

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



<b>Property Reference</b>	4907-0015-3990-009			<b>Issued on Date</b>	12/02/2020
<b>Assessment Reference</b>	009	<b>Prop Type Ref</b>	2FF Det		
<b>Property</b>	Plot 009, 1 Bed, K, Ba, Welwyn Garden City				
<b>SAP Rating</b>	84 B	<b>DER</b>	17.87	<b>TER</b>	19.51
<b>Environmental</b>	89 B	<b>% DER&lt;TER</b>	8.40		
<b>CO<sub>2</sub> Emissions (t/year)</b>	0.78	<b>DFEE</b>	42.75	<b>TFEE</b>	46.75
<b>General Requirements Compliance</b>	Pass	<b>% DFEE&lt;TFEE</b>	8.56		
<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 51 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) 19.51 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 17.87 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)46.8 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)42.7 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	1.34 (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: 2.52 m<sup>2</sup>, No overhang  
Windows facing South West: 2.54 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	50.6200 (1b)	2.3900 (2b)	120.9818 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	120.9818 (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)			6.5300	1.3258	8.6572		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	57.9400	9.0500	48.8900	0.2500	12.2225	52.8000	2581.3920 (29a)
External Wall to Corridor	3.2100	2.1200	1.0900	0.2200	0.2398	52.8000	57.5520 (29a)
External Wall to Stairwell	12.3200		12.3200	0.2000	2.4640	52.8000	650.4960 (29a)
Total net area of external elements Aum(A, m2)			73.4700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	29.2140		(33)
E-FC-4			50.6200			70.0000	3543.4000 (32d)
E-FC-4			50.6200			70.0000	3543.4000 (32b)
Metal			79.1600			14.0000	1108.2400 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 11484.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							226.8763 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							5.8202 (36)
Total fabric heat loss							(33) + (36) = 35.0342 (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	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620 (38)
Average = Sum(39)m / 12 =	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962 (39)
HLP	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865 (40)
HLP (average)												1.0865 (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												1.7084 (42)
Average daily hot water use (litres/day)												74.7737 (43)
Daily hot water use	82.2511	79.2601	76.2692	73.2782	70.2873	67.2963	67.2963	70.2873	73.2782	76.2692	79.2601	82.2511 (44)
Energy conte	121.9760	106.6810	110.0852	95.9749	92.0902	79.4669	73.6377	84.5004	85.5096	99.6532	108.7792	118.1272 (45)

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

Energy content (annual)													Total = Sum(45)m =	1176.4816 (45)
Distribution loss (46)m = 0.15 x (45)m														
	18.2964	16.0021	16.5128	14.3962	13.8135	11.9200	11.0457	12.6751	12.8264	14.9480	16.3169	17.7191	17.7191	(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	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)
Combi loss	13.9973	12.6282	13.9581	13.4816	13.9119	13.4411	13.8755	13.8991	13.4632	13.9390	13.5197	13.9897	13.9897	(61)
Total heat required for water heating calculated for each month	135.9733	119.3092	124.0433	109.4565	106.0022	92.9080	87.5132	98.3995	98.9728	113.5922	122.2990	132.1170	132.1170	(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	(63)
Output from w/h	135.9733	119.3092	124.0433	109.4565	106.0022	92.9080	87.5132	98.3995	98.9728	113.5922	122.2990	132.1170	132.1170	(64)
Heat gains from water heating, kWh/month	44.0563	38.6285	40.0928	35.2821	34.0980	29.7830	27.9534	31.5712	31.7977	36.6194	39.5490	42.7747	42.7747	(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	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.5678	12.0508	9.8003	7.4195	5.5462	4.6823	5.0594	6.5764	8.8268	11.2077	13.0810	13.9448	13.9448 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	148.8441	150.3886	146.4965	138.2105	127.7509	117.9204	111.3530	109.8084	113.7006	121.9866	132.4462	142.2767	142.2767 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418 (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)	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347 (71)
Water heating gains (Table 5)	59.2155	57.4828	53.8882	49.0029	45.8306	41.3653	37.5718	42.4343	44.1635	49.2197	54.9292	57.4929	57.4929 (72)
Total internal gains	273.2529	271.5478	261.8105	246.2583	230.7532	215.5935	205.6097	210.4447	218.3164	234.0394	252.0819	265.3400	265.3400 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	Specific data FF or Table 6c	Access factor Table 6d	Gains W						
Northeast	3.9900	11.2829	0.4300	0.0000	0.7700	14.9058 (75)						
Southwest	2.5400	36.7938	0.4300	0.0000	0.7700	30.9434 (79)						
Southeast	2.5200	36.7938	0.4300	0.0000	0.7700	30.6997 (77)						
Solar gains	76.5489	135.3422	198.3321	267.7862	326.5982	311.1926	270.8389	222.1712	153.1278	92.5896	64.9265	64.9265 (83)
Total gains	349.8018	406.8899	460.1426	514.0445	550.8159	542.1917	481.2836	440.4877	387.1672	344.6715	330.2665	330.2665 (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	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064
alpha	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671
util living area	0.9943	0.9876	0.9697	0.9170	0.7974	0.6190	0.4620	0.5145	0.7624	0.9462	0.9885	0.9957	0.9957 (86)
MIT	19.8434	20.0197	20.2880	20.6066	20.8536	20.9668	20.9934	20.9891	20.9116	20.5832	20.1411	19.7938	19.7938 (87)
Th 2	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119 (88)
util rest of house	0.9927	0.9840	0.9607	0.8926	0.7443	0.5352	0.3614	0.4094	0.6851	0.9250	0.9845	0.9944	0.9944 (89)
MIT 2	18.4774	18.7332	19.1182	19.5599	19.8718	19.9897	20.0093	20.0072	19.9426	19.5384	18.9112	18.4053	18.4053 (90)
Living area fraction	19.1496	19.3663	19.6938	20.0750	20.3550	20.4706	20.4936	20.4904	20.4194	20.0526	19.5164	19.0885	19.0885 (92)
Temperature adjustment	19.1496	19.3663	19.6938	20.0750	20.3550	20.4706	20.4936	20.4904	20.4194	20.0526	19.5164	19.0885	19.0885 (93)
adjusted MIT	19.1496	19.3663	19.6938	20.0750	20.3550	20.4706	20.4936	20.4904	20.4194	20.0526	19.5164	19.0885	19.0885 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Useful gains	0.9907	0.9809	0.9572	0.8944	0.7639	0.5752	0.4110	0.4612	0.7191	0.9261	0.9819	0.9928	0.9928 (94)	
Ext temp.	346.5525	399.1342	440.4399	459.7611	420.7753	311.8571	212.4022	221.9654	316.7335	358.5398	338.4339	327.8814	327.8814 (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	4.2000 (96)	
Month fracti	816.6727	795.5909	725.6115	614.5812	475.9900	322.8582	214.1339	224.9571	347.5435	519.8554	682.8555	818.8130	818.8130 (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	1.0000 (97a)	
Space heating per m2	349.7695	266.4189	212.1676	111.4704	41.0797	0.0000	0.0000	0.0000	0.0000	120.0188	247.9835	365.2531	365.2531 (98)	
													(98) / (4) =	33.8633 (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													1833.3278 (211)
Space heating requirement	349.7695	266.4189	212.1676	111.4704	41.0797	0.0000	0.0000	0.0000	0.0000	120.0188	247.9835	365.2531	(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)	374.0850	284.9400	226.9173	119.2197	43.9355	0.0000	0.0000	0.0000	0.0000	128.3623	265.2230	390.6451	(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	135.9733	119.3092	124.0433	109.4565	106.0022	92.9080	87.5132	98.3995	98.9728	113.5922	122.2990	132.1170	(64)
Efficiency of water heater (217)m	89.5808	89.4854	89.2924	88.8858	88.1708	87.3000	87.3000	87.3000	87.3000	88.9152	89.4175	89.6273	(217)
Fuel for water heating, kWh/month	151.7884	133.3280	138.9180	123.1429	120.2237	106.4239	100.2443	112.7142	113.3709	127.7533	136.7730	147.4070	(219)
Water heating fuel used													1512.0877 (219)
Annual totals kWh/year													
Space heating fuel - main system													1833.3278 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
(MEV)Decentralised, Database: total watage = 5.0830, total flow = 21.0000, SFP = 0.2420)													
mechanical ventilation fans (SFP = 0.2420)													35.7257 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													110.7257 (231)
Electricity for lighting (calculated in Appendix L)													239.6109 (232)
Total delivered energy for all uses													3695.7521 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1833.3278	0.2160	395.9988	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1512.0877	0.2160	326.6109	(264)
Space and water heating			722.6097	(265)
Pumps and fans	110.7257	0.5190	57.4666	(267)
Energy for lighting	239.6109	0.5190	124.3580	(268)
Total CO2, kg/year			904.4344	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.8700	(273)

