

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



<b>Property Reference</b>	4907-0015-3990-024			<b>Issued on Date</b>	12/02/2020
<b>Assessment Reference</b>	024	<b>Prop Type Ref</b>	1FF Det		
<b>Property</b>	Plot 024, 2 Bed, K, Ba, ES, Welwyn Garden City				
<b>SAP Rating</b>	84 B	<b>DER</b>	16.86	<b>TER</b>	18.51
<b>Environmental</b>	89 B	<b>% DER&lt;TER</b>	8.91		
<b>CO<sub>2</sub> Emissions (t/year)</b>	0.82	<b>DFEE</b>	40.76	<b>TFEE</b>	45.03
<b>General Requirements Compliance</b>	Pass	<b>% DFEE&lt;TFEE</b>	9.47		
<b>Assessor Details</b>	Mr. Fraser Browning, Fraser Browning, Tel: 01884 242050, Fraser.browning@aessc.co.uk			<b>Assessor ID</b>	4907-0015
<b>Client</b>	TW North Thames, Taylor Wimpey				

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

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

DWELLING AS DESIGNED

Mid-floor flat, total floor area 56 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 18.51 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 16.86 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)45.0 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)40.8 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.35 (max. 2.00)	1.40 (max. 3.30)	OK

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 4.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas  
Data from database  
Ideal LOGIC COMBI ESP1 35  
Combi boiler  
Efficiency: 89.6% SEDBUK2009  
Minimum: 88.0% OK

Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage No cylinder

#### 6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock Yes OK

#### 7 Low energy lights

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

#### 8 Mechanical ventilation

Continuous extract system (decentralised)  
Specific fan power: 0.1900 0.1800  
Maximum 0.7 OK

#### 9 Summertime temperature

Overheating risk (East Anglia): Slight OK

Based on:

Overshading: Average  
Windows facing North East: 3.99 m<sup>2</sup>, No overhang  
Windows facing South East: 4.52 m<sup>2</sup>, No overhang  
Windows facing South West: 2.90 m<sup>2</sup>, No overhang  
Air change rate: 6.00 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Door U-value 1.08 W/m<sup>2</sup>K

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### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	56.4000 (1b)	2.3900 (2b)	134.7960 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	134.7960 (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				0 * 10 =	0.0000 (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) =				0.0000 / (5) =	0.0000 (8)
Pressure test				Yes	
Measured/design AP50				4.0000	
Infiltration rate				0.2000	(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) =		0.1850 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.2359	0.2313	0.2266	0.2035	0.1989	0.1758	0.1758	0.1711	0.1850	0.1989	0.2081	0.2174 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation:												
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (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
DTC			2.1200	1.0800	2.2896		(26)
Windows (Uw = 1.40)			8.8900	1.3258	11.7860		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	59.1100	11.4100	47.7000	0.2500	11.9250	52.8000	2518.5600 (29a)
External Wall to Stairwell	20.2500	2.1200	18.1300	0.2000	3.6260	52.8000	957.2640 (29a)
Total net area of external elements Aum(A, m2)			79.3600				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	32.9675	(33)
E-FC-4			56.4000			70.0000	3948.0000 (32d)
E-FC-4			56.4000			70.0000	3948.0000 (32b)
Metal			114.3900			14.0000	1601.4600 (32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		12973.2840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							230.0228 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.2540 (36)
Total fabric heat loss					(33) + (36) =		39.2214 (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	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413 (38)
Heat transfer coeff	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628 (39)
Average = Sum(39)m / 12 =												61.4628 (39)
HLP	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898 (40)
HLP (average)												1.0898 (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												1.8782 (42)
Average daily hot water use (litres/day)												78.8083 (43)
Daily hot water use	86.6892	83.5368	80.3845	77.2322	74.0798	70.9275	70.9275	74.0798	77.2322	80.3845	83.5368	86.6892 (44)
Energy conte	128.5575	112.4372	116.0252	101.1535	97.0592	83.7547	77.6111	89.0598	90.1235	105.0303	114.6487	124.5011 (45)
Energy content (annual)										Total = Sum(45)m =		1239.9620 (45)

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### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	19.2836	16.8656	17.4038	15.1730	14.5589	12.5632	11.6417	13.3590	13.5185	15.7545	17.1973	18.6752 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.0240	12.6507	13.9804	13.5003	13.9291	13.4554	13.8887	13.9149	13.4799	13.9592	13.5427	14.0156 (61)
Total heat required for water heating calculated for each month	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167 (64)
Heat gains from water heating, kWh/month	46.2514	40.5481	42.0735	37.0086	35.7545	31.2123	29.2779	33.0911	33.3360	38.4124	41.5064	44.9005 (65)
												Solar input (sum of months) = Sum(63)m = 0.0000 (63)
												Total per year (kWh/year) = Sum(64)m = 1404.3028 (64)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.6875	13.0453	10.6092	8.0318	6.0039	5.0687	5.4769	7.1191	9.5553	12.1326	14.1606	15.0957 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	163.7855	165.4850	161.2021	152.0844	140.5748	129.7575	122.5309	120.8313	125.1142	134.2319	145.7415	156.5588 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912 (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)	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298 (71)
Water heating gains (Table 5)	62.1658	60.3394	56.5504	51.4009	48.0571	43.3504	39.3520	44.4773	46.3000	51.6295	57.6477	60.3502 (72)
Total internal gains	294.8125	293.0434	282.5354	265.6908	248.8095	232.3503	221.5334	226.6014	235.1432	252.1678	271.7235	286.1784 (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	3.9900	11.2829	0.4300	0.0000	0.7700	14.9058 (75)						
Southeast	2.0000	36.7938	0.4300	0.0000	0.7700	24.3649 (77)						
Southwest	2.9000	36.7938	0.4300	0.0000	0.7700	35.3291 (79)						
Southeast	2.5200	36.7938	0.4300	0.0000	0.7700	30.6997 (77)						
Solar gains	105.2995	184.3150	265.3389	350.8108	413.0572	418.9203	400.2008	352.4092	294.7254	207.2532	127.0261	89.5310 (83)
Total gains	400.1119	477.3584	547.8742	616.5015	661.8667	651.2706	621.7343	579.0106	529.8686	459.4210	398.7496	375.7093 (84)

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

Temperature during heating periods in the living area from Table 9, Th1 (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)	0.9940	0.9854	0.9625	0.8983	0.7647	0.5828	0.4308	0.4808	0.7272	0.9352	0.9872	0.9955 (86)
tau	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321 (87)
alpha	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088 (88)
util living area	0.9940	0.9854	0.9625	0.8983	0.7647	0.5828	0.4308	0.4808	0.7272	0.9352	0.9872	0.9955 (86)
MIT	19.8692	20.0662	20.3456	20.6585	20.8822	20.9752	20.9953	20.9922	20.9303	20.6231	20.1714	19.8156 (87)
Th 2	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092 (88)
util rest of house	0.9922	0.9811	0.9517	0.8702	0.7087	0.5011	0.3359	0.3810	0.6476	0.9106	0.9827	0.9942 (89)
MIT 2	18.5116	18.7966	19.1954	19.6238	19.8994	19.9931	20.0074	20.0059	19.9564	19.5879	18.9514	18.4336 (90)
Living area fraction	19.0303	19.2817	19.6349	20.0191	20.2749	20.3683	20.3849	20.3828	20.3285	19.9834	19.4176	18.9616 (91)
Temperature adjustment	19.0303	19.2817	19.6349	20.0191	20.2749	20.3683	20.3849	20.3828	20.3285	19.9834	19.4176	18.9616 (92)
adjusted MIT	19.0303	19.2817	19.6349	20.0191	20.2749	20.3683	20.3849	20.3828	20.3285	19.9834	19.4176	18.9616 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	396.0241	466.4031	518.6616	536.6823	479.5964	346.1438	231.4599	242.7151	357.5807	418.0163	390.4513	372.7885 (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	905.3660	883.9415	807.3074	683.4130	527.0396	354.5378	232.6313	244.7924	382.8211	576.7308	757.0709	907.2905 (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	378.9503	280.5858	214.7525	105.6461	35.2977	0.0000	0.0000	0.0000	0.0000	118.0836	263.9662	397.6695 (98)
Space heating												1794.9516 (98)
Space heating per m2												(98) / (4) = 31.8254 (99)

