
PV		-463.63	
Total CO_2 kg/year	1233.37	960.78	22.1%
CO_2 per m^2 building fabric	21.18	16.50	22.1%

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Conclusion

The provision of 6 no. Mitsubishi PV-TD190MF5 photovoltaic units each with a maximum output of 190W has the potential to generate 1.14Kw of electricity.

The assumption has been made in the calculations that these will be laid flat on top of the roof surface in order to avoid being seen from the ground.

They should produce an annual reduction in the carbon dioxide emissions from the flat of 22% which is in line with the expectations of the London Plan 2004 (as amended).

The u-values used are better than the normal (lean), the energy generated by the panels is clean and also green because of the renewable nature.

P. Carter BA MBEng MFPWS Dip DEA

6TH September 2011

elmhurst accredited energy assessor

BINDT THE BRITISH INSTITUTE OF NON-DESTRUCTIVE TESTING

REGISTERED AIRTIGHTNESS TESTER OF DWELLINGS 0314

14 Stanmoor, Abbeydale, Gloucester, GL4 5BT
Tel: 01452 503355, M: 07922041056
Company Number 5808356 VAT Registration Number 935 1234 41

Full SAP Calculation Printout

Users Ref: 5648-0001-0366-A
Issued On Date: 06.Sep.2011
EES Ref: 5648-0001-0366
Prop Type Ref:
Property: 10-13, Flat 2, Charlotte Street, London, W1T 2LT,
DER: 17.82
TER: 22.50

SAP Rating:	**85 B**	**CO2 Emissions:** 0.96 t/year	**Fabric Energy:** 77.6	**Energy used:** 84 kWh/m/year			
EI Rating:	**88 B**	**SAP Energy Cost:** £ 261.77	**HLP:** 1.86	**Ene1:** 2	**ZC:** 0.00		

Surveyor: Paul Carter, Tel: 01452 50335
Address: Stanmoor, Abbeydale, Goucester, GL4 5BT
Client:

Software Version: Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20
SAP version: SAP 2009, Regs Region: England and Wales (Part L1A 2010), Calculation Type: New Design,

CALCULATION DETAILS for survey reference no '5648-0001-0366-A'
SAP2009 - 9.81 input data (DesignData) -

SAP2009 Input Data

FullRefNo:	5648-0001-0366-A
Sap Version:	SAP 2009
Regs Region:	England & Wales
Region:	Thames Valley
Calculation Type:	New Build (As Designed)
DwellingOrientation:	South West
Property Type:	Flat, End-Terrace
Storeys:	1
Date Built:	2011
Sheltered Sides:	2
Sunlight Shade:	Average or unknown
Measurements	Perimeter, Floor Area, Storey Height
1st Storey:	26.4, 58.23, 2.8
Living Area:	32.27 m2, fraction: 55.4%
Thermal Mass:	Precise calculation
External Walls	Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1	45.28, 50.69, 70, , CavityWallDensePlasterAACblock, , Cavity, 0, 0.26, Nett
External Wall 2	30.81, 36.75, 18, , TimberWallTwoLayers, , TimberFrame, 0, 0.27, Nett
Party Walls	Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Stud	14.1, 20, , PartyWallDoublePlaster, , UnfilledWithEdge, 0, 0.2
Internal Walls	Area, Kappa
Internal Partition 1	40.68, 9
External Roofs	Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
External Roof 1	58.44, 61.29, 9, PlasterInsulatedFlatRoof, , , 0.17
Heat Loss Floors	Area, Kappa, Construction, Element, Type, UValueFinal, ShelterFactor
Party Floors	Area, Kappa, Construction, Element
Party Floor 1	58.23, 30
Description	Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
Opening Type 1	SAP table, Window, Double Low-E Soft 0.05, 20 mm, True, 0.63, Wood, 0.7, 1.70
Opening Type 2	SAP table, Roof Window, Double Low-E Soft 0.05, 20 mm, True, 0.63, Wood, 0.7, 2.00
Openings	Opening Type, Location, Orientation, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
Opening 1 Front	Window, External Wall 2, Southwest, None, 0, , 0, 0, 0, 5.94,
Opening 2 Rear	Window, External Wall 1, Northeast, None, 0, , 0, 0, 0, 5.41,
Opening 3 Roof	Roof Window, External Roof 1, Horizontal, None, , , 0, 0, 0, 2.85,
Conservatory:	None
Draught Proofing:	100
Draught Lobby:	No
Thermal Bridges	Bridge Type, Length, Psi
0.	Other lintels (including other steel lintels), 9.1, 0.3
1.	Jamb, 22.8, 0.05
2.	Sill, 7, 0.04
3.	Eaves (insulation at rafter level), 19.2, 0.04
4.	Gable (insulation at rafter level), 2.1, 0.04
5.	Flat roof, 5.9, 0.04
6.	Corner (normal), 9.75, 0.09
7.	Corner (inverted - internal area greater than external area), 3.25, -0.09
8.	Party wall between dwellings, 5.9, 0.06
Pressure Test:	False
Designed q50:	15
AsBuilt q50:	15
Property Tested:	False
Mechanical Ventilation	None
Chimneys MHS:	0
Chimneys SHS:	0
Chimneys Other:	0
Chimneys Total:	0
Open Flues MHS:	0
Open Flues SHS:	0
Open Flues Other:	0
Open Flues Total:	0
Intermittent Fans:	2
Passive Vents:	0
Flueless Gas Fires:	0
Cooling System	None
Light Fittings:	5
LEL Fittings:	5
Percentage of LEL Fittings:	100
External Lights Fitted:	No
External LELs Fitted:	No
Electricity Tariff:	Standard
Main Heating 1	
Description	Gas heating
Percentage	100

```
    Sedbuk ID               10243
    Fuel Type               Mains gas
    MHS                     BGW - Mains gas BGW Post 98 Combi condens. with auto ign.
    SAP Code                104
    Boiler Efficiency Type  Split Efficiences
    Efficiency Winter       90
    Efficiency Summer       86.7
    MHS Controls            CBD
    Dealayed Start Stat     Yes
    Ctrl SAP Code           2106
    Boiler Compensator      WeatherCompensator
    Flue Type               Balanced
    Fan Assisted Flue       Yes
    Pumped                  Pump in heated space
    Heat Emitter            Radiators
    Combi boiler type       Standard Combi
    Combi keep hot type     Gas/Oil, time clock
Main Heating 2               None
Smoke Control Area           Unknown
Community Heating            None
Secondary Heating            None
Water Heating
    Type                    MainHeating1
    WHS                     HWP -
    Low Water Usage         Yes
    SAP Code                901
    Hot Water Cylinder      None
Flue Gas Heat Recovery System None
Waste Water Heat Recovery    none
PV Unit
    Type                    One Dwelling
    PVUnit 1                Cells Peak = 1.14, Orientation = SouthWest, Elevation = Horizontal, Overshading = NoneOrLittle
Wind Turbine                 None
Terrain Type:                Urban
Small Scale Hydro            None
Special Features             None
```

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF FABRIC ENERGY EFFICIENCY
Calculated by program Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.2300 (1b)	x	2.8000 (2b)	=	163.0440 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.2300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	163.0440	(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							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1227	(8)
Pressure test		No	
Measured/design q50		15.0000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.8727	(18)
Number of sides on which dwelling is sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.7418	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	1.0014	0.9458	0.9458	0.8345	0.7603	0.7232	0.6861	0.6861	0.7789	0.8345	0.8901	0.9458	(22b)
Effective ach	1.0014	0.9472	0.9472	0.8482	0.7890	0.7615	0.7354	0.7354	0.8033	0.8482	0.8962	0.9472	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.70)			11.3500	1.5918	18.0665			(27)
Opening Type 2 (Uw = 2.00)			2.8500	1.8519	5.2778			(27a)
External Wall 1	50.6900	5.4100	45.2800	0.2600	11.7728	70.0000	3169.6000	(29a)
External Wall 2	36.7500	5.9400	30.8100	0.2700	8.3187	18.0000	554.5800	(29a)
External Roof 1	61.2900	2.8500	58.4400	0.1700	9.9348	9.0000	525.9600	(30)
Total net area of external elements Aum(A, m2)			148.7300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		56.1906			(33)
Stud			14.1000	0.2000	2.8200	20.0000	282.0000	(32)
Party Floor 1			58.2300			30.0000	1746.9000	(32d)
Internal Partition 1			40.6800			9.0000	366.1200	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	6645.1600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		114.1192 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.1770 (36)
Total fabric heat loss	(33) + (36) =	62.3676 (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	53.8790	50.9649	50.9649	45.6362	42.4537	40.9735	39.5673	39.5673	43.2216	45.6362	48.2173	50.9649	(38)
(39)m	116.2466	113.3325	113.3325	108.0037	104.8213	103.3411	101.9349	101.9349	105.5891	108.0037	110.5848	113.3325	(39)
(40)m	1.9963	1.9463	1.9463	1.8548	1.8001	1.7747	1.7506	1.7506	1.8133	1.8548	1.8991	1.9463	(40)
									Average = Sum(40)m / 12 =			1.8611	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N	1.9312 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	80.0653 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	88.0719	84.8693	81.6667	78.4640	75.2614	72.0588	72.0588	75.2614	78.4640	81.6667	84.8693	88.0719	(44)
(45)m	130.9205	114.5039	118.1578	103.0128	98.8433	85.2942	79.0376	90.6968	91.7800	106.9608	116.7561	126.7895	(45)
Energy content (annual)										Total = Sum(45)m =		1262.7534	(45)
(46)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:													
(57)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	(57)
Primary circuit loss (annual) from Table 3												0.0000	(58)
(59)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	(59)
(65)m	27.8206	24.3321	25.1085	21.8902	21.0042	18.1250	16.7955	19.2731	19.5033	22.7292	24.8107	26.9428	(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	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	(66)
(67)m	15.0185	13.3393	10.8482	8.2128	6.1392	5.1830	5.6004	7.2796	9.7706	12.4060	14.4797	15.4359	(67)
(68)m	168.4619	170.2100	165.8048	156.4267	144.5886	133.4624	126.0294	124.2813	128.6865	138.0646	149.9027	161.0289	(68)
(69)m	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	(69)
(70)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	(70)
(71)m	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	(71)
(72)m	37.3933	36.2085	33.7480	30.4031	28.2314	25.1736	22.5746	25.9047	27.0879	30.5500	34.4593	36.2134	(72)
(73)m	272.8413	271.7254	262.3687	247.0102	230.9268	215.7866	206.1719	209.4331	217.5125	232.9881	250.8092	264.6458	(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	5.4100	11.5098	0.6300	0.7000	0.7700	19.0298 (75)
Southwest	5.9400	37.3877	0.6300	0.7000	0.7700	67.8714 (79)
Horizontal	2.8500	26.0000	0.6300	0.7000	1.0000	29.4103 (82)

(83)m	116.3115	215.7282	327.2077	469.6371	569.0821	597.4141	577.9287	501.4333	384.5814	257.2201	142.7170	97.2307 (83)
(84)m	389.1528	487.4536	589.5764	716.6473	800.0089	813.2007	784.1006	710.8664	602.0939	490.2082	393.5263	361.8765 (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	15.8790	16.2873	16.2873	17.0909	17.6098	17.8620	18.1084	18.1084	17.4817	17.0909	16.6920	16.2873	
alpha	2.0586	2.0858	2.0858	2.1394	2.1740	2.1908	2.2072	2.2072	2.1654	2.1394	2.1128	2.0858	
(86)m	0.9699	0.9520	0.9183	0.8563	0.7496	0.6133	0.4614	0.4962	0.7373	0.8934	0.9581	0.9724	(86)
(87)m	17.5702	17.9579	18.5923	19.3501	20.1214	20.6166	20.8668	20.8453	20.3850	19.4680	18.3274	17.6795	(87)
(88)m	19.3424	19.3757	19.3757	19.4376	19.4753	19.4930	19.5099	19.5099	19.4662	19.4376	19.4075	19.3757	(88)
(89)m	0.9635	0.9420	0.9005	0.8249	0.6913	0.5154	0.3180	0.3463	0.6497	0.8619	0.9480	0.9664	(89)
(90)m	16.3361	16.7377	17.3593	18.1253	18.8618	19.2890	19.4703	19.4628	19.1061	18.2595	17.1277	16.4653	(90)
Living area fraction										fLA = Living area / (4) =		0.5542	(91)
(92)m	17.0200	17.4139	18.0426	18.8040	19.5599	20.0247	20.2442	20.2290	19.8149	18.9292	17.7926	17.1382	(92)
Temperature adjustment												0.0000	
(93)m	17.0200	17.4139	18.0426	18.8040	19.5599	20.0247	20.2442	20.2290	19.8149	18.9292	17.7926	17.1382	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9506	0.9255	0.8813	0.8095	0.6949	0.5529	0.3928	0.4236	0.6726	0.8488	0.9336	0.9544	(94)
(95)m	369.9462	451.1588	519.6048	580.1242	555.9651	449.6559	307.9699	301.0965	404.9613	416.0865	367.3962	345.3915	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	1455.4105	1406.9028	1274.1511	1091.2741	823.8807	560.5979	340.8930	339.3361	582.3085	877.9861	1193.4940	1386.9850	(97)
(98)m	807.5854	642.2599	561.3824	368.0279	199.3292	0.0000	0.0000	0.0000	0.0000	343.6533	594.7904	774.9456	(98)
Space heating (October to May) (kWh/year)												4291.9742	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	73.7073	(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.	0.0000	0.0000	0.0000	0.0000	0.0000	15.4000	17.8000	17.8000	0.0000	0.0000	0.0000	0.0000	
(100)m	0.0000	0.0000	0.0000	0.0000	0.0000	888.7331	631.9961	631.9961	0.0000	0.0000	0.0000	0.0000	(100)
(101)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.7345	0.8218	0.8017	0.0000	0.0000	0.0000	0.0000	(101)
(102)m	0.0000	0.0000	0.0000	0.0000	0.0000	652.8007	519.3865	506.6961	0.0000	0.0000	0.0000	0.0000	(102)
(103)m	0.0000	0.0000	0.0000	0.0000	0.0000	1026.6609	981.5599	909.7591	0.0000	0.0000	0.0000	0.0000	(103)
(98)m	0.0000	0.0000	0.0000	0.0000	0.0000	41.0589	7.3051	8.3884	0.0000	0.0000	0.0000	0.0000	(98)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	269.1793	343.8570	299.8789	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.000	(105)
(106)m	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)
(107)m	0.0000	0.0000	0.0000	0.0000	0.0000	67.2948	85.9643	74.9697	0.0000	0.0000	0.0000	0.0000	(107)
										Total = Sum(107)6..8 =		228.2288	(107)
Space cooling requirement in kWh/m2/year											(107) / (4) =	3.9194	(108)