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

	DER		
Total Floor Area	50.6200	TFA	
Assumed number of occupants	1.7084	N	
CO2 emission factor in Table 12 for electricity displaced from grid	0.5190	EF	
CO2 emissions from appliances, equation (L14)	17.4243		ZC2
CO2 emissions from cooking, equation (L16)	3.1608		ZC3
Total CO2 emissions	38.4551		ZC4
Residual CO2 emissions offset from biofuel CHP	0.0000		ZC5
Additional allowable electricity generation, kWh/m <sup>2</sup> /year	0.0000		ZC6
Resulting CO2 emissions offset from additional allowable electricity generation	0.0000		ZC7
Net CO2 emissions	38.4551		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	50.6200 (1b)	2.3900 (2b)	120.9818 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.6200		120.9818 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 120.9818 (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) = 0.1653 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4153 (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) = 0.3842 (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	0.4898	0.4802	0.4706	0.4226	0.4130	0.3650	0.3650	0.3554	0.3842	0.4130	0.4322	0.4514 (22b)
Effective ac	0.6200	0.6153	0.6107	0.5893	0.5853	0.5666	0.5666	0.5631	0.5738	0.5853	0.5934	0.6019 (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)			9.0500	1.3258	11.9981		(27)
External Wall	57.9400	9.0500	48.8900	0.1800	8.8002		(29a)
External Wall to Corridor	3.2100	2.1200	1.0900	0.1800	0.1962		(29a)
External Wall to Stairwell	12.3200		12.3200	0.1800	2.2176		(29a)
Total net area of external elements Aum(A, m2)			73.4700				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 25.3321		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.1559 (36)
Total fabric heat loss							(33) + (36) = 31.4880 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	24.7512	24.5652	24.3829	23.5267	23.3665	22.6208	22.6208	22.4827	22.9081	23.3665	23.6906	24.0294 (38)
Heat transfer coeff	56.2392	56.0532	55.8709	55.0147	54.8545	54.1088	54.1088	53.9707	54.3961	54.8545	55.1786	55.5174 (39)
Average = Sum(39)m / 12 =												55.0140 (39)
HLP	1.1110	1.1073	1.1037	1.0868	1.0837	1.0689	1.0689	1.0662	1.0746	1.0837	1.0901	1.0967 (40)
HLP (average)												1.0868 (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												1.7084 (42)
Average daily hot water use (litres/day)												74.7737 (43)
Daily hot water use	82.2511	79.2601	76.2692	73.2782	70.2873	67.2963	67.2963	70.2873	73.2782	76.2692	79.2601	82.2511 (44)
Energy conte	121.9760	106.6810	110.0852	95.9749	92.0902	79.4669	73.6377	84.5004	85.5096	99.6532	108.7792	118.1272 (45)
Energy content (annual)												Total = Sum(45)m = 1176.4816 (45)
Distribution loss (46)m = 0.15 x (45)m	18.2964	16.0021	16.5128	14.3962	13.8135	11.9200	11.0457	12.6751	12.8264	14.9480	16.3169	17.7191 (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)

# FULL SAP CALCULATION PRINTOUT

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### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi loss	41.9142	36.4814	38.8659	36.1372	35.8176	33.1872	34.2935	35.8176	36.1372	38.8659	39.0872	41.9142 (61)
Total heat required for water heating calculated for each month	163.8902	143.1623	148.9511	132.1122	127.9079	112.6541	107.9312	120.3180	121.6468	138.5191	147.8664	160.0415 (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	163.8902	143.1623	148.9511	132.1122	127.9079	112.6541	107.9312	120.3180	121.6468	138.5191	147.8664	160.0415 (64)
Heat gains from water heating, kWh/month	51.0356	44.5918	46.3198	40.9460	39.5744	34.7195	33.0579	37.0508	37.4662	42.8512	45.9409	49.7559 (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	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.5678	12.0508	9.8003	7.4195	5.5462	4.6823	5.0594	6.5764	8.8268	11.2077	13.0810	13.9448 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	148.8441	150.3886	146.4965	138.2105	127.7509	117.9204	111.3530	109.8084	113.7006	121.9866	132.4462	142.2767 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418 (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)	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347 (71)
Water heating gains (Table 5)	68.5962	66.3568	62.2578	56.8694	53.1914	48.2216	44.4327	49.7994	52.0364	57.5957	63.8068	66.8762 (72)
Total internal gains	282.6336	280.4217	270.1801	254.1249	238.1140	222.4498	212.4705	217.8098	226.1894	242.4154	260.9595	274.7232 (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	11.2829	0.6300	0.6300	0.7000	0.7700	13.7584 (75)					
Southeast	2.5200	36.7938	0.6300	0.6300	0.7000	0.7700	28.3366 (77)					
Southwest	2.5400	36.7938	0.6300	0.6300	0.7000	0.7700	28.5615 (79)					
Solar gains	70.6564	124.9240	183.0651	247.1728	295.4253	301.4578	287.2380	249.9906	205.0692	141.3405	85.4623	59.9287 (83)
Total gains	353.2900	405.3457	453.2453	501.2977	533.5393	523.9075	499.7085	467.8004	431.2586	383.7559	346.4218	334.6519 (84)