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### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

	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 %)													93.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													1919.7344 (211)
Space heating requirement	378.9503	280.5858	214.7525	105.6461	35.2977	0.0000	0.0000	0.0000	0.0000	118.0836	263.9662	397.6695	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	405.2945	300.0917	229.6818	112.9905	37.7516	0.0000	0.0000	0.0000	0.0000	126.2926	282.3168	425.3150	(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	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167	(64)
Efficiency of water heater (217)m	89.6021	89.4886	89.2661	88.8059	88.0512	87.3000	87.3000	87.3000	87.3000	88.8651	89.4285	89.6511	(217)
Fuel for water heating, kWh/month	159.1275	139.7809	145.6382	129.1062	126.0497	111.3518	104.8107	117.9550	118.6751	133.8990	143.3452	154.5065	(219)
Water heating fuel used													1584.2458 (219)
Annual totals kWh/year													
Space heating fuel - main system													1919.7344 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans: (MEVDcentralised, Database: total watage = 6.9550, total flow = 29.0000, SFP = 0.2398)													39.4399 (230a)
mechanical ventilation fans (SFP = 0.2398)													30.0000 (230c)
central heating pump													45.0000 (230e)
main heating flue fan													114.4399 (231)
Total electricity for the above, kWh/year													259.3860 (232)
Electricity for lighting (calculated in Appendix L)													3877.8061 (238)
Total delivered energy for all uses													

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	1919.7344	0.2160	414.6626 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1584.2458	0.2160	342.1971 (264)
Space and water heating			756.8597 (265)
Pumps and fans	114.4399	0.5190	59.3943 (267)
Energy for lighting	259.3860	0.5190	134.6213 (268)
Total CO2, kg/year			950.8754 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.8600 (273)

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

	DER	TFA	N	EF	
Total Floor Area		56.4000			16.8600 ZC1
Assumed number of occupants			1.8782		56.4000
CO2 emission factor in Table 12 for electricity displaced from grid				0.5190	1.8782
CO2 emissions from appliances, equation (L14)					0.5190
CO2 emissions from cooking, equation (L16)					17.2085 ZC2
Total CO2 emissions					2.9092 ZC3
Residual CO2 emissions offset from biofuel CHP					36.9777 ZC4
Additional allowable electricity generation, kWh/m <sup>2</sup> /year					0.0000 ZC5
Resulting CO2 emissions offset from additional allowable electricity generation					0.0000 ZC6
Net CO2 emissions					0.0000 ZC7
					36.9777 ZC8

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### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	56.4000 (1b)	x 2.3900 (2b)	= 134.7960 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 134.7960 (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) =	0.1484 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3984	(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) =	0.3685 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4698	0.4606	0.4514	0.4053	0.3961	0.3501	0.3501	0.3409	0.3685	0.3961	0.4146	0.4330 (22b)
Effective ac	0.6104	0.6061	0.6019	0.5822	0.5785	0.5613	0.5613	0.5581	0.5679	0.5785	0.5859	0.5937 (25)

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

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opaque door			2.1200	1.0000	2.1200		(26)
TER Opening Type (Uw = 1.40)			11.4100	1.3258	15.1269		(27)
External Wall	59.1100	11.4100	47.7000	0.1800	8.5860		(29a)
External Wall to Stairwell	20.2500	2.1200	18.1300	0.1800	3.2634		(29a)
Total net area of external elements Aum(A, m2)			79.3600				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 29.0963		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.7253 (36)
Total fabric heat loss							(33) + (36) = 35.8216 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	27.1509	26.9603	26.7734	25.8957	25.7315	24.9670	24.9670	24.8254	25.2615	25.7315	26.0637	26.4110 (38)
Heat transfer coeff	62.9725	62.7819	62.5950	61.7173	61.5530	60.7886	60.7886	60.6470	61.0830	61.5530	61.8853	62.2326 (39)
Average = Sum(39)m / 12 =												61.7165 (39)
HLP	1.1165	1.1132	1.1098	1.0943	1.0914	1.0778	1.0778	1.0753	1.0830	1.0914	1.0973	1.1034 (40)
HLP (average)												1.0943 (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												1.8782 (42)
Average daily hot water use (litres/day)												78.8083 (43)
Daily hot water use	86.6892	83.5368	80.3845	77.2322	74.0798	70.9275	70.9275	74.0798	77.2322	80.3845	83.5368	86.6892 (44)
Energy conte	128.5575	112.4372	116.0252	101.1535	97.0592	83.7547	77.6111	89.0598	90.1235	105.0303	114.6487	124.5011 (45)
Energy content (annual)												Total = Sum(45)m = 1239.9620 (45)
Distribution loss (46)m = 0.15 x (45)m	19.2836	16.8656	17.4038	15.1730	14.5589	12.5632	11.6417	13.3590	13.5185	15.7545	17.1973	18.6752 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
Combi loss	44.1759	38.4498	40.9631	38.0871	37.7503	34.9779	36.1439	37.7503	38.0871	40.9631	41.1962	44.1759 (61)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total heat required for water heating calculated for each month	172.7334	150.8871	156.9882	139.2406	134.8095	118.7327	113.7550	126.8101	128.2106	145.9933	155.8450	168.6770 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	172.7334	150.8871	156.9882	139.2406	134.8095	118.7327	113.7550	126.8101	128.2106	145.9933	155.8450	168.6770 (64)
Heat gains from water heating, kWh/month	53.7893	46.9978	48.8191	43.1553	41.7098	36.5929	34.8417	39.0500	39.4878	45.1633	48.4198	52.4406 (65)
												1712.6825 (64)

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

Metabolic gains (Table 5), Watts	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.6875	13.0453	10.6092	8.0318	6.0039	5.0687	5.4769	7.1191	9.5553	12.1326	14.1606	15.0957 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	163.7855	165.4850	161.2021	152.0844	140.5748	129.7575	122.5309	120.8313	125.1142	134.2319	145.7415	156.5588 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912 (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)	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298 (71)
Water heating gains (Table 5)	72.2975	69.9373	65.6171	59.9380	56.0615	50.8235	46.8302	52.4865	54.8442	60.7034	67.2497	70.4847 (72)
Total internal gains	304.9441	302.6413	291.6021	274.2278	256.8139	239.8234	229.0117	234.6106	243.6874	261.2416	281.3254	296.3129 (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							
Northeast	3.9900	11.2829	0.6300	0.7000	0.7700	13.7584 (75)						
Southeast	4.5200	36.7938	0.6300	0.7000	0.7700	50.8259 (77)						
Southwest	2.9000	36.7938	0.6300	0.7000	0.7700	32.6096 (79)						
Solar gains	97.1938	170.1271	244.9139	323.8065	381.2614	386.6731	369.3947	325.2819	272.0384	191.2995	117.2481	82.6392 (83)
Total gains	402.1380	472.7683	536.5160	598.0344	638.0753	626.4966	598.4063	559.8925	515.7258	452.5412	398.5735	378.9520 (84)

