

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

Property Reference	The Hall P01	Issued on Date	17/11/2020
Assessment Reference	Plot 01 R1	Prop Type Ref	
Property	Plot 1, The Hall, Leatherhead Road, Chessington, KT9 2NB		

SAP Rating	102 A	DER	-0.02	TER	17.75
Environmental	102 A	% DER<TER	100.11		
CO <sub>2</sub> Emissions (t/year)	-0.51	DFEE	53.54	TREE	57.95
General Requirements Compliance	Pass	% DFEE<TFEE	7.61		

Assessor Details	Mr. Steven Leahy, County Inspections, Tel: 01455883250, info@countyinspections.co.uk	Assessor ID	A593-0001
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Client	Prunus Developments, 8899
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### CALCULATION OF HEAT DEMAND 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	52.1900 (1b)	2.4000 (2b)	125.2560 (1b) - (3b)
First floor	52.1900 (1c)	2.6000 (2c)	135.6940 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.3800		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 260.9500 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> per hour							
Number of chimneys	0	0	0	0 + 40 =	0.0000 (6a)							
Number of open flues	0	0	0	0 + 20 =	0.0000 (6b)							
Number of intermittent fans				4 * 10 =	40.0000 (7a)							
Number of passive vents				0 * 10 =	0.0000 (7b)							
Number of flueless gas fires				0 * 40 =	0.0000 (7c)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)				40.0000 / (5) =	0.1533 (8)							
Pressure test				Yes								
Measured/design AP50				5.0000								
Infiltration rate				0.4033 (18)								
Number of sides sheltered				1 (19)								
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.9250 (20)							
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3730 (21)							
Wind speed	Jan 3.8000	Feb 3.6000	Mar 3.6000	Apr 3.3000	May 3.2000	Jun 3.0000	Jul 3.1000	Aug 2.9000	Sep 2.9000	Oct 3.1000	Nov 3.1000	Dec 3.4000 (22)
Wind factor	0.9500	0.9000	0.9000	0.8250	0.8000	0.7500	0.7750	0.7250	0.7250	0.7750	0.7750	0.8500 (22a)
Adj infiltr rate	0.3544	0.3357	0.3357	0.3078	0.2984	0.2798	0.2891	0.2705	0.2705	0.2891	0.2891	0.3171 (22b)
Effective ac	0.5628	0.5564	0.5564	0.5474	0.5445	0.5391	0.5418	0.5366	0.5366	0.5418	0.5418	0.5503 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K					
Entrance Door			2.1000	1.2000	2.5200		(26a)					
Windows (Uw = 1.40)			20.4000	1.3258	27.0455		(27)					
Ground Floor			52.1900	0.1300	6.7847		(28a)					
Cavity Walls	156.0000	22.5000	133.5000	0.1800	24.0300		(29a)					
Roof	52.1900		52.1900	0.1300	6.7847		(30)					
Total net area of external elements Aum(A, m <sup>2</sup> )			260.3800				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	67.1649	(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							21.7320 (36)					
Total fabric heat loss						(33) + (36) =	88.8969 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 48.4643	Feb 47.9100	Mar 47.9100	Apr 47.1349	May 46.8914	Jun 46.4271	Jul 46.6555	Aug 46.2061	Sep 46.2061	Oct 46.6555	Nov 46.6555	Dec 47.3858 (38)
Heat transfer coeff	137.3611	136.8069	136.8069	136.0317	135.7883	135.3239	135.5524	135.1030	135.1030	135.5524	135.5524	136.2826 (39)
Average = Sum(39)m / 12 =												135.9387 (39)

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### CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3160	1.3107	1.3107	1.3032	1.3009	1.2965	1.2986	1.2943	1.2943	1.2986	1.2986	1.3056 (40)
HLP (average)												1.3023 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.7765 (42)
Average daily hot water use (litres/day)												100.1429 (43)
Daily hot water use	110.1572	106.1514	102.1457	98.1400	94.1343	90.1286	90.1286	94.1343	98.1400	102.1457	106.1514	110.1572 (44)
Energy content	163.3599	142.8756	147.4348	128.5372	123.3345	106.4283	98.6215	113.1696	114.5212	133.4634	145.6858	158.2053 (45)
Energy content (annual)										Total =	Sum(45)m =	1575.6372 (45)
Distribution loss (46)m = 0.15 x (45)m	24.5040	21.4313	22.1152	19.2806	18.5002	15.9642	14.7932	16.9754	17.1782	20.0195	21.8529	23.7308 (46)
Water storage loss:												210.0000 (47)
Store volume												2.3000 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												1.2420 (55)
Enter (49) or (54) in (55)												
Total storage loss	38.5020	34.7760	38.5020	37.2600	38.5020	37.2600	38.5020	38.5020	37.2600	38.5020	37.2600	38.5020 (56)
If cylinder contains dedicated solar storage	38.5020	34.7760	38.5020	37.2600	38.5020	37.2600	38.5020	38.5020	37.2600	38.5020	37.2600	38.5020 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	225.1243	198.6628	209.1992	188.3092	185.0989	166.2003	160.3859	174.9340	174.2932	195.2278	205.4578	219.9697 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum(63)m =												0.0000 (63)
Output from w/h	225.1243	198.6628	209.1992	188.3092	185.0989	166.2003	160.3859	174.9340	174.2932	195.2278	205.4578	219.9697 (64)
Total per year (kWh/year) = Sum(64)m =												2302.8632 (64)
RHI water heating demand												2303 (64)
Heat gains from water heating, kWh/month	103.7287	92.1359	98.4336	90.5562	90.4203	83.2050	82.2032	87.0404	85.8959	93.7881	96.2581	102.0148 (65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Metabolic gains (Table 5), Watts												
(66)m	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	59.2311	52.6085	42.7841	32.3904	24.2122	20.4409	22.0871	28.7097	38.5341	48.9279	57.1061	60.8773 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	392.8663	396.9430	386.6698	364.7993	337.1918	311.2447	293.9104	289.8336	300.1068	321.9773	349.5848	375.5320 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617 (71)
Water heating gains (Table 5)	139.4203	137.1070	132.3032	125.7725	121.5326	115.5625	110.4881	116.9898	119.2999	126.0593	133.6918	137.1166 (72)
Total internal gains	704.4843	699.6251	674.7238	635.9289	595.9032	560.2147	539.4523	548.4998	570.9074	609.9311	653.3494	686.4926 (73)

#### 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W				
North	0.6300	12.3515	0.7600	0.7000	0.7700	2.8688 (74)						
East	4.9500	23.0403	0.7600	0.7000	0.7700	42.0472 (76)						
South	2.8800	52.3706	0.7600	0.7000	0.7700	55.6065 (78)						
West	11.9400	23.0403	0.7600	0.7000	0.7700	101.4230 (80)						
Solar gains	201.9455	322.3782	509.5368	729.3751	850.1471	923.9579	877.3353	775.5096	623.0925	417.6929	246.1656	161.4463 (83)
Total gains	906.4298	1022.0034	1184.2605	1365.3039	1446.0504	1484.1727	1416.7876	1324.0093	1194.0000	1027.6241	899.5149	847.9389 (84)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	52.7705	52.9843	52.9843	53.2862	53.3817	53.5649	53.4746	53.6525	53.6525	53.4746	53.4746	53.1881
alpha	4.5180	4.5323	4.5323	4.5524	4.5588	4.5710	4.5650	4.5768	4.5768	4.5650	4.5650	4.5459
util living area	0.9884	0.9798	0.9476	0.8553	0.6812	0.4405	0.2769	0.3152	0.6113	0.8897	0.9761	0.9912 (86)
MIT	19.8990	20.0456	20.3665	20.7124	20.9233	20.9918	20.9993	20.9987	20.9647	20.7085	20.2373	19.8514 (87)
Th 2	19.8283	19.8325	19.8325	19.8383	19.8401	19.8436	19.8419	19.8453	19.8453	19.8419	19.8419	19.8364 (88)
util rest of house	0.9844	0.9730	0.9302	0.8116	0.6016	0.3397	0.1666	0.1984	0.5021	0.8436	0.9665	0.9881 (89)
MIT 2	18.4170	18.6302	19.0828	19.5432	19.7820	19.8405	19.8418	19.8451	19.8266	19.5556	18.9151	18.3540 (90)