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

Temperature during heating periods in the living area from Table 9, T <sub>hl</sub> (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)	0.9933	0.9862	0.9678	0.9131	0.7885	0.5902	0.4201	0.4686	0.7348	0.9383	0.9863	0.9948 (94)
tau	62.5058	62.7132	62.9178	63.8970	64.0836	64.9668	64.9668	65.1331	64.6238	64.0836	63.7073	63.3185
alpha	5.1671	5.1809	5.1945	5.2598	5.2722	5.3311	5.3311	5.3422	5.3083	5.2722	5.2472	5.2212
util living area	0.9960	0.9912	0.9778	0.9331	0.8211	0.6344	0.4716	0.5221	0.7778	0.9559	0.9915	0.9970 (86)
MIT	19.9025	20.0638	20.3134	20.6285	20.8647	20.9738	20.9955	20.9924	20.9249	20.6175	20.2056	19.8777 (87)
Th 2	19.9919	19.9948	19.9978	20.0116	20.0142	20.0263	20.0263	20.0285	20.0216	20.0142	20.0090	20.0035 (88)
util rest of house	0.9947	0.9884	0.9704	0.9109	0.7681	0.5489	0.3698	0.4163	0.6992	0.9364	0.9882	0.9960 (89)
MIT 2	18.5384	18.7748	19.1364	19.5864	19.8870	20.0096	20.0247	20.0255	19.9649	19.5822	18.9925	18.5106 (90)
Living area fraction	19.2097	19.4091	19.7156	20.0992	20.3681	20.4841	20.5024	20.5013	20.4373	20.0917	19.5895	19.1833 (92)
Temperature adjustment												0.0000
adjusted MIT	19.2097	19.4091	19.7156	20.0992	20.3681	20.4841	20.5024	20.5013	20.4373	20.0917	19.5895	19.1833 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	350.9291	399.7571	438.6630	457.7478	420.7005	309.2109	209.9133	219.1920	316.8787	360.0600	341.6922	332.9225 (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	838.5084	813.2839	738.3699	616.1224	475.4864	318.3805	211.1535	221.3520	344.7264	520.6618	689.1506	831.8347 (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	362.7590	277.8900	222.9820	114.0297	40.7607	0.0000	0.0000	0.0000	0.0000	119.4878	250.1700	371.1906 (98)
Space heating												1759.2697 (98)
Space heating per m2												34.7544 (99)

#### 8c. Space cooling requirement

Not applicable

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

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### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	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 %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													1883.5865 (211)
Space heating requirement	362.7590	277.8900	222.9820	114.0297	40.7607	0.0000	0.0000	0.0000	0.0000	119.4878	250.1700	371.1906	(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)	388.3929	297.5267	238.7387	122.0875	43.6410	0.0000	0.0000	0.0000	0.0000	127.9312	267.8480	397.4204	(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	163.8902	143.1623	148.9511	132.1122	127.9079	112.6541	107.9312	120.3180	121.6468	138.5191	147.8664	160.0415	(64)
Efficiency of water heater (217)m	86.9949	86.6925	86.0648	84.6831	82.5282	80.3000	80.3000	80.3000	80.3000	84.6816	86.3646	87.0996	(216)
Fuel for water heating, kWh/month	188.3906	165.1381	173.0686	156.0077	154.9868	140.2915	134.4100	149.8356	151.4904	163.5764	171.2119	183.7454	(219)
Water heating fuel used													1932.1530 (219)
Annual totals kWh/year													
Space heating fuel - main system													1883.5865 (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)													239.6109 (232)
Total delivered energy for all uses													4130.3504 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1883.5865	0.2160	406.8547 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1932.1530	0.2160	417.3451 (264)
Space and water heating			824.1997 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	239.6109	0.5190	124.3580 (268)
Total CO2, kg/m2/year			987.4828 (272)
Emissions per m2 for space and water heating			16.2821 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.4567 (272b)
Emissions per m2 for pumps and fans			0.7690 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.2821 * 1.00) + 2.4567 + 0.7690, rounded to 2 d.p.			19.5100 (273)



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	50.6200 (1b)	2.3900 (2b)	120.9818 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.6200		120.9818 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 120.9818 (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) =	0.1653 (8)
Pressure test				Yes	
Measured/design AP50				4.0000	
Infiltration rate				0.3653	0.3653 (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) =	0.3379 (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	0.4308	0.4224	0.4139	0.3717	0.3633	0.3210	0.3210	0.3126	0.3379	0.3633	0.3802	0.3971 (22b)
	0.5928	0.5892	0.5857	0.5691	0.5660	0.5515	0.5515	0.5489	0.5571	0.5660	0.5723	0.5788 (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)			6.5300	1.3258	8.6572		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	57.9400	9.0500	48.8900	0.2500	12.2225	52.8000	2581.3920 (29a)
External Wall to Corridor	3.2100	2.1200	1.0900	0.2200	0.2398	52.8000	57.5520 (29a)
External Wall to Stairwell	12.3200		12.3200	0.2000	2.4640	52.8000	650.4960 (29a)
Total net area of external elements Aum(A, m2)			73.4700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	29.2140		(33)
E-FC-4			50.6200			70.0000	3543.4000 (32d)
E-FC-4			50.6200			30.0000	1518.6000 (32b)
Metal			79.1600			14.0000	1108.2400 (32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	9459.6800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		186.8763 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		5.8202 (36)
Total fabric heat loss	(33) + (36) =	35.0342 (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
(38)m	23.6674	23.5236	23.3825	22.7201	22.5961	22.0192	22.0192	21.9123	22.2414	22.5961	22.8469	23.1090 (38)
Heat transfer coeff	58.7017	58.5578	58.4167	57.7543	57.6304	57.0534	57.0534	56.9465	57.2756	57.6304	57.8811	58.1432 (39)
Average = Sum(39)m / 12 =												57.7537 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1597	1.1568	1.1540	1.1409	1.1385	1.1271	1.1271	1.1250	1.1315	1.1385	1.1434	1.1486 (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												1.7084 (42)
Average daily hot water use (litres/day)												74.7737 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	82.2511	79.2601	76.2692	73.2782	70.2873	67.2963	67.2963	70.2873	73.2782	76.2692	79.2601	82.2511 (44)
Energy conte	121.9760	106.6810	110.0852	95.9749	92.0902	79.4669	73.6377	84.5004	85.5096	99.6532	108.7792	118.1272 (45)
Energy content (annual)										Total = Sum(45)m =		1176.4816 (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)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	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	0.0000	(57)
Heat gains from water heating, kWh/month	25.9199	22.6697	23.3931	20.3947	19.5692	16.8867	15.6480	17.9563	18.1708	21.1763	23.1156	25.1020		(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	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.5678	12.0508	9.8003	7.4195	5.5462	4.6823	5.0594	6.5764	8.8268	11.2077	13.0810	13.9448	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	148.8441	150.3886	146.4965	138.2105	127.7509	117.9204	111.3530	109.8084	113.7006	121.9866	132.4462	142.2767	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	(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)	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	(71)
Water heating gains (Table 5)	34.8386	33.7347	31.4423	28.3259	26.3027	23.4538	21.0323	24.1349	25.2372	28.4628	32.1050	33.7393	(72)
Total internal gains	245.8759	244.7996	236.3646	222.5814	208.2252	194.6819	186.0701	189.1452	196.3901	210.2825	226.2577	238.5864	(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	0.4300	0.0000	0.7700	14.9058	(75)						
Southwest	2.5400	36.7938	0.4300	0.0000	0.7700	30.9434	(79)						
Southeast	2.5200	36.7938	0.4300	0.0000	0.7700	30.6997	(77)						
Solar gains	76.5489	135.3422	198.3321	267.7862	320.0627	326.5982	311.1926	270.8389	222.1712	153.1278	92.5896	64.9265	(83)
Total gains	322.4248	380.1418	434.6967	490.3675	528.2879	521.2802	497.2627	459.9841	418.5614	363.4103	318.8472	303.5128	(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)														
tau	44.7634	44.8734	44.9818	45.4977	45.5956	46.0567	46.0567	46.1431	45.8780	45.5956	45.3981	45.1934		
alpha	3.9842	3.9916	3.9988	4.0332	4.0397	4.0704	4.0704	4.0762	4.0585	4.0397	4.0265	4.0129		
util living area	0.9920	0.9839	0.9650	0.9141	0.8073	0.6415	0.4889	0.5433	0.7786	0.9433	0.9853	0.9937	(86)	
MIT	19.4724	19.6837	20.0098	20.4179	20.7456	20.9284	20.9815	20.9719	20.8387	20.4037	19.8616	19.4343	(87)	
Th 2	19.9524	19.9547	19.9570	19.9675	19.9695	19.9788	19.9788	19.9805	19.9752	19.9695	19.9655	19.9613	(88)	
util rest of house	0.9899	0.9799	0.9559	0.8915	0.7583	0.5586	0.3826	0.4342	0.7067	0.9236	0.9809	0.9920	(89)	
MIT 2	18.5655	18.7765	19.0987	19.4982	19.7929	19.9423	19.9729	19.9707	19.8804	19.4946	18.9629	18.5346	(90)	
Living area fraction									fLA = Living area / (4) =				0.4921	(91)
MIT	19.0118	19.2229	19.5470	19.9508	20.2617	20.4275	20.4692	20.4634	20.3520	19.9420	19.4051	18.9773	(92)	
Temperature adjustment													0.0000	
adjusted MIT	19.0118	19.2229	19.5470	19.9508	20.2617	20.4275	20.4692	20.4634	20.3520	19.9420	19.4051	18.9773	(93)	