8f. Fabric Energy Efficiency

Fabric Energy Efficiency (99) + (108) = 77.6267

Fabric Energy Efficiency rounded 77.6 (109)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF DATA FOR RENEWABLE HEAT INCENTIVE (RHI)
Calculated by program Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.2300 (1b)	x	2.8000 (2b)	=	163.0440 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.2300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	163.0440	(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							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1227	(8)
Pressure test		No	
Measured/design q50		15.0000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.8727	(18)
Number of sides on which dwelling is sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.7418	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	1.0014	0.9458	0.9458	0.8345	0.7603	0.7232	0.6861	0.6861	0.7789	0.8345	0.8901	0.9458	(22b)
Effective ach	1.0014	0.9472	0.9472	0.8482	0.7890	0.7615	0.7354	0.7354	0.8033	0.8482	0.8962	0.9472	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.70)			11.3500	1.5918	18.0665			(27)
Opening Type 2 (Uw = 2.00)			2.8500	1.8519	5.2778			(27a)
External Wall 1	50.6900	5.4100	45.2800	0.2600	11.7728	70.0000	3169.6000	(29a)
External Wall 2	36.7500	5.9400	30.8100	0.2700	8.3187	18.0000	554.5800	(29a)
External Roof 1	61.2900	2.8500	58.4400	0.1700	9.9348	9.0000	525.9600	(30)
Total net area of external elements Aum(A, m2)			148.7300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		56.1906			(33)
Stud			14.1000	0.2000	2.8200	20.0000	282.0000	(32)
Party Floor 1			58.2300			30.0000	1746.9000	(32d)
Internal Partition 1			40.6800			9.0000	366.1200	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		6645.1600	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							114.1192	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.1770	(36)
Total fabric heat loss					(33) + (36) =		62.3676	(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	53.8790	50.9649	50.9649	45.6362	42.4537	40.9735	39.5673	39.5673	43.2216	45.6362	48.2173	50.9649	(38)
(39)m	116.2466	113.3325	113.3325	108.0037	104.8213	103.3411	101.9349	101.9349	105.5891	108.0037	110.5848	113.3325	(39)
(40)m	1.9963	1.9463	1.9463	1.8548	1.8001	1.7747	1.7506	1.7506	1.8133	1.8548	1.8991	1.9463	(40)
									Average = Sum(40)m / 12 =			1.8611	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N 1.9312 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 80.0653 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	88.0719	84.8693	81.6667	78.4640	75.2614	72.0588	72.0588	75.2614	78.4640	81.6667	84.8693	88.0719	(44)
(45)m	130.9205	114.5039	118.1578	103.0128	98.8433	85.2942	79.0376	90.6968	91.7800	106.9608	116.7561	126.7895	(45)
Energy content (annual)										Total = Sum(45)m =		1262.7534	(45)
(46)m	19.6381	17.1756	17.7237	15.4519	14.8265	12.7941	11.8556	13.6045	13.7670	16.0441	17.5134	19.0184	(46)
Water storage loss:													
(57)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	(57)
(61)m	47.4156	42.7468	47.1993	45.5323	46.9451	45.3096	46.7445	46.8745	45.4310	47.0941	45.7423	47.3737	(61)
(62)m	178.3361	157.2508	165.3570	148.5451	145.7883	130.6038	125.7822	137.5714	137.2110	154.0549	162.4984	174.1632	(62)
(63)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	178.3361	157.2508	165.3570	148.5451	145.7883	130.6038	125.7822	137.5714	137.2110	154.0549	162.4984	174.1632	(64)
								Total per year (kWh/year) = Sum(64)m =				1817.1622	(64)
RHI water heating demand												1817	(64)
(65)m	55.3850	48.7593	51.0873	45.6348	44.6016	39.6877	37.9661	41.8753	41.8746	47.3380	50.2570	54.0009	(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	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	(66)
(67)m	37.5463	33.3483	27.1206	20.5321	15.3480	12.9574	14.0009	18.1989	24.4265	31.0151	36.1992	38.5898	(67)
(68)m	251.4357	254.0448	247.4699	233.4728	215.8039	199.1976	188.1036	185.4945	192.0694	206.0665	223.7354	240.3417	(68)
(69)m	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	(69)

(70)m	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	(70)
(71)m	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	(71)
(72)m	74.4422	72.5584	68.6657	63.3817	59.9484	55.1218	51.0298	56.2841	58.1592	63.6263	69.8014	72.5819	(72)
(73)m	460.5657	457.0931	440.3979	414.5282	388.2419	364.4185	350.2759	357.1191	371.7967	397.8496	426.8776	448.6550	(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	5.4100	12.7761	0.6300	0.7000	0.7700	21.1235	(75)
Southwest	5.9400	39.7858	0.6300	0.7000	0.7700	72.2249	(79)
Horizontal	2.8500	29.0000	0.6300	0.7000	1.0000	32.8038	(82)

(83)m	126.1521	214.1432	337.5999	473.1332	572.4832	635.7286	606.3308	536.2812	403.9435	269.5603	164.1009	103.5042	(83)
(84)m	586.7179	671.2364	777.9978	887.6614	960.7252	1000.1471	956.6067	893.4003	775.7402	667.4099	590.9785	552.1592	(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	15.8790	16.2873	16.2873	17.0909	17.6098	17.8620	18.1084	18.1084	17.4817	17.0909	16.6920	16.2873	
alpha	2.0586	2.0858	2.0858	2.1394	2.1740	2.1908	2.2072	2.2072	2.1654	2.1394	2.1128	2.0858	
(86)m	0.9337	0.9124	0.8646	0.7914	0.6546	0.4895	0.3194	0.3390	0.6066	0.8092	0.9086	0.9369	(86)
(87)m	18.1048	18.4203	19.0415	19.7047	20.4108	20.7899	20.9510	20.9446	20.6443	19.9032	18.8437	18.2058	(87)
(88)m	19.3424	19.3757	19.3757	19.4376	19.4753	19.4930	19.5099	19.5099	19.4662	19.4376	19.4075	19.3757	(88)
(89)m	0.9204	0.8954	0.8370	0.7496	0.5825	0.3833	0.1787	0.1908	0.4975	0.7581	0.8880	0.9239	(89)
(90)m	16.8588	17.1852	17.7839	18.4461	19.0982	19.3997	19.5020	19.5008	19.2910	18.6515	17.6253	16.9803	(90)
Living area fraction									fLA = Living area / (4) =			0.5542	(91)
(92)m	17.5493	17.8697	18.4808	19.1436	19.8256	20.1701	20.3050	20.3010	20.0410	19.3452	18.3005	17.6594	(92)
Temperature adjustment												-0.1500	
(93)m	17.3993	17.7197	18.3308	18.9936	19.6756	20.0201	20.1550	20.1510	19.8910	19.1952	18.1505	17.5094	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.8991	0.8726	0.8150	0.7357	0.5930	0.4229	0.2420	0.2573	0.5309	0.7485	0.8667	0.9035	(94)
(95)m	527.5420	585.7247	634.0683	653.0354	569.6795	422.9153	231.4519	229.8965	411.8521	499.5570	512.1988	498.8831	(95)
(96)m	5.1000	5.5000	7.4000	9.3000	12.6000	15.4000	17.8000	17.8000	15.1000	11.6000	7.6000	5.5000	(96)
(97)m	1429.7539	1384.8865	1238.8196	1046.9434	741.6756	477.4494	240.0569	239.6462	505.8729	820.3045	1166.7295	1361.0600	(97)
(98)m	671.2456	537.0367	449.9349	283.6138	127.9652	0.0000	0.0000	0.0000	0.0000	238.6361	471.2621	641.4596	(98)
Space heating (October to May) (kWh/year)												3421.1541	(98)
RHI space heating demand												3421	(98)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF ENERGY RATINGS
Calculated by program Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.2300 (1b)	x	2.8000 (2b)	=	163.0440 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.2300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	163.0440	(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							2 * 10	=	20.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1227	(8)
Pressure test			No	
Measured/design q50			15.0000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)			0.8727	(18)
Number of sides on which dwelling is sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.7418	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	1.0014	0.9458	0.9458	0.8345	0.7603	0.7232	0.6861	0.6861	0.7789	0.8345	0.8901	0.9458	(22b)
Effective ach	1.0014	0.9472	0.9472	0.8482	0.7890	0.7615	0.7354	0.7354	0.8033	0.8482	0.8962	0.9472	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.70)			11.3500	1.5918	18.0665			(27)
Opening Type 2 (Uw = 2.00)			2.8500	1.8519	5.2778			(27a)
External Wall 1	50.6900	5.4100	45.2800	0.2600	11.7728	70.0000	3169.6000	(29a)
External Wall 2	36.7500	5.9400	30.8100	0.2700	8.3187	18.0000	554.5800	(29a)
External Roof 1	61.2900	2.8500	58.4400	0.1700	9.9348	9.0000	525.9600	(30)
Total net area of external elements Aum(A, m2)			148.7300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	56.1906			(33)
Stud			14.1000	0.2000	2.8200	20.0000	282.0000	(32)
Party Floor 1			58.2300			30.0000	1746.9000	(32d)
Internal Partition 1			40.6800			9.0000	366.1200	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		6645.1600	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							114.1192	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.1770	(36)
Total fabric heat loss					(33) + (36) =		62.3676	(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	53.8790	50.9649	50.9649	45.6362	42.4537	40.9735	39.5673	39.5673	43.2216	45.6362	48.2173	50.9649	(38)
(39)m	116.2466	113.3325	113.3325	108.0037	104.8213	103.3411	101.9349	101.9349	105.5891	108.0037	110.5848	113.3325	(39)
(40)m	1.9963	1.9463	1.9463	1.8548	1.8001	1.7747	1.7506	1.7506	1.8133	1.8548	1.8991	1.9463	(40)
									Average = Sum(40)m / 12 =			1.8611	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N		1.9312 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		80.0653 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	88.0719	84.8693	81.6667	78.4640	75.2614	72.0588	72.0588	75.2614	78.4640	81.6667	84.8693	88.0719	(44)
(45)m	130.9205	114.5039	118.1578	103.0128	98.8433	85.2942	79.0376	90.6968	91.7800	106.9608	116.7561	126.7895	(45)
Energy content (annual)										Total = Sum(45)m =		1262.7534	(45)
(46)m	19.6381	17.1756	17.7237	15.4519	14.8265	12.7941	11.8556	13.6045	13.7670	16.0441	17.5134	19.0184	(46)
Water storage loss:													
(57)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	(57)
(61)m	47.4156	42.7468	47.1993	45.5323	46.9451	45.3096	46.7445	46.8745	45.4310	47.0941	45.7423	47.3737	(61)
(62)m	178.3361	157.2508	165.3570	148.5451	145.7883	130.6038	125.7822	137.5714	137.2110	154.0549	162.4984	174.1632	(62)
(63)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	178.3361	157.2508	165.3570	148.5451	145.7883	130.6038	125.7822	137.5714	137.2110	154.0549	162.4984	174.1632	(64)
								Total per year (kWh/year) = Sum(64)m =				1817.1622	(64)
(65)m	55.3850	48.7593	51.0873	45.6348	44.6016	39.6877	37.9661	41.8753	41.8746	47.3380	50.2570	54.0009	(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	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	(66)
(67)m	37.5463	33.3483	27.1206	20.5321	15.3480	12.9574	14.0009	18.1989	24.4265	31.0151	36.1992	38.5898	(67)
(68)m	251.4357	254.0448	247.4699	233.4728	215.8039	199.1976	188.1036	185.4945	192.0694	206.0665	223.7354	240.3417	(68)
(69)m	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	(69)
(70)m	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	(70)

(71)m	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469 (71)
(72)m	74.4422	72.5584	68.6657	63.3817	59.9484	55.1218	51.0298	56.2841	58.1592	63.6263	69.8014	72.5819 (72)
(73)m	460.5657	457.0931	440.3979	414.5282	388.2419	364.4185	350.2759	357.1191	371.7967	397.8496	426.8776	448.6550 (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	5.4100	11.5098	0.6300	0.7000	0.7700	19.0298 (75)
Southwest	5.9400	37.3877	0.6300	0.7000	0.7700	67.8714 (79)
Horizontal	2.8500	26.0000	0.6300	0.7000	1.0000	29.4103 (82)