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

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	62.1965	62.3853	62.5716	63.4614	63.6308	64.4310	64.4310	64.5814	64.1204	63.6308	63.2892	62.9360
alpha	5.1464	5.1590	5.1714	5.2308	5.2421	5.2954	5.2954	5.3054	5.2747	5.2421	5.2193	5.1957
util living area	0.9956	0.9893	0.9719	0.9168	0.7910	0.6011	0.4435	0.4920	0.7455	0.9463	0.9902	0.9967 (86)
MIT	19.9089	20.0896	20.3522	20.6661	20.8860	20.9790	20.9965	20.9941	20.9376	20.6433	20.2173	19.8785 (87)
Th 2	19.9874	19.9901	19.9928	20.0055	20.0079	20.0190	20.0190	20.0211	20.0147	20.0079	20.0031	19.9980 (88)
util rest of house	0.9942	0.9859	0.9628	0.8909	0.7348	0.5174	0.3465	0.3906	0.6646	0.9236	0.9865	0.9956 (89)
MIT 2	18.5443	18.8084	19.1869	19.6294	19.9031	20.0059	20.0178	20.0187	19.9689	19.6107	19.0050	18.5078 (90)
Living area fraction										fLA = Living area / (4) =		0.3821 (91)
MIT	19.0657	19.2979	19.6322	20.0255	20.2787	20.3777	20.3917	20.3914	20.3391	20.0052	19.4682	19.0315 (92)
Temperature adjustment												0.0000
adjusted MIT	19.0657	19.2979	19.6322	20.0255	20.2787	20.3777	20.3917	20.3914	20.3391	20.0052	19.4682	19.0315 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9924	0.9828	0.9588	0.8915	0.7512	0.5488	0.3837	0.4295	0.6930	0.9235	0.9838	0.9942 (94)
Useful gains	399.0660	464.6577	514.4130	533.1299	479.3397	343.8241	229.5842	240.4520	357.3730	417.9374	392.1230	376.7542 (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	929.8321	903.9294	822.0089	686.6384	528.0438	351.2202	230.4928	242.0669	381.1014	578.9217	765.4082	923.0040 (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	394.8900	295.1906	228.8513	110.5261	36.2358	0.0000	0.0000	0.0000	0.0000	119.7723	268.7654	406.4099 (98)
Space heating												1860.6414 (98)
Space heating per m2												(98) / (4) = 32.9901 (99)

#### 8c. Space cooling requirement

Not applicable

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

# FULL SAP CALCULATION PRINTOUT

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### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													1992.1214 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	394.8900	295.1906	228.8513	110.5261	36.2358	0.0000	0.0000	0.0000	0.0000	119.7723	268.7654	406.4099	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	422.7944	316.0499	245.0228	118.3363	38.7964	0.0000	0.0000	0.0000	0.0000	128.2359	287.7574	435.1284	(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	172.7334	150.8871	156.9882	139.2406	134.8095	118.7327	113.7550	126.8101	128.2106	145.9933	155.8450	168.6770	(64)
Efficiency of water heater (217)m	87.0674	86.7109	85.9989	84.4766	82.2467	80.3000	80.3000	80.3000	80.3000	84.5576	86.4109	87.1837	(217)
Fuel for water heating, kWh/month	198.3903	174.0117	182.5467	164.8275	163.9087	147.8614	141.6625	157.9205	159.6645	172.6555	180.3534	193.4732	(219)
Water heating fuel used													2037.2759 (219)
Annual totals kWh/year													
Space heating fuel - main system													1992.1214 (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)													259.3860 (232)
Total delivered energy for all uses													4363.7832 (238)

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 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP  
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1992.1214	0.2160	430.2982 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2037.2759	0.2160	440.0516 (264)
Space and water heating			870.3498 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	259.3860	0.5190	134.6213 (268)
Total CO2, kg/m2/year			1043.8961 (272)
Emissions per m2 for space and water heating			15.4317 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.3869 (272b)
Emissions per m2 for pumps and fans			0.6902 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.4317 * 1.00) + 2.3869 + 0.6902, rounded to 2 d.p.			18.5100 (273)

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	56.4000 (1b)	2.3900 (2b)	134.7960 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	134.7960 (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) =	0.1484 (8)
Pressure test					Yes
Measured/design AP50					4.0000
Infiltration rate					0.3484 (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) =	0.3222 (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	0.4109	0.4028	0.3947	0.3545	0.3464	0.3061	0.3061	0.2981	0.3222	0.3464	0.3625	0.3786 (22b)
Effective ac	0.5844	0.5811	0.5779	0.5628	0.5600	0.5469	0.5469	0.5444	0.5519	0.5600	0.5657	0.5717 (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
DTC			2.1200	1.0800	2.2896		(26)
Windows (Uw = 1.40)			8.8900	1.3258	11.7860		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	59.1100	11.4100	47.7000	0.2500	11.9250	52.8000	2518.5600 (29a)
External Wall to Stairwell	20.2500	2.1200	18.1300	0.2000	3.6260	52.8000	957.2640 (29a)
Total net area of external elements Aum(A, m2)			79.3600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	32.9675		(33)
E-FC-4			56.4000			70.0000	3948.0000 (32d)
E-FC-4			56.4000			30.0000	1692.0000 (32b)
Metal			114.3900			14.0000	1601.4600 (32c)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	10717.2840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							190.0228 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.2540 (36)
Total fabric heat loss						(33) + (36) =	39.2214 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	25.9958	25.8500	25.7071	25.0359	24.9103	24.3257	24.3257	24.2175	24.5509	24.9103	25.1644	25.4300 (38)
Average = Sum(39)m / 12 =	65.2173	65.0715	64.9286	64.2574	64.1318	63.5472	63.5472	63.4389	63.7724	64.1318	64.3858	64.6514 (39)
												64.2568 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1563	1.1537	1.1512	1.1393	1.1371	1.1267	1.1267	1.1248	1.1307	1.1371	1.1416	1.1463 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

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

Assumed occupancy	1.8782 (42)											
Average daily hot water use (litres/day)	78.8083 (43)											
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	86.6892	83.5368	80.3845	77.2322	74.0798	70.9275	70.9275	74.0798	77.2322	80.3845	83.5368	86.6892 (44)
Energy content (annual)	128.5575	112.4372	116.0252	101.1535	97.0592	83.7547	77.6111	89.0598	90.1235	105.0303	114.6487	124.5011 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1239.9620 (45)
Water storage loss:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	27.3185	23.8929	24.6553	21.4951	20.6251	17.7979	16.4924	18.9252	19.1512	22.3189	24.3629	26.4565	26.4565	(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	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.6875	13.0453	10.6092	8.0318	6.0039	5.0687	5.4769	7.1191	9.5553	12.1326	14.1606	15.0957	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	163.7855	165.4850	161.2021	152.0844	140.5748	129.7575	122.5309	120.8313	125.1142	134.2319	145.7415	156.5588	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	(71)
Water heating gains (Table 5)	36.7184	35.5549	33.1389	29.8543	27.7219	24.7193	22.1671	25.4371	26.5990	29.9986	33.8373	35.5598	(72)
Total internal gains	266.3650	265.2590	256.1239	241.1442	225.4743	210.7192	201.3486	204.5612	212.4421	227.5368	244.9130	258.3880	(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							
Northeast	3.9900	11.2829	0.4300	0.0000	0.7700	14.9058 (75)							
Southeast	2.0000	36.7938	0.4300	0.0000	0.7700	24.3649 (77)							
Southwest	2.9000	36.7938	0.4300	0.0000	0.7700	35.3291 (79)							
Southeast	2.5200	36.7938	0.4300	0.0000	0.7700	30.6997 (77)							
Solar gains	105.2995	184.3150	265.3389	350.8108	413.0572	418.9203	400.2008	352.4092	294.7254	207.2532	127.0261	89.5310	(83)
Total gains	371.6645	449.5740	521.4628	591.9550	638.5315	629.6395	601.5495	556.9704	507.1675	434.7900	371.9391	347.9190	(84)