#### 8. Space heating requirement

Utilisation	0.9875	0.9763	0.9516	0.8911	0.7733	0.5966	0.4347	0.4874	0.7353	0.9229	0.9779	0.9900	(94)
Useful gains	318.4081	371.1385	413.6491	436.9434	408.5277	310.9738	216.1756	224.1876	307.7759	335.4079	311.7992	300.4805	(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	863.6048	838.7187	762.1661	638.2315	493.4159	332.4801	220.7528	231.3965	358.0868	538.3829	712.2346	859.2024	(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	405.6263	314.2139	259.2967	144.9274	63.1568	0.0000	0.0000	0.0000	0.0000	151.0133	288.3135	415.6891	(98)
Space heating												2042.2371	(98)
Space heating per m2												40.3445	(99)

#### 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b													
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	536.3018	422.1950	432.7937	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8826	0.9302	0.9100	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	473.3163	392.7449	393.8292	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	674.0242	644.7367	602.1598	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	144.5097	187.4819	154.9980	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling Cooled fraction												486.9895 (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												121.7474 (107)
Energy for space heating												2.4051 (108)
Energy for space cooling												40.3445 (99)
Total												2.4051 (108)
Dwelling Fabric Energy Efficiency (DFEE)												42.7496 (109)
												42.7 (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	50.6200 (1b)	x 2.3900 (2b)	= 120.9818 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 120.9818 (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) =	0.1653 (8)
Pressure test				Yes	
Measured/design AP50					5.0000
Infiltration rate					0.4153 (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) =	0.3842 (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	0.4898	0.4802	0.4706	0.4226	0.4130	0.3650	0.3650	0.3554	0.3842	0.4130	0.4322	0.4514 (22b)
	0.6200	0.6153	0.6107	0.5893	0.5853	0.5666	0.5666	0.5631	0.5738	0.5853	0.5934	0.6019 (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)			9.0500	1.3258	11.9981		(27)
External Wall	57.9400	9.0500	48.8900	0.1800	8.8002		(29a)
External Wall to Corridor	3.2100	2.1200	1.0900	0.1800	0.1962		(29a)
External Wall to Stairwell	12.3200		12.3200	0.1800	2.2176		(29a)
Total net area of external elements Aum(A, m2)			73.4700				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 25.3321		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.1559 (36)
Total fabric heat loss							(33) + (36) = 31.4880 (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	24.7512	24.5652	24.3829	23.5267	23.3665	22.6208	22.6208	22.4827	22.9081	23.3665	23.6906	24.0294 (38)
Average = Sum(39)m / 12 =	56.2392	56.0532	55.8709	55.0147	54.8545	54.1088	54.1088	53.9707	54.3961	54.8545	55.1786	55.5174 (39)
												55.0140 (39)
HLP	1.1110	1.1073	1.1037	1.0868	1.0837	1.0689	1.0689	1.0662	1.0746	1.0837	1.0901	1.0967 (40)
HLP (average)												1.0868 (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												
Average daily hot water use (litres/day)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	82.2511	79.2601	76.2692	73.2782	70.2873	67.2963	67.2963	70.2873	73.2782	76.2692	79.2601	82.2511 (44)
Energy conte	121.9760	106.6810	110.0852	95.9749	92.0902	79.4669	73.6377	84.5004	85.5096	99.6532	108.7792	118.1272 (45)
Energy content (annual)												Total = Sum(45)m = 1176.4816 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	25.9199	22.6697	23.3931	20.3947	19.5692	16.8867	15.6480	17.9563	18.1708	21.1763	23.1156	25.1020	25.1020	(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	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	85.4183	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.5678	12.0508	9.8003	7.4195	5.5462	4.6823	5.0594	6.5764	8.8268	11.2077	13.0810	13.9448	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	148.8441	150.3886	146.4965	138.2105	127.7509	117.9204	111.3530	109.8084	113.7006	121.9866	132.4462	142.2767	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	31.5418	(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)	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	(71)
Water heating gains (Table 5)	34.8386	33.7347	31.4423	28.3259	26.3027	23.4538	21.0323	24.1349	25.2372	28.4628	32.1050	33.7393	(72)
Total internal gains	245.8759	244.7996	236.3646	222.5814	208.2252	194.6819	186.0701	189.1452	196.3901	210.2825	226.2577	238.5864	(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	0.6300	0.7000	0.7700	13.7584 (75)							
Southeast	2.5200	36.7938	0.6300	0.7000	0.7700	28.3366 (77)							
Southwest	2.5400	36.7938	0.6300	0.7000	0.7700	28.5615 (79)							
Solar gains	70.6564	124.9240	183.0651	247.1728	295.4253	301.4578	287.2380	249.9906	205.0692	141.3405	85.4623	59.9287	(83)
Total gains	316.5324	369.7236	419.4298	469.7542	503.6505	496.1397	473.3081	439.1358	401.4594	351.6231	311.7200	298.5150	(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)	62.5058	62.7132	62.9178	63.8970	64.0836	64.9668	64.9668	65.1331	64.6238	64.0836	63.7073	63.3185	21.0000 (85)
alpha	5.1671	5.1809	5.1945	5.2598	5.2722	5.3311	5.3311	5.3422	5.3083	5.2722	5.2472	5.2212	
util living area	0.9976	0.9942	0.9839	0.9470	0.8459	0.6634	0.4965	0.5534	0.8119	0.9686	0.9947	0.9982	(86)
MIT	19.8351	19.9998	20.2564	20.5855	20.8420	20.9677	20.9942	20.9901	20.9071	20.5682	20.1429	19.8109	(87)
Th 2	19.9919	19.9948	19.9978	20.0116	20.0142	20.0263	20.0263	20.0285	20.0216	20.0142	20.0090	20.0035	(88)
util rest of house	0.9968	0.9922	0.9784	0.9283	0.7961	0.5765	0.3901	0.4426	0.7367	0.9538	0.9926	0.9976	(89)
MIT 2	18.9324	19.0987	19.3545	19.6827	19.9107	20.0120	20.0249	20.0258	19.9721	19.6742	19.2532	18.9177	(90)
Living area fraction	19.3766	19.5422	19.7983	20.1270	20.3690	20.4823	20.5019	20.5003	20.4322	20.1142	19.6910	19.3572	(91)
MIT	19.3766	19.5422	19.7983	20.1270	20.3690	20.4823	20.5019	20.5003	20.4322	20.1142	19.6910	19.3572	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3766	19.5422	19.7983	20.1270	20.3690	20.4823	20.5019	20.5003	20.4322	20.1142	19.6910	19.3572	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9961	0.9911	0.9770	0.9308	0.8155	0.6186	0.4427	0.4974	0.7708	0.9556	0.9917	0.9971	(94)
Ext temp.	315.3096	366.4371	409.7811	437.2330	410.7149	306.8968	209.5353	218.4377	309.4254	336.0087	309.1394	297.6532	(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	847.8961	820.7397	742.9900	617.6486	475.5352	318.2850	211.1257	221.2967	344.4454	521.8945	694.7566	841.4899	(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 per m2	396.2444	305.2914	247.9075	129.8992	48.2263	0.0000	0.0000	0.0000	0.0000	138.2990	277.6444	404.6145	(98)
										(98) / (4) =		1948.1265	(98)
												38.4853	(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	508.6229	400.4053	410.1775	0.0000	0.0000	0.0000	0.0000	(100)	
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9232	0.9625	0.9475	0.0000	0.0000	0.0000	0.0000	(101)	
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	469.5755	385.3897	388.6457	0.0000	0.0000	0.0000	0.0000	(102)	
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	644.6392	616.7378	577.7917	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	126.0459	172.1230	140.7246	0.0000	0.0000	0.0000	0.0000	(104)	
Space cooling													438.8935	(104)
Cooled fraction													1.0000	(105)
													fc = cooled area / (4) =	

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	31.5115	43.0308	35.1812	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling per m2												109.7234 (107)
Energy for space heating												2.1676 (108)
Energy for space cooling												38.4853 (99)
Total												2.1676 (108)
Target Fabric Energy Efficiency (TFEE)												40.6529 (109)
												46.8 (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	50.6200 (1b)	2.3900 (2b)	120.9818 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	120.9818 (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:												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)			6.5300	1.3258	8.6572		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	57.9400	9.0500	48.8900	0.2500	12.2225	52.8000	2581.3920 (29a)
External Wall to Corridor	3.2100	2.1200	1.0900	0.2200	0.2398	52.8000	57.5520 (29a)
External Wall to Stairwell	12.3200		12.3200	0.2000	2.4640	52.8000	650.4960 (29a)
Total net area of external elements Aum(A, m2)			73.4700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	29.2140		(33)
E-FC-4			50.6200			70.0000	3543.4000 (32d)
E-FC-4			50.6200			70.0000	3543.4000 (32b)
Metal			79.1600			14.0000	1108.2400 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 11484.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							226.8763 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							5.8202 (36)
Total fabric heat loss							(33) + (36) = 35.0342 (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	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620 (38)
Average = Sum(39)m / 12 =	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962 (39)
HLP	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865 (40)
HLP (average)												1.0865 (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												1.7084 (42)
Average daily hot water use (litres/day)												74.7737 (43)
Daily hot water use	82.2511	79.2601	76.2692	73.2782	70.2873	67.2963	67.2963	70.2873	73.2782	76.2692	79.2601	82.2511 (44)
Energy conte	121.9760	106.6810	110.0852	95.9749	92.0902	79.4669	73.6377	84.5004	85.5096	99.6532	108.7792	118.1272 (45)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)													Total = Sum(45)m =	1176.4816 (45)
Distribution loss (46)m = 0.15 x (45)m														
	18.2964	16.0021	16.5128	14.3962	13.8135	11.9200	11.0457	12.6751	12.8264	14.9480	16.3169	17.7191	17.7191	(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	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)
Combi loss	13.9973	12.6282	13.9581	13.4816	13.9119	13.4411	13.8755	13.8991	13.4632	13.9390	13.5197	13.9897	13.9897	(61)
Total heat required for water heating calculated for each month	135.9733	119.3092	124.0433	109.4565	106.0022	92.9080	87.5132	98.3995	98.9728	113.5922	122.2990	132.1170	132.1170	(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	(63)
Output from w/h	135.9733	119.3092	124.0433	109.4565	106.0022	92.9080	87.5132	98.3995	98.9728	113.5922	122.2990	132.1170	132.1170	(64)
RHI water heating demand													Total per year (kWh/year) = Sum(64)m =	1340.5861 (64)
Heat gains from water heating, kWh/month	44.0563	38.6285	40.0928	35.2821	34.0980	29.7830	27.9534	31.5712	31.7977	36.6194	39.5490	42.7747	42.7747	(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	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.9194	30.1269	24.5009	18.5487	13.8654	11.7057	12.6485	16.4410	22.0670	28.0191	32.7025	34.8621	34.8621	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	222.1554	224.4607	218.6514	206.2843	190.6730	176.0005	166.1985	163.8932	169.7024	182.0696	197.6809	212.3533	212.3533	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	(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)	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	(71)
Water heating gains (Table 5)	59.2155	57.4828	53.8882	49.0029	45.8306	41.3653	37.5718	42.4343	44.1635	49.2197	54.9292	57.4929	57.4929	(72)
Total internal gains	399.4162	396.1963	381.1664	357.9618	334.4949	313.1975	300.5446	306.8944	320.0588	343.4343	369.4385	388.8342	388.8342	(73)