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### CALCULATION OF HEAT DEMAND 09 Jan 2014

Living area fraction										FLA = Living area / (4) =	0.1650 (91)	
MIT	18.6615	18.8637	19.2946	19.7361	19.9703	20.0304	20.0328	20.0354	20.0143	19.7458	19.1333	18.6010 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6615	18.8637	19.2946	19.7361	19.9703	20.0304	20.0328	20.0354	20.0143	19.7458	19.1333	18.6010 (93)

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9787	0.9653	0.9201	0.8072	0.6111	0.3562	0.1849	0.2177	0.5190	0.8390	0.9584	0.9834 (94)
Useful gains	887.0973	986.5486	1089.6208	1102.0900	883.7106	528.7344	261.8962	288.2904	619.6552	862.2024	862.1063	833.8538 (95)
Ext temp.	5.3000	5.7000	7.5000	10.0000	13.1000	16.1000	18.1000	17.9000	15.3000	11.8000	8.1000	5.2000 (96)
Heat loss rate W												
Month fracti	1835.3451	1800.8864	1613.5786	1324.4119	932.9037	531.8775	261.9924	288.5016	636.9193	1077.0668	1495.5842	1826.3235 (97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating	705.4964	547.2350	389.8246	160.0717	36.5996	0.0000	0.0000	0.0000	0.0000	159.8591	456.1041	738.3974 (98)
RHI space heating demand												3193.5880 (98)
												3194 (98)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	52.1900 (1b)	2.4000 (2b)	125.2560 (1b) - (3b)
First floor	52.1900 (1c)	2.6000 (2c)	135.6940 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.3800		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 260.9500 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				4 * 10 =	40.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1533 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4033 (18)
Number of sides sheltered					1 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.9250 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3730 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
Effective ac	0.4756	0.4663	0.4570	0.4103	0.4010	0.3544	0.3544	0.3451	0.3730	0.4010	0.4197	0.4383 (22b)
	0.6131	0.6087	0.6044	0.5842	0.5804	0.5628	0.5628	0.5595	0.5696	0.5804	0.5881	0.5961 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Entrance Door			2.1000	1.2000	2.5200		(26a)
Windows (Uw = 1.40)			20.4000	1.3258	27.0455		(27)
Ground Floor			52.1900	0.1300	6.7847		(28a)
Cavity Walls	156.0000	22.5000	133.5000	0.1800	24.0300		(29a)
Roof	52.1900		52.1900	0.1300	6.7847		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			260.3800				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 67.1649		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K 250.0000 (35)  
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 21.7320 (36)  
 Total fabric heat loss (33) + (36) = 88.8969 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	52.7970	52.4188	52.0481	50.3067	49.9809	48.4643	48.4643	48.1834	49.0485	49.9809	50.6400	51.3291 (38)
Heat transfer coeff	141.6939	141.3157	140.9449	139.2036	138.8778	137.3611	137.3611	137.0803	137.9453	138.8778	139.5369	140.2259 (39)
Average = Sum(39)m / 12 =												139.2020 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3575	1.3539	1.3503	1.3336	1.3305	1.3160	1.3160	1.3133	1.3216	1.3305	1.3368	1.3434 (40)
HLP (average)												1.3336 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.7765 (42)
Average daily hot water use (litres/day)												100.1429 (43)
Daily hot water use	110.1572	106.1514	102.1457	98.1400	94.1343	90.1286	90.1286	94.1343	98.1400	102.1457	106.1514	110.1572 (44)
Energy conte	163.3599	142.8756	147.4348	128.5372	123.3345	106.4283	98.6215	113.1696	114.5212	133.4634	145.6858	158.2053 (45)
Energy content (annual)												Total = Sum(45)m = 1575.6372 (45)
Distribution loss (46)m = 0.15 x (45)m												
Water storage loss:	24.5040	21.4313	22.1152	19.2806	18.5002	15.9642	14.7932	16.9754	17.1782	20.0195	21.8529	23.7308 (46)
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.3000 (48)
Temperature factor from Table 2b												0.5400 (49)

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### CALCULATION OF ENERGY RATINGS 09 Jan 2014

Enter (49) or (54) in (55)												1.2420 (55)					
Total storage loss	38.5020	34.7760	38.5020	37.2600	38.5020	37.2600	38.5020	38.5020	37.2600	38.5020	37.2600	38.5020	37.2600	38.5020	37.2600	38.5020	37.2600
If cylinder contains dedicated solar storage	38.5020	34.7760	38.5020	37.2600	38.5020	37.2600	38.5020	38.5020	37.2600	38.5020	37.2600	38.5020	37.2600	38.5020	37.2600	38.5020	37.2600
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120
Total heat required for water heating calculated for each month	225.1243	198.6628	209.1992	188.3092	185.0989	166.2003	160.3859	174.9340	174.2932	195.2278	205.4578	219.9697	219.9697	219.9697	219.9697	219.9697	219.9697
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Output from w/h	225.1243	198.6628	209.1992	188.3092	185.0989	166.2003	160.3859	174.9340	174.2932	195.2278	205.4578	219.9697	219.9697	219.9697	219.9697	219.9697	219.9697
Heat gains from water heating, kWh/month	103.7287	92.1359	98.4336	90.5562	90.4203	83.2050	82.2032	87.0404	85.8959	93.7881	96.2581	102.0148	102.0148	102.0148	102.0148	102.0148	102.0148

#### 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	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	59.2311	52.6085	42.7841	32.3904	24.2122	20.4409	22.0871	28.7097	38.5341	48.9279	57.1061	60.8773
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	392.8663	396.9430	386.6698	364.7993	337.1918	311.2447	293.9104	289.8336	300.1068	321.9773	349.5848	375.5320
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000
Losses e.g. evaporation (negative values) (Table 5)	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617
Water heating gains (Table 5)	139.4203	137.1070	132.3032	125.7725	121.5326	115.5625	110.4881	116.9898	119.2999	126.0593	133.6918	137.1166
Total internal gains	704.4843	699.6251	674.7238	635.9289	595.9032	560.2147	539.4523	548.4998	570.9074	609.9311	653.3494	686.4926