(83)m	116.3115	215.7282	327.2077	469.6371	569.0821	597.4141	577.9287	501.4333	384.5814	257.2201	142.7170	97.2307 (83)
(84)m	576.8773	672.8214	767.6056	884.1653	957.3240	961.8326	928.2046	858.5524	756.3781	655.0697	569.5947	545.8857 (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	15.8790	16.2873	16.2873	17.0909	17.6098	17.8620	18.1084	18.1084	17.4817	17.0909	16.6920	16.2873	
alpha	2.0586	2.0858	2.0858	2.1394	2.1740	2.1908	2.2072	2.2072	2.1654	2.1394	2.1128	2.0858	
(86)m	0.9395	0.9166	0.8757	0.8060	0.6911	0.5520	0.4042	0.4302	0.6609	0.8343	0.9200	0.9420	(86)
(87)m	17.9366	18.3021	18.8871	19.5784	20.2665	20.6925	20.8985	20.8847	20.5157	19.7186	18.6629	18.0456	(87)
(88)m	19.3424	19.3757	19.3757	19.4376	19.4753	19.4930	19.5099	19.5099	19.4662	19.4376	19.4075	19.3757	(88)
(89)m	0.9277	0.9007	0.8510	0.7680	0.6284	0.4558	0.2734	0.2934	0.5675	0.7915	0.9024	0.9304	(89)
(90)m	16.6927	17.0688	17.6352	18.3282	18.9754	19.3344	19.4808	19.4763	19.1949	18.4810	17.4493	16.8220	(90)
Living area fraction										fLA = Living area / (4) =		0.5542	(91)
(92)m	17.3820	17.7522	18.3290	19.0210	19.6909	20.0870	20.2665	20.2568	19.9269	19.1668	18.1218	17.5001	(92)
Temperature adjustment												-0.1500	
(93)m	17.2320	17.6022	18.1790	18.8710	19.5409	19.9370	20.1165	20.1068	19.7769	19.0168	17.9718	17.3501	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9071	0.8780	0.8282	0.7518	0.6314	0.4863	0.3294	0.3514	0.5887	0.7774	0.8814	0.9106	(94)
(95)m	523.2663	590.7441	635.7157	664.7190	604.4282	467.7565	305.7579	301.7248	445.3139	509.2736	502.0205	497.1076	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	1480.0560	1428.2431	1289.6060	1098.5103	821.8967	551.5345	327.8694	326.8840	578.2974	887.4496	1213.3197	1411.0002	(97)
(98)m	711.8515	562.7993	486.4944	312.3298	161.7965	0.0000	0.0000	0.0000	0.0000	281.3629	512.1354	679.9361	(98)
Space heating (October to May) (kWh/year)												3708.7060	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	63.6906	(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 %) 93.0000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	711.8515	562.7993	486.4944	312.3298	161.7965	0.0000	0.0000	0.0000	0.0000	281.3629	512.1354	679.9361	(98)
(211)m	765.4317	605.1606	523.1123	335.8384	173.9748	0.0000	0.0000	0.0000	0.0000	302.5407	550.6833	731.1141	(211)
(215)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	(215)
Annual totals kWh/year													
Space heating fuel used, main system 1												3987.8559	(211)
Space heating fuel used, secondary												0.0000	(215)

Water heating												
(64)m	178.3361	157.2508	165.3570	148.5451	145.7883	130.6038	125.7822	137.5714	137.2110	154.0549	162.4984	174.1632 (64)
Efficiency of water heater												86.7000 (216)
(217)m	89.3189	89.2581	89.1393	88.9093	88.4051	86.7000	86.7000	86.7000	86.7000	88.8041	89.1824	89.3068 (217)
(219)m	199.6621	176.1754	185.5040	167.0750	164.9094	150.6388	145.0775	158.6752	158.2595	173.4772	182.2091	195.0167 (219)

Water heating fuel used 2056.6799 (219)

Electricity for pumps, fans and electric keep-hot (Table 4f):
central heating pump 130.0000 (230c)
boiler with a fan-assisted flue 45.0000 (230e)
Total electricity for the above, kWh/year 175.0000 (231)
Electricity for lighting (calculated in Appendix L) 265.2314 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.14 * 961 * 1.00) -876.4320 (233)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3987.8559	3.1000	123.6235	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating cost (other fuel)	2056.6799	3.1000	63.7571	(247)
Pumps and fans for heating	175.0000	11.4600	20.0550	(249)
Energy for lighting	265.2314	11.4600	30.3955	(250)
Additional standing charges			106.0000	(251)
Energy saving/generation technologies				
PV Unit	-876.4320	11.4600	-100.4391	(252)
Total energy cost			243.3920	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4700 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1081 (257)
SAP value		84.5413
SAP rating (Section 12)		85 (258)
SAP band		B

10a. Fuel costs - using BEDF prices (312)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3987.8559	3.4100	135.9859 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating cost (other fuel)	2056.6799	3.4100	70.1328 (247)
Pumps and fans for heating	175.0000	12.4600	21.8050 (249)
Energy for lighting	265.2314	12.4600	33.0478 (250)
Additional standing charges			110.0000 (251)
Energy saving/generation technologies			
PV Unit	-876.4320	12.4600	-109.2034 (252)
Total energy cost			261.7681 (255)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3987.8559	0.1980	789.5955 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating cost (other fuel)	2056.6799	0.1980	407.2226 (264)
Space and water heating			1196.8181 (265)
Pumps and fans	175.0000	0.5170	90.4750 (267)
Energy for lighting	265.2314	0.5170	137.1247 (268)
Energy saving/generation technologies			
PV Unit	-876.4320	0.5290	-463.6325 (269)
Total CO2, kg/year			960.7852 (272)
CO2 emissions per m2			16.5000 (273)
EI value			87.5283
EI rating			88 (274)
EI band			B

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	3987.8559	1.0200	4067.6130 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating cost (other fuel)	2056.6799	1.0200	2097.8135 (264)
Space and water heating			6165.4265 (265)
Pumps and fans	175.0000	2.9200	511.0000 (267)
Energy for lighting	265.2314	2.9200	774.4758 (268)
Energy saving/generation technologies			
PV Unit	-876.4320	2.9200	-2559.1814 (269)
Primary energy kWh/year			4891.7209 (272)
Primary energy kWh/m2/year			84.0069 (273)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE
Calculated by program Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.2300 (1b)	x	2.8000 (2b)	=	163.0440 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.2300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	163.0440	(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							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1227	(8)
Pressure test		No	
Measured/design q50		15.0000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.8727	(18)
Number of sides on which dwelling is sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.7418	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	1.0014	0.9458	0.9458	0.8345	0.7603	0.7232	0.6861	0.6861	0.7789	0.8345	0.8901	0.9458	(22b)
Effective ach	1.0014	0.9472	0.9472	0.8482	0.7890	0.7615	0.7354	0.7354	0.8033	0.8482	0.8962	0.9472	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.70)			11.3500	1.5918	18.0665			(27)
Opening Type 2 (Uw = 2.00)			2.8500	1.8519	5.2778			(27a)
External Wall 1	50.6900	5.4100	45.2800	0.2600	11.7728	70.0000	3169.6000	(29a)
External Wall 2	36.7500	5.9400	30.8100	0.2700	8.3187	18.0000	554.5800	(29a)
External Roof 1	61.2900	2.8500	58.4400	0.1700	9.9348	9.0000	525.9600	(30)
Total net area of external elements Aum(A, m2)			148.7300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		56.1906			(33)
Stud			14.1000	0.2000	2.8200	20.0000	282.0000	(32)
Party Floor 1			58.2300			30.0000	1746.9000	(32d)
Internal Partition 1			40.6800			9.0000	366.1200	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	6645.1600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		114.1192 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.1770 (36)
Total fabric heat loss	(33) + (36) =	62.3676 (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	53.8790	50.9649	50.9649	45.6362	42.4537	40.9735	39.5673	39.5673	43.2216	45.6362	48.2173	50.9649	(38)
(39)m	116.2466	113.3325	113.3325	108.0037	104.8213	103.3411	101.9349	101.9349	105.5891	108.0037	110.5848	113.3325	(39)
(40)m	1.9963	1.9463	1.9463	1.8548	1.8001	1.7747	1.7506	1.7506	1.8133	1.8548	1.8991	1.9463	(40)
									Average = Sum(40)m / 12 =			1.8611	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N	1.9312 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	80.0653 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	88.0719	84.8693	81.6667	78.4640	75.2614	72.0588	72.0588	75.2614	78.4640	81.6667	84.8693	88.0719	(44)
(45)m	130.9205	114.5039	118.1578	103.0128	98.8433	85.2942	79.0376	90.6968	91.7800	106.9608	116.7561	126.7895	(45)
Energy content (annual)										Total = Sum(45)m =		1262.7534	(45)
(46)m	19.6381	17.1756	17.7237	15.4519	14.8265	12.7941	11.8556	13.6045	13.7670	16.0441	17.5134	19.0184	(46)
Water storage loss:													
(57)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	(57)
(61)m	47.4156	42.7468	47.1993	45.5323	46.9451	45.3096	46.7445	46.8745	45.4310	47.0941	45.7423	47.3737	(61)
(62)m	178.3361	157.2508	165.3570	148.5451	145.7883	130.6038	125.7822	137.5714	137.2110	154.0549	162.4984	174.1632	(62)
(63)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	178.3361	157.2508	165.3570	148.5451	145.7883	130.6038	125.7822	137.5714	137.2110	154.0549	162.4984	174.1632	(64)
								Total per year (kWh/year) = Sum(64)m =				1817.1622	(64)
(65)m	55.3850	48.7593	51.0873	45.6348	44.6016	39.6877	37.9661	41.8753	41.8746	47.3380	50.2570	54.0009	(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	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	(66)
(67)m	15.0185	13.3393	10.8482	8.2128	6.1392	5.1830	5.6004	7.2796	9.7706	12.4060	14.4797	15.4359	(67)
(68)m	168.4619	170.2100	165.8048	156.4267	144.5886	133.4624	126.0294	124.2813	128.6865	138.0646	149.9027	161.0289	(68)
(69)m	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	(69)
(70)m	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	(70)

(71)m	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	(71)
(72)m	74.4422	72.5584	68.6657	63.3817	59.9484	55.1218	51.0298	56.2841	58.1592	63.6263	69.8014	72.5819	(72)
(73)m	319.8901	318.0753	307.2864	289.9889	272.6438	255.7348	244.6271	249.8125	258.5838	276.0645	296.1513	311.0143	(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	5.4100	11.5098	0.6300	0.7000	0.7700	19.0298	(75)
Southwest	5.9400	37.3877	0.6300	0.7000	0.7700	67.8714	(79)
Horizontal	2.8500	26.0000	0.6300	0.7000	1.0000	29.4103	(82)

(83)m	116.3115	215.7282	327.2077	469.6371	569.0821	597.4141	577.9287	501.4333	384.5814	257.2201	142.7170	97.2307	(83)
(84)m	436.2017	533.8036	634.4940	759.6260	841.7259	853.1489	822.5558	751.2458	643.1653	533.2846	438.8684	408.2450	(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	15.8790	16.2873	16.2873	17.0909	17.6098	17.8620	18.1084	18.1084	17.4817	17.0909	16.6920	16.2873	
alpha	2.0586	2.0858	2.0858	2.1394	2.1740	2.1908	2.2072	2.2072	2.1654	2.1394	2.1128	2.0858	
(86)m	0.9630	0.9436	0.9079	0.8434	0.7336	0.5959	0.4448	0.4765	0.7160	0.8782	0.9490	0.9655	(86)
(87)m	17.6651	18.0474	18.6703	19.4124	20.1632	20.6393	20.8765	20.8577	20.4238	19.5381	18.4175	17.7748	(87)
(88)m	19.3424	19.3757	19.3757	19.4376	19.4753	19.4930	19.5099	19.5099	19.4662	19.4376	19.4075	19.3757	(88)
(89)m	0.9553	0.9322	0.8882	0.8102	0.6738	0.4981	0.3048	0.3301	0.6262	0.8435	0.9370	0.9581	(89)
(90)m	16.4290	16.8244	17.4330	18.1812	18.8949	19.3028	19.4736	19.4672	19.1331	18.3225	17.2148	16.5588	(90)
Living area fraction										fLA = Living area / (4) =		0.5542	(91)
(92)m	17.1140	17.5022	18.1187	18.8635	19.5978	20.0434	20.2510	20.2378	19.8484	18.9962	17.8813	17.2327	(92)
Temperature adjustment												-0.1500	
(93)m	16.9640	17.3522	17.9687	18.7135	19.4478	19.8934	20.1010	20.0878	19.6984	18.8462	17.7313	17.0827	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9394	0.9127	0.8660	0.7914	0.6726	0.5265	0.3639	0.3911	0.6419	0.8267	0.9193	0.9432	(94)
(95)m	409.7737	487.2194	549.4636	601.1884	566.1426	449.2041	299.3313	293.8304	412.8677	440.8473	403.4576	385.0628	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	1448.9004	1399.9012	1265.7776	1081.4954	812.1303	547.0300	326.2976	324.9455	570.0096	869.0180	1186.7187	1380.6938	(97)
(98)m	773.1103	613.3221	532.9376	345.8211	183.0148	0.0000	0.0000	0.0000	0.0000	318.5589	563.9480	740.7495	(98)
Space heating (October to May) (kWh/year)												4071.4623	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	69.9204	(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 %)	93.0000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	773.1103	613.3221	532.9376	345.8211	183.0148	0.0000	0.0000	0.0000	0.0000	318.5589	563.9480	740.7495	(98)
(211)m	831.3014	659.4862	573.0512	371.8506	196.7901	0.0000	0.0000	0.0000	0.0000	342.5365	606.3957	796.5048	(211)
(215)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	(215)

Annual totals kWh/year

Space heating fuel used, main system 1	4377.9165 (211)
Space heating fuel used, secondary	0.0000 (215)