#### 6. Solar gains

[Jan]		Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	Specific data FF or Table 6c	Access factor Table 6d	Gains W							
Northeast		3.9900	12.9465	0.4300	0.0000	0.7700	17.1035 (75)							
Southwest		2.5400	40.9830	0.4300	0.0000	0.7700	34.4665 (79)							
Southeast		2.5200	40.9830	0.4300	0.0000	0.7700	34.1951 (77)							
Solar gains	85.7651	141.5013	204.3126	290.7174	335.8777	357.3654	337.0855	295.3077	242.8920	167.4392	106.3107	72.0202	72.0202	(83)
Total gains	485.1813	537.6977	585.4791	648.6792	670.3726	670.5629	637.6301	602.2021	562.9508	510.8735	475.7491	460.8544	460.8544	(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	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	
alpha	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	
util living area	0.9762	0.9608	0.9210	0.8189	0.6558	0.4536	0.2927	0.3098	0.5673	0.8429	0.9532	0.9805	0.9805	(86)
MIT	20.1430	20.2858	20.5323	20.7947	20.9436	20.9923	20.9993	20.9991	20.9785	20.8027	20.4365	20.0989	20.0989	(87)
Th 2	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	(88)
util rest of house	0.9699	0.9507	0.9011	0.7785	0.5925	0.3762	0.2080	0.2202	0.4818	0.7967	0.9389	0.9752	0.9752	(89)
MIT 2	18.9089	19.1111	19.4536	19.7949	19.9645	20.0078	20.0118	20.0117	19.9988	19.8142	19.3279	18.8461	18.8461	(90)
Living area fraction													fLA = Living area / (4) =	
MIT	19.5162	19.6892	19.9844	20.2869	20.4463	20.4922	20.4977	20.4976	20.4809	20.3006	19.8734	19.4626	19.4626	(92)
Temperature adjustment													0.0000	
adjusted MIT	19.5162	19.6892	19.9844	20.2869	20.4463	20.4922	20.4977	20.4976	20.4809	20.3006	19.8734	19.4626	19.4626	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	0.9659	0.9468	0.9004	0.7905	0.6211	0.4141	0.2497	0.2643	0.5232	0.8114	0.9366	0.9715	0.9715	(94)
Useful gains	468.6526	509.0738	527.1844	512.7817	416.3824	277.7129	159.2243	159.1764	294.5565	414.5007	445.5777	447.7205	447.7205	(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	4.7000	(96)
Heat loss rate W	814.8345	796.8506	714.0950	593.2400	437.0177	280.0541	159.3645	159.3579	301.4290	489.5001	669.4927	811.8883	811.8883	(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	257.5593	193.3861	139.0615	57.9300	15.3526	0.0000	0.0000	0.0000	0.0000	55.7996	161.2188	270.9408	270.9408	(98)
Space heating													1151.2486 (98)	
RHI space heating demand													1151 (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 (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	50.6200 (1b)	2.3900 (2b)	120.9818 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	120.9818 (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	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 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
DTC			2.1200	1.0800	2.2896		(26)
Windows (Uw = 1.40)			6.5300	1.3258	8.6572		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	57.9400	9.0500	48.8900	0.2500	12.2225	52.8000	2581.3920 (29a)
External Wall to Corridor	3.2100	2.1200	1.0900	0.2200	0.2398	52.8000	57.5520 (29a)
External Wall to Stairwell	12.3200		12.3200	0.2000	2.4640	52.8000	650.4960 (29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			73.4700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	29.2140			(33)
E-FC-4			50.6200			70.0000	3543.4000 (32d)
E-FC-4			50.6200			70.0000	3543.4000 (32b)
Metal			79.1600			14.0000	1108.2400 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 11484.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							226.8763 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							5.8202 (36)
Total fabric heat loss							(33) + (36) = 35.0342 (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	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620 (38)
Average = Sum(39)m / 12 =	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962 (39)
HLP	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865 (40)
HLP (average)												1.0865 (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												1.7084 (42)
Average daily hot water use (litres/day)												74.7737 (43)
Daily hot water use	82.2511	79.2601	76.2692	73.2782	70.2873	67.2963	67.2963	70.2873	73.2782	76.2692	79.2601	82.2511 (44)
Energy conte	121.9760	106.6810	110.0852	95.9749	92.0902	79.4669	73.6377	84.5004	85.5096	99.6532	108.7792	118.1272 (45)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)													Total = Sum(45)m =	1176.4816 (45)
Distribution loss (46)m = 0.15 x (45)m														
	18.2964	16.0021	16.5128	14.3962	13.8135	11.9200	11.0457	12.6751	12.8264	14.9480	16.3169	17.7191	17.7191	(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	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)
Combi loss	13.9973	12.6282	13.9581	13.4816	13.9119	13.4411	13.8755	13.8991	13.4632	13.9390	13.5197	13.9897	13.9897	(61)
Total heat required for water heating calculated for each month	135.9733	119.3092	124.0433	109.4565	106.0022	92.9080	87.5132	98.3995	98.9728	113.5922	122.2990	132.1170	132.1170	(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	(63)
Output from w/h	135.9733	119.3092	124.0433	109.4565	106.0022	92.9080	87.5132	98.3995	98.9728	113.5922	122.2990	132.1170	132.1170	(64)
Heat gains from water heating, kWh/month	44.0563	38.6285	40.0928	35.2821	34.0980	29.7830	27.9534	31.5712	31.7977	36.6194	39.5490	42.7747	42.7747	(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	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.9194	30.1269	24.5009	18.5487	13.8654	11.7057	12.6485	16.4410	22.0670	28.0191	32.7025	34.8621	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	222.1554	224.4607	218.6514	206.2843	190.6730	176.0005	166.1985	163.8932	169.7024	182.0696	197.6809	212.3533	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	(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)	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	(71)
Water heating gains (Table 5)	59.2155	57.4828	53.8882	49.0029	45.8306	41.3653	37.5718	42.4343	44.1635	49.2197	54.9292	57.4929	(72)
Total internal gains	399.4162	396.1963	381.1664	357.9618	334.4949	313.1975	300.5446	306.8944	320.0588	343.4343	369.4385	388.8342	(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)							
Southwest	2.5400	36.7938	0.4300	0.0000	0.7700	30.9434 (79)							