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b g	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
North	0.6300	10.6334	0.7600	0.7000	0.7700	2.4698 (74)						
East	4.9500	19.6403	0.7600	0.7000	0.7700	35.8424 (76)						
South	2.8800	46.7521	0.7600	0.7000	0.7700	49.6407 (78)						
West	11.9400	19.6403	0.7600	0.7000	0.7700	86.4563 (80)						
Solar gains	174.4092	325.2608	505.5782	704.5503	843.5438	856.8518	818.3526	714.6771	576.0595	377.1877	214.3801	145.5256
Total gains	878.8935	1024.8859	1180.3020	1340.4791	1439.4470	1417.0666	1357.8049	1263.1769	1146.9669	987.1188	867.7294	832.0182

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

Temperature during heating periods in the living area from Table 9, Thl (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, nil,m (see Table 9a)	0.9920	0.9836	0.9609	0.8969	0.7706	0.5910	0.4387	0.4882	0.7349	0.9343	0.9846	0.9937
tau	51.1568	51.2938	51.4287	52.0720	52.1942	52.7705	52.7705	52.8786	52.5470	52.1942	51.9476	51.6924
alpha	4.4105	4.4196	4.4286	4.4715	4.4796	4.5180	4.5180	4.5252	4.5031	4.4796	4.4632	4.4462
util living area	19.7043	19.9007	20.2104	20.5803	20.8412	20.9637	20.9924	20.9878	20.9049	20.5452	20.0557	19.6710
MIT	19.7961	19.7989	19.8016	19.8146	19.8170	19.8283	19.8283	19.8304	19.8240	19.8170	19.8121	19.8070
util rest of house	0.9894	0.9783	0.9481	0.8645	0.7062	0.4949	0.3252	0.3696	0.6426	0.9059	0.9786	0.9915
MIT 2	18.1121	18.3976	18.8407	19.3548	19.6756	19.8068	19.8259	19.8261	19.7569	19.3248	18.6336	18.0713
Living area fraction	18.3748	18.6456	19.0667	19.5570	19.8679	19.9977	20.0183	20.0178	19.9463	19.5261	18.8682	18.3352
Temperature adjustment	18.3748	18.6456	19.0667	19.5570	19.8679	19.9977	20.0183	20.0178	19.9463	19.5261	18.8682	18.3352
adjusted MIT	18.3748	18.6456	19.0667	19.5570	19.8679	19.9977	20.0183	20.0178	19.9463	19.5261	18.8682	18.3352

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	865.4880	995.2687	1106.9509	1147.5654	1020.8670	721.9438	467.0053	491.5195	749.2068	885.4590	843.2339	821.7519
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	1994.3077	1942.4621	1771.2070	1483.4890	1134.3439	741.4301	469.5468	495.9241	806.4639	1239.6387	1642.1044	1982.1190
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000
Space heating kWh	839.8419	636.5140	494.2065	241.8650	84.4268	0.0000	0.0000	0.0000	0.0000	263.5097	575.1868	863.3131
Space heating per m2												3998.8637
												(98) / (4) = 38.3106 (99)

#### 8c. Space cooling requirement

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

Not applicable

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 %)													92.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4323.0959 (211)
Space heating requirement	839.8419	636.5140	494.2065	241.8650	84.4268	0.0000	0.0000	0.0000	0.0000	263.5097	575.1868	863.3131	(98)
Space heating efficiency (main heating system 1)	92.5000	92.5000	92.5000	92.5000	92.5000	0.0000	0.0000	0.0000	0.0000	92.5000	92.5000	92.5000	(210)
Space heating fuel (main heating system)	907.9371	688.1232	534.2773	261.4757	91.2722	0.0000	0.0000	0.0000	0.0000	284.8754	621.8235	933.3114	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	225.1243	198.6628	209.1992	188.3092	185.0989	166.2003	160.3859	174.9340	174.2932	195.2278	205.4578	219.9697	(64)
Efficiency of water heater (217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(216)
Fuel for water heating, kWh/month	251.5355	221.9696	233.7421	210.4014	206.8145	185.6987	179.2021	195.4570	194.7410	218.1317	229.5618	245.7762	(219)
Water heating fuel used													2573.0315 (219)
Annual totals kWh/year													
Space heating fuel - main system													4323.0959 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													75.0000 (231)
Electricity for lighting (calculated in Appendix L)													418.4160 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 5.09 * 908 * 1.00) =										-3696.7825			-3696.7825 (233)
Total delivered energy for all uses													3692.7609 (238)

#### 10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4323.0959	3.4800	150.4437 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2573.0315	3.4800	89.5415 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	418.4160	13.1900	55.1891 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-3696.7825	13.1900	-487.6056 (252)
Total energy cost			-62.5388 (255)

#### 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	-0.1758 (257)
SAP value		102.4529
SAP rating (Section 12)		102 (258)
SAP band		A

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4323.0959	0.2160	933.7887 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2573.0315	0.2160	555.7748 (264)
Space and water heating			1489.5635 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	418.4160	0.5190	217.1579 (268)
Energy saving/generation technologies			
PV Unit	-3696.7825	0.5190	-1918.6301 (269)
Total kg/year			-172.9837 (272)
CO2 emissions per m2			-1.6600 (273)
EI value			101.5517
EI rating			102 (274)
EI band			A

#### Calculation of stars for heating and DHW

Main heating energy efficiency  $3.48 \times (1 + 0.29 \times 0.00) / 0.8950 = 3.888$ , stars = 4

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating environmental impact  $0.216 \times (1 + 0.29 \times 0.00) / 0.8950 = 0.2413$ , stars = 4  
Water heating energy efficiency  $3.48 / 0.8950 = 3.888$ , stars = 4  
Water heating environmental impact  $0.216 / 0.8950 = 0.2413$ , stars = 4

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

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

#### 1. Overall dwelling dimensions

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	52.1900 (1b)	2.4000 (2b)	125.2560 (1b) - (3b)
First floor	52.1900 (1c)	2.6000 (2c)	135.6940 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.3800		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 260.9500 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> per hour							
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)							
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)							
Number of intermittent fans				4 * 10 =	40.0000 (7a)							
Number of passive vents				0 * 10 =	0.0000 (7b)							
Number of flueless gas fires				0 * 40 =	0.0000 (7c)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1533 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.4033 (18)							
Number of sides sheltered					1 (19)							
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)							
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3730 (21)							
Wind speed	Jan 3.8000	Feb 3.6000	Mar 3.6000	Apr 3.3000	May 3.2000	Jun 3.0000	Jul 3.1000	Aug 2.9000	Sep 2.9000	Oct 3.1000	Nov 3.1000	Dec 3.4000 (22)
Wind factor	0.9500	0.9000	0.9000	0.8250	0.8000	0.7500	0.7750	0.7250	0.7250	0.7750	0.7750	0.8500 (22a)
Adj infiltr rate	0.3544	0.3357	0.3357	0.3078	0.2984	0.2798	0.2891	0.2705	0.2705	0.2891	0.2891	0.3171 (22b)
Effective ac	0.5628	0.5564	0.5564	0.5474	0.5445	0.5391	0.5418	0.5366	0.5366	0.5418	0.5418	0.5503 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K					
Entrance Door			2.1000	1.2000	2.5200		(26a)					
Windows (Uw = 1.40)			20.4000	1.3258	27.0455		(27)					
Ground Floor			52.1900	0.1300	6.7847		(28a)					
Cavity Walls	156.0000	22.5000	133.5000	0.1800	24.0300		(29a)					
Roof	52.1900		52.1900	0.1300	6.7847		(30)					
Total net area of external elements Aum(A, m <sup>2</sup> )			260.3800				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 67.1649		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							21.7320 (36)					
Total fabric heat loss							(33) + (36) = 88.8969 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 48.4643	Feb 47.9100	Mar 47.9100	Apr 47.1349	May 46.8914	Jun 46.4271	Jul 46.6555	Aug 46.2061	Sep 46.2061	Oct 46.6555	Nov 46.6555	Dec 47.3858 (38)
Heat transfer coeff	137.3611	136.8069	136.8069	136.0317	135.7883	135.3239	135.5524	135.1030	135.1030	135.5524	135.5524	136.2826 (39)
Average = Sum(39)m / 12 =												135.9387 (39)
HLP	Jan 1.3160	Feb 1.3107	Mar 1.3107	Apr 1.3032	May 1.3009	Jun 1.2965	Jul 1.2986	Aug 1.2943	Sep 1.2943	Oct 1.2986	Nov 1.2986	Dec 1.3056 (40)
HLP (average)												1.3023 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.7765 (42)
Average daily hot water use (litres/day)												100.1429 (43)
Daily hot water use	110.1572	106.1514	102.1457	98.1400	94.1343	90.1286	90.1286	94.1343	98.1400	102.1457	106.1514	110.1572 (44)
Energy conte	163.3599	142.8756	147.4348	128.5372	123.3345	106.4283	98.6215	113.1696	114.5212	133.4634	145.6858	158.2053 (45)
Energy content (annual)												Total = Sum(45)m = 1575.6372 (45)
Distribution loss (46)m = 0.15 x (45)m												
Water storage loss:	24.5040	21.4313	22.1152	19.2806	18.5002	15.9642	14.7932	16.9754	17.1782	20.0195	21.8529	23.7308 (46)
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.3000 (48)
Temperature factor from Table 2b												0.5400 (49)