Water heating

(64)m	178.3361	157.2508	165.3570	148.5451	145.7883	130.6038	125.7822	137.5714	137.2110	154.0549	162.4984	174.1632	(64)
Efficiency of water heater												86.7000	(216)
(217)m	89.3625	89.3063	89.1961	88.9823	88.5063	86.7000	86.7000	86.7000	86.7000	88.8971	89.2402	89.3526	(217)
(219)m	199.5649	176.0802	185.3860	166.9378	164.7208	150.6388	145.0775	158.6752	158.2595	173.2958	182.0910	194.9168	(219)

Water heating fuel used	2055.6443 (219)

Electricity for pumps, fans and electric keep-hot (Table 4f):

central heating pump	130.0000 (230c)
boiler with a fan-assisted flue	45.0000 (230e)
Total electricity for the above, kWh/year	175.0000 (231)
Electricity for lighting (calculated in Appendix L)	265.2314 (232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV Unit 0 (0.80 * 1.14 * 961 * 1.00)	-876.4320	(233)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4377.9165	0.1980	866.8275	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating cost (other fuel)	2055.6443	0.1980	407.0176	(264)
Space and water heating			1273.8450	(265)
Pumps and fans	175.0000	0.5170	90.4750	(267)
Energy for lighting	265.2314	0.5170	137.1247	(268)
Energy saving/generation technologies				
PV Unit	-876.4320	0.5290	-463.6325	(269)
Total CO2, kg/year			1037.8122	(272)

Dwelling Carbon Dioxide Emission Rate (DER)	17.8200 (273)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF TARGET EMISSIONS
Calculated by program Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.2300 (1b)	x	2.8000 (2b)	=	163.0440 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.2300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	163.0440	(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							2 * 10	=	20.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1227	(8)
Pressure test		Yes	
Measured/design q50		10.0000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.6227	(18)
Number of sides on which dwelling is sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.5293	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.7145	0.6748	0.6748	0.5954	0.5425	0.5160	0.4896	0.4896	0.5557	0.5954	0.6351	0.6748	(22b)
Effective ach	0.7553	0.7277	0.7277	0.6773	0.6472	0.6331	0.6198	0.6198	0.6544	0.6773	0.7017	0.7277	(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	
Doors			1.8500	2.0000	3.7000			(26)
Windows (Uw = 2.00)			12.7075	1.8519	23.5324			(27)
External Wall 1	87.4400	14.5575	72.8825	0.3500	25.5089			(29a)
External Roof 1	61.2900		61.2900	0.1600	9.8064			(30)
Total net area of external elements Aum(A, m2)			148.7300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	62.5477			(33)
Stud			14.1000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.110 * total exposed area)	16.3603	(36)
Total fabric heat loss	(33) + (36) = 78.9080	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.6365	39.1529	39.1529	36.4399	34.8197	34.0661	33.3502	33.3502	35.2106	36.4399	37.7540	39.1529	(38)
(39)m	119.5445	118.0609	118.0609	115.3479	113.7277	112.9741	112.2582	112.2582	114.1186	115.3479	116.6620	118.0609	(39)
(40)m	2.0530	2.0275	2.0275	1.9809	1.9531	1.9401	1.9278	1.9278	1.9598	1.9809	2.0035	2.0275	(40)
									Average = Sum(40)m / 12 =			1.9841	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N	1.9312 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	84.2793 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	92.7072	89.3361	85.9649	82.5937	79.2226	75.8514	75.8514	79.2226	82.5937	85.9649	89.3361	92.7072	(44)
(45)m	137.8111	120.5304	124.3766	108.4345	104.0455	89.7834	83.1975	95.4703	96.6106	112.5903	122.9011	133.4627	(45)
Energy content (annual)										Total = Sum(45)m =		1329.2141	(45)
(46)m	20.6717	18.0796	18.6565	16.2652	15.6068	13.4675	12.4796	14.3206	14.4916	16.8885	18.4352	20.0194	(46)

Water storage loss:		
b) If manufacturer declared cylinder loss factor is not known :		
Cylinder volume (litres) including any solar storage within same cylinder	150.0000	(50)
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0191	(51)
Volume factor from Table 2a	0.9283	(52)
Temperature factor from Table 2b	0.5400	(53)
Enter (49) or (54) in (55)	1.4364	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	44.5282	43.0918	44.5282	43.0918	44.5282	(57)
Primary circuit loss (annual) from Table 3												610.0000	(58)
(59)m	51.8082	46.7945	51.8082	50.1370	51.8082	50.1370	51.8082	51.8082	50.1370	51.8082	50.1370	51.8082	(59)
(62)m	234.1475	207.5440	220.7130	201.6633	200.3819	183.0122	179.5339	191.8068	189.8394	208.9267	216.1299	229.7991	(62)
(63)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	234.1475	207.5440	220.7130	201.6633	200.3819	183.0122	179.5339	191.8068	189.8394	208.9267	216.1299	229.7991	(64)
								Total per year (kWh/year) = Sum(64)m =				2463.4976	(64)
(65)m	122.8913	109.6872	118.4244	110.6375	111.6643	104.4360	104.7323	108.8130	106.7060	114.5054	115.4476	121.4455	(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	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	(66)
(67)m	25.5475	22.6911	18.4536	13.9706	10.4432	8.8166	9.5266	12.3831	16.6205	21.1036	24.6310	26.2576	(67)

(68)m	168.4619	170.2100	165.8048	156.4267	144.5886	133.4624	126.0294	124.2813	128.6865	138.0646	149.9027	161.0289 (68)
(69)m	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559 (69)
(70)m	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000 (70)
(71)m	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469 (71)
(72)m	165.1765	163.2250	159.1725	153.6632	150.0864	145.0500	140.7692	146.2541	148.2028	153.9051	160.3440	163.2331 (72)
(73)m	421.1535	418.0937	405.3986	386.0281	367.0857	349.2965	338.2928	344.8860	355.4774	375.0408	396.8452	412.4872 (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
East	12.7075	19.8726	0.7200	0.7000	0.7700	88.2019 (76)

(83)m	88.2019	170.9603	273.2496	405.7108	493.6345	515.0825	499.9459	435.1139	326.6811	208.1975	109.6578	72.7578 (83)
(84)m	509.3554	589.0540	678.6482	791.7389	860.7203	864.3790	838.2387	779.9999	682.1585	583.2383	506.5031	485.2451 (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	33.8263	34.2514	34.2514	35.0570	35.5564	35.7936	36.0219	36.0219	35.4346	35.0570	34.6621	34.2514	
alpha	3.2551	3.2834	3.2834	3.3371	3.3704	3.3862	3.4015	3.4015	3.3623	3.3371	3.3108	3.2834	
(86)m	0.9909	0.9849	0.9688	0.9314	0.8434	0.6989	0.5144	0.5455	0.8126	0.9491	0.9856	0.9916	(86)
(87)m	18.9671	19.1800	19.5830	20.0456	20.5332	20.8323	20.9589	20.9509	20.7045	20.1273	19.4170	19.0259	(87)
(88)m	19.3053	19.3219	19.3219	19.3526	19.3712	19.3798	19.3881	19.3881	19.3667	19.3526	19.3377	19.3219	(88)
(89)m	0.9876	0.9793	0.9565	0.9036	0.7764	0.5701	0.3279	0.3510	0.7034	0.9212	0.9794	0.9884	(89)
(90)m	17.5506	17.7728	18.1688	18.6336	19.0839	19.3133	19.3818	19.3803	19.2284	18.7233	18.0210	17.6211	(90)
Living area fraction										fLA = Living area / (4) =		0.5542	(91)
(92)m	18.3356	18.5526	18.9525	19.4161	19.8871	20.1551	20.2558	20.2507	20.0464	19.5013	18.7947	18.3996	(92)
Temperature adjustment												0.0000	
(93)m	18.3356	18.5526	18.9525	19.4161	19.8871	20.1551	20.2558	20.2507	20.0464	19.5013	18.7947	18.3996	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9849	0.9759	0.9530	0.9049	0.8005	0.6369	0.4326	0.4605	0.7553	0.9244	0.9766	0.9859	(94)
(95)m	501.6808	574.8668	646.7429	716.4736	689.0097	550.5062	362.6421	359.1588	515.2566	539.1262	494.6422	478.4032	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	1653.9699	1600.0368	1434.7368	1236.0773	931.0954	627.5821	376.7145	376.1405	655.7741	1003.6824	1375.9876	1593.7756	(97)
(98)m	857.3031	688.9143	586.2674	374.1147	180.1117	0.0000	0.0000	0.0000	0.0000	345.6299	634.5687	829.8371	(98)
Space heating (October to May) (kWh/year)												4496.7468	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	77.2239	(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)	0.1000 (201)
Fraction of space heat from main system(s)	0.9000 (202)
Efficiency of main space heating system 1 (in %)	78.9000 (206)
Efficiency of secondary/supplementary heating system, %	100.0000 (208)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	857.3031	688.9143	586.2674	374.1147	180.1117	0.0000	0.0000	0.0000	0.0000	345.6299	634.5687	829.8371	(98)
(211)m	977.9122	785.8338	668.7461	426.7468	205.4506	0.0000	0.0000	0.0000	0.0000	394.2546	723.8426	946.5822	(211)
(215)m	85.7303	68.8914	58.6267	37.4115	18.0112	0.0000	0.0000	0.0000	0.0000	34.5630	63.4569	82.9837	(215)

Annual totals kWh/year	
Space heating fuel used, main system 1	5129.3689 (211)
Space heating fuel used, secondary	449.6747 (215)

Water heating

(64)m	234.1475	207.5440	220.7130	201.6633	200.3819	183.0122	179.5339	191.8068	189.8394	208.9267	216.1299	229.7991 (64)

Efficiency of water heater	68.8000 (216)

(217)m	76.2925	76.0983	75.6257	74.7875	72.9776	68.8000	68.8000	68.8000	68.8000	74.5054	75.8433	76.2657 (217)
(219)m	306.9077	272.7313	291.8494	269.6486	274.5799	266.0061	260.9505	278.7889	275.9293	280.4181	284.9691	301.3139 (219)

Water heating fuel used	3364.0926 (219)
Electricity for pumps, fans and electric keep-hot (Table 4f):	
central heating pump	130.0000 (230c)
boiler with a fan-assisted flue	45.0000 (230e)
Total electricity for the above, kWh/year	175.0000 (231)
Electricity for lighting (calculated in Appendix L)	451.1777 (232)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5129.3689	0.1940	995.0976	(261)
Space heating - secondary	449.6747	0.4220	189.7627	(263)
Water heating cost (other fuel)	3364.0926	0.1940	652.6340	(264)
Space and water heating			1837.4943	(265)
Pumps and fans	175.0000	0.4220	73.8500	(267)
Energy for lighting	451.1777	0.4220	190.3970	(268)
Total CO2, kg/year			2101.7412	(272)
Emissions per m2 for space and water heating			32.8240	(272a)
Emissions per m2 for lighting			3.2697	(272b)
Target Carbon Dioxide Emission Rate (TER)			22.5000	(273)

= [(32.8240 * 1.00 * 1.0206) + (3.2697 * 1.2251)] * 0.60

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING
Calculated by program Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20

No improvements selected

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2010 Edition
Calculated by program Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20

New Build (As Designed)

1 TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 22.50 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.82 kg/m²OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.26 (max. 0.30)	0.27 (max. 0.70)	OK
Party wall	0.20 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.17 (max. 0.20)	0.17 (max. 0.35)	OK
Openings	1.76 (max. 2.00)	2.00 (max. 3.30)	OK

3 Design air permeability
Design air permeability at 50 pascals: 15.0 (assumed) OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Worcester Greenstar 24i junior
Combi boiler
Efficiency: 89.1% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Programmer, room thermostat and TRVs 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
Windows facing North East: 5.41 m², No overhang
Windows facing South West: 5.94 m², No overhang
Windows facing Horizontal: 2.85 m², No overhang
Ventilation rate: 6.00
Blinds/curtains: None

10 Key features
Photovoltaic array

SAP 2009 OVERHEATING ASSESSMENT FOR New Build (As Designed) BRE SAP Worksheet 9.90
Calculated by program Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20

Overheating Calculation Input Data

Dwelling type	EndTerrace Flat
Number of storeys	1
Cross ventilation possible	Yes
Region	Thames Valley
Front of dwelling faces	South West
Overshading	Average or unknown
Thermal mass parameter	114.1 (calculated from construction elements)
Night ventilation	Yes
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	322.83 (P1)
Transmission heat loss coefficient	62.37 (37)
Summer heat loss coefficient	385.19 (P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (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 East	5.4100	98.9568	0.6300	0.7000	0.9000	191.2346
South West	5.9400	116.7611	0.6300	0.7000	0.9000	247.7470
Horizontal	2.8500	204.0000	0.6300	0.7000	1.0000	230.7577
					total:	669.7392

	Jun	Jul	Aug	
Solar gains	702	670	593	(P3)
Internal gains	354	340	347	
Total summer gains	1057	1010	940	(P5)
Summer gain/loss ratio	2.74	2.62	2.44	(P6)
Summer external temperature	15.40	17.80	17.80	
Thermal mass temperature increment (TMP = 114.1)	0.00	0.00	0.00	
Threshold temperature	19.34	21.62	21.44	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

SAP 2009 IMPROVEMENTS
Calculated by program Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20

5648-0001-0366

Current energy efficiency rating: B 85
Current environmental impact rating: B 88

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
L	Not considered
M	Not considered
N Solar water heating	Not applicable
O	Not considered
P	Not considered
Q	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic (PV) panels	Not applicable
V Wind turbine	Not applicable

Recommended measures: SAP change Cost change CO2 change
(none)

		Typical annual savings		Energy efficiency	Environmental impact
Lower cost measures					
(none)					
	Sub Total	£0	0.0000 kg/m²		
Higher cost measures					
(none)					
	Sub Total	£0	0.0000 kg/m²		