Southeast	2.5200	36.7938	0.4300	0.0000	0.7700	30.6997 (77)							
Solar gains	76.5489	135.3422	198.3321	267.7862	326.5982	311.1926	270.8389	222.1712	153.1278	92.5896	64.9265	(83)	
Total gains	475.9651	531.5385	579.4985	625.7479	654.5576	639.7957	611.7372	577.7333	542.2301	496.5621	462.0280	453.7607	(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	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	(86)
alpha	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	(87)
util living area	0.9799	0.9649	0.9317	0.8540	0.7142	0.5362	0.3929	0.4334	0.6577	0.8825	0.9640	0.9838	(86)
MIT	20.0837	20.2448	20.4780	20.7344	20.9108	20.9819	20.9967	20.9948	20.9536	20.7289	20.3533	20.0320	(87)
Th 2	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	(88)
util rest of house	0.9746	0.9559	0.9145	0.8196	0.6566	0.4591	0.3061	0.3426	0.5787	0.8463	0.9531	0.9794	(89)
MIT 2	18.8237	19.0529	19.3791	19.7202	19.9307	20.0004	20.0107	20.0098	19.9782	19.7228	19.2111	18.7496	(90)
Living area fraction	19.4438	19.6395	19.9199	20.2193	20.4130	20.4834	20.4959	20.4945	20.4582	20.2179	19.7732	19.3807	(91)
Temperature adjustment	19.4438	19.6395	19.9199	20.2193	20.4130	20.4834	20.4959	20.4945	20.4582	20.2179	19.7732	19.3807	(92)
adjusted MIT	19.4438	19.6395	19.9199	20.2193	20.4130	20.4834	20.4959	20.4945	20.4582	20.2179	19.7732	19.3807	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	462.0500	505.9205	528.8862	517.7463	445.6676	317.6646	213.4155	223.7748	333.7836	424.3909	438.8975	442.8014	(94)
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	832.8498	810.6144	738.0420	622.5175	479.1825	323.5653	214.2608	225.1814	349.6770	528.9481	696.9760	834.8798	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	275.8750	204.7543	155.6119	75.4353	24.9351	0.0000	0.0000	0.0000	0.0000	77.7905	185.8165	291.7063	(98)
Space heating													1291.9250 (98)
Space heating per m <sup>2</sup>													(98) / (4) = 25.5220 (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													1381.7379 (211)
Space heating requirement	275.8750	204.7543	155.6119	75.4353	24.9351	0.0000	0.0000	0.0000	0.0000	77.7905	185.8165	291.7063	(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)	295.0535	218.9885	166.4299	80.6794	26.6685	0.0000	0.0000	0.0000	0.0000	83.1984	198.7342	311.9854	(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	135.9733	119.3092	124.0433	109.4565	106.0022	92.9080	87.5132	98.3995	98.9728	113.5922	122.2990	132.1170	(64)
Efficiency of water heater (217)m	89.4179	89.2949	89.0521	88.5779	87.8918	87.3000	87.3000	87.3000	87.3000	88.5730	89.2022	89.4776	(216)
Fuel for water heating, kWh/month	152.0650	133.6125	139.2929	123.5710	120.6052	106.4239	100.2443	112.7142	113.3709	128.2469	137.1031	147.6537	(219)
Water heating fuel used													1514.9035 (219)
Annual totals kWh/year													
Space heating fuel - main system													1381.7379 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans: (MEVDecentralised, Database: total watage = 5.0830, total flow = 21.0000, SFP = 0.2420)													
mechanical ventilation fans (SFP = 0.2420)													35.7257 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													110.7257 (231)
Electricity for lighting (calculated in Appendix L)													239.6109 (232)
Total delivered energy for all uses													3246.9780 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1381.7379	3.4800	48.0845 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1514.9035	3.4800	52.7186 (247)
Mechanical ventilation fans	35.7257	13.1900	4.7122 (249)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	239.6109	13.1900	31.6047 (250)
Additional standing charges			120.0000 (251)
Total energy cost			267.0125 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	1.1728 (257)
SAP value		83.6391
SAP rating (Section 12)		B (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	1381.7379	0.2160	298.4554 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1514.9035	0.2160	327.2192 (264)
Space and water heating			625.6746 (265)
Pumps and fans	110.7257	0.5190	57.4666 (267)
Energy for lighting	239.6109	0.5190	124.3580 (268)
Total kg/year			807.4992 (272)
CO2 emissions per m2			15.9500 (273)
EI value			88.6839
EI rating			B (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	$3.48 / 0.8839 = 3.937$ , stars = 4
Water heating environmental impact	$0.216 / 0.8839 = 0.2444$ , 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	50.6200 (1b)	x 2.3900 (2b)	= 120.9818 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 120.9818 (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	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)			6.5300	1.3258	8.6572		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	57.9400	9.0500	48.8900	0.2500	12.2225	52.8000	2581.3920 (29a)
External Wall to Corridor	3.2100	2.1200	1.0900	0.2200	0.2398	52.8000	57.5520 (29a)
External Wall to Stairwell	12.3200		12.3200	0.2000	2.4640	52.8000	650.4960 (29a)
Total net area of external elements Aum(A, m2)			73.4700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	29.2140		(33)
E-FC-4			50.6200			70.0000	3543.4000 (32d)
E-FC-4			50.6200			70.0000	3543.4000 (32b)
Metal			79.1600			14.0000	1108.2400 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 11484.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							226.8763 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							5.8202 (36)
Total fabric heat loss							(33) + (36) = 35.0342 (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	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620	19.9620 (38)
Average = Sum(39)m / 12 =	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962	54.9962 (39)
HLP	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865	1.0865 (40)
HLP (average)												1.0865 (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												1.7084 (42)
Average daily hot water use (litres/day)												74.7737 (43)
Daily hot water use	82.2511	79.2601	76.2692	73.2782	70.2873	67.2963	67.2963	70.2873	73.2782	76.2692	79.2601	82.2511 (44)
Energy conte	121.9760	106.6810	110.0852	95.9749	92.0902	79.4669	73.6377	84.5004	85.5096	99.6532	108.7792	118.1272 (45)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