#### 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)													21.0000 (85)
tau	45.6478	45.7500	45.8507	46.3297	46.4204	46.8475	46.8475	46.9274	46.6820	46.4204	46.2372	46.0473	
alpha	4.0432	4.0500	4.0567	4.0886	4.0947	4.1232	4.1232	4.1285	4.1121	4.0947	4.0825	4.0698	
util living area	0.9914	0.9812	0.9572	0.8957	0.7754	0.6037	0.4540	0.5060	0.7435	0.9319	0.9836	0.9934	(86)
MIT	19.5212	19.7547	20.0914	20.4906	20.7912	20.9451	20.9866	20.9793	20.8701	20.4605	19.9106	19.4770	(87)
Th 2	19.9551	19.9572	19.9592	19.9689	19.9707	19.9791	19.9791	19.9806	19.9758	19.9707	19.9670	19.9632	(88)
util rest of house	0.9892	0.9765	0.9464	0.8696	0.7230	0.5220	0.3537	0.4018	0.6682	0.9090	0.9787	0.9917	(89)
MIT 2	18.6145	18.8468	19.1778	19.5641	19.8290	19.9519	19.9750	19.9737	19.9019	19.5467	19.0108	18.5768	(90)
Living area fraction									fLA = Living area / (4) =			0.3821	(91)
MIT	18.9610	19.1937	19.5269	19.9181	20.1967	20.3314	20.3615	20.3580	20.2719	19.8959	19.3546	18.9208	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9610	19.1937	19.5269	19.9181	20.1967	20.3314	20.3615	20.3580	20.2719	19.8959	19.3546	18.9208	(93)

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9865	0.9721	0.9410	0.8681	0.7354	0.5513	0.3920	0.4414	0.6917	0.9071	0.9749	0.9894	(94)
Useful gains	366.6423	437.0293	490.6870	513.8953	469.5823	347.1083	235.7991	245.8590	350.8130	394.3810	362.6110	344.2217	(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	956.1478	930.1128	845.8164	707.9939	544.9061	364.2124	239.0332	251.0880	393.5936	596.1602	789.0246	951.7204	(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	438.5922	331.3521	264.2163	139.7510	56.0409	0.0000	0.0000	0.0000	0.0000	150.1237	307.0179	451.9790	(98)
Space heating												2139.0731	(98)
Space heating per m <sup>2</sup>												37.9268	(99)

#### 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	597.3434	470.2491	482.1357	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9042	0.9451	0.9280	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	540.1099	444.4264	447.4225	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	806.4187	772.2212	721.1996	0.0000	0.0000	0.0000	0.0000	(103)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	191.7423	243.8794	203.6901	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling Cooled fraction												639.3118 (104)
Intermittency factor (Table 10b)												1.0000 (105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling												
Space cooling per m2	0.0000	0.0000	0.0000	0.0000	0.0000	47.9356	60.9698	50.9225	0.0000	0.0000	0.0000	0.0000 (107)
Energy for space heating												159.8280 (107)
Energy for space cooling												2.8338 (108)
Total												37.9268 (99)
Dwelling Fabric Energy Efficiency (DFEE)												2.8338 (108)
												40.7607 (109)
												40.8 (109)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	56.4000 (1b)	2.3900 (2b)	134.7960 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	134.7960 (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) =	0.1484 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3984	(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) =	0.3685 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4698	0.4606	0.4514	0.4053	0.3961	0.3501	0.3501	0.3409	0.3685	0.3961	0.4146	0.4330 (22b)
Effective ac	0.6104	0.6061	0.6019	0.5822	0.5785	0.5613	0.5613	0.5581	0.5679	0.5785	0.5859	0.5937 (25)

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

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			2.1200	1.0000	2.1200		(26)					
TER Opening Type (Uw = 1.40)			11.4100	1.3258	15.1269		(27)					
External Wall	59.1100	11.4100	47.7000	0.1800	8.5860		(29a)					
External Wall to Stairwell	20.2500	2.1200	18.1300	0.1800	3.2634		(29a)					
Total net area of external elements Aum(A, m2)			79.3600				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 29.0963		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.7253 (36)					
Total fabric heat loss						(33) + (36) =	35.8216 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	27.1509	26.9603	26.7734	25.8957	25.7315	24.9670	24.9670	24.8254	25.2615	25.7315	26.0637	26.4110 (38)
Average = Sum(39)m / 12 =	62.9725	62.7819	62.5950	61.7173	61.5530	60.7886	60.7886	60.6470	61.0830	61.5530	61.8853	62.2326 (39)
	61.7165											61.7165 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1165	1.1132	1.1098	1.0943	1.0914	1.0778	1.0778	1.0753	1.0830	1.0914	1.0973	1.1034 (40)
Days in month												1.0943 (40)
	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												1.8782 (42)
Average daily hot water use (litres/day)												78.8083 (43)
Daily hot water use	86.6892	83.5368	80.3845	77.2322	74.0798	70.9275	70.9275	74.0798	77.2322	80.3845	83.5368	86.6892 (44)
Energy conte	128.5575	112.4372	116.0252	101.1535	97.0592	83.7547	77.6111	89.0598	90.1235	105.0303	114.6487	124.5011 (45)
Energy content (annual)												Total = Sum(45)m = 1239.9620 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
												0.0000 (59)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat gains from water heating, kWh/month  
 27.3185 23.8929 24.6553 21.4951 20.6251 17.7979 16.4924 18.9252 19.1512 22.3189 24.3629 26.4565 (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	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123	93.9123 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.6875	13.0453	10.6092	8.0318	6.0039	5.0687	5.4769	7.1191	9.5553	12.1326	14.1606	15.0957 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	163.7855	165.4850	161.2021	152.0844	140.5748	129.7575	122.5309	120.8313	125.1142	134.2319	145.7415	156.5588 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912	32.3912 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298 (71)
Water heating gains (Table 5)	36.7184	35.5549	33.1389	29.8543	27.7219	24.7193	22.1671	25.4371	26.5990	29.9986	33.8373	35.5598 (72)
Total internal gains	266.3650	265.2590	256.1239	241.1442	225.4743	210.7192	201.3486	204.5612	212.4421	227.5368	244.9130	258.3880 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W					
Northeast	3.9900	11.2829	0.6300	0.7000	0.7700	13.7584 (75)						
Southeast	4.5200	36.7938	0.6300	0.7000	0.7700	50.8259 (77)						
Southwest	2.9000	36.7938	0.6300	0.7000	0.7700	32.6096 (79)						
Solar gains	97.1938	170.1271	244.9139	323.8065	381.2614	386.6731	369.3947	325.2819	272.0384	191.2995	117.2481	82.6392 (83)
Total gains	363.5589	435.3860	501.0378	564.9507	606.7357	597.3923	570.7433	529.8431	484.4805	418.8363	362.1611	341.0272 (84)