Potential energy efficiency rating: B 85
Potential environmental impact rating: B 88

Further improvements to achieve even higher standards
(none)

Total Savings £0 0.0000 kg/m²

Enhanced energy efficiency rating: B 85
Enhanced environmental impact rating: B 88

Fuel prices for cost data on this page from database revision number 312 TEST (29 Jul 2011)
Recommendation texts revision number 3.0 (01 Mar 2011)

Typical heating and lighting costs of this home (per year):

	Current	Potential	Enhanced
Electricity	£55	£55	£55
Mains gas	£316	£316	£316
Space heating	£268	£268	£268
Water heating	£70	£70	£70
Lighting	£33	£33	£33
Generated (PV)	-£109	-£109	-£109
Total cost	£262	£262	£262
Carbon dioxide emissions	1.0 tonnes	1.0 tonnes	1.0 tonnes
Primary energy	84 kWh/m²	84 kWh/m²	84 kWh/m²

Full SAP Calculation Printout

Users Ref: 5648-0001-0366 **Issued On Date:** 06.Sep.2011
EES Ref: 5648-0001-0366 **Prop Type Ref:**
Property: 10-13, Flat 2, Charlotte Street, London, W1T 2LT, **DER:** 22.49
TER: 22.50

SAP Rating:	**80 C**	**CO2 Emissions:** 1.23 t/year	**Fabric Energy:** 62.1	**Energy used:** 111 kWh/m/year			
EI Rating:	**84 B**	**SAP Energy Cost:** £ 338.07	**HLP:** 1.58	**Ene1:** 0	**ZC:** 0.00		

Surveyor: Paul Carter, Tel: 01452 50335
Address: Stanmoor, Abbeydale, Goucester, GL4 5BT
Client:

Software Version: Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20
SAP version: SAP 2009, Regs Region: England and Wales (Part L1A 2010), Calculation Type: New Design,

CALCULATION DETAILS for survey reference no '5648-0001-0366'
SAP2009 - 9.81 input data (DesignData) -


```
-----------------------------------------------------------------------------------------------
          SAP2009 Input Data
-----------------------------------------------------------------------------------------------
FullRefNo:                    5648-0001-0366
Sap Version:                  SAP 2009
Regs Region:                  England & Wales
Region:                       Thames Valley
Calculation Type:             New Build (As Designed)
DwellingOrientation:          South West
Property Type:                Flat, End-Terrace
Storeys:                      1
Date Built:                   2011
Sheltered Sides:              2
Sunlight Shade:               Average or unknown
Measurements                  Perimeter, Floor Area, Storey Height
    1st Storey:              26.4, 58.23, 2.8
Living Area:                  32.27 m2, fraction: 55.4%
Thermal Mass:                 Precise calculation
External Walls                Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
    External Wall 1          45.28, 50.69, 70, , CavityWallDensePlasterAACblock, , Cavity, 0, 0.26, Nett
    External Wall 2          30.81, 36.75, 18, , TimberWallTwoLayers, , TimberFrame, 0, 0.27, Nett
Party Walls                   Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
    Stud party wall          14.1, 20, , PartyWallDoublePlaster, , UnfilledWithEdge, 0, 0.2
Internal Walls                Area, Kappa
    Internal Partition 1     40.68, 9
External Roofs                Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
    External Roof 1          58.44, 61.29, 9, PlasterInsulatedFlatRoof, , , 0.17
Heat Loss Floors              Area, Kappa, Construction, Element, Type, UValueFinal, ShelterFactor
Party Floors                  Area, Kappa, Construction, Element
    Party Floor 1            58.23, 30
Description                   Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
    Opening Type 1           SAP table, Window, Double Low-E Soft 0.05, 20 mm, True, 0.63, Wood, 0.7, 1.70
    Opening Type 2           SAP table, Roof Window, Double Low-E Soft 0.05, 20 mm, True, 0.63, Wood, 0.7, 2.00
Openings                      Opening Type, Location, Orientation, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
    Opening 1 Front          Window, External Wall 2, Southwest, None, 0, , 0, 0, 0, 5.94,
    Opening 2 Rear           Window, External Wall 1, Northeast, None, 0, , 0, 0, 0, 5.41,
    Opening 3 Roof           Roof Window, External Roof 1, Horizontal, None, , , 0, 0, 0, 2.85,
Conservatory:                 None
Draught Proofing:             100
Draught Lobby:                No
Thermal Bridges               Bridge Type, Length, Psi
    0.                       Other lintels (including other steel lintels), 9.1, 0.3
    1.                       Jamb, 22.8, 0.05
    2.                       Sill, 7, 0.04
    3.                       Eaves (insulation at rafter level), 19.2, 0.04
    4.                       Gable (insulation at rafter level), 2.1, 0.04
    5.                       Flat roof, 5.9, 0.04
    6.                       Corner (normal), 9.75, 0.09
    7.                       Corner (inverted - internal area greater than external area), 3.25, -0.09
    8.                       Party wall between dwellings, 5.9, 0.06
Pressure Test:                True
Designed q50:                 3.8
AsBuilt q50:                  15
Property Tested:              False
Mechanical Ventilation        None
Chimneys MHS:                 0
Chimneys SHS:                 0
Chimneys Other:               0
Chimneys Total:               0
Open Flues MHS:               0
Open Flues SHS:               0
Open Flues Other:             0
Open Flues Total:             0
Intermittent Fans:            2
Passive Vents:                0
Flueless Gas Fires:           0
Cooling System                None
Light Fittings:               5
LEL Fittings:                 5
Percentage of LEL Fittings:   100
External Lights Fitted:       No
External LELs Fitted:         No
Electricity Tariff:           Standard
Main Heating 1
    Description              Gas heating
    Percentage               100
```

Sedbuk ID	10243
Fuel Type	Mains gas
MHS	BGW - Mains gas BGW Post 98 Combi condens. with auto ign.
SAP Code	104
Boiler Efficiency Type	Split Efficiences
Efficiency Winter	90
Efficiency Summer	86.7
MHS Controls	CBD
Dealayed Start Stat	Yes
Ctrl SAP Code	2106
Boiler Compensator	WeatherCompensator
Flue Type	Balanced
Fan Assisted Flue	Yes
Pumped	Pump in heated space
Heat Emitter	Radiators
Combi boiler type	Standard Combi
Combi keep hot type	Gas/Oil, time clock
Main Heating 2	None
Smoke Control Area	Unknown
Community Heating	None
Secondary Heating	None
Water Heating	
Type	MainHeating1
WHS	HWP -
Low Water Usage	Yes
SAP Code	901
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

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF FABRIC ENERGY EFFICIENCY
Calculated by program Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.2300 (1b)	x	2.8000 (2b)	=	163.0440 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.2300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	163.0440	(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							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1227	(8)
Pressure test		Yes	
Measured/design q50		3.8000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3127	(18)
Number of sides on which dwelling is sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.3588	0.3389	0.3389	0.2990	0.2724	0.2591	0.2458	0.2458	0.2791	0.2990	0.3189	0.3389	(22b)
Effective ach	0.5644	0.5574	0.5574	0.5447	0.5371	0.5336	0.5302	0.5302	0.5389	0.5447	0.5509	0.5574	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.70)			11.3500	1.5918	18.0665			(27)
Opening Type 2 (Uw = 2.00)			2.8500	1.8519	5.2778			(27a)
External Wall 1	50.6900	5.4100	45.2800	0.2600	11.7728	70.0000	3169.6000	(29a)
External Wall 2	36.7500	5.9400	30.8100	0.2700	8.3187	18.0000	554.5800	(29a)
External Roof 1	61.2900	2.8500	58.4400	0.1700	9.9348	9.0000	525.9600	(30)
Total net area of external elements Aum(A, m2)			148.7300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		56.1906			(33)
Stud party wall			14.1000	0.2000	2.8200	20.0000	282.0000	(32)
Party Floor 1			58.2300			30.0000	1746.9000	(32d)
Internal Partition 1			40.6800			9.0000	366.1200	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		6645.1600	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							114.1192	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.1770	(36)
Total fabric heat loss					(33) + (36) =		62.3676	(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	30.3653	29.9912	29.9912	29.3071	28.8986	28.7086	28.5281	28.5281	28.9972	29.3071	29.6385	29.9912	(38)
(39)m	92.7328	92.3588	92.3588	91.6747	91.2662	91.0762	90.8956	90.8956	91.3647	91.6747	92.0060	92.3588	(39)
(40)m	1.5925	1.5861	1.5861	1.5744	1.5673	1.5641	1.5610	1.5610	1.5690	1.5744	1.5800	1.5861	(40)
									Average = Sum(40)m / 12 =			1.5752	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N	1.9312	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	80.0653	(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	88.0719	84.8693	81.6667	78.4640	75.2614	72.0588	72.0588	75.2614	78.4640	81.6667	84.8693	88.0719	(44)
(45)m	130.9205	114.5039	118.1578	103.0128	98.8433	85.2942	79.0376	90.6968	91.7800	106.9608	116.7561	126.7895	(45)
Energy content (annual)										Total = Sum(45)m =		1262.7534	(45)
(46)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:													
(57)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	(57)
Primary circuit loss (annual) from Table 3												0.0000	(58)
(59)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	(59)
(65)m	27.8206	24.3321	25.1085	21.8902	21.0042	18.1250	16.7955	19.2731	19.5033	22.7292	24.8107	26.9428	(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	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	(66)
(67)m	15.0185	13.3393	10.8482	8.2128	6.1392	5.1830	5.6004	7.2796	9.7706	12.4060	14.4797	15.4359	(67)
(68)m	168.4619	170.2100	165.8048	156.4267	144.5886	133.4624	126.0294	124.2813	128.6865	138.0646	149.9027	161.0289	(68)
(69)m	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	(69)
(70)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	(70)
(71)m	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	(71)
(72)m	37.3933	36.2085	33.7480	30.4031	28.2314	25.1736	22.5746	25.9047	27.0879	30.5500	34.4593	36.2134	(72)
(73)m	272.8413	271.7254	262.3687	247.0102	230.9268	215.7866	206.1719	209.4331	217.5125	232.9881	250.8092	264.6458	(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	5.4100	11.5098	0.6300	0.7000	0.7700	19.0298 (75)
Southwest	5.9400	37.3877	0.6300	0.7000	0.7700	67.8714 (79)
Horizontal	2.8500	26.0000	0.6300	0.7000	1.0000	29.4103 (82)

(83)m	116.3115	215.7282	327.2077	469.6371	569.0821	597.4141	577.9287	501.4333	384.5814	257.2201	142.7170	97.2307 (83)
(84)m	389.1528	487.4536	589.5764	716.6473	800.0089	813.2007	784.1006	710.8664	602.0939	490.2082	393.5263	361.8765 (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	19.9053	19.9860	19.9860	20.1351	20.2252	20.2674	20.3077	20.3077	20.2034	20.1351	20.0626	19.9860	
alpha	2.3270	2.3324	2.3324	2.3423	2.3483	2.3512	2.3538	2.3538	2.3469	2.3423	2.3375	2.3324	
(86)m	0.9688	0.9483	0.9083	0.8384	0.7218	0.5788	0.4281	0.4626	0.7070	0.8815	0.9557	0.9717	(86)
(87)m	18.1430	18.4793	19.0739	19.6882	20.3229	20.7197	20.9075	20.8905	20.5349	19.7474	18.7324	18.1818	(87)
(88)m	19.6230	19.6277	19.6277	19.6363	19.6415	19.6439	19.6461	19.6461	19.6402	19.6363	19.6322	19.6277	(88)
(89)m	0.9629	0.9387	0.8907	0.8074	0.6660	0.4896	0.3034	0.3311	0.6247	0.8503	0.9459	0.9661	(89)
(90)m	17.0767	17.4100	17.9904	18.5805	19.1624	19.4909	19.6168	19.6106	19.3614	18.6570	17.6679	17.1192	(90)
Living area fraction										fLA = Living area / (4) =		0.5542	(91)
(92)m	17.6676	18.0026	18.5908	19.1943	19.8056	20.1719	20.3321	20.3199	20.0117	19.2613	18.2578	17.7081	(92)
Temperature adjustment												0.0000	
(93)m	17.6676	18.0026	18.5908	19.1943	19.8056	20.1719	20.3321	20.3199	20.0117	19.2613	18.2578	17.7081	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9513	0.9237	0.8741	0.7957	0.6734	0.5265	0.3692	0.3998	0.6497	0.8398	0.9328	0.9553	(94)
(95)m	370.2034	450.2524	515.3395	570.2146	538.7592	428.1807	289.4782	284.2321	391.1610	411.6944	367.0718	345.7086	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	1221.0685	1200.9017	1088.9860	962.0663	739.7645	507.4674	311.9593	310.8549	521.8523	775.6850	1035.7869	1182.9382	(97)
(98)m	633.0436	504.4363	426.7930	282.1333	149.5480	0.0000	0.0000	0.0000	0.0000	270.8090	481.4748	622.8988	(98)
Space heating (October to May) (kWh/year)												3371.1369	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	57.8935	(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.	0.0000	0.0000	0.0000	0.0000	0.0000	15.4000	17.8000	17.8000	0.0000	0.0000	0.0000	0.0000	
(100)m	0.0000	0.0000	0.0000	0.0000	0.0000	783.2549	563.5529	563.5529	0.0000	0.0000	0.0000	0.0000	(100)
(101)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.7895	0.8634	0.8458	0.0000	0.0000	0.0000	0.0000	(101)
(102)m	0.0000	0.0000	0.0000	0.0000	0.0000	618.4035	486.5731	476.6522	0.0000	0.0000	0.0000	0.0000	(102)
(103)m	0.0000	0.0000	0.0000	0.0000	0.0000	1026.6609	981.5599	909.7591	0.0000	0.0000	0.0000	0.0000	(103)
(98)m	0.0000	0.0000	0.0000	0.0000	0.0000	27.1566	4.5915	5.3479	0.0000	0.0000	0.0000	0.0000	(98)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	293.9453	368.2702	322.2315	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.000	(105)
(106)m	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)
(107)m	0.0000	0.0000	0.0000	0.0000	0.0000	73.4863	92.0676	80.5579	0.0000	0.0000	0.0000	0.0000	(107)
										Total = Sum(107)6..8 =		246.1118	(107)
Space cooling requirement in kWh/m2/year											(107) / (4) =	4.2265	(108)