Energy content (annual)													Total = Sum(45)m =	1176.4816 (45)
Distribution loss (46)m = 0.15 x (45)m														
	18.2964	16.0021	16.5128	14.3962	13.8135	11.9200	11.0457	12.6751	12.8264	14.9480	16.3169	17.7191	17.7191	(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	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)
Combi loss	13.9973	12.6282	13.9581	13.4816	13.9119	13.4411	13.8755	13.8991	13.4632	13.9390	13.5197	13.9897	13.9897	(61)
Total heat required for water heating calculated for each month	135.9733	119.3092	124.0433	109.4565	106.0022	92.9080	87.5132	98.3995	98.9728	113.5922	122.2990	132.1170	132.1170	(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	(63)
Output from w/h	135.9733	119.3092	124.0433	109.4565	106.0022	92.9080	87.5132	98.3995	98.9728	113.5922	122.2990	132.1170	132.1170	(64)
Heat gains from water heating, kWh/month	44.0563	38.6285	40.0928	35.2821	34.0980	29.7830	27.9534	31.5712	31.7977	36.6194	39.5490	42.7747	42.7747	(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	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	102.5020	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.9194	30.1269	24.5009	18.5487	13.8654	11.7057	12.6485	16.4410	22.0670	28.0191	32.7025	34.8621	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	222.1554	224.4607	218.6514	206.2843	190.6730	176.0005	166.1985	163.8932	169.7024	182.0696	197.6809	212.3533	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	46.9586	(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)	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	-68.3347	(71)
Water heating gains (Table 5)	59.2155	57.4828	53.8882	49.0029	45.8306	41.3653	37.5718	42.4343	44.1635	49.2197	54.9292	57.4929	(72)
Total internal gains	399.4162	396.1963	381.1664	357.9618	334.4949	313.1975	300.5446	306.8944	320.0588	343.4343	369.4385	388.8342	(73)

#### 6. Solar gains

[Jan]	Area	Solar flux	Specific data	Specific data	Access	Gains						
	m2	Table 6a	g	FF	factor	W						
		W/m2	or Table 6b	or Table 6c	Table 6d							
Northeast	3.9900	12.9465	0.4300	0.0000	0.7700	17.1035 (75)						
Southwest	2.5400	40.9830	0.4300	0.0000	0.7700	34.4665 (79)						
Southeast	2.5200	40.9830	0.4300	0.0000	0.7700	34.1951 (77)						
Solar gains	85.7651	141.5013	204.3126	290.7174	335.8777	357.3654	337.0855	295.3077	242.8920	167.4392	106.3107	72.0202 (83)
Total gains	485.1813	537.6977	585.4791	648.6792	670.3726	670.5629	637.6301	602.2021	562.9508	510.8735	475.7491	460.8544 (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	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064	58.0064
alpha	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671	4.8671
util living area	0.9762	0.9608	0.9210	0.8189	0.6558	0.4536	0.2927	0.3098	0.5673	0.8429	0.9532	0.9805	(86)
MIT	20.1430	20.2858	20.5323	20.7947	20.9436	20.9923	20.9993	20.9991	20.9785	20.8027	20.4365	20.0989	(87)
Th 2	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	20.0119	(88)
util rest of house	0.9699	0.9507	0.9011	0.7785	0.5925	0.3762	0.2080	0.2202	0.4818	0.7967	0.9389	0.9752	(89)
MIT 2	18.9089	19.1111	19.4536	19.7949	19.9645	20.0078	20.0118	20.0117	19.9988	19.8142	19.3279	18.8461	(90)
Living area fraction	19.5162	19.6892	19.9844	20.2869	20.4463	20.4922	20.4977	20.4976	20.4809	20.3006	19.8734	19.4626	(91)
Temperature adjustment	19.5162	19.6892	19.9844	20.2869	20.4463	20.4922	20.4977	20.4976	20.4809	20.3006	19.8734	19.4626	(92)
adjusted MIT	19.5162	19.6892	19.9844	20.2869	20.4463	20.4922	20.4977	20.4976	20.4809	20.3006	19.8734	19.4626	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	468.6526	509.0738	527.1844	512.7817	416.3824	277.7129	159.2243	159.1764	294.5565	414.5007	445.5777	447.7205	(94)
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	814.8345	796.8506	714.0950	593.2400	437.0177	280.0541	159.3645	159.3579	301.4290	489.5001	669.4927	811.8883	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	257.5593	193.3861	139.0615	57.9300	15.3526	0.0000	0.0000	0.0000	0.0000	55.7996	161.2188	270.9408	(98)
Space heating													1151.2486 (98)
Space heating per m2													(98) / (4) = 22.7430 (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													1231.2820 (211)
Space heating requirement	257.5593	193.3861	139.0615	57.9300	15.3526	0.0000	0.0000	0.0000	0.0000	55.7996	161.2188	270.9408	(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)	275.4645	206.8300	148.7288	61.9572	16.4199	0.0000	0.0000	0.0000	0.0000	59.6787	172.4265	289.7763	(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	135.9733	119.3092	124.0433	109.4565	106.0022	92.9080	87.5132	98.3995	98.9728	113.5922	122.2990	132.1170	(64)
Efficiency of water heater (217)m	89.3681	89.2517	88.9626	88.3815	87.6923	87.3000	87.3000	87.3000	87.3000	88.3288	89.0913	89.4255	(217)
Fuel for water heating, kWh/month	152.1496	133.6771	139.4331	123.8455	120.8797	106.4239	100.2443	112.7142	113.3709	128.6015	137.2737	147.7396	(219)
Water heating fuel used													1516.3530 (219)
Annual totals kWh/year													
Space heating fuel - main system													1231.2820 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans: (MEVDecentralised, Database: total watage = 5.0830, total flow = 21.0000, SFP = 0.2420)													
mechanical ventilation fans (SFP = 0.2420)													35.7257 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													110.7257 (231)
Electricity for lighting (calculated in Appendix L)													239.6109 (232)
Total delivered energy for all uses													3097.9715 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1231.2820	3.9200	48.2663 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1516.3530	3.9200	59.4410 (247)
Mechanical ventilation fans	35.7257	16.9600	6.0591 (249)
Pumps and fans for heating	75.0000	16.9600	12.7200 (249)
Energy for lighting	239.6109	16.9600	40.6380 (250)
Additional standing charges			88.0000 (251)
Total energy cost			255.1244 (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	1231.2820	0.2160	265.9569 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1516.3530	0.2160	327.5322 (264)
Space and water heating			593.4891 (265)
Pumps and fans	110.7257	0.5190	57.4666 (267)
Energy for lighting	239.6109	0.5190	124.3580 (268)
Total kg/year			775.3138 (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	1231.2820	1.2200	1502.1640 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1516.3530	1.2200	1849.9506 (264)
Space and water heating			3352.1146 (265)
Pumps and fans	110.7257	3.0700	339.9279 (267)
Energy for lighting	239.6109	3.0700	735.6054 (268)
Primary energy kWh/year			4427.6479 (272)
Primary energy kWh/m2/year			87.4684 (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:	SAP change	Cost change	CO2 change
(none)			

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
(none)			
	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	£59	£59	£0
Mains gas	£196	£196	£0
Space heating	£155	£155	£0
Water heating	£59	£59	£0
Lighting	£41	£41	£0
Total cost of fuels	£255	£255	£0
Total cost of uses	£255	£255	£0
Delivered energy	61 kWh/m <sup>2</sup>	61 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>	15 kg/m <sup>2</sup>	15 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>
Primary energy	87 kWh/m <sup>2</sup>	87 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	226.9 (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	239.54 (P1)
Transmission heat loss coefficient	35.03 (37)
Summer heat loss coefficient	274.58 (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 West	2.5400	122.3147	0.4300	0.0000	0.9000	120.2329
South East	2.5200	122.3147	0.4300	0.0000	0.9000	119.2862
total:						393.9961

	Jun	Jul	Aug	
Solar gains	418	394	345	(P4)
Internal gains	310	298	304	
Total summer gains	728	692	649	(P5)

	2.65	2.52	2.36	
Summer gain/loss ratio	2.65	2.52	2.36	(P6)
Summer external temperature	15.40	17.60	17.60	
Thermal mass temperature increment (TMP = 226.9)	0.41	0.41	0.41	
Threshold temperature	18.46	20.53	20.38	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

Assessment of likelihood of high internal temperature: Slight