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Enter (49) or (54) in (55)													1.2420 (55)		
Total storage loss	38.5020	34.7760	38.5020	37.2600	38.5020	37.2600	38.5020	38.5020	37.2600	38.5020	37.2600	38.5020	37.2600	38.5020	(56)
If cylinder contains dedicated solar storage	38.5020	34.7760	38.5020	37.2600	38.5020	37.2600	38.5020	38.5020	37.2600	38.5020	37.2600	38.5020	37.2600	38.5020	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	225.1243	198.6628	209.1992	188.3092	185.0989	166.2003	160.3859	174.9340	174.2932	195.2278	205.4578	219.9697	219.9697	219.9697	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Output from w/h	225.1243	198.6628	209.1992	188.3092	185.0989	166.2003	160.3859	174.9340	174.2932	195.2278	205.4578	219.9697	219.9697	219.9697	(64)
Heat gains from water heating, kWh/month	103.7287	92.1359	98.4336	90.5562	90.4203	83.2050	82.2032	87.0404	85.8959	93.7881	96.2581	102.0148	102.0148	102.0148	(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	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	59.2311	52.6085	42.7841	32.3904	24.2122	20.4409	22.0871	28.7097	38.5341	48.9279	57.1061	60.8773	60.8773	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	392.8663	396.9430	386.6698	364.7993	337.1918	311.2447	293.9104	289.8336	300.1068	321.9773	349.5848	375.5320	375.5320	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	(71)
Water heating gains (Table 5)	139.4203	137.1070	132.3032	125.7725	121.5326	115.5625	110.4881	116.9898	119.2999	126.0593	133.6918	137.1166	137.1166	(72)
Total internal gains	704.4843	699.6251	674.7238	635.9289	595.9032	560.2147	539.4523	548.4998	570.9074	609.9311	653.3494	686.4926	686.4926	(73)

#### 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains								
	m <sup>2</sup>	Table 6a	Specific data	Specific data	factor	W								
		W/m <sup>2</sup>	or Table 6b	or Table 6c	Table 6d									
North	0.6300	12.3515	0.7600	0.7000	0.7700	2.8688 (74)								
East	4.9500	23.0403	0.7600	0.7000	0.7700	42.0472 (76)								
South	2.8800	52.3706	0.7600	0.7000	0.7700	55.6065 (78)								
West	11.9400	23.0403	0.7600	0.7000	0.7700	101.4230 (80)								
Solar gains	201.9455	322.3782	509.5368	729.3751	850.1471	923.9579	877.3353	775.5096	623.0925	417.6929	246.1656	161.4463	161.4463	(83)
Total gains	906.4298	1022.0034	1184.2605	1365.3039	1446.0504	1484.1727	1416.7876	1324.0093	1194.0000	1027.6241	899.5149	847.9389	847.9389	(84)

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

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)	
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
tau	52.7705	52.9843	52.9843	53.2862	53.3817	53.5649	53.4746	53.6525	53.6525	53.4746	53.4746	53.1881	53.1881	
alpha	4.5180	4.5323	4.5323	4.5524	4.5588	4.5710	4.5650	4.5768	4.5768	4.5650	4.5650	4.5459	4.5459	
util living area	0.9884	0.9798	0.9476	0.8553	0.6812	0.4405	0.2769	0.3152	0.6113	0.8897	0.9761	0.9912	0.9912	(86)
MIT	19.8990	20.0456	20.3665	20.7124	20.9233	20.9918	20.9993	20.9987	20.9647	20.7085	20.2373	19.8514	19.8514	(87)
Th 2	19.8283	19.8325	19.8325	19.8383	19.8401	19.8436	19.8419	19.8453	19.8453	19.8419	19.8419	19.8364	19.8364	(88)
util rest of house	0.9844	0.9730	0.9302	0.8116	0.6016	0.3397	0.1666	0.1984	0.5021	0.8436	0.9665	0.9881	0.9881	(89)
MIT 2	18.4170	18.6302	19.0828	19.5432	19.7820	19.8405	19.8418	19.8451	19.8266	19.5556	18.9151	18.3540	18.3540	(90)
Living area fraction	18.6615	18.8637	19.2946	19.7361	19.9703	20.0304	20.0328	20.0354	20.0143	19.7458	19.1333	18.6010	18.6010	(92)
Temperature adjustment												0.0000	0.0000	
adjusted MIT	18.6615	18.8637	19.2946	19.7361	19.9703	20.0304	20.0328	20.0354	20.0143	19.7458	19.1333	18.6010	18.6010	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Useful gains	887.0973	986.5486	1089.6208	1102.0900	883.7106	528.7344	261.8962	288.2904	619.6552	862.2024	862.1063	833.8538	833.8538	(95)
Ext temp.	5.3000	5.7000	7.5000	10.0000	13.1000	16.1000	18.1000	17.9000	15.3000	11.8000	8.1000	5.2000	5.2000	(96)
Heat loss rate W	1835.3451	1800.8864	1613.5786	1324.4119	932.9037	531.8775	261.9924	288.5016	636.9193	1077.0668	1495.5842	1826.3235	1826.3235	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	705.4964	547.2350	389.8246	160.0717	36.5996	0.0000	0.0000	0.0000	0.0000	159.8591	456.1041	738.3974	738.3974	(98)
Space heating													3193.5880 (98)	
Space heating per m2													(98) / (4) = 30.5958 (99)	