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

Temperature during heating periods in the living area from Table 9, Th1 (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)	62.1965	62.3853	62.5716	63.4614	63.6308	64.4310	64.4310	64.5814	64.1204	63.6308	63.2892	62.9360
tau	5.1464	5.1590	5.1714	5.2308	5.2421	5.2954	5.2954	5.3054	5.2747	5.2421	5.2193	5.1957
util living area	0.9972	0.9926	0.9787	0.9314	0.8144	0.6261	0.4641	0.5181	0.7769	0.9597	0.9936	0.9980 (86)
MIT	19.8455	20.0300	20.3001	20.6289	20.8682	20.9747	20.9956	20.9924	20.9240	20.5991	20.1587	19.8157 (87)
Th 2	19.9874	19.9901	19.9928	20.0055	20.0079	20.0190	20.0190	20.0211	20.0147	20.0079	20.0031	19.9980 (88)
util rest of house	0.9963	0.9901	0.9715	0.9087	0.7604	0.5406	0.3630	0.4122	0.6978	0.9416	0.9911	0.9973 (89)
MIT 2	18.9391	19.1246	19.3926	19.7161	19.9237	20.0081	20.0179	20.0190	19.9756	19.6970	19.2640	18.9181 (90)
Living area fraction	19.2855	19.4705	19.7393	20.0648	20.2846	20.3774	20.3915	20.3910	20.3379	20.0417	19.6059	19.2611 (92)
MIT	19.2855	19.4705	19.7393	20.0648	20.2846	20.3774	20.3915	20.3910	20.3379	20.0417	19.6059	19.2611 (92)
Temperature adjustment												0.0000
adjusted MIT	19.2855	19.4705	19.7393	20.0648	20.2846	20.3774	20.3915	20.3910	20.3379	20.0417	19.6059	19.2611 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.9954	0.9885	0.9693	0.9102	0.7767	0.5728	0.4018	0.4529	0.7257	0.9424	0.9898	0.9967 (94)	
Useful gains	361.9046	430.3821	485.6677	514.2229	471.2265	342.1949	229.3475	239.9661	351.5915	394.7025	358.4678	339.8900 (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	943.6715	914.7639	828.7166	689.0640	528.4089	351.2002	230.4801	242.0397	381.0320	581.1657	773.9301	937.2901 (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	432.8346	325.5045	255.2284	125.8856	42.5436	0.0000	0.0000	0.0000	0.0000	138.7286	299.1329	444.4657 (98)
Space heating per m2										(98) / (4) =		36.6015 (99)

#### 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	571.4127	449.8355	460.9173	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9369	0.9700	0.9575	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	535.3488	436.3450	441.3348	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	768.7273	736.2140	689.4924	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	168.0325	223.1026	184.6292	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling Cooled fraction												575.7643 (104)
Intermittency factor (Table 10b)												fc = cooled area / (4) = 1.0000 (105)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	42.0081	55.7756	46.1573	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												143.9411 (107)
Energy for space heating												2.5521 (108)
Energy for space cooling												36.6015 (99)
Total												2.5521 (108)
Target Fabric Energy Efficiency (TFEE)												39.1536 (109)
												45.0 (109)

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF HEAT DEMAND 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	56.4000 (1b)	2.3900 (2b)	134.7960 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	134.7960 (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				0 * 10 =	0.0000 (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) =				0.0000 / (5) =	0.0000 (8)
Pressure test				Yes	
Measured/design AP50				4.0000	
Infiltration rate				0.2000	0.2000 (18)
Number of sides sheltered				1	1 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.9250 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.1850 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.9000	4.8000	4.7000	4.2000	4.2000	3.7000	3.8000	3.8000	4.0000	4.2000	4.3000	4.5000 (22)
Wind factor	1.2250	1.2000	1.1750	1.0500	1.0500	0.9250	0.9500	0.9500	1.0000	1.0500	1.0750	1.1250 (22a)
Adj infilt rate	0.2266	0.2220	0.2174	0.1943	0.1943	0.1711	0.1758	0.1758	0.1850	0.1943	0.1989	0.2081 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation:												
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (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
DTC			2.1200	1.0800	2.2896		(26)
Windows (Uw = 1.40)			8.8900	1.3258	11.7860		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	59.1100	11.4100	47.7000	0.2500	11.9250	52.8000	2518.5600 (29a)
External Wall to Stairwell	20.2500	2.1200	18.1300	0.2000	3.6260	52.8000	957.2640 (29a)
Total net area of external elements Aum(A, m2)			79.3600				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	32.9675	(33)
E-FC-4			56.4000			70.0000	3948.0000 (32d)
E-FC-4			56.4000			70.0000	3948.0000 (32b)
Metal			114.3900			14.0000	1601.4600 (32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		12973.2840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							230.0228 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.2540 (36)
Total fabric heat loss						(33) + (36) =	39.2214 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413 (38)
Average = Sum(39)m / 12 =	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628 (39)
HLP	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898 (40)
HLP (average)												1.0898 (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												1.8782 (42)
Average daily hot water use (litres/day)												78.8083 (43)
Daily hot water use	86.6892	83.5368	80.3845	77.2322	74.0798	70.9275	70.9275	74.0798	77.2322	80.3845	83.5368	86.6892 (44)
Energy conte	128.5575	112.4372	116.0252	101.1535	97.0592	83.7547	77.6111	89.0598	90.1235	105.0303	114.6487	124.5011 (45)
Energy content (annual)										Total = Sum(45)m =		1239.9620 (45)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF HEAT DEMAND 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	19.2836	16.8656	17.4038	15.1730	14.5589	12.5632	11.6417	13.3590	13.5185	15.7545	17.1973	18.6752 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
Combi loss	14.0240	12.6507	13.9804	13.5003	13.9291	13.4554	13.8887	13.9149	13.4799	13.9592	13.5427	14.0156 (61)
Total heat required for water heating calculated for each month	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167 (64)
RHI water heating demand												
Heat gains from water heating, kWh/month	46.2514	40.5481	42.0735	37.0086	35.7545	31.2123	29.2779	33.0911	33.3360	38.4124	41.5064	44.9005 (65)
												1404.3028 (64)
												1404 (64)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	36.7188	32.6133	26.5229	20.0795	15.0097	12.6718	13.6923	17.7978	23.8882	30.3316	35.4014	37.7393 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	244.4559	246.9926	240.6002	226.9916	209.8132	193.6679	182.8819	180.3452	186.7376	200.3462	217.5246	233.6699 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477 (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)	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298 (71)
Water heating gains (Table 5)	62.1658	60.3394	56.5504	51.4009	48.0571	43.3504	39.3520	44.4773	46.3000	51.6295	57.6477	60.3502 (72)
Total internal gains	432.0531	428.6579	412.3861	387.1847	361.5926	338.4028	324.6388	331.3330	345.6384	371.0199	399.2864	420.4719 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W					
Northeast	3.9900	12.9465	0.4300	0.0000	0.7700	17.1035 (75)						
Southeast	2.0000	40.9830	0.4300	0.0000	0.7700	27.1390 (77)						
Southwest	2.9000	40.9830	0.4300	0.0000	0.7700	39.3515 (79)						
Southeast	2.5200	40.9830	0.4300	0.0000	0.7700	34.1951 (77)						
Solar gains	117.7891	192.3106	272.6596	379.9095	432.5667	457.5539	432.6617	383.3496	321.3893	226.1154	145.5990	99.1673 (83)
Total gains	549.8422	620.9685	685.0457	767.0941	794.1593	795.9567	757.3005	714.6826	667.0278	597.1353	544.8853	519.6392 (84)