8f. Fabric Energy Efficiency

Fabric Energy Efficiency	(99) + (108) =	62.1200
Fabric Energy Efficiency rounded		62.1 (109)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF DATA FOR RENEWABLE HEAT INCENTIVE (RHI)
Calculated by program Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.2300 (1b)	x	2.8000 (2b)	=	163.0440 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.2300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	163.0440	(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							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1227	(8)
Pressure test		Yes	
Measured/design q50		3.8000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3127	(18)
Number of sides on which dwelling is sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.3588	0.3389	0.3389	0.2990	0.2724	0.2591	0.2458	0.2458	0.2791	0.2990	0.3189	0.3389	(22b)
Effective ach	0.5644	0.5574	0.5574	0.5447	0.5371	0.5336	0.5302	0.5302	0.5389	0.5447	0.5509	0.5574	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.70)			11.3500	1.5918	18.0665			(27)
Opening Type 2 (Uw = 2.00)			2.8500	1.8519	5.2778			(27a)
External Wall 1	50.6900	5.4100	45.2800	0.2600	11.7728	70.0000	3169.6000	(29a)
External Wall 2	36.7500	5.9400	30.8100	0.2700	8.3187	18.0000	554.5800	(29a)
External Roof 1	61.2900	2.8500	58.4400	0.1700	9.9348	9.0000	525.9600	(30)
Total net area of external elements Aum(A, m2)			148.7300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		56.1906			(33)
Stud party wall			14.1000	0.2000	2.8200	20.0000	282.0000	(32)
Party Floor 1			58.2300			30.0000	1746.9000	(32d)
Internal Partition 1			40.6800			9.0000	366.1200	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		6645.1600	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							114.1192	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.1770	(36)
Total fabric heat loss					(33) + (36) =		62.3676	(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	30.3653	29.9912	29.9912	29.3071	28.8986	28.7086	28.5281	28.5281	28.9972	29.3071	29.6385	29.9912	(38)
(39)m	92.7328	92.3588	92.3588	91.6747	91.2662	91.0762	90.8956	90.8956	91.3647	91.6747	92.0060	92.3588	(39)
(40)m	1.5925	1.5861	1.5861	1.5744	1.5673	1.5641	1.5610	1.5610	1.5690	1.5744	1.5800	1.5861	(40)
									Average = Sum(40)m / 12 =			1.5752	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N	1.9312	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	80.0653	(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	88.0719	84.8693	81.6667	78.4640	75.2614	72.0588	72.0588	75.2614	78.4640	81.6667	84.8693	88.0719	(44)
(45)m	130.9205	114.5039	118.1578	103.0128	98.8433	85.2942	79.0376	90.6968	91.7800	106.9608	116.7561	126.7895	(45)
Energy content (annual)										Total = Sum(45)m =		1262.7534	(45)
(46)m	19.6381	17.1756	17.7237	15.4519	14.8265	12.7941	11.8556	13.6045	13.7670	16.0441	17.5134	19.0184	(46)
Water storage loss:													
(57)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	(57)
(61)m	47.4156	42.7468	47.1993	45.5323	46.9451	45.3096	46.7445	46.8745	45.4310	47.0941	45.7423	47.3737	(61)
(62)m	178.3361	157.2508	165.3570	148.5451	145.7883	130.6038	125.7822	137.5714	137.2110	154.0549	162.4984	174.1632	(62)
(63)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	178.3361	157.2508	165.3570	148.5451	145.7883	130.6038	125.7822	137.5714	137.2110	154.0549	162.4984	174.1632	(64)
								Total per year (kWh/year) = Sum(64)m =				1817.1622	(64)
RHI water heating demand												1817	(64)
(65)m	55.3850	48.7593	51.0873	45.6348	44.6016	39.6877	37.9661	41.8753	41.8746	47.3380	50.2570	54.0009	(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	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	(66)
(67)m	37.5463	33.3483	27.1206	20.5321	15.3480	12.9574	14.0009	18.1989	24.4265	31.0151	36.1992	38.5898	(67)
(68)m	251.4357	254.0448	247.4699	233.4728	215.8039	199.1976	188.1036	185.4945	192.0694	206.0665	223.7354	240.3417	(68)
(69)m	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	(69)

(70)m	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	(70)
(71)m	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	(71)
(72)m	74.4422	72.5584	68.6657	63.3817	59.9484	55.1218	51.0298	56.2841	58.1592	63.6263	69.8014	72.5819	(72)
(73)m	460.5657	457.0931	440.3979	414.5282	388.2419	364.4185	350.2759	357.1191	371.7967	397.8496	426.8776	448.6550	(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	5.4100	12.7761	0.6300	0.7000	0.7700	21.1235	(75)
Southwest	5.9400	39.7858	0.6300	0.7000	0.7700	72.2249	(79)
Horizontal	2.8500	29.0000	0.6300	0.7000	1.0000	32.8038	(82)

(83)m	126.1521	214.1432	337.5999	473.1332	572.4832	635.7286	606.3308	536.2812	403.9435	269.5603	164.1009	103.5042	(83)
(84)m	586.7179	671.2364	777.9978	887.6614	960.7252	1000.1471	956.6067	893.4003	775.7402	667.4099	590.9785	552.1592	(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	19.9053	19.9860	19.9860	20.1351	20.2252	20.2674	20.3077	20.3077	20.2034	20.1351	20.0626	19.9860	
alpha	2.3270	2.3324	2.3324	2.3423	2.3483	2.3512	2.3538	2.3538	2.3469	2.3423	2.3375	2.3324	
(86)m	0.9260	0.9013	0.8438	0.7639	0.6190	0.4527	0.2910	0.3096	0.5668	0.7842	0.8979	0.9305	(86)
(87)m	18.6928	18.9483	19.5117	20.0175	20.5710	20.8569	20.9687	20.9642	20.7521	20.1574	19.2539	18.7219	(87)
(88)m	19.6230	19.6277	19.6277	19.6363	19.6415	19.6439	19.6461	19.6461	19.6402	19.6363	19.6322	19.6277	(88)
(89)m	0.9129	0.8844	0.8166	0.7233	0.5525	0.3600	0.1730	0.1848	0.4694	0.7346	0.8774	0.9177	(89)
(90)m	17.6132	17.8623	18.4014	18.8755	19.3623	19.5778	19.6404	19.6395	19.5139	19.0226	18.1689	17.6467	(90)
Living area fraction									fLA = Living area / (4) =			0.5542	(91)
(92)m	18.2115	18.4641	19.0167	19.5084	20.0322	20.2866	20.3765	20.3736	20.2001	19.6514	18.7702	18.2425	(92)
Temperature adjustment												-0.1500	
(93)m	18.0615	18.3141	18.8667	19.3584	19.8822	20.1366	20.2265	20.2236	20.0501	19.5014	18.6202	18.0925	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.8938	0.8642	0.7987	0.7140	0.5652	0.3952	0.2249	0.2396	0.5010	0.7289	0.8585	0.8992	(94)
(95)m	524.3843	580.0581	621.3966	633.8147	542.9716	395.2643	215.1526	214.0908	388.6496	486.5019	507.3810	496.4771	(95)
(96)m	5.1000	5.5000	7.4000	9.3000	12.6000	15.4000	17.8000	17.8000	15.1000	11.6000	7.6000	5.5000	(96)
(97)m	1201.9582	1183.4980	1059.0508	922.0971	664.6141	431.3937	220.5601	220.2966	452.2637	724.3629	1013.9230	1163.0300	(97)
(98)m	504.1150	405.5116	325.6147	207.5634	90.5020	0.0000	0.0000	0.0000	0.0000	176.9686	364.7102	495.9153	(98)
Space heating (October to May) (kWh/year)												2570.9009	(98)
RHI space heating demand												2571	(98)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF ENERGY RATINGS
Calculated by program Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.2300 (1b)	x	2.8000 (2b)	=	163.0440 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.2300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	163.0440	(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							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1227	(8)
Pressure test		Yes	
Measured/design q50		3.8000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3127	(18)
Number of sides on which dwelling is sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.3588	0.3389	0.3389	0.2990	0.2724	0.2591	0.2458	0.2458	0.2791	0.2990	0.3189	0.3389	(22b)
Effective ach	0.5644	0.5574	0.5574	0.5447	0.5371	0.5336	0.5302	0.5302	0.5389	0.5447	0.5509	0.5574	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.70)			11.3500	1.5918	18.0665			(27)
Opening Type 2 (Uw = 2.00)			2.8500	1.8519	5.2778			(27a)
External Wall 1	50.6900	5.4100	45.2800	0.2600	11.7728	70.0000	3169.6000	(29a)
External Wall 2	36.7500	5.9400	30.8100	0.2700	8.3187	18.0000	554.5800	(29a)
External Roof 1	61.2900	2.8500	58.4400	0.1700	9.9348	9.0000	525.9600	(30)
Total net area of external elements Aum(A, m2)			148.7300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		56.1906			(33)
Stud party wall			14.1000	0.2000	2.8200	20.0000	282.0000	(32)
Party Floor 1			58.2300			30.0000	1746.9000	(32d)
Internal Partition 1			40.6800			9.0000	366.1200	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		6645.1600	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							114.1192	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.1770	(36)
Total fabric heat loss					(33) + (36) =		62.3676	(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	30.3653	29.9912	29.9912	29.3071	28.8986	28.7086	28.5281	28.5281	28.9972	29.3071	29.6385	29.9912	(38)
(39)m	92.7328	92.3588	92.3588	91.6747	91.2662	91.0762	90.8956	90.8956	91.3647	91.6747	92.0060	92.3588	(39)
(40)m	1.5925	1.5861	1.5861	1.5744	1.5673	1.5641	1.5610	1.5610	1.5690	1.5744	1.5800	1.5861	(40)
									Average = Sum(40)m / 12 =			1.5752	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N		1.9312 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		80.0653 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	88.0719	84.8693	81.6667	78.4640	75.2614	72.0588	72.0588	75.2614	78.4640	81.6667	84.8693	88.0719	(44)
(45)m	130.9205	114.5039	118.1578	103.0128	98.8433	85.2942	79.0376	90.6968	91.7800	106.9608	116.7561	126.7895	(45)
Energy content (annual)										Total = Sum(45)m =		1262.7534	(45)
(46)m	19.6381	17.1756	17.7237	15.4519	14.8265	12.7941	11.8556	13.6045	13.7670	16.0441	17.5134	19.0184	(46)
Water storage loss:													
(57)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	(57)
(61)m	47.4156	42.7468	47.1993	45.5323	46.9451	45.3096	46.7445	46.8745	45.4310	47.0941	45.7423	47.3737	(61)
(62)m	178.3361	157.2508	165.3570	148.5451	145.7883	130.6038	125.7822	137.5714	137.2110	154.0549	162.4984	174.1632	(62)
(63)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	178.3361	157.2508	165.3570	148.5451	145.7883	130.6038	125.7822	137.5714	137.2110	154.0549	162.4984	174.1632	(64)
								Total per year (kWh/year) = Sum(64)m =				1817.1622	(64)
(65)m	55.3850	48.7593	51.0873	45.6348	44.6016	39.6877	37.9661	41.8753	41.8746	47.3380	50.2570	54.0009	(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	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	115.8703	(66)
(67)m	37.5463	33.3483	27.1206	20.5321	15.3480	12.9574	14.0009	18.1989	24.4265	31.0151	36.1992	38.5898	(67)
(68)m	251.4357	254.0448	247.4699	233.4728	215.8039	199.1976	188.1036	185.4945	192.0694	206.0665	223.7354	240.3417	(68)
(69)m	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	48.5182	(69)
(70)m	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	(70)

(71)m	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469 (71)
(72)m	74.4422	72.5584	68.6657	63.3817	59.9484	55.1218	51.0298	56.2841	58.1592	63.6263	69.8014	72.5819 (72)
(73)m	460.5657	457.0931	440.3979	414.5282	388.2419	364.4185	350.2759	357.1191	371.7967	397.8496	426.8776	448.6550 (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	5.4100	11.5098	0.6300	0.7000	0.7700	19.0298 (75)
Southwest	5.9400	37.3877	0.6300	0.7000	0.7700	67.8714 (79)
Horizontal	2.8500	26.0000	0.6300	0.7000	1.0000	29.4103 (82)

(83)m	116.3115	215.7282	327.2077	469.6371	569.0821	597.4141	577.9287	501.4333	384.5814	257.2201	142.7170	97.2307 (83)
(84)m	576.8773	672.8214	767.6056	884.1653	957.3240	961.8326	928.2046	858.5524	756.3781	655.0697	569.5947	545.8857 (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	19.9053	19.9860	19.9860	20.1351	20.2252	20.2674	20.3077	20.3077	20.2034	20.1351	20.0626	19.9860	
alpha	2.3270	2.3324	2.3324	2.3423	2.3483	2.3512	2.3538	2.3538	2.3469	2.3423	2.3375	2.3324	
(86)m	0.9330	0.9063	0.8571	0.7805	0.6581	0.5156	0.3721	0.3974	0.6242	0.8130	0.9114	0.9366	(86)
(87)m	18.5424	18.8454	19.3777	19.9104	20.4542	20.7828	20.9317	20.9213	20.6508	19.9975	19.0880	18.5781	(87)
(88)m	19.6230	19.6277	19.6277	19.6363	19.6415	19.6439	19.6461	19.6461	19.6402	19.6363	19.6322	19.6277	(88)
(89)m	0.9214	0.8905	0.8327	0.7435	0.5993	0.4297	0.2599	0.2793	0.5387	0.7711	0.8939	0.9253	(89)
(90)m	17.4653	17.7615	18.2734	18.7766	19.2644	19.5287	19.6252	19.6216	19.4396	18.8769	18.0083	17.5050	(90)
Living area fraction										fLA = Living area / (4) =		0.5542	(91)
(92)m	18.0622	18.3622	18.8854	19.4049	19.9238	20.2237	20.3492	20.3418	20.1108	19.4979	18.6067	18.0997	(92)
Temperature adjustment												-0.1500	
(93)m	17.9122	18.2122	18.7354	19.2549	19.7738	20.0737	20.1992	20.1918	19.9608	19.3479	18.4567	17.9497	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9027	0.8703	0.8137	0.7317	0.6055	0.4584	0.3074	0.3289	0.5607	0.7607	0.8749	0.9071	(94)
(95)m	520.7635	585.5261	624.5711	646.9676	579.6396	440.9420	285.3504	282.4192	424.0860	498.3212	498.3556	495.1827	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	1243.7513	1220.2624	1102.3390	967.6201	736.8603	498.5226	299.8856	299.2145	517.1992	783.6276	1054.0810	1205.2557	(97)
(98)m	537.9029	426.5428	355.4593	230.8698	116.9722	0.0000	0.0000	0.0000	0.0000	212.2679	400.1223	528.2943	(98)
Space heating (October to May) (kWh/year)												2808.4316	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	48.2300	(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 %)	93.0000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	537.9029	426.5428	355.4593	230.8698	116.9722	0.0000	0.0000	0.0000	0.0000	212.2679	400.1223	528.2943	(98)
(211)m	578.3903	458.6481	382.2143	248.2471	125.7766	0.0000	0.0000	0.0000	0.0000	228.2451	430.2391	568.0584	(211)
(215)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	(215)

Annual totals kWh/year	
Space heating fuel used, main system 1	3019.8189 (211)
Space heating fuel used, secondary	0.0000 (215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(64)m	178.3361	157.2508	165.3570	148.5451	145.7883	130.6038	125.7822	137.5714	137.2110	154.0549	162.4984	174.1632	(64)
Efficiency of water heater												86.7000	(216)
(217)m	89.1551	89.0866	88.9254	88.6785	88.1387	86.7000	86.7000	86.7000	86.7000	88.5821	89.0214	89.1586	(217)
(219)m	200.0291	176.5144	185.9504	167.5097	165.4079	150.6388	145.0775	158.6752	158.2595	173.9120	182.5387	195.3409	(219)

Water heating fuel used	2059.8540 (219)
Electricity for pumps, fans and electric keep-hot (Table 4f):	
central heating pump	130.0000 (230c)
boiler with a fan-assisted flue	45.0000 (230e)
Total electricity for the above, kWh/year	175.0000 (231)
Electricity for lighting (calculated in Appendix L)	265.2314 (232)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3019.8189	3.1000	93.6144	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating cost (other fuel)	2059.8540	3.1000	63.8555	(247)
Pumps and fans for heating	175.0000	11.4600	20.0550	(249)
Energy for lighting	265.2314	11.4600	30.3955	(250)
Additional standing charges			106.0000	(251)
Total energy cost			313.9204	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4700 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.4293 (257)
SAP value		80.0618
SAP rating (Section 12)		80 (258)
SAP band		C

10a. Fuel costs - using BEDF prices (312)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3019.8189	3.4100	102.9758	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating cost (other fuel)	2059.8540	3.4100	70.2410	(247)
Pumps and fans for heating	175.0000	12.4600	21.8050	(249)
Energy for lighting	265.2314	12.4600	33.0478	(250)
Additional standing charges			110.0000	(251)
Total energy cost			338.0697	(255)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3019.8189	0.1980	597.9241	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating cost (other fuel)	2059.8540	0.1980	407.8511	(264)
Space and water heating			1005.7752	(265)
Pumps and fans	175.0000	0.5170	90.4750	(267)
Energy for lighting	265.2314	0.5170	137.1247	(268)
Total CO2, kg/year			1233.3749	(272)
CO2 emissions per m2			21.1800	(273)
EI value			83.9899	
EI rating			84	(274)
EI band			B	

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	3019.8189	1.0200	3080.2152	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating cost (other fuel)	2059.8540	1.0200	2101.0510	(264)
Space and water heating			5181.2663	(265)
Pumps and fans	175.0000	2.9200	511.0000	(267)
Energy for lighting	265.2314	2.9200	774.4758	(268)
Primary energy kWh/year			6466.7421	(272)
Primary energy kWh/m2/year			111.0552	(273)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE
Calculated by program Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.2300 (1b)	x	2.8000 (2b)	=	163.0440 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.2300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	163.0440	(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							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1227	(8)
Pressure test		Yes	
Measured/design q50		3.8000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3127	(18)
Number of sides on which dwelling is sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2658	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.3588	0.3389	0.3389	0.2990	0.2724	0.2591	0.2458	0.2458	0.2791	0.2990	0.3189	0.3389	(22b)
Effective ach	0.5644	0.5574	0.5574	0.5447	0.5371	0.5336	0.5302	0.5302	0.5389	0.5447	0.5509	0.5574	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.70)			11.3500	1.5918	18.0665			(27)
Opening Type 2 (Uw = 2.00)			2.8500	1.8519	5.2778			(27a)
External Wall 1	50.6900	5.4100	45.2800	0.2600	11.7728	70.0000	3169.6000	(29a)
External Wall 2	36.7500	5.9400	30.8100	0.2700	8.3187	18.0000	554.5800	(29a)
External Roof 1	61.2900	2.8500	58.4400	0.1700	9.9348	9.0000	525.9600	(30)
Total net area of external elements Aum(A, m2)			148.7300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		56.1906			(33)
Stud party wall			14.1000	0.2000	2.8200	20.0000	282.0000	(32)
Party Floor 1			58.2300			30.0000	1746.9000	(32d)
Internal Partition 1			40.6800			9.0000	366.1200	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	6645.1600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		114.1192 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.1770 (36)
Total fabric heat loss	(33) + (36) =	62.3676 (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	30.3653	29.9912	29.9912	29.3071	28.8986	28.7086	28.5281	28.5281	28.9972	29.3071	29.6385	29.9912	(38)
(39)m	92.7328	92.3588	92.3588	91.6747	91.2662	91.0762	90.8956	90.8956	91.3647	91.6747	92.0060	92.3588	(39)
(40)m	1.5925	1.5861	1.5861	1.5744	1.5673	1.5641	1.5610	1.5610	1.5690	1.5744	1.5800	1.5861	(40)
									Average = Sum(40)m / 12 =			1.5752	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N	1.9312 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	80.0653 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	88.0719	84.8693	81.6667	78.4640	75.2614	72.0588	72.0588	75.2614	78.4640	81.6667	84.8693	88.0719	(44)
(45)m	130.9205	114.5039	118.1578	103.0128	98.8433	85.2942	79.0376	90.6968	91.7800	106.9608	116.7561	126.7895	(45)
Energy content (annual)										Total = Sum(45)m =		1262.7534	(45)
(46)m	19.6381	17.1756	17.7237	15.4519	14.8265	12.7941	11.8556	13.6045	13.7670	16.0441	17.5134	19.0184	(46)
Water storage loss:													
(57)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	(57)
(61)m	47.4156	42.7468	47.1993	45.5323	46.9451	45.3096	46.7445	46.8745	45.4310	47.0941	45.7423	47.3737	(61)
(62)m	178.3361	157.2508	165.3570	148.5451	145.7883	130.6038	125.7822	137.5714	137.2110	154.0549	162.4984	174.1632	(62)
(63)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	178.3361	157.2508	165.3570	148.5451	145.7883	130.6038	125.7822	137.5714	137.2110	154.0549	162.4984	174.1632	(64)
								Total per year (kWh/year) = Sum(64)m =				1817.1622	(64)
(65)m	55.3850	48.7593	51.0873	45.6348	44.6016	39.6877	37.9661	41.8753	41.8746	47.3380	50.2570	54.0009	(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	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	(66)
(67)m	15.0185	13.3393	10.8482	8.2128	6.1392	5.1830	5.6004	7.2796	9.7706	12.4060	14.4797	15.4359	(67)
(68)m	168.4619	170.2100	165.8048	156.4267	144.5886	133.4624	126.0294	124.2813	128.6865	138.0646	149.9027	161.0289	(68)
(69)m	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	(69)
(70)m	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	(70)

(71)m	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469 (71)
(72)m	74.4422	72.5584	68.6657	63.3817	59.9484	55.1218	51.0298	56.2841	58.1592	63.6263	69.8014	72.5819 (72)
(73)m	319.8901	318.0753	307.2864	289.9889	272.6438	255.7348	244.6271	249.8125	258.5838	276.0645	296.1513	311.0143 (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	5.4100	11.5098	0.6300	0.7000	0.7700	19.0298 (75)
Southwest	5.9400	37.3877	0.6300	0.7000	0.7700	67.8714 (79)
Horizontal	2.8500	26.0000	0.6300	0.7000	1.0000	29.4103 (82)

(83)m	116.3115	215.7282	327.2077	469.6371	569.0821	597.4141	577.9287	501.4333	384.5814	257.2201	142.7170	97.2307 (83)
(84)m	436.2017	533.8036	634.4940	759.6260	841.7259	853.1489	822.5558	751.2458	643.1653	533.2846	438.8684	408.2450 (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	19.9053	19.9860	19.9860	20.1351	20.2252	20.2674	20.3077	20.3077	20.2034	20.1351	20.0626	19.9860	
alpha	2.3270	2.3324	2.3324	2.3423	2.3483	2.3512	2.3538	2.3538	2.3469	2.3423	2.3375	2.3324	
(86)m	0.9609	0.9385	0.8958	0.8235	0.7043	0.5606	0.4117	0.4430	0.6837	0.8638	0.9453	0.9639	(86)
(87)m	18.2473	18.5755	19.1554	19.7497	20.3612	20.7388	20.9150	20.9004	20.5700	19.8185	18.8287	18.2858	(87)
(88)m	19.6230	19.6277	19.6277	19.6363	19.6415	19.6439	19.6461	19.6461	19.6402	19.6363	19.6322	19.6277	(88)
(89)m	0.9536	0.9274	0.8763	0.7907	0.6474	0.4721	0.2905	0.3153	0.5999	0.8295	0.9335	0.9570	(89)
(90)m	17.1788	17.5030	18.0671	18.6353	19.1926	19.5026	19.6194	19.6142	19.3856	18.7206	17.7610	17.2211	(90)
Living area fraction										fLA = Living area / (4) =		0.5542	(91)
(92)m	17.7709	18.0973	18.6702	19.2529	19.8402	20.1877	20.3374	20.3270	20.0420	19.3290	18.3527	17.8111	(92)
Temperature adjustment												-0.1500	
(93)m	17.6209	17.9473	18.5202	19.1029	19.6902	20.0377	20.1874	20.1770	19.8920	19.1790	18.2027	17.6611	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9390	0.9095	0.8568	0.7757	0.6496	0.4996	0.3412	0.3681	0.6172	0.8154	0.9172	0.9432	(94)
(95)m	409.6117	485.4761	543.6318	589.2701	546.8104	426.2584	280.6546	276.5329	396.9759	434.8589	402.5160	385.0614	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	1216.7420	1195.8001	1082.4658	953.6811	729.2388	495.2426	298.8096	297.8617	510.9092	768.1463	1030.7193	1178.6004	(97)
(98)m	600.5050	477.3378	400.8925	262.3759	135.7267	0.0000	0.0000	0.0000	0.0000	247.9659	452.3063	590.3930	(98)
Space heating (October to May) (kWh/year)												3167.5031	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	54.3964	(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 %) 93.0000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	600.5050	477.3378	400.8925	262.3759	135.7267	0.0000	0.0000	0.0000	0.0000	247.9659	452.3063	590.3930	(98)
(211)m	645.7043	513.2664	431.0672	282.1247	145.9427	0.0000	0.0000	0.0000	0.0000	266.6300	486.3509	634.8311	(211)
(215)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	(215)

Annual totals kWh/year
Space heating fuel used, main system 1 3405.9173 (211)
Space heating fuel used, secondary 0.0000 (215)

Water heating												
(64)m	178.3361	157.2508	165.3570	148.5451	145.7883	130.6038	125.7822	137.5714	137.2110	154.0549	162.4984	174.1632 (64)
Efficiency of water heater												86.7000 (216)
(217)m	89.2224	89.1591	89.0106	88.7785	88.2603	86.7000	86.7000	86.7000	86.7000	88.7062	89.1036	89.2264 (217)
(219)m	199.8781	176.3710	185.7722	167.3211	165.1800	150.6388	145.0775	158.6752	158.2595	173.6687	182.3702	195.1926 (219)

Water heating fuel used 2058.4049 (219)

Electricity for pumps, fans and electric keep-hot (Table 4f):
central heating pump 130.0000 (230c)
boiler with a fan-assisted flue 45.0000 (230e)
Total electricity for the above, kWh/year 175.0000 (231)
Electricity for lighting (calculated in Appendix L) 265.2314 (232)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3405.9173	0.1980	674.3716	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating cost (other fuel)	2058.4049	0.1980	407.5642	(264)
Space and water heating			1081.9358	(265)
Pumps and fans	175.0000	0.5170	90.4750	(267)
Energy for lighting	265.2314	0.5170	137.1247	(268)
Total CO2, kg/year			1309.5354	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			22.4900	(273)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF TARGET EMISSIONS
Calculated by program Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.2300 (1b)	x	2.8000 (2b)	=	163.0440 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.2300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	163.0440	(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							2 * 10	=	20.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1227	(8)
Pressure test		Yes	
Measured/design q50		10.0000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.6227	(18)
Number of sides on which dwelling is sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.5293	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.7145	0.6748	0.6748	0.5954	0.5425	0.5160	0.4896	0.4896	0.5557	0.5954	0.6351	0.6748	(22b)
Effective ach	0.7553	0.7277	0.7277	0.6773	0.6472	0.6331	0.6198	0.6198	0.6544	0.6773	0.7017	0.7277	(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	
Doors			1.8500	2.0000	3.7000			(26)
Windows (Uw = 2.00)			12.7075	1.8519	23.5324			(27)
External Wall 1	87.4400	14.5575	72.8825	0.3500	25.5089			(29a)
External Roof 1	61.2900		61.2900	0.1600	9.8064			(30)
Total net area of external elements Aum(A, m2)			148.7300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		62.5477			(33)
Stud party wall			14.1000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (User defined value 0.110 * total exposed area)		16.3603 (36)
Total fabric heat loss	(33) + (36) =	78.9080 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.6365	39.1529	39.1529	36.4399	34.8197	34.0661	33.3502	33.3502	35.2106	36.4399	37.7540	39.1529	(38)
(39)m	119.5445	118.0609	118.0609	115.3479	113.7277	112.9741	112.2582	112.2582	114.1186	115.3479	116.6620	118.0609	(39)
(40)m	2.0530	2.0275	2.0275	1.9809	1.9531	1.9401	1.9278	1.9278	1.9598	1.9809	2.0035	2.0275	(40)
									Average = Sum(40)m / 12 =			1.9841	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N	1.9312 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	84.2793 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	92.7072	89.3361	85.9649	82.5937	79.2226	75.8514	75.8514	79.2226	82.5937	85.9649	89.3361	92.7072	(44)
(45)m	137.8111	120.5304	124.3766	108.4345	104.0455	89.7834	83.1975	95.4703	96.6106	112.5903	122.9011	133.4627	(45)
Energy content (annual)										Total = Sum(45)m =		1329.2141	(45)
(46)m	20.6717	18.0796	18.6565	16.2652	15.6068	13.4675	12.4796	14.3206	14.4916	16.8885	18.4352	20.0194	(46)

Water storage loss:	
b) If manufacturer declared cylinder loss factor is not known :	
Cylinder volume (litres) including any solar storage within same cylinder	150.0000 (50)
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0191 (51)
Volume factor from Table 2a	0.9283 (52)
Temperature factor from Table 2b	0.5400 (53)
Enter (49) or (54) in (55)	1.4364 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	44.5282	43.0918	44.5282	43.0918	44.5282	(57)
Primary circuit loss (annual) from Table 3												610.0000	(58)
(59)m	51.8082	46.7945	51.8082	50.1370	51.8082	50.1370	51.8082	51.8082	50.1370	51.8082	50.1370	51.8082	(59)
(62)m	234.1475	207.5440	220.7130	201.6633	200.3819	183.0122	179.5339	191.8068	189.8394	208.9267	216.1299	229.7991	(62)
(63)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	234.1475	207.5440	220.7130	201.6633	200.3819	183.0122	179.5339	191.8068	189.8394	208.9267	216.1299	229.7991	(64)
								Total per year (kWh/year) = Sum(64)m =				2463.4976	(64)
(65)m	122.8913	109.6872	118.4244	110.6375	111.6643	104.4360	104.7323	108.8130	106.7060	114.5054	115.4476	121.4455	(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	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	96.5586	(66)
(67)m	25.5475	22.6911	18.4536	13.9706	10.4432	8.8166	9.5266	12.3831	16.6205	21.1036	24.6310	26.2576	(67)

(68)m	168.4619	170.2100	165.8048	156.4267	144.5886	133.4624	126.0294	124.2813	128.6865	138.0646	149.9027	161.0289 (68)
(69)m	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559	32.6559 (69)
(70)m	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000 (70)
(71)m	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469	-77.2469 (71)
(72)m	165.1765	163.2250	159.1725	153.6632	150.0864	145.0500	140.7692	146.2541	148.2028	153.9051	160.3440	163.2331 (72)
(73)m	421.1535	418.0937	405.3986	386.0281	367.0857	349.2965	338.2928	344.8860	355.4774	375.0408	396.8452	412.4872 (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
East	12.7075	19.8726	0.7200	0.7000	0.7700	88.2019 (76)

(83)m	88.2019	170.9603	273.2496	405.7108	493.6345	515.0825	499.9459	435.1139	326.6811	208.1975	109.6578	72.7578 (83)
(84)m	509.3554	589.0540	678.6482	791.7389	860.7203	864.3790	838.2387	779.9999	682.1585	583.2383	506.5031	485.2451 (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	33.8263	34.2514	34.2514	35.0570	35.5564	35.7936	36.0219	36.0219	35.4346	35.0570	34.6621	34.2514	
alpha	3.2551	3.2834	3.2834	3.3371	3.3704	3.3862	3.4015	3.4015	3.3623	3.3371	3.3108	3.2834	
(86)m	0.9909	0.9849	0.9688	0.9314	0.8434	0.6989	0.5144	0.5455	0.8126	0.9491	0.9856	0.9916	(86)
(87)m	18.9671	19.1800	19.5830	20.0456	20.5332	20.8323	20.9589	20.9509	20.7045	20.1273	19.4170	19.0259	(87)
(88)m	19.3053	19.3219	19.3219	19.3526	19.3712	19.3798	19.3881	19.3881	19.3667	19.3526	19.3377	19.3219	(88)
(89)m	0.9876	0.9793	0.9565	0.9036	0.7764	0.5701	0.3279	0.3510	0.7034	0.9212	0.9794	0.9884	(89)
(90)m	17.5506	17.7728	18.1688	18.6336	19.0839	19.3133	19.3818	19.3803	19.2284	18.7233	18.0210	17.6211	(90)
Living area fraction										fLA = Living area / (4) =		0.5542	(91)
(92)m	18.3356	18.5526	18.9525	19.4161	19.8871	20.1551	20.2558	20.2507	20.0464	19.5013	18.7947	18.3996	(92)
Temperature adjustment												0.0000	
(93)m	18.3356	18.5526	18.9525	19.4161	19.8871	20.1551	20.2558	20.2507	20.0464	19.5013	18.7947	18.3996	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9849	0.9759	0.9530	0.9049	0.8005	0.6369	0.4326	0.4605	0.7553	0.9244	0.9766	0.9859	(94)
(95)m	501.6808	574.8668	646.7429	716.4736	689.0097	550.5062	362.6421	359.1588	515.2566	539.1262	494.6422	478.4032	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	1653.9699	1600.0368	1434.7368	1236.0773	931.0954	627.5821	376.7145	376.1405	655.7741	1003.6824	1375.9876	1593.7756	(97)
(98)m	857.3031	688.9143	586.2674	374.1147	180.1117	0.0000	0.0000	0.0000	0.0000	345.6299	634.5687	829.8371	(98)
Space heating (October to May) (kWh/year)												4496.7468	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	77.2239	(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)	0.1000 (201)
Fraction of space heat from main system(s)	0.9000 (202)
Efficiency of main space heating system 1 (in %)	78.9000 (206)
Efficiency of secondary/supplementary heating system, %	100.0000 (208)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	857.3031	688.9143	586.2674	374.1147	180.1117	0.0000	0.0000	0.0000	0.0000	345.6299	634.5687	829.8371	(98)
(211)m	977.9122	785.8338	668.7461	426.7468	205.4506	0.0000	0.0000	0.0000	0.0000	394.2546	723.8426	946.5822	(211)
(215)m	85.7303	68.8914	58.6267	37.4115	18.0112	0.0000	0.0000	0.0000	0.0000	34.5630	63.4569	82.9837	(215)

Annual totals kWh/year	
Space heating fuel used, main system 1	5129.3689 (211)
Space heating fuel used, secondary	449.6747 (215)

Water heating	
(64)m 234.1475 207.5440 220.7130 201.6633 200.3819 183.0122 179.5339 191.8068 189.8394 208.9267 216.1299 229.7991	(64)
Efficiency of water heater	68.8000 (216)
(217)m 76.2925 76.0983 75.6257 74.7875 72.9776 68.8000 68.8000 68.8000 68.8000 74.5054 75.8433 76.2657	(217)
(219)m 306.9077 272.7313 291.8494 269.6486 274.5799 266.0061 260.9505 278.7889 275.9293 280.4181 284.9691 301.3139	(219)
Water heating fuel used	3364.0926 (219)
Electricity for pumps, fans and electric keep-hot (Table 4f):	
central heating pump	130.0000 (230c)
boiler with a fan-assisted flue	45.0000 (230e)
Total electricity for the above, kWh/year	175.0000 (231)
Electricity for lighting (calculated in Appendix L)	451.1777 (232)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5129.3689	0.1940	995.0976	(261)
Space heating - secondary	449.6747	0.4220	189.7627	(263)
Water heating cost (other fuel)	3364.0926	0.1940	652.6340	(264)
Space and water heating			1837.4943	(265)
Pumps and fans	175.0000	0.4220	73.8500	(267)
Energy for lighting	451.1777	0.4220	190.3970	(268)
Total CO2, kg/year			2101.7412	(272)
Emissions per m2 for space and water heating			32.8240	(272a)
Emissions per m2 for lighting			3.2697	(272b)
Target Carbon Dioxide Emission Rate (TER)			22.5000	(273)

= [(32.8240 * 1.00 * 1.0206) + (3.2697 * 1.2251)] * 0.60

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING
Calculated by program Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20

No improvements selected

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2010 Edition
Calculated by program Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20

New Build (As Designed)

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1 TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 22.50 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 22.49 kg/m²OK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.26 (max. 0.30)	0.27 (max. 0.70)	OK
Party wall	0.20 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.17 (max. 0.20)	0.17 (max. 0.35)	OK
Openings	1.76 (max. 2.00)	2.00 (max. 3.30)	OK

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3 Design air permeability
Design air permeability at 50 pascals: 3.80
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 24i junior
Combi boiler
Efficiency: 89.1% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

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6 Controls
Space heating controls: Programmer, room thermostat and TRVs 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

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 5.41 m², No overhang
Windows facing South West: 5.94 m², No overhang
Windows facing Horizontal: 2.85 m², No overhang
Ventilation rate: 6.00
Blinds/curtains: None

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10 Key features
Design air permeability 3.8 m³/m²h

SAP 2009 OVERHEATING ASSESSMENT FOR New Build (As Designed) BRE SAP Worksheet 9.90
Calculated by program Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20

Overheating Calculation Input Data

Dwelling type	EndTerrace Flat
Number of storeys	1
Cross ventilation possible	Yes
Region	Thames Valley
Front of dwelling faces	South West
Overshading	Average or unknown
Thermal mass parameter	114.1 (calculated from construction elements)
Night ventilation	Yes
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	322.83 (P1)
Transmission heat loss coefficient	62.37 (37)
Summer heat loss coefficient	385.19 (P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (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 East	5.4100	98.9568	0.6300	0.7000	0.9000	191.2346
South West	5.9400	116.7611	0.6300	0.7000	0.9000	247.7470
Horizontal	2.8500	204.0000	0.6300	0.7000	1.0000	230.7577
					total:	669.7392

	Jun	Jul	Aug	
Solar gains	702	670	593	(P3)
Internal gains	354	340	347	
Total summer gains	1057	1010	940	(P5)
Summer gain/loss ratio	2.74	2.62	2.44	(P6)
Summer external temperature	15.40	17.80	17.80	
Thermal mass temperature increment (TMP = 114.1)	0.00	0.00	0.00	
Threshold temperature	19.34	21.62	21.44	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

SAP 2009 IMPROVEMENTS
Calculated by program Elmhurst Energy Systems SAP2009 Calculator (Design System) version 3.02r20

5648-0001-0366

Current energy efficiency rating: C 80
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
L	Not considered
M	Not considered
N Solar water heating	Not applicable
O	Not considered
P	Not considered
Q	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic (PV) panels	Not applicable
V Wind turbine	Not applicable

Recommended measures: SAP change Cost change CO2 change
(none)

		Typical annual savings		Energy efficiency	Environmental impact
Lower cost measures					
(none)					
	Sub Total	£0	0.0000 kg/m²		
Higher cost measures					
(none)					
	Sub Total	£0	0.0000 kg/m²		

Potential energy efficiency rating: C 80
Potential environmental impact rating: B 84

Further improvements to achieve even higher standards
(none)
Total Savings £0 0.0000 kg/m²

Enhanced energy efficiency rating: C 80
Enhanced environmental impact rating: B 84

Fuel prices for cost data on this page from database revision number 312 TEST (29 Jul 2011)
Recommendation texts revision number 3.0 (01 Mar 2011)

Typical heating and lighting costs of this home (per year):

	Current	Potential	Enhanced
Electricity	£55	£55	£55
Mains gas	£283	£283	£283
Space heating	£235	£235	£235
Water heating	£70	£70	£70
Lighting	£33	£33	£33
Total cost	£338	£338	£338
Carbon dioxide emissions	1.2 tonnes	1.2 tonnes	1.2 tonnes
Primary energy	111 kWh/m²	111 kWh/m²	111 kWh/m²