#### 8c. Space cooling requirement

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Not applicable

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 %)													92.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3452.5275 (211)
Space heating requirement	705.4964	547.2350	389.8246	160.0717	36.5996	0.0000	0.0000	0.0000	0.0000	159.8591	456.1041	738.3974	(98)
Space heating efficiency (main heating system 1)	92.5000	92.5000	92.5000	92.5000	92.5000	0.0000	0.0000	0.0000	0.0000	92.5000	92.5000	92.5000	(210)
Space heating fuel (main heating system)	762.6988	591.6054	421.4320	173.0505	39.5672	0.0000	0.0000	0.0000	0.0000	172.8207	493.0855	798.2675	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	225.1243	198.6628	209.1992	188.3092	185.0989	166.2003	160.3859	174.9340	174.2932	195.2278	205.4578	219.9697	(64)
Efficiency of water heater (217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(216)
Fuel for water heating, kWh/month	251.5355	221.9696	233.7421	210.4014	206.8145	185.6987	179.2021	195.4570	194.7410	218.1317	229.5618	245.7762	(219)
Water heating fuel used													(219)
Annual totals kWh/year													
Space heating fuel - main system													3452.5275 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													75.0000 (231)
Electricity for lighting (calculated in Appendix L)													418.4160 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 5.09 * 976 * 1.00) =										-3975.1394			-3975.1394 (233)
Total delivered energy for all uses													2543.8357 (238)

#### 10a. Fuel costs - using BEDF prices (467)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3452.5275	3.9500	136.3748 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2573.0315	3.9500	101.6347 (247)
Pumps and fans for heating	75.0000	18.7000	14.0250 (249)
Energy for lighting	418.4160	18.7000	78.2438 (250)
Additional standing charges			91.0000 (251)
Energy saving/generation technologies			
PV Unit	-3975.1394	18.7000	-743.3511 (252)
Total energy cost			-322.0727 (255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3452.5275	0.2160	745.7459 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2573.0315	0.2160	555.7748 (264)
Space and water heating			1301.5208 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	418.4160	0.5190	217.1579 (268)
Energy saving/generation technologies			
PV Unit	-3975.1394	0.5190	-2063.0973 (269)
Total kg/year			-505.4937 (272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	3452.5275	1.2200	4212.0836 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2573.0315	1.2200	3139.0985 (264)
Space and water heating			7351.1821 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	418.4160	3.0700	1284.5371 (268)
Energy saving/generation technologies			
PV Unit	-3975.1394	3.0700	-12203.6779 (269)
Primary energy kWh/year			-3337.7088 (272)
Primary energy kWh/m2/year			-31.9765 (273)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 102  
 Current environmental impact rating: A 102

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.4	-£ 40	-245 kg (48.5%)

	Typical annual savings	Energy efficiency	Environmental impact
Recommended measures			
Solar water heating	£40	2.35 kg/m <sup>2</sup>	A 104 A 104
<b>Total Savings</b>	<b>£40</b>	<b>2.35 kg/m<sup>2</sup></b>	

Potential energy efficiency rating: A 104  
 Potential environmental impact rating: A 104

Fuel prices for cost data on this page from database revision number 467 TEST (29 Oct 2020)  
 Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£92	£102	-£9
Mains gas	£329	£279	£50
Space heating	£241	£244	-£2
Water heating	£102	£59	£42
Lighting	£78	£78	£0
Generated (PV)	-£743	-£743	£0
<b>Total cost of fuels</b>	<b>-£322</b>	<b>-£362</b>	<b>£41</b>
<b>Total cost of uses</b>	<b>-£322</b>	<b>-£362</b>	<b>£40</b>
Delivered energy	24 kWh/m <sup>2</sup>	13 kWh/m <sup>2</sup>	12 kWh/m <sup>2</sup>
Carbon dioxide emissions	-0.5 tonnes	-0.8 tonnes	0.2 tonnes
CO2 emissions per m <sup>2</sup>	-5 kg/m <sup>2</sup>	-7 kg/m <sup>2</sup>	2 kg/m <sup>2</sup>
Primary energy	-32 kWh/m <sup>2</sup>	-45 kWh/m <sup>2</sup>	13 kWh/m <sup>2</sup>

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	52.1900 (1b)	x 2.4000 (2b)	= 125.2560 (1b) - (3b)
First floor	52.1900 (1c)	x 2.6000 (2c)	= 135.6940 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.3800		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 260.9500 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1533 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4033 (18)
Number of sides sheltered					1 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3730 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
Effective ac	0.4756	0.4663	0.4570	0.4103	0.4010	0.3544	0.3544	0.3451	0.3730	0.4010	0.4197	0.4383 (22b)
	0.6131	0.6087	0.6044	0.5842	0.5804	0.5628	0.5628	0.5595	0.5696	0.5804	0.5881	0.5961 (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
Entrance Door			2.1000	1.2000	2.5200		(26a)
Windows (Uw = 1.40)			20.4000	1.3258	27.0455		(27)
Ground Floor			52.1900	0.1300	6.7847		(28a)
Cavity Walls	156.0000	22.5000	133.5000	0.1800	24.0300		(29a)
Roof	52.1900		52.1900	0.1300	6.7847		(30)
Total net area of external elements Aum(A, m2)			260.3800				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 67.1649		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)  
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 21.7320 (36)  
 Total fabric heat loss (33) + (36) = 88.8969 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	52.7970	52.4188	52.0481	50.3067	49.9809	48.4643	48.4643	48.1834	49.0485	49.9809	50.6400	51.3291 (38)
Heat transfer coeff	141.6939	141.3157	140.9449	139.2036	138.8778	137.3611	137.3611	137.0803	137.9453	138.8778	139.5369	140.2259 (39)
Average = Sum(39)m / 12 =												139.2020 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3575	1.3539	1.3503	1.3336	1.3305	1.3160	1.3160	1.3133	1.3216	1.3305	1.3368	1.3434 (40)
HLP (average)												1.3336 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.7765 (42)
Average daily hot water use (litres/day)												100.1429 (43)
Daily hot water use	110.1572	106.1514	102.1457	98.1400	94.1343	90.1286	90.1286	94.1343	98.1400	102.1457	106.1514	110.1572 (44)
Energy conte	163.3599	142.8756	147.4348	128.5372	123.3345	106.4283	98.6215	113.1696	114.5212	133.4634	145.6858	158.2053 (45)
Energy content (annual)												Total = Sum(45)m = 1575.6372 (45)
Distribution loss (46)m = 0.15 x (45)m												
Water storage loss:	24.5040	21.4313	22.1152	19.2806	18.5002	15.9642	14.7932	16.9754	17.1782	20.0195	21.8529	23.7308 (46)
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.3000 (48)
Temperature factor from Table 2b												0.5400 (49)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Enter (49) or (54) in (55)													1.2420 (55)	
Total storage loss														
	38.5020	34.7760	38.5020	37.2600	38.5020	37.2600	38.5020	38.5020	37.2600	38.5020	37.2600	38.5020	37.2600	38.5020 (56)
If cylinder contains dedicated solar storage														
	24.7513	22.3560	24.7513	23.9529	24.7513	23.9529	24.7513	24.7513	23.9529	24.7513	23.9529	24.7513	23.9529	24.7513 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	23.2624	(59)
Total heat required for water heating calculated for each month														
	211.3736	186.2428	194.0528	168.2485	158.5539	140.2865	133.6082	149.0868	155.5832	180.0814	192.1506	206.2190	206.2190	(62)
Aperture area of solar collector													3.0000 (H1)	
Zero-loss collector efficiency													0.7000 (H2)	
Collector heat loss coefficient													1.8000 (H3)	
Collector 2nd order heat loss coefficient													0.0050 (H3a)	
Collector effective heat loss coefficient													1.8063 (H3b)	
Collector performance ratio													2.5804 (H4)	
Annual solar radiation per m2													1079.5246 (H5)	
Overshading factor													0.8000 (H6)	
Solar energy available													1813.6014 (H7)	
Adjustment factor for showers													1.0000 (H7a)	
Solar-to-load ratio													1.1510 (H8)	
Utilisation factor													0.5805 (H9)	
Collector performance factor													0.8793 (H10)	
Dedicated solar storage volume													75.0000 (H11)	
Effective solar volume													115.5000 (H13)	
Daily hot water demand													100.1429 (H14)	
Volume ratio Veff/V													1.1534 (H15)	
Solar storage volume factor													1.0000 (H16)	
Solar input													-925.7814 (H17)	
Solar input	-26.8458	-44.7979	-76.2960	-102.2517	-126.3234	-124.1960	-122.5547	-107.0767	-83.8625	-57.2682	-31.8430	-22.4654	-22.4654	(63)
Solar input (sum of months) = Sum(63)m =													-925.7814 (63)	
Output from w/h														
	184.5277	141.4448	117.7567	65.9968	32.2305	16.0905	11.0535	42.0102	71.7207	122.8131	160.3076	183.7536	183.7536	(64)
Total per year (kWh/year) = Sum(64)m =													1149.7058 (64)	
Heat gains from water heating, kWh/month														
	92.7281	82.1999	86.3164	74.5076	69.1842	62.4739	60.7810	66.3627	70.9279	81.6709	85.6124	91.0142	91.0142	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	59.2311	52.6085	42.7841	32.3904	24.2122	20.4409	22.0871	28.7097	38.5341	48.9279	57.1061	60.8773	60.8773 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	392.8663	396.9430	386.6698	364.7993	337.1918	311.2447	293.9104	289.8336	300.1068	321.9773	349.5848	375.5320	375.5320 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)													
	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617 (71)
Water heating gains (Table 5)													
	124.6346	122.3213	116.0167	103.4828	92.9896	86.7693	81.6949	89.1972	98.5110	109.7728	118.9061	122.3309	122.3309 (72)
Total internal gains	689.6986	684.8394	658.4373	613.6391	567.3602	531.4216	510.6591	520.7071	550.1185	593.6446	638.5636	671.7069	671.7069 (73)