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

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321
alpha	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088
util living area	0.9756	0.9568	0.9100	0.7951	0.6264	0.4284	0.2756	0.2919	0.5390	0.8258	0.9499	0.9804 (86)	
MIT	20.1629	20.3220	20.5736	20.8257	20.9551	20.9942	20.9995	20.9994	20.9833	20.8256	20.4607	20.1144 (87)	
Th 2	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092 (88)	
util rest of house	0.9690	0.9457	0.8880	0.7524	0.5635	0.3545	0.1955	0.2071	0.4559	0.7769	0.9348	0.9750 (89)	
MIT 2	18.9340	19.1584	19.5054	19.8280	19.9722	20.0062	20.0091	20.0091	19.9993	19.8374	19.3580	18.8651 (90)	
Living area fraction										fLA = Living area / (4) =		0.3821 (91)	
MIT	19.4036	19.6030	19.9136	20.2092	20.3478	20.3837	20.3875	20.3874	20.3753	20.2150	19.7793	19.3425 (92)	
Temperature adjustment												0.0000	
adjusted MIT	19.4036	19.6030	19.9136	20.2092	20.3478	20.3837	20.3875	20.3874	20.3753	20.2150	19.7793	19.3425 (93)	

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	530.0068	583.8872	606.6900	584.1854	465.0559	304.5708	171.2391	171.2069	324.9955	470.5298	507.0474	504.2216 (95)
Ext temp.	4.7000	5.2000	7.0000	9.5000	12.5000	15.4000	17.6000	17.6000	15.0000	11.4000	7.7000	4.7000 (96)
Heat loss rate W	903.7212	885.2500	793.7044	658.2182	482.3455	306.3122	171.3291	171.3244	330.3795	541.7953	742.4277	899.9677 (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	278.0435	202.5158	139.1387	53.3037	12.8634	0.0000	0.0000	0.0000	0.0000	53.0215	169.4739	294.4351 (98)
Space heating RHI space heating demand												1202.7957 (98)
												1203 (98)



**FULL SAP CALCULATION PRINTOUT**  
**Calculation Type: New Build (As Designed)**



CALCULATION OF HEAT DEMAND 09 Jan 2014

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# 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 (m2)	Storey height (m)	Volume (m3)
Ground floor	56.4000 (1b)	x 2.3900 (2b)	= 134.7960 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 134.7960 (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				0 * 10 =	0.0000 (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) =				0.0000 / (5) =	0.0000 (8)
Pressure test					Yes
Measured/design AP50					4.0000
Infiltration rate					0.2000 (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) =	0.1850 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.2359	0.2313	0.2266	0.2035	0.1989	0.1758	0.1758	0.1711	0.1850	0.1989	0.2081	0.2174 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (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
DTC			2.1200	1.0800	2.2896		(26)
Windows (Uw = 1.40)			8.8900	1.3258	11.7860		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	59.1100	11.4100	47.7000	0.2500	11.9250	52.8000	2518.5600 (29a)
External Wall to Stairwell	20.2500	2.1200	18.1300	0.2000	3.6260	52.8000	957.2640 (29a)
Total net area of external elements Aum(A, m2)			79.3600				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	32.9675	(33)
E-FC-4			56.4000			70.0000	3948.0000 (32d)
E-FC-4			56.4000			70.0000	3948.0000 (32b)
Metal			114.3900			14.0000	1601.4600 (32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =	12973.2840 (34)	
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							230.0228 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.2540 (36)
Total fabric heat loss						(33) + (36) =	39.2214 (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	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413	22.2413 (38)
Heat transfer coeff	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628 (39)
Average = Sum(39)m / 12 =												61.4628 (39)
HLP	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898 (40)
HLP (average)												1.0898 (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												1.8782 (42)
Average daily hot water use (litres/day)												78.8083 (43)
Daily hot water use	86.6892	83.5368	80.3845	77.2322	74.0798	70.9275	70.9275	74.0798	77.2322	80.3845	83.5368	86.6892 (44)
Energy conte	128.5575	112.4372	116.0252	101.1535	97.0592	83.7547	77.6111	89.0598	90.1235	105.0303	114.6487	124.5011 (45)
Energy content (annual)										Total = Sum(45)m =		1239.9620 (45)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF ENERGY RATINGS 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	19.2836	16.8656	17.4038	15.1730	14.5589	12.5632	11.6417	13.3590	13.5185	15.7545	17.1973	18.6752 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.0240	12.6507	13.9804	13.5003	13.9291	13.4554	13.8887	13.9149	13.4799	13.9592	13.5427	14.0156 (61)
Total heat required for water heating calculated for each month	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167 (64)
Heat gains from water heating, kWh/month	46.2514	40.5481	42.0735	37.0086	35.7545	31.2123	29.2779	33.0911	33.3360	38.4124	41.5064	44.9005 (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	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	36.7188	32.6133	26.5229	20.0795	15.0097	12.6718	13.6923	17.7978	23.8882	30.3316	35.4014	37.7393 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	244.4559	246.9926	240.6002	226.9916	209.8132	193.6679	182.8819	180.3452	186.7376	200.3462	217.5246	233.6699 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477 (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)	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298 (71)
Water heating gains (Table 5)	62.1658	60.3394	56.5504	51.4009	48.0571	43.3504	39.3520	44.4773	46.3000	51.6295	57.6477	60.3502 (72)
Total internal gains	432.0531	428.6579	412.3861	387.1847	361.5926	338.4028	324.6388	331.3330	345.6384	371.0199	399.2864	420.4719 (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	3.9900	11.2829	0.4300	0.0000	0.7700	14.9058 (75)						
Southeast	2.0000	36.7938	0.4300	0.0000	0.7700	24.3649 (77)						
Southwest	2.9000	36.7938	0.4300	0.0000	0.7700	35.3291 (79)						
Southeast	2.5200	36.7938	0.4300	0.0000	0.7700	30.6997 (77)						
Solar gains	105.2995	184.3150	265.3389	350.8108	413.0572	418.9203	400.2008	352.4092	294.7254	207.2532	127.0261	89.5310 (83)
Total gains	537.3526	612.9729	677.7250	737.9954	774.6498	757.3230	724.8397	683.7422	640.3638	578.2731	526.3125	510.0029 (84)

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

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321
alpha	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088
util living area	0.9797	0.9615	0.9221	0.8339	0.6857	0.5092	0.3712	0.4103	0.6298	0.8695	0.9622	0.9839 (86)
MIT	20.1007	20.2802	20.5211	20.7693	20.9273	20.9861	20.9976	20.9961	20.9627	20.7547	20.3743	20.0454 (87)
Th 2	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092 (88)
util rest of house	0.9742	0.9516	0.9029	0.7969	0.6275	0.4346	0.2886	0.3236	0.5514	0.8308	0.9508	0.9795 (89)
MIT 2	18.8448	19.0995	19.4340	19.7598	19.9444	20.0005	20.0083	20.0076	19.9827	19.7513	19.2373	18.7655 (90)
Living area fraction	19.3247	19.5506	19.8493	20.1455	20.3200	20.3771	20.3863	20.3853	20.3571	20.1347	19.6717	0.3821 (91)
Temperature adjustment	19.3247	19.5506	19.8493	20.1455	20.3200	20.3771	20.3863	20.3853	20.3571	20.1347	19.6717	19.2545 (92)
adjusted MIT	19.3247	19.5506	19.8493	20.1455	20.3200	20.3771	20.3863	20.3853	20.3571	20.1347	19.6717	0.0000 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9694	0.9461	0.8994	0.8024	0.6465	0.4627	0.3202	0.3568	0.5799	0.8362	0.9460	0.9752 (94)
Ext temp.	520.9359	579.9411	609.5527	592.1889	500.7899	350.4438	232.1182	243.9268	371.3573	483.5793	497.8909	497.3335 (95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Month fracti	923.4589	900.4695	820.4880	691.1821	529.8065	355.0751	232.7168	244.9478	384.5799	586.0297	772.6931	925.2922 (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	299.4771	215.3951	156.9359	71.2751	21.5883	0.0000	0.0000	0.0000	0.0000	76.2231	197.8576	318.4013 (98)
Space heating per m2												1357.1535 (98)
												(98) / (4) = 24.0630 (99)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

	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 %)													93.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													1451.5010 (211)
Space heating requirement	299.4771	215.3951	156.9359	71.2751	21.5883	0.0000	0.0000	0.0000	0.0000	76.2231	197.8576	318.4013	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	320.2964	230.3690	167.8458	76.2301	23.0891	0.0000	0.0000	0.0000	0.0000	81.5221	211.6124	340.5362	(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	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167	(64)
Efficiency of water heater (217)m	89.4425	89.2975	89.0216	88.4996	87.8056	87.3000	87.3000	87.3000	87.3000	88.5222	89.2143	89.5054	(216)
Fuel for water heating, kWh/month	159.4114	140.0800	146.0383	129.5530	126.4024	111.3518	104.8107	117.9550	118.6751	134.4177	143.6893	154.7579	(219)
Water heating fuel used													1587.1426 (219)
Annual totals kWh/year													
Space heating fuel - main system													1451.5010 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans: (MEVDecentralised, Database: total watage = 6.9550, total flow = 29.0000, SFP = 0.2398)													
mechanical ventilation fans (SFP = 0.2398)													39.4399 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													114.4399 (231)
Electricity for lighting (calculated in Appendix L)													259.3860 (232)
Total delivered energy for all uses													3412.4695 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1451.5010	3.4800	50.5122	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1587.1426	3.4800	55.2326	(247)
Mechanical ventilation fans	39.4399	13.1900	5.2021	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	259.3860	13.1900	34.2130	(250)
Additional standing charges			120.0000	(251)
Total energy cost			275.0524	(255)

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

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	1.1393	(257)
SAP value		84.1072	
SAP rating (Section 12)		84	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1451.5010	0.2160	313.5242	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1587.1426	0.2160	342.8228	(264)
Space and water heating			656.3470	(265)
Pumps and fans	114.4399	0.5190	59.3943	(267)
Energy for lighting	259.3860	0.5190	134.6213	(268)
Total kg/year			850.3627	(272)
CO2 emissions per m2			15.0800	(273)
EI value			88.7625	
EI rating			89	(274)
EI band			B	

#### Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9050 = 3.845$ , stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9050 = 0.2387$ , stars = 4
Water heating energy efficiency	$3.48 / 0.8838 = 3.938$ , stars = 4
Water heating environmental impact	$0.216 / 0.8838 = 0.2444$ , stars = 4

**FULL SAP CALCULATION PRINTOUT**  
**Calculation Type: New Build (As Designed)**



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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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 (m2)	Storey height (m)	Volume (m3)
Ground floor	56.4000 (1b)	x 2.3900 (2b)	= 134.7960 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 134.7960 (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				0 * 10 =	0.0000 (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) =				0.0000 / (5) =	0.0000 (8)
Pressure test				Yes	
Measured/design AP50				4.0000	
Infiltration rate				0.2000	(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) =		0.1850 (21)

  

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.9000	4.8000	4.7000	4.2000	4.2000	3.7000	3.8000	3.8000	4.0000	4.2000	4.3000	4.5000 (22)
Wind factor	1.2250	1.2000	1.1750	1.0500	1.0500	0.9250	0.9500	0.9500	1.0000	1.0500	1.0750	1.1250 (22a)
Adj infiltr rate	0.2266	0.2220	0.2174	0.1943	0.1943	0.1711	0.1758	0.1758	0.1850	0.1943	0.1989	0.2081 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation:												
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (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
DTC			2.1200	1.0800	2.2896		(26)
Windows (Uw = 1.40)			8.8900	1.3258	11.7860		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	59.1100	11.4100	47.7000	0.2500	11.9250	52.8000	2518.5600 (29a)
External Wall to Stairwell	20.2500	2.1200	18.1300	0.2000	3.6260	52.8000	957.2640 (29a)
Total net area of external elements Aum(A, m2)			79.3600				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	32.9675	(33)
E-FC-4			56.4000			70.0000	3948.0000 (32d)
E-FC-4			56.4000			70.0000	3948.0000 (32b)
Metal			114.3900			14.0000	1601.4600 (32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		12973.2840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							230.0228 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.2540 (36)
Total fabric heat loss					(33) + (36) =		39.2214 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628	61.4628 (39)
Average = Sum(39)m / 12 =												61.4628 (39)

  

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898	1.0898 (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												1.8782 (42)
Average daily hot water use (litres/day)												78.8083 (43)
Daily hot water use	86.6892	83.5368	80.3845	77.2322	74.0798	70.9275	70.9275	74.0798	77.2322	80.3845	83.5368	86.6892 (44)
Energy conte	128.5575	112.4372	116.0252	101.1535	97.0592	83.7547	77.6111	89.0598	90.1235	105.0303	114.6487	124.5011 (45)
Energy content (annual)										Total = Sum(45)m =		1239.9620 (45)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

Distribution loss (46)m = 0.15 x (45)m	19.2836	16.8656	17.4038	15.1730	14.5589	12.5632	11.6417	13.3590	13.5185	15.7545	17.1973	18.6752 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.0240	12.6507	13.9804	13.5003	13.9291	13.4554	13.8887	13.9149	13.4799	13.9592	13.5427	14.0156 (61)
Total heat required for water heating calculated for each month	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167 (64)
Heat gains from water heating, kWh/month	46.2514	40.5481	42.0735	37.0086	35.7545	31.2123	29.2779	33.0911	33.3360	38.4124	41.5064	44.9005 (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	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947	112.6947 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	36.7188	32.6133	26.5229	20.0795	15.0097	12.6718	13.6923	17.7978	23.8882	30.3316	35.4014	37.7393 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	244.4559	246.9926	240.6002	226.9916	209.8132	193.6679	182.8819	180.3452	186.7376	200.3462	217.5246	233.6699 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477	48.1477 (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)	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298	-75.1298 (71)
Water heating gains (Table 5)	62.1658	60.3394	56.5504	51.4009	48.0571	43.3504	39.3520	44.4773	46.3000	51.6295	57.6477	60.3502 (72)
Total internal gains	432.0531	428.6579	412.3861	387.1847	361.5926	338.4028	324.6388	331.3330	345.6384	371.0199	399.2864	420.4719 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g Specific data or Table 6c	FF	Access factor Table 6d	Gains W					
Northeast	3.9900	12.9465	0.4300	0.0000	0.7700	17.1035 (75)						
Southeast	2.0000	40.9830	0.4300	0.0000	0.7700	27.1390 (77)						
Southwest	2.9000	40.9830	0.4300	0.0000	0.7700	39.3515 (79)						
Southeast	2.5200	40.9830	0.4300	0.0000	0.7700	34.1951 (77)						
Solar gains	117.7891	192.3106	272.6596	379.9095	432.5667	457.5539	432.6617	383.3496	321.3893	226.1154	145.5990	99.1673 (83)
Total gains	549.8422	620.9685	685.0457	767.0941	794.1593	795.9567	757.3005	714.6826	667.0278	597.1353	544.8853	519.6392 (84)