#### 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains							
	m2	Table 6a	Specific data	Specific data	factor	W							
		W/m2	or Table 6b	or Table 6c	Table 6d								
North	0.6300	10.6334	0.7600	0.7000	0.7700	2.4698 (74)							
East	4.9500	19.6403	0.7600	0.7000	0.7700	35.8424 (76)							
South	2.8800	46.7521	0.7600	0.7000	0.7700	49.6407 (78)							
West	11.9400	19.6403	0.7600	0.7000	0.7700	86.4563 (80)							
Solar gains	174.4092	325.2608	505.5782	704.5503	843.5438	856.8518	818.3526	714.6771	576.0595	377.1877	214.3801	145.5256	145.5256 (83)
Total gains	864.1078	1010.1002	1164.0154	1318.1894	1410.9039	1388.2734	1329.0117	1235.3842	1126.1780	970.8323	852.9437	817.2324	817.2324 (84)

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

Temperature during heating periods in the living area from Table 9, T <sub>hl</sub> (C)													21.0000 (85)
Utilisation factor for gains for living area, nil <sub>m</sub> (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	51.1568	51.2938	51.4287	52.0720	52.1942	52.7705	52.7705	52.8786	52.5470	52.1942	51.9476	51.6924	51.6924
alpha	4.4105	4.4196	4.4286	4.4715	4.4796	4.5180	4.5180	4.5252	4.5031	4.4796	4.4632	4.4462	4.4462
util living area	0.9925	0.9844	0.9627	0.9016	0.7796	0.6012	0.4476	0.4982	0.7436	0.9376	0.9855	0.9941	0.9941 (86)
MIT	19.6920	19.8889	20.1986	20.5683	20.8331	20.9611	20.9917	20.9868	20.9002	20.5348	20.0437	19.6586	19.6586 (87)
Th 2	19.7961	19.7989	19.8016	19.8146	19.8170	19.8283	19.8283	19.8304	19.8240	19.8170	19.8121	19.8070	19.8070 (88)
util rest of house	0.9900	0.9794	0.9503	0.8701	0.7159	0.5043	0.3321	0.3777	0.6518	0.9103	0.9799	0.9921	0.9921 (89)
MIT 2	18.0942	18.3806	18.8244	19.3398	19.6675	19.8052	19.8257	19.8257	19.7530	19.3114	18.6166	18.0532	18.0532 (90)
Living area fraction													fLA = Living area / (4) = 0.1650 (91)
MIT	18.3578	18.6294	19.0511	19.5425	19.8598	19.9959	20.0180	20.0173	19.9422	19.5132	18.8521	18.3180	18.3180 (92)
Temperature adjustment													0.0000
adjusted MIT	18.3578	18.6294	19.0511	19.5425	19.8598	19.9959	20.0180	20.0173	19.9422	19.5132	18.8521	18.3180	18.3180 (93)

#### 8. Space heating requirement

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9856	0.9724	0.9403	0.8615	0.7185	0.5188	0.3512	0.3975	0.6620	0.9013	0.9733	0.9884 (94)
Useful gains	851.6736	982.2387	1094.4750	1135.6426	1013.6954	720.2486	466.7392	491.0547	745.5421	875.0033	830.1712	807.7661 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1991.9076	1940.1841	1769.0184	1481.4682	1133.2162	741.1827	469.5069	495.8554	805.9066	1237.8457	1639.8448	1979.7144 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	848.3340	643.7393	501.8603	248.9945	88.9235	0.0000	0.0000	0.0000	0.0000	269.9547	582.9650	871.9296 (98)
Space heating												4056.7009 (98)
Space heating per m2											(98) / (4) =	38.8647 (99)

#### 8c. Space cooling requirement

Not applicable

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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 %)												92.5000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												4385.6226 (211)
Space heating requirement	848.3340	643.7393	501.8603	248.9945	88.9235	0.0000	0.0000	0.0000	0.0000	269.9547	582.9650	871.9296 (98)
Space heating efficiency (main heating system 1)	92.5000	92.5000	92.5000	92.5000	92.5000	0.0000	0.0000	0.0000	0.0000	92.5000	92.5000	92.5000 (210)
Space heating fuel (main heating system)	917.1179	695.9344	542.5517	269.1832	96.1335	0.0000	0.0000	0.0000	0.0000	291.8429	630.2324	942.6266 (211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating requirement	184.5277	141.4448	117.7567	65.9968	32.2305	16.0905	11.0535	42.0102	71.7207	122.8131	160.3076	183.7536 (64)
Efficiency of water heater (217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000 (216)
Fuel for water heating, kWh/month	206.1762	158.0389	131.5717	73.7394	36.0118	17.9782	12.3503	46.9387	80.1348	137.2214	179.1147	205.3113 (219)
Water heating fuel used												1284.5875 (219)
Annual totals kWh/year												4385.6226 (211)
Space heating fuel - main system												0.0000 (215)
Space heating fuel - secondary												
Electricity for pumps and fans:												
central heating pump												30.0000 (230c)
main heating flue fan												45.0000 (230e)
pump for solar water heating												50.0000 (230g)
Total electricity for the above, kWh/year												125.0000 (231)
Electricity for lighting (calculated in Appendix L)												418.4160 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 5.09 * 908 * 1.00) =										-3696.7825		-3696.7825 (233)
Total delivered energy for all uses												2516.8437 (238)

#### 10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost f/year
Space heating - main system 1	4385.6226	3.4800	152.6197 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1284.5875	3.4800	44.7036 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Pump for solar water heating	50.0000	13.1900	6.5950 (249)
Energy for lighting	418.4160	13.1900	55.1891 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-3696.7825	13.1900	-487.6056 (252)
Total energy cost			-98.6057 (255)

#### 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	-0.2772 (257)
SAP value		103.8675
SAP rating (Section 12)		104 (258)
SAP band		A

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Space heating - main system 1	4385.6226	0.2160	947.2945 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1284.5875	0.2160	277.4709 (264)
Space and water heating			1224.7654 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	418.4160	0.5190	217.1579 (268)
Energy saving/generation technologies			
PV Unit			
Total kg/year	-3696.7825	0.5190	-1918.6301 (269)
CO2 emissions per m2			-411.8318 (272)
EI value			-3.9500 (273)
EI rating			103.6943
EI band			104 (274)
			A

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

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

#### 1. Overall dwelling dimensions

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	52.1900 (1b)	x 2.4000 (2b)	= 125.2560 (1b) - (3b)
First floor	52.1900 (1c)	x 2.6000 (2c)	= 135.6940 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.3800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 260.9500 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> per hour							
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)							
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)							
Number of intermittent fans					4 * 10 = 40.0000 (7a)							
Number of passive vents					0 * 10 = 0.0000 (7b)							
Number of flueless gas fires					0 * 40 = 0.0000 (7c)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.1533 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.4033 (18)							
Number of sides sheltered					1 (19)							
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.9250 (20)							
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3730 (21)							
Wind speed	Jan 3.8000	Feb 3.6000	Mar 3.6000	Apr 3.3000	May 3.2000	Jun 3.0000	Jul 3.1000	Aug 2.9000	Sep 2.9000	Oct 3.1000	Nov 3.1000	Dec 3.4000 (22)
Wind factor	0.9500	0.9000	0.9000	0.8250	0.8000	0.7500	0.7750	0.7250	0.7250	0.7750	0.7750	0.8500 (22a)
Adj infilt rate	0.3544	0.3357	0.3357	0.3078	0.2984	0.2798	0.2891	0.2705	0.2705	0.2891	0.2891	0.3171 (22b)
Effective ac	0.5628	0.5564	0.5564	0.5474	0.5445	0.5391	0.5418	0.5366	0.5366	0.5418	0.5418	0.5503 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K					
Entrance Door			2.1000	1.2000	2.5200		(26a)					
Windows (Uw = 1.40)			20.4000	1.3258	27.0455		(27)					
Ground Floor			52.1900	0.1300	6.7847		(28a)					
Cavity Walls	156.0000	22.5000	133.5000	0.1800	24.0300		(29a)					
Roof	52.1900		52.1900	0.1300	6.7847		(30)					
Total net area of external elements Aum(A, m <sup>2</sup> )			260.3800				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.1649		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							21.7320 (36)					
Total fabric heat loss						(33) + (36) =	88.8969 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 48.4643	Feb 47.9100	Mar 47.9100	Apr 47.1349	May 46.8914	Jun 46.4271	Jul 46.6555	Aug 46.2061	Sep 46.2061	Oct 46.6555	Nov 46.6555	Dec 47.3858 (38)
Heat transfer coeff	137.3611	136.8069	136.8069	136.0317	135.7883	135.3239	135.5524	135.1030	135.1030	135.5524	135.5524	136.2826 (39)
Average = Sum(39)m / 12 =												135.9387 (39)
HLP	Jan 1.3160	Feb 1.3107	Mar 1.3107	Apr 1.3032	May 1.3009	Jun 1.2965	Jul 1.2986	Aug 1.2943	Sep 1.2943	Oct 1.2986	Nov 1.2986	Dec 1.3056 (40)
HLP (average)												1.3023 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.7765 (42)
Average daily hot water use (litres/day)												100.1429 (43)
Daily hot water use	110.1572	106.1514	102.1457	98.1400	94.1343	90.1286	90.1286	94.1343	98.1400	102.1457	106.1514	110.1572 (44)
Energy conte	163.3599	142.8756	147.4348	128.5372	123.3345	106.4283	98.6215	113.1696	114.5212	133.4634	145.6858	158.2053 (45)
Energy content (annual)												Total = Sum(45)m = 1575.6372 (45)
Distribution loss (46)m = 0.15 x (45)m												
Water storage loss:	24.5040	21.4313	22.1152	19.2806	18.5002	15.9642	14.7932	16.9754	17.1782	20.0195	21.8529	23.7308 (46)
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.3000 (48)
Temperature factor from Table 2b												0.5400 (49)



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Enter (49) or (54) in (55)												1.2420 (55)
Total storage loss												
	38.5020	34.7760	38.5020	37.2600	38.5020	37.2600	38.5020	38.5020	37.2600	38.5020	37.2600	38.5020 (56)
If cylinder contains dedicated solar storage												
	24.7513	22.3560	24.7513	23.9529	24.7513	23.9529	24.7513	24.7513	23.9529	24.7513	23.9529	24.7513 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
	211.3736	186.2428	194.0528	168.2485	158.5539	140.2865	133.6082	149.0868	155.5832	180.0814	192.1506	206.2190 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1144.9962 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1923.5935 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.2208 (H8)
Utilisation factor												0.5592 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												115.5000 (H13)
Daily hot water demand												100.1429 (H14)
Volume ratio Veff/V												1.1534 (H15)
Solar storage volume factor												1.0000 (H16)
Solar input												-945.7934 (H17)
Solar input	-29.8625	-42.6701	-73.9515	-101.8998	-122.6295	-129.0226	-126.5703	-111.8819	-87.2722	-60.9610	-35.1298	-23.9420 (63)
Solar input (sum of months) = Sum(63)m =												-945.7934 (63)
Output from w/h												
	181.5110	143.5727	120.1013	66.3487	35.9244	11.2639	7.0379	37.2049	68.3110	119.1203	157.0208	182.2770 (64)
Total per year (kWh/year) = Sum(64)m =												1129.6939 (64)
Heat gains from water heating, kWh/month												
	92.7281	82.1999	86.3164	74.5076	69.1842	62.4739	60.7810	66.3627	70.9279	81.6709	85.6124	91.0142 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925	166.5925 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	59.2311	52.6085	42.7841	32.3904	24.2122	20.4409	24.2122	22.0871	28.7097	38.5341	48.9279	60.8773 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	392.8663	396.9430	386.6698	364.7993	337.1918	311.2447	293.9104	289.8336	300.1068	321.9773	349.5848	375.5320 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358	54.4358 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)												
	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617	-111.0617 (71)
Water heating gains (Table 5)												
	124.6346	122.3213	116.0167	103.4828	92.9896	86.7693	81.6949	89.1972	98.5110	109.7728	118.9061	122.3309 (72)
Total internal gains	689.6986	684.8394	658.4373	613.6391	567.3602	531.4216	510.6591	520.7071	550.1185	593.6446	638.5636	671.7069 (73)

#### 6. Solar gains

[Jan]	Area		Solar flux		g		FF		Access		Gains	
	m2		Table 6a		Specific data		Specific data		factor		W	
			W/m2		or Table 6b		or Table 6c		Table 6d			
North	0.6300		12.3515		0.7600		0.7000		0.7700		2.8688 (74)	
East	4.9500		23.0403		0.7600		0.7000		0.7700		42.0472 (76)	
South	2.8800		52.3706		0.7600		0.7000		0.7700		55.6065 (78)	
West	11.9400		23.0403		0.7600		0.7000		0.7700		101.4230 (80)	
Solar gains	201.9455	322.3782	509.5368	729.3751	850.1471	923.9579	877.3353	775.5096	623.0925	417.6929	246.1656	161.4463 (83)
Total gains	891.6441	1007.2176	1167.9740	1343.0142	1417.5073	1455.3795	1387.9944	1296.2167	1173.2110	1011.3375	884.7292	833.1532 (84)

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

Temperature during heating periods in the living area from Table 9, Thl (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	52.7705	52.9843	52.9843	53.2862	53.3817	53.5649	53.4746	53.6525	53.6525	53.4746	53.4746	53.1881
alpha	4.5180	4.5323	4.5323	4.5524	4.5588	4.5710	4.5650	4.5768	4.5768	4.5650	4.5650	4.5459
util living area	0.9891	0.9808	0.9500	0.8612	0.6912	0.4487	0.2826	0.3219	0.6201	0.8945	0.9775	0.9918 (86)
MIT	19.8868	20.0338	20.3554	20.7026	20.9186	20.9912	20.9992	20.9986	20.9627	20.7000	20.2257	19.8390 (87)
Th 2	19.8283	19.8325	19.8325	19.8383	19.8401	19.8436	19.8419	19.8453	19.8453	19.8419	19.8419	19.8364 (88)
util rest of house	0.9853	0.9744	0.9332	0.8185	0.6115	0.3463	0.1701	0.2026	0.5102	0.8496	0.9684	0.9889 (89)
MIT 2	18.3994	18.6136	19.0678	19.5317	19.7781	19.8402	19.8418	19.8451	19.8253	19.5457	18.8990	18.3361 (90)
Living area fraction												fLA = Living area / (4) = 0.1650 (91)
MIT	18.6448	18.8479	19.2802	19.7249	19.9662	20.0301	20.0328	20.0354	20.0129	19.7361	19.1178	18.5840 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6448	18.8479	19.2802	19.7249	19.9662	20.0301	20.0328	20.0354	20.0129	19.7361	19.1178	18.5840 (93)

#### 8. Space heating requirement

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9798	0.9669	0.9231	0.8137	0.6208	0.3631	0.1887	0.2224	0.5271	0.8447	0.9605	0.9844	(94)
Useful gains	873.6578	973.8654	1078.1136	1092.7514	879.9925	528.4343	261.8851	288.2658	618.3689	854.2474	849.7955	820.1393	(95)
Ext temp.	5.3000	5.7000	7.5000	10.0000	13.1000	16.1000	18.1000	17.9000	15.3000	11.8000	8.1000	5.2000	(96)
Heat loss rate W	1833.0560	1798.7202	1611.6127	1322.8960	932.3520	531.8338	261.9902	288.4972	636.7332	1075.7636	1493.4948	1824.0090	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	713.7923	554.3024	396.9233	165.7041	38.9555	0.0000	0.0000	0.0000	0.0000	164.8080	463.4635	746.8790	(98)
Space heating												3244.8282	(98)
Space heating per m2											(98) / (4) =	31.0867	(99)

#### 8c. Space cooling requirement

Not applicable

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
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 %)													92.5000	(206)	
Efficiency of secondary/supplementary heating system, %													0.0000	(208)	
Space heating requirement													3507.9224	(211)	
Space heating requirement	713.7923	554.3024	396.9233	165.7041	38.9555	0.0000	0.0000	0.0000	0.0000	164.8080	463.4635	746.8790	(98)		
Space heating efficiency (main heating system 1)	92.5000	92.5000	92.5000	92.5000	92.5000	0.0000	0.0000	0.0000	0.0000	92.5000	92.5000	92.5000	(210)		
Space heating fuel (main heating system)	771.6673	599.2459	429.1063	179.1395	42.1141	0.0000	0.0000	0.0000	0.0000	178.1708	501.0417	807.4368	(211)		
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)		
Water heating requirement	181.5110	143.5727	120.1013	66.3487	35.9244	11.2639	7.0379	37.2049	68.3110	119.1203	157.0208	182.2770	(64)		
Efficiency of water heater (217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(216)		
Fuel for water heating, kWh/month	202.8056	160.4164	134.1913	74.1326	40.1390	12.5854	7.8636	41.5697	76.3251	133.0954	175.4422	203.6614	(219)		
Water heating fuel used												1262.2278	(219)		
Annual totals kWh/year															
Space heating fuel - main system													3507.9224	(211)	
Space heating fuel - secondary													0.0000	(215)	
Electricity for pumps and fans:															
central heating pump														30.0000	(230c)
main heating flue fan														45.0000	(230e)
pump for solar water heating														50.0000	(230g)
Total electricity for the above, kWh/year														125.0000	(231)
Electricity for lighting (calculated in Appendix L)														418.4160	(232)
Energy saving/generation technologies (Appendices M ,N and Q)															
PV Unit 0 (0.80 * 5.09 * 976 * 1.00) =														-3975.1394	(233)
Total delivered energy for all uses														1338.4268	(238)

#### 10a. Fuel costs - using BEDF prices (467)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year		
Space heating - main system 1	3507.9224	3.9500	138.5629	(240)	
Space heating - secondary	0.0000	0.0000	0.0000	(242)	
Water heating (other fuel)	1262.2278	3.9500	49.8590	(247)	
Pumps and fans for heating	75.0000	18.7000	14.0250	(249)	
Pump for solar water heating	50.0000	18.7000	9.3500	(249)	
Energy for lighting	418.4160	18.7000	78.2438	(250)	
Additional standing charges			91.0000	(251)	
Energy saving/generation technologies					
PV Unit		-3975.1394	18.7000	-743.3511	(252)
Total energy cost				-362.3113	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year		
Space heating - main system 1	3507.9224	0.2160	757.7112	(261)	
Space heating - secondary	0.0000	0.0000	0.0000	(263)	
Water heating (other fuel)	1262.2278	0.2160	272.6412	(264)	
Space and water heating			1030.3524	(265)	
Pumps and fans	125.0000	0.5190	64.8750	(267)	
Energy for lighting	418.4160	0.5190	217.1579	(268)	
Energy saving/generation technologies					
PV Unit		-3975.1394	0.5190	-2063.0973	(269)
Total kg/year				-750.7120	(272)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

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 13a. Primary energy - Individual heating systems including micro-CHP  
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	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	3507.9224	1.2200	4279.6653 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1262.2278	1.2200	1539.9179 (264)
Space and water heating			5819.5832 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	418.4160	3.0700	1284.5371 (268)
Energy saving/generation technologies			
PV Unit	-3975.1394	3.0700	-12203.6779 (269)
Primary energy kWh/year			-4715.8076 (272)
Primary energy kWh/m2/year			-45.1792 (273)