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

Temperature during heating periods in the living area from Table 9, Th1 (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)	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321	58.6321 (85)
tau	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088	4.9088
alpha	0.9756	0.9568	0.9100	0.7951	0.6264	0.4284	0.2756	0.2919	0.5390	0.8258	0.9499	0.9804 (86)
util living area	20.1629	20.3220	20.5736	20.8257	20.9551	20.9942	20.9995	20.9994	20.9833	20.8256	20.4607	20.1144 (87)
MIT	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092	20.0092 (88)
Th 2	0.9690	0.9457	0.8880	0.7524	0.5635	0.3545	0.1955	0.2071	0.4559	0.7769	0.9348	0.9750 (89)
util rest of house	18.9340	19.1584	19.5054	19.8280	19.9722	20.0062	20.0091	20.0091	19.9993	19.8374	19.3580	18.8651 (90)
Living area fraction	19.4036	19.6030	19.9136	20.2092	20.3478	20.3837	20.3875	20.3874	20.3753	20.2150	19.7793	19.3425 (92)
Temperature adjustment	19.4036	19.6030	19.9136	20.2092	20.3478	20.3837	20.3875	20.3874	20.3753	20.2150	19.7793	19.3425 (93)
adjusted MIT												

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	530.0068	583.8872	606.6900	584.1854	465.0559	304.5708	171.2391	171.2069	324.9955	470.5298	507.0474	504.2216 (95)
Ext temp.	4.7000	5.2000	7.0000	9.5000	12.5000	15.4000	17.6000	17.6000	15.0000	11.4000	7.7000	4.7000 (96)
Heat loss rate W	903.7212	885.2500	793.7044	658.2182	482.3455	306.3122	171.3291	171.3244	330.3795	541.7953	742.4277	899.9677 (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	278.0435	202.5158	139.1387	53.3037	12.8634	0.0000	0.0000	0.0000	0.0000	53.0215	169.4739	294.4351 (98)
Space heating												1202.7957 (98)
Space heating per m2												21.3262 (99)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

8c. Space cooling requirement

Not applicable

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

	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 %)													93.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													1286.4125 (211)
Space heating requirement	278.0435	202.5158	139.1387	53.3037	12.8634	0.0000	0.0000	0.0000	0.0000	53.0215	169.4739	294.4351	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	297.3727	216.5945	148.8115	57.0093	13.7577	0.0000	0.0000	0.0000	0.0000	56.7075	181.2555	314.9039	(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	142.5816	125.0879	130.0056	114.6538	110.9884	97.2101	91.4998	102.9747	103.6034	118.9894	128.1914	138.5167	(64)
Efficiency of water heater (217)m	89.3893	89.2508	88.9255	88.2908	87.6218	87.3000	87.3000	87.3000	87.3000	88.2620	89.0936	89.4510	(216)
Fuel for water heating, kWh/month	159.5063	140.1532	146.1960	129.8594	126.6675	111.3518	104.8107	117.9550	118.6751	134.8139	143.8840	154.8521	(219)
Water heating fuel used													1588.7250 (219)
Annual totals kWh/year													
Space heating fuel - main system													1286.4125 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans: (MEVDecentralised, Database: total watage = 6.9550, total flow = 29.0000, SFP = 0.2398)													
mechanical ventilation fans (SFP = 0.2398)													39.4399 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													114.4399 (231)
Electricity for lighting (calculated in Appendix L)													259.3860 (232)
Total delivered energy for all uses													3248.9634 (238)

10a. Fuel costs - using BEDF prices (443)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1286.4125	3.9200	50.4274 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1588.7250	3.9200	62.2780 (247)
Mechanical ventilation fans	39.4399	16.9600	6.6890 (249)
Pumps and fans for heating	75.0000	16.9600	12.7200 (249)
Energy for lighting	259.3860	16.9600	43.9919 (250)
Additional standing charges			88.0000 (251)
Total energy cost			264.1063 (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	1286.4125	0.2160	277.8651 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1588.7250	0.2160	343.1646 (264)
Space and water heating			621.0297 (265)
Pumps and fans	114.4399	0.5190	59.3943 (267)
Energy for lighting	259.3860	0.5190	134.6213 (268)
Total kg/year			815.0453 (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	1286.4125	1.2200	1569.4232 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1588.7250	1.2200	1938.2445 (264)
Space and water heating			3507.6678 (265)
Pumps and fans	114.4399	3.0700	351.3305 (267)
Energy for lighting	259.3860	3.0700	796.3149 (268)
Primary energy kWh/year			4655.3132 (272)
Primary energy kWh/m2/year			82.5410 (273)

SAP 2012 EPC IMPROVEMENTS



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

Current energy efficiency rating: B 84  
 Current environmental impact rating: B 89

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

Recommended measures: (none)	SAP change	Cost change	CO2 change
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Recommended measures (none)	Typical annual savings	Energy efficiency	Environmental impact
	Total Savings £0	0.00 kg/m <sup>2</sup>	

Potential energy efficiency rating: B 84  
 Potential environmental impact rating: B 89

Fuel prices for cost data on this page from database revision number 443 TEST (28 May 2019)  
 Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£63	£63	£0
Mains gas	£201	£201	£0
Space heating	£158	£158	£0
Water heating	£62	£62	£0
Lighting	£44	£44	£0
Total cost of fuels	£264	£264	£0
Total cost of uses	£264	£264	£0
Delivered energy	58 kWh/m <sup>2</sup>	58 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.8 tonnes	0.8 tonnes	0.0 tonnes
CO2 emissions per m <sup>2</sup>	14 kg/m <sup>2</sup>	14 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>
Primary energy	83 kWh/m <sup>2</sup>	83 kWh/m <sup>2</sup>	0 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

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SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014  
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No improvements selected / applicable  
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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

No improvements selected / applicable

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

#### Overheating Calculation Input Data

Dwelling type	Detached Flat
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	East Anglia
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	230.0 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

#### Overheating Calculation

Summer ventilation heat loss coefficient	266.90 (P1)
Transmission heat loss coefficient	39.22 (37)
Summer heat loss coefficient	306.12 (P2)

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

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

[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	3.9900	100.0415	0.4300	0.0000	0.9000	154.4770
South East	2.0000	122.3147	0.4300	0.0000	0.9000	94.6716
South West	2.9000	122.3147	0.4300	0.0000	0.9000	137.2738
South East	2.5200	122.3147	0.4300	0.0000	0.9000	119.2862

total: 505.7085

Solar gains	535	506	448	(P4)
Internal gains	335	322	328	
Total summer gains	870	827	776	(P5)

Summer gain/loss ratio	2.84	2.70	2.54	(P6)
Summer external temperature	15.40	17.60	17.60	
Thermal mass temperature increment (TMP = 230.0)	0.39	0.39	0.39	
Threshold temperature	18.63	20.69	20.53	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight