

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



<b>Property Reference</b>	4907-0015-3990-007			<b>Issued on Date</b>	12/02/2020
<b>Assessment Reference</b>	007	<b>Prop Type Ref</b>	2FF Semi		
<b>Property</b>	Plot 007, 1 Bed, K, Ba, Welwyn Garden City				
<b>SAP Rating</b>	84 B	<b>DER</b>	17.53	<b>TER</b>	19.39
<b>Environmental</b>	89 B	<b>% DER&lt;TER</b>	9.57		
<b>CO<sub>2</sub> Emissions (t/year)</b>	0.70	<b>DFEE</b>	39.05	<b>TFEE</b>	43.77
<b>General Requirements Compliance</b>	Pass	<b>% DFEE&lt;TFEE</b>	10.79		
<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 47 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) 19.39 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 17.53 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)43.8 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)39.0 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.33 (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 North West: 3.79 m<sup>2</sup>, No overhang  
Air change rate: 4.00 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	46.9100 (1b)	2.3900 (2b)	112.1149 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	46.9100		112.1149 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 112.1149 (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					2 (19)
Shelter factor					
Infiltration rate adjusted to include shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
				(21) = (18) x (20) =	0.1700 (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	0.2168	0.2125	0.2083	0.1870	0.1828	0.1615	0.1615	0.1573	0.1700	0.1828	0.1913	0.1998 (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)			5.2600	1.3258	6.9735		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	34.9900	7.7800	27.2100	0.2500	6.8025	52.8000	1436.6880 (29a)
External Wall to Corridor	3.6000	2.1200	1.4800	0.2200	0.3256	52.8000	78.1440 (29a)
External Wall to Stairwell	11.9300		11.9300	0.2000	2.3860	52.8000	629.9040 (29a)
Total net area of external elements Aum(A, m2)			50.5200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	22.1181		(33)
AAC Party Wall			23.1000	0.0000	0.0000	52.8000	1219.6800 (32)
E-FC-4			46.9100			70.0000	3283.7000 (32d)
E-FC-4			46.9100			70.0000	3283.7000 (32b)
Metal			72.8500			14.0000	1019.9000 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 10951.7160 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							233.4623 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.3670 (36)
Total fabric heat loss							(33) + (36) = 26.4851 (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	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990 (38)
Average = Sum(39)m / 12 =	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840 (39)
HLP	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589 (40)
HLP (average)												0.9589 (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												1.5997 (42)
Average daily hot water use (litres/day)												72.1921 (43)
Daily hot water use	79.4113	76.5236	73.6359	70.7483	67.8606	64.9729	64.9729	67.8606	70.7483	73.6359	76.5236	79.4113 (44)

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Energy conte	117.7647	102.9977	106.2844	92.6614	88.9108	76.7232	71.0954	81.5830	82.5573	96.2126	105.0236	114.0488 (45)
Energy content (annual)	Total = Sum(45)m = 1135.8629 (45)											
Distribution loss (46)m = 0.15 x (45)m	17.6647	15.4497	15.9427	13.8992	13.3366	11.5085	10.6643	12.2374	12.3836	14.4319	15.7535	17.1073 (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	13.9810	12.6144	13.9444	13.4701	13.9014	13.4324	13.8674	13.8894	13.4530	13.9266	13.5057	13.9739 (61)
Total heat required for water heating calculated for each month	131.7457	115.6122	120.2288	106.1315	102.8121	90.1557	84.9628	95.4724	96.0103	110.1392	118.5293	128.0227 (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	131.7457	115.6122	120.2288	106.1315	102.8121	90.1557	84.9628	95.4724	96.0103	110.1392	118.5293	128.0227 (64)
Heat gains from water heating, kWh/month	42.6520	37.4004	38.8257	34.1774	33.0382	28.8686	27.1061	30.5987	30.8136	35.4723	38.2968	41.4147 (65)
Total per year (kWh/year) = Sum(64)m = 1299.8227 (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	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	12.8590	11.4213	9.2884	7.0319	5.2564	4.4377	4.7951	6.2329	8.3657	10.6222	12.3977	13.2164 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	139.2161	140.6608	137.0204	129.2703	119.4873	110.2927	104.1501	102.7055	106.3459	114.0959	123.8789	133.0736 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983 (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)	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867 (71)
Water heating gains (Table 5)	57.3280	55.6553	52.1851	47.4687	44.4061	40.0953	36.4329	41.1273	42.7966	47.6779	53.1899	55.6649 (72)
Total internal gains	259.3982	257.7324	248.4888	233.7659	219.1449	204.8207	195.3731	200.0606	207.5032	222.3910	239.4616	251.9499 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data 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)						
Northwest	1.2700	11.2829	0.4300	0.0000	0.7700	4.7444 (81)						
Northwest	2.5200	11.2829	0.4300	0.0000	0.7700	9.4142 (81)						
Solar gains	29.0644	59.1614	106.5900	175.0514	235.3035	250.8584	234.6729	187.0839	129.8816	72.2999	36.5705	23.7354 (83)
Total gains	288.4625	316.8937	355.0788	408.8174	454.4484	455.6791	430.0460	387.1446	337.3848	294.6909	276.0321	275.6854 (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	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272
alpha	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085
util living area	0.9968	0.9940	0.9837	0.9391	0.8093	0.6123	0.4568	0.5265	0.8090	0.9695	0.9938	0.9975 (86)
MIT	19.9831	20.1025	20.3356	20.6483	20.8891	20.9805	20.9967	20.9932	20.9179	20.6006	20.2303	19.9457 (87)
Th 2	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177 (88)
util rest of house	0.9959	0.9922	0.9785	0.9202	0.7600	0.5358	0.3670	0.4296	0.7404	0.9563	0.9915	0.9968 (89)
MIT 2	18.7549	18.9288	19.2661	19.7052	20.0109	20.1047	20.1164	20.1147	20.0506	19.6477	19.1159	18.7004 (90)
Living area fraction	fLA = Living area / (4) =											0.4259 (91)
MIT	19.2780	19.4287	19.7216	20.1069	20.3849	20.4777	20.4913	20.4889	20.4200	20.0535	19.5905	19.2308 (92)
Temperature adjustment												0.0000
adjusted MIT	19.2780	19.4287	19.7216	20.1069	20.3849	20.4777	20.4913	20.4889	20.4200	20.0535	19.5905	19.2308 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9946	0.9904	0.9756	0.9199	0.7759	0.5677	0.4053	0.4709	0.7658	0.9552	0.9898	0.9958 (94)
Useful gains	286.9149	313.8386	346.4288	376.0822	352.6170	258.7027	174.3116	182.3197	258.3682	281.4784	273.2048	274.5160 (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	673.7724	653.5615	594.7615	504.1301	390.6824	264.4024	175.0480	183.9332	284.2983	425.2587	561.8754	676.1472 (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	287.8220	228.2938	184.7595	92.1945	28.3206	0.0000	0.0000	0.0000	0.0000	106.9726	207.8428	298.8136 (98)
Space heating												1435.0194 (98)
Space heating per m2												(98) / (4) = 30.5909 (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													1534.7801 (211)
Space heating requirement	287.8220	228.2938	184.7595	92.1945	28.3206	0.0000	0.0000	0.0000	0.0000	106.9726	207.8428	298.8136	(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)	307.8310	244.1645	197.6038	98.6037	30.2895	0.0000	0.0000	0.0000	0.0000	114.4092	222.2918	319.5867	(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	131.7457	115.6122	120.2288	106.1315	102.8121	90.1557	84.9628	95.4724	96.0103	110.1392	118.5293	128.0227	(64)
Efficiency of water heater (217)m	89.4702	89.3984	89.2109	88.7589	87.9718	87.3000	87.3000	87.3000	87.3000	88.8479	89.3111	87.3000	(216)
Fuel for water heating, kWh/month	147.2509	129.3225	134.7692	119.5727	116.8694	103.2711	97.3228	109.3613	109.9774	123.9638	132.7151	143.0168	(219)
Water heating fuel used													1467.4130 (219)
Annual totals kWh/year													
Space heating fuel - main system													1534.7801 (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)													33.1073 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													108.1073 (231)
Electricity for lighting (calculated in Appendix L)													227.0943 (232)
Total delivered energy for all uses													3337.3948 (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	1534.7801	0.2160	331.5125	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1467.4130	0.2160	316.9612	(264)
Space and water heating			648.4737	(265)
Pumps and fans	108.1073	0.5190	56.1077	(267)
Energy for lighting	227.0943	0.5190	117.8619	(268)
Total CO2, kg/year			822.4434	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.5300	(273)

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

DER			17.5300	ZC1
Total Floor Area		TFA	46.9100	
Assumed number of occupants		N	1.5997	
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190	
CO2 emissions from appliances, equation (L14)			17.5861	ZC2
CO2 emissions from cooking, equation (L16)			3.3552	ZC3
Total CO2 emissions			38.4713	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			38.4713	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 (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	46.9100 (1b)	x 2.3900 (2b)	= 112.1149 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	46.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 112.1149 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				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) =	0.1784 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate					0.4284 (18)
Number of sides sheltered				2	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3641 (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	0.4643	0.4552	0.4461	0.4005	0.3914	0.3459	0.3459	0.3368	0.3641	0.3914	0.4096	0.4279 (22b)
Effective ac	0.6078	0.6036	0.5995	0.5802	0.5766	0.5598	0.5598	0.5567	0.5663	0.5766	0.5839	0.5915 (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
TER Opaque door			2.1200	1.0000	2.1200		(26)
TER Opening Type (Uw = 1.40)			7.7800	1.3258	10.3144		(27)
External Wall	34.9900	7.7800	27.2100	0.1800	4.8978		(29a)
External Wall to Corridor	3.6000	2.1200	1.4800	0.1800	0.2664		(29a)
External Wall to Stairwell	11.9300		11.9300	0.1800	2.1474		(29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			50.5200				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	19.7460	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.6839 (36)
Total fabric heat loss						(33) + (36) =	24.4299 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	22.4863	22.3314	22.1797	21.4668	21.3335	20.7126	20.7126	20.5976	20.9517	21.3335	21.6033	21.8853 (38)
Heat transfer coeff	46.9162	46.7613	46.6096	45.8967	45.7634	45.1425	45.1425	45.0275	45.3816	45.7634	46.0332	46.3152 (39)
Average = Sum(39)m / 12 =												45.8961 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0001	0.9968	0.9936	0.9784	0.9756	0.9623	0.9623	0.9599	0.9674	0.9756	0.9813	0.9873 (40)
HLP (average)												0.9784 (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												1.5997 (42)
Average daily hot water use (litres/day)												72.1921 (43)
Daily hot water use	79.4113	76.5236	73.6359	70.7483	67.8606	64.9729	64.9729	67.8606	70.7483	73.6359	76.5236	79.4113 (44)
Energy conte	117.7647	102.9977	106.2844	92.6614	88.9108	76.7232	71.0954	81.5830	82.5573	96.2126	105.0236	114.0488 (45)
Energy content (annual)												Total = Sum(45)m = 1135.8629 (45)
Distribution loss (46)m = 0.15 x (45)m	17.6647	15.4497	15.9427	13.8992	13.3366	11.5085	10.6643	12.2374	12.3836	14.4319	15.7535	17.1073 (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 EMISSIONS 09 Jan 2014

Combi loss	40.4671	35.2218	37.5241	34.8896	34.5810	32.0414	33.1095	34.5810	34.8896	37.5241	37.7377	40.4671 (61)
Total heat required for water heating calculated for each month	158.2318	138.2196	143.8085	127.5509	123.4918	108.7647	104.2048	116.1640	117.4469	133.7367	142.7613	154.5159 (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	158.2318	138.2196	143.8085	127.5509	123.4918	108.7647	104.2048	116.1640	117.4469	133.7367	142.7613	154.5159 (64)
Heat gains from water heating, kWh/month	49.2735	43.0522	44.7206	39.5323	38.2081	33.5208	31.9166	35.7716	36.1727	41.3717	44.3548	48.0380 (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	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	12.8590	11.4213	9.2884	7.0319	5.2564	4.4377	4.7951	6.2329	8.3657	10.6222	12.3977	13.2164 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	139.2161	140.6608	137.0204	129.2703	119.4873	110.2927	104.1501	102.7055	106.3459	114.0959	123.8789	133.0736 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983 (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)	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867 (71)
Water heating gains (Table 5)	66.2279	64.0658	60.1083	54.9060	51.3550	46.5567	42.8986	48.0801	50.2399	55.6071	61.6038	64.5672 (72)
Total internal gains	268.2981	266.1428	256.4121	241.2032	226.0938	211.2821	201.8389	207.0134	214.9465	230.3203	247.8754	260.8522 (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	0.7000	0.7700	13.7584 (75)						
Northwest	3.7900	11.2829	0.6300	0.7000	0.7700	13.0687 (81)						
Solar gains	26.8271	54.6073	98.3851	161.5765	217.1906	231.5481	216.6085	172.6828	119.8837	66.7345	33.7554	21.9084 (83)
Total gains	295.1252	320.7502	354.7972	402.7798	443.2843	442.8303	418.4474	379.6963	334.8302	297.0548	281.6309	282.7606 (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)	69.4353	69.6652	69.8921	70.9776	71.1844	72.1635	72.1635	72.3477	71.7832	71.1844	70.7672	70.3362
alpha	5.6290	5.6443	5.6595	5.7318	5.7456	5.8109	5.8109	5.8232	5.7855	5.7456	5.7178	5.6891
util living area	0.9974	0.9953	0.9874	0.9508	0.8339	0.6324	0.4714	0.5381	0.8226	0.9739	0.9948	0.9980 (86)
MIT	19.9933	20.1070	20.3292	20.6437	20.8843	20.9816	20.9971	20.9942	20.9219	20.6141	20.2571	19.9769 (87)
Th 2	20.0832	20.0860	20.0887	20.1014	20.1038	20.1149	20.1149	20.1169	20.1106	20.1038	20.0989	20.0939 (88)
util rest of house	0.9966	0.9938	0.9831	0.9337	0.7852	0.5533	0.3783	0.4387	0.7533	0.9616	0.9928	0.9973 (89)
MIT 2	18.7376	18.9055	19.2298	19.6836	19.9931	20.1030	20.1138	20.1145	20.0482	19.6517	19.1346	18.7216 (90)
Living area fraction	19.2724	19.4172	19.6981	20.0925	20.3727	20.4772	20.4900	20.4892	20.4204	20.0616	19.6127	0.4259 (91)
MIT	19.2724	19.4172	19.6981	20.0925	20.3727	20.4772	20.4900	20.4892	20.4204	20.0616	19.6127	19.2563 (92)
Temperature adjustment												0.0000
adjusted MIT	19.2724	19.4172	19.6981	20.0925	20.3727	20.4772	20.4900	20.4892	20.4204	20.0616	19.6127	19.2563 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	293.8227	318.2752	347.9550	376.0028	355.0192	259.7212	174.9474	182.7135	260.9877	285.4385	279.2045	281.7689 (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	702.4487	678.8447	615.1559	513.7000	396.8918	265.3111	175.6052	184.1252	286.8279	432.9935	575.9982	697.3342 (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	304.0178	242.3027	198.7974	99.1419	31.1532	0.0000	0.0000	0.0000	0.0000	109.7809	213.6915	309.1806 (98)
Space heating												1508.0660 (98)
Space heating per m2												(98) / (4) = 32.1481 (99)

#### 8c. Space cooling requirement

Not applicable

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

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### 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													1614.6317 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	304.0178	242.3027	198.7974	99.1419	31.1532	0.0000	0.0000	0.0000	0.0000	109.7809	213.6915	309.1806	(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)	325.5008	259.4247	212.8452	106.1477	33.3546	0.0000	0.0000	0.0000	0.0000	117.5385	228.7917	331.0285	(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	158.2318	138.2196	143.8085	127.5509	123.4918	108.7647	104.2048	116.1640	117.4469	133.7367	142.7613	154.5159	(64)
Efficiency of water heater (217)m	86.6685	86.4503	85.8666	84.4252	82.1489	80.3000	80.3000	80.3000	80.3000	84.5590	86.0645	86.7635	(217)
Fuel for water heating, kWh/month	182.5713	159.8833	167.4789	151.0816	150.3267	135.4479	129.7694	144.6625	146.2601	158.1578	165.8770	178.0886	(219)
Water heating fuel used													1869.6052 (219)
Annual totals kWh/year													
Space heating fuel - main system													1614.6317 (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)													227.0943 (232)
Total delivered energy for all uses													3786.3312 (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	1614.6317	0.2160	348.7604 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1869.6052	0.2160	403.8347 (264)
Space and water heating			752.5952 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	227.0943	0.5190	117.8619 (268)
Total CO2, kg/m2/year			909.3821 (272)
Emissions per m2 for space and water heating			16.0434 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.5125 (272b)
Emissions per m2 for pumps and fans			0.8298 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.0434 * 1.00) + 2.5125 + 0.8298, rounded to 2 d.p.			19.3900 (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	46.9100 (1b)	2.3900 (2b)	112.1149 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	46.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	112.1149 (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) =	0.1784 (8)
Pressure test				Yes	
Measured/design AP50				4.0000	
Infiltration rate				0.3784	(18)
Number of sides sheltered				2	(19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3216 (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	0.4101	0.4020	0.3940	0.3538	0.3458	0.3055	0.3055	0.2975	0.3216	0.3458	0.3618	0.3779 (22b)
Effective ac	0.5841	0.5808	0.5776	0.5626	0.5598	0.5467	0.5467	0.5443	0.5517	0.5598	0.5655	0.5714 (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)			5.2600	1.3258	6.9735		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	34.9900	7.7800	27.2100	0.2500	6.8025	52.8000	1436.6880 (29a)
External Wall to Corridor	3.6000	2.1200	1.4800	0.2200	0.3256	52.8000	78.1440 (29a)
External Wall to Stairwell	11.9300		11.9300	0.2000	2.3860	52.8000	629.9040 (29a)
Total net area of external elements Aum(A, m2)			50.5200				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	22.1181	(33)
AAC Party Wall			23.1000	0.0000	0.0000	52.8000	1219.6800 (32)
E-FC-4			46.9100			70.0000	3283.7000 (32d)
E-FC-4			46.9100			30.0000	1407.3000 (32b)
Metal			72.8500			14.0000	1019.9000 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) =
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							9075.3160 (34)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							193.4623 (35)
Total fabric heat loss							(33) + (36) =
							26.4851 (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	21.6098	21.4890	21.3706	20.8145	20.7104	20.2260	20.2260	20.1363	20.4126	20.7104	20.9209	21.1410 (38)
Heat transfer coeff	48.0949	47.9741	47.8557	47.2995	47.1955	46.7111	46.7111	46.6214	46.8977	47.1955	47.4060	47.6261 (39)
Average = Sum(39)m / 12 =												47.2991 (39)
HLP	1.0253	1.0227	1.0202	1.0083	1.0061	0.9958	0.9958	0.9938	0.9997	1.0061	1.0106	1.0153 (40)
HLP (average)												1.0083 (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												1.5997 (42)
Average daily hot water use (litres/day)												72.1921 (43)
Daily hot water use	79.4113	76.5236	73.6359	70.7483	67.8606	64.9729	64.9729	67.8606	70.7483	73.6359	76.5236	79.4113 (44)
Energy conte	117.7647	102.9977	106.2844	92.6614	88.9108	76.7232	71.0954	81.5830	82.5573	96.2126	105.0236	114.0488 (45)
Energy content (annual)												Total = Sum(45)m =
Distribution loss (46)m = 0.15 x (45)m												1135.8629 (45)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	0.0000	(46)
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	25.0250	21.8870	22.5854	19.6905	18.8935	16.3037	15.1078	17.3364	17.5434	20.4452	22.3175	24.2354		(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	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	12.8590	11.4213	9.2884	7.0319	5.2564	4.4377	4.7951	6.2329	8.3657	10.6222	12.3977	13.2164	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	139.2161	140.6608	137.0204	129.2703	119.4873	110.2927	104.1501	102.7055	106.3459	114.0959	123.8789	133.0736	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	(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)	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	(71)
Water heating gains (Table 5)	33.6357	32.5700	30.3568	27.3480	25.3945	22.6440	20.3061	23.3016	24.3659	27.4801	30.9965	32.5744	(72)
Total internal gains	232.7059	231.6470	223.6606	210.6452	197.1333	184.3694	176.2464	179.2349	186.0725	199.1932	214.2682	225.8594	(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)
Northwest	1.2700	11.2829	0.4300	0.0000	0.7700	4.7444 (81)
Northwest	2.5200	11.2829	0.4300	0.0000	0.7700	9.4142 (81)

Solar gains	29.0644	59.1614	106.5900	175.0514	235.3035	250.8584	234.6729	187.0839	129.8816	72.2999	36.5705	23.7354	(83)
Total gains	261.7703	290.8084	330.2506	385.6967	432.4368	435.2278	410.9192	366.3189	315.9541	271.4931	250.8387	249.5948	(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)	52.4156	52.5475	52.6775	53.2969	53.4144	53.9683	53.9683	54.0722	53.7536	53.4144	53.1773	52.9315	21.0000 (85)
tau	4.4944	4.5032	4.5118	4.5531	4.5610	4.5979	4.5979	4.6048	4.5836	4.5610	4.5452	4.5288	
util living area	0.9956	0.9923	0.9813	0.9391	0.8262	0.6433	0.4896	0.5637	0.8306	0.9688	0.9923	0.9965	(86)
MIT	19.6397	19.7862	20.0717	20.4712	20.7944	20.9521	20.9890	20.9799	20.8457	20.4263	19.9685	19.6143	(87)
Th 2	20.0623	20.0645	20.0666	20.0764	20.0783	20.0869	20.0869	20.0885	20.0836	20.0783	20.0745	20.0706	(88)
util rest of house	0.9945	0.9903	0.9762	0.9221	0.7816	0.5665	0.3930	0.4617	0.7691	0.9570	0.9899	0.9956	(89)
MIT 2	18.8143	18.9618	19.2461	19.6410	19.9337	20.0623	20.0833	20.0813	19.9887	19.6061	19.1519	18.7956	(90)
Living area fraction									fLA = Living area / (4) =			0.4259	(91)
MIT	19.1658	19.3130	19.5977	19.9946	20.3003	20.4413	20.4691	20.4640	20.3537	19.9554	19.4997	19.1443	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1658	19.3130	19.5977	19.9946	20.3003	20.4413	20.4691	20.4640	20.3537	19.9554	19.4997	19.1443	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	259.9487	287.3694	321.3149	354.9837	343.0375	260.0190	178.3877	184.9650	249.3050	259.2998	247.8144	248.1822	(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	714.9715	691.4490	626.8001	524.7695	405.8959	272.8534	180.7296	189.4708	293.2843	441.5346	587.8185	711.7393	(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	338.5370	271.5415	227.2810	122.2458	46.7666	0.0000	0.0000	0.0000	0.0000	135.5827	244.8029	344.8865	(98)
Space heating												1731.6440	(98)
Space heating per m2										(98) / (4) =		36.9142	(99)

#### 8c. Space cooling requirement

Ext. temp.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	439.0844	345.6622	354.3227	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9098	0.9496	0.9252	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	399.4730	328.2556	327.8368	0.0000	0.0000	0.0000	0.0000	(102)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	569.7564	540.2258	489.0361	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												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	122.6041	157.7058	119.9323	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling Cooled fraction												400.2421 (104)
Intermittency factor (Table 10b)												FC = cooled area / (4) =
Intermittency factor	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	1.0000 (105)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	30.6510	39.4265	29.9831	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												100.0605 (107)
Energy for space heating												2.1330 (108)
Energy for space cooling												36.9142 (99)
Total												2.1330 (108)
Dwelling Fabric Energy Efficiency (DFEE)												39.0472 (109)
												39.0 (109)

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# 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	46.9100 (1b)	x 2.3900 (2b)	= 112.1149 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	46.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 112.1149 (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) =	0.1784 (8)
Pressure test				Yes	
Measured/design AP50					5.0000
Infiltration rate					0.4284 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3641 (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	0.4643	0.4552	0.4461	0.4005	0.3914	0.3459	0.3459	0.3368	0.3641	0.3914	0.4096	0.4279 (22b)
Effective ac	0.6078	0.6036	0.5995	0.5802	0.5766	0.5598	0.5598	0.5567	0.5663	0.5766	0.5839	0.5915 (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)			7.7800	1.3258	10.3144		(27)
External Wall	34.9900	7.7800	27.2100	0.1800	4.8978		(29a)
External Wall to Corridor	3.6000	2.1200	1.4800	0.1800	0.2664		(29a)
External Wall to Stairwell	11.9300		11.9300	0.1800	2.1474		(29a)
Total net area of external elements Aum(A, m2)			50.5200				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	19.7460	(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.6839 (36)
Total fabric heat loss						(33) + (36) =	24.4299 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	22.4863	22.3314	22.1797	21.4668	21.3335	20.7126	20.7126	20.5976	20.9517	21.3335	21.6033	21.8853 (38)
Heat transfer coeff	46.9162	46.7613	46.6096	45.8967	45.7634	45.1425	45.1425	45.0275	45.3816	45.7634	46.0332	46.3152 (39)
Average = Sum(39)m / 12 =												45.8961 (39)
HLP	1.0001	0.9968	0.9936	0.9784	0.9756	0.9623	0.9623	0.9599	0.9674	0.9756	0.9813	0.9873 (40)
HLP (average)												0.9784 (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												1.5997 (42)
Average daily hot water use (litres/day)												72.1921 (43)
Daily hot water use	79.4113	76.5236	73.6359	70.7483	67.8606	64.9729	64.9729	67.8606	70.7483	73.6359	76.5236	79.4113 (44)
Energy conte	117.7647	102.9977	106.2844	92.6614	88.9108	76.7232	71.0954	81.5830	82.5573	96.2126	105.0236	114.0488 (45)
Energy content (annual)												Total = Sum(45)m = 1135.8629 (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	25.0250	21.8870	22.5854	19.6905	18.8935	16.3037	15.1078	17.3364	17.5434	20.4452	22.3175	24.2354	24.2354	(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	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	79.9834	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	12.8590	11.4213	9.2884	7.0319	5.2564	4.4377	4.7951	6.2329	8.3657	10.6222	12.3977	13.2164	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	139.2161	140.6608	137.0204	129.2703	119.4873	110.2927	104.1501	102.7055	106.3459	114.0959	123.8789	133.0736	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	30.9983	(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)	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	(71)
Water heating gains (Table 5)	33.6357	32.5700	30.3568	27.3480	25.3945	22.6440	20.3061	23.3016	24.3659	27.4801	30.9965	32.5744	(72)
Total internal gains	232.7059	231.6470	223.6606	210.6452	197.1333	184.3694	176.2464	179.2349	186.0725	199.1932	214.2682	225.8594	(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)							
Northwest	3.7900	11.2829	0.6300	0.7000	0.7700	13.0687 (81)							
Solar gains	26.8271	54.6073	98.3851	161.5765	217.1906	231.5481	216.6085	172.6828	119.8837	66.7345	33.7554	21.9084	(83)
Total gains	259.5330	286.2544	322.0456	372.2218	414.3239	415.9176	392.8549	351.9178	305.9563	265.9277	248.0236	247.7678	(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)													21.0000 (85)
tau	69.4353	69.6652	69.8921	70.9776	71.1844	72.1635	72.1635	72.3477	71.7832	71.1844	70.7672	70.3362	
alpha	5.6290	5.6443	5.6595	5.7318	5.7456	5.8109	5.8109	5.8232	5.7855	5.7456	5.7178	5.6891	
util living area	0.9987	0.9974	0.9921	0.9643	0.8629	0.6668	0.5008	0.5772	0.8623	0.9841	0.9973	0.9990	(86)
MIT	19.9208	20.0375	20.2656	20.5941	20.8593	20.9760	20.9961	20.9917	20.8979	20.5570	20.1893	19.9053	(87)
Th 2	20.0832	20.0860	20.0887	20.1014	20.1038	20.1149	20.1149	20.1169	20.1106	20.1038	20.0989	20.0939	(88)
util rest of house	0.9982	0.9965	0.9892	0.9511	0.8183	0.5860	0.4026	0.4723	0.7996	0.9761	0.9962	0.9986	(89)
MIT 2	19.0924	19.2109	19.4400	19.7705	20.0095	20.1040	20.1138	20.1145	20.0523	19.7412	19.3733	19.0856	(90)
Living area fraction										fLA = Living area / (4) =		0.4259	(91)
MIT	19.4452	19.5630	19.7916	20.1213	20.3715	20.4754	20.4896	20.4881	20.4125	20.0887	19.7208	19.4348	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4452	19.5630	19.7916	20.1213	20.3715	20.4754	20.4896	20.4881	20.4125	20.0887	19.7208	19.4348	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.9978	0.9958	0.9880	0.9514	0.8328	0.6200	0.4446	0.5173	0.8232	0.9760	0.9956	0.9983	0.9983	(94)
Useful gains	258.9639	285.0461	318.1833	354.1438	345.0407	257.8498	174.6815	182.0369	251.8526	259.5341	246.9259	247.3501	(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	710.5561	685.6604	619.5173	515.0207	396.8352	265.2306	175.5867	184.0778	286.4700	434.2332	580.9774	705.6015	(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	335.9846	269.2128	224.1925	115.8314	38.5351	0.0000	0.0000	0.0000	0.0000	129.9761	240.5171	340.9390	(98)
Space heating												1695.1886	(98)
Space heating per m2												36.1370	(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	424.3395	334.0545	342.2092	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9377	0.9710	0.9525	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	397.9224	324.3822	325.9555	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	547.1859	519.1116	472.2036	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	107.4697	144.8787	108.8086	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												361.1571	(104)
Cooled fraction												1.0000	(105)
Intermittency factor (Table 10b)												fC = cooled area / (4) =	

# 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	26.8674	36.2197	27.2022	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												90.2893 (107)
Energy for space heating												1.9247 (108)
Energy for space cooling												36.1370 (99)
Total												1.9247 (108)
Target Fabric Energy Efficiency (TFEE)												38.0618 (109)
												43.8 (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	46.9100 (1b)	2.3900 (2b)	112.1149 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	46.9100		112.1149 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 112.1149 (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					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.1700 (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	0.2083	0.2040	0.1998	0.1785	0.1785	0.1573	0.1615	0.1615	0.1700	0.1785	0.1828	0.1913 (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)			5.2600	1.3258	6.9735		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	34.9900	7.7800	27.2100	0.2500	6.8025	52.8000	1436.6880 (29a)
External Wall to Corridor	3.6000	2.1200	1.4800	0.2200	0.3256	52.8000	78.1440 (29a)
External Wall to Stairwell	11.9300		11.9300	0.2000	2.3860	52.8000	629.9040 (29a)
Total net area of external elements Aum(A, m2)			50.5200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	22.1181		(33)
AAC Party Wall			23.1000	0.0000	0.0000	52.8000	1219.6800 (32)
E-FC-4			46.9100			70.0000	3283.7000 (32d)
E-FC-4			46.9100			70.0000	3283.7000 (32b)
Metal			72.8500			14.0000	1019.9000 (32c)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	10951.7160 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							233.4623 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.3670 (36)
Total fabric heat loss						(33) + (36) =	26.4851 (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	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990 (38)
Average = Sum(39)m / 12 =	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840 (39)
HLP	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589 (40)
HLP (average)												0.9589 (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												1.5997 (42)
Average daily hot water use (litres/day)												72.1921 (43)
Daily hot water use	79.4113	76.5236	73.6359	70.7483	67.8606	64.9729	64.9729	67.8606	70.7483	73.6359	76.5236	79.4113 (44)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)	117.7647	102.9977	106.2844	92.6614	88.9108	76.7232	71.0954	81.5830	82.5573	96.2126	105.0236	114.0488 (45)
Distribution loss (46)m = 0.15 x (45)m	17.6647	15.4497	15.9427	13.8992	13.3366	11.5085	10.6643	12.2374	12.3836	14.4319	15.7535	17.1073 (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	13.9810	12.6144	13.9444	13.4701	13.9014	13.4324	13.8674	13.8894	13.4530	13.9266	13.5057	13.9739 (61)
Total heat required for water heating calculated for each month	131.7457	115.6122	120.2288	106.1315	102.8121	90.1557	84.9628	95.4724	96.0103	110.1392	118.5293	128.0227 (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	131.7457	115.6122	120.2288	106.1315	102.8121	90.1557	84.9628	95.4724	96.0103	110.1392	118.5293	128.0227 (64)
RHI water heating demand												1300 (64)
Heat gains from water heating, kWh/month	42.6520	37.4004	38.8257	34.1774	33.0382	28.8686	27.1061	30.5987	30.8136	35.4723	38.2968	41.4147 (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	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.1475	28.5532	23.2210	17.5798	13.1411	11.0943	11.9877	15.5821	20.9143	26.5555	30.9942	33.0410 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	207.7853	209.9415	204.5080	192.9408	178.3393	164.6160	155.4479	153.2918	158.7252	170.2924	184.8939	198.6173 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977 (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)	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867 (71)
Water heating gains (Table 5)	57.3280	55.6553	52.1851	47.4687	44.4061	40.0953	36.4329	41.1273	42.7966	47.6779	53.1899	55.6649 (72)
Total internal gains	378.4518	375.3409	361.1051	339.1803	317.0776	296.9965	285.0596	291.1922	303.6272	325.7168	350.2691	368.5142 (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)						
Northwest	1.2700	12.9465	0.4300	0.0000	0.7700	5.4440 (81)						
Northwest	2.5200	12.9465	0.4300	0.0000	0.7700	10.8022 (81)						
Solar gains	33.3497	63.4935	112.6482	193.9807	250.6951	277.9635	257.7026	207.7391	145.4378	81.1798	43.0412	26.9372 (83)
Total gains	411.8016	438.8345	473.7533	533.1610	567.7727	574.9600	542.7622	498.9313	449.0650	406.8966	393.3103	395.4514 (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)												
tau	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272
alpha	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085
util living area	0.9813	0.9719	0.9388	0.8333	0.6465	0.4355	0.2816	0.3062	0.5860	0.8704	0.9636	0.9844 (86)
MIT	20.2782	20.3767	20.5942	20.8398	20.9664	20.9967	20.9998	20.9997	20.9852	20.8296	20.5191	20.2457 (87)
Th 2	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177 (88)
util rest of house	0.9762	0.9644	0.9227	0.7963	0.5881	0.3681	0.2086	0.2269	0.5063	0.8303	0.9523	0.9800 (89)
MIT 2	19.1812	19.3216	19.6263	19.9472	20.0896	20.1159	20.1176	20.1176	20.1085	19.9433	19.5265	19.1348 (90)
Living area fraction	19.6484	19.7710	20.0386	20.3274	20.4631	20.4911	20.4934	20.4933	20.4819	20.3208	19.9493	19.6079 (92)
Temperature adjustment												0.0000
adjusted MIT	19.6484	19.7710	20.0386	20.3274	20.4631	20.4911	20.4934	20.4933	20.4819	20.3208	19.9493	19.6079 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	400.6282	421.6649	436.3358	429.5386	347.2050	228.1488	130.1170	130.0932	242.4195	341.9661	373.5359	386.3134 (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	672.4412	655.4615	586.5277	487.0588	358.2105	229.0162	130.1550	130.1519	246.5971	401.2927	551.0223	670.6193 (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	202.2289	157.1113	111.7428	41.4145	8.1881	0.0000	0.0000	0.0000	0.0000	44.1390	127.7902	211.5236 (98)
Space heating												904.1384 (98)
RHI space heating demand												904 (98)





# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	46.9100 (1b)	2.3900 (2b)	112.1149 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	46.9100		112.1149 (4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	112.1149 (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					2	(19)
Shelter factor					(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor					(21) = (18) x (20) =	0.1700 (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	0.2168	0.2125	0.2083	0.1870	0.1828	0.1615	0.1615	0.1573	0.1700	0.1828	0.1913	0.1998 (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)			5.2600	1.3258	6.9735		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	34.9900	7.7800	27.2100	0.2500	6.8025	52.8000	1436.6880 (29a)
External Wall to Corridor	3.6000	2.1200	1.4800	0.2200	0.3256	52.8000	78.1440 (29a)
External Wall to Stairwell	11.9300		11.9300	0.2000	2.3860	52.8000	629.9040 (29a)
Total net area of external elements Aum(A, m2)			50.5200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	22.1181			(33)
AAC Party Wall			23.1000	0.0000	0.0000	52.8000	1219.6800 (32)
E-FC-4			46.9100			70.0000	3283.7000 (32d)
E-FC-4			46.9100			70.0000	3283.7000 (32b)
Metal			72.8500			14.0000	1019.9000 (32c)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =	10951.7160			(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K				233.4623			(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				4.3670			(36)
Total fabric heat loss			(33) + (36) =	26.4851			(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	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840 (39)
Average = Sum(39)m / 12 =	44.9840 (39)											
HLP	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589 (40)
HLP (average)	0.9589 (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	1.5997 (42)											
Average daily hot water use (litres/day)	72.1921 (43)											
Daily hot water use	79.4113	76.5236	73.6359	70.7483	67.8606	64.9729	64.9729	67.8606	70.7483	73.6359	76.5236	79.4113 (44)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	117.7647	102.9977	106.2844	92.6614	88.9108	76.7232	71.0954	81.5830	82.5573	96.2126	105.0236	114.0488 (45)
Energy content (annual)	Total = Sum(45)m = 1135.8629 (45)											
Distribution loss (46)m = 0.15 x (45)m	17.6647	15.4497	15.9427	13.8992	13.3366	11.5085	10.6643	12.2374	12.3836	14.4319	15.7535	17.1073 (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	13.9810	12.6144	13.9444	13.4701	13.9014	13.4324	13.8674	13.8894	13.4530	13.9266	13.5057	13.9739 (61)
Total heat required for water heating calculated for each month	131.7457	115.6122	120.2288	106.1315	102.8121	90.1557	84.9628	95.4724	96.0103	110.1392	118.5293	128.0227 (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	131.7457	115.6122	120.2288	106.1315	102.8121	90.1557	84.9628	95.4724	96.0103	110.1392	118.5293	128.0227 (64)
Heat gains from water heating, kWh/month	42.6520	37.4004	38.8257	34.1774	33.0382	28.8686	27.1061	30.5987	30.8136	35.4723	38.2968	41.4147 (65)
Total per year (kWh/year) = Sum(64)m = 1299.8227 (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	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.1475	28.5532	23.2210	17.5798	13.1411	11.0943	11.9877	15.5821	20.9143	26.5555	30.9942	33.0410 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	207.7853	209.9415	204.5080	192.9408	178.3393	164.6160	155.4479	153.2918	158.7252	170.2924	184.8939	198.6173 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977 (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)	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867 (71)
Water heating gains (Table 5)	57.3280	55.6553	52.1851	47.4687	44.4061	40.0953	36.4329	41.1273	42.7966	47.6779	53.1899	55.6649 (72)
Total internal gains	378.4518	375.3409	361.1051	339.1803	317.0776	296.9965	285.0596	291.1922	303.6272	325.7168	350.2691	368.5142 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data 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)						
Northwest	1.2700	11.2829	0.4300	0.0000	0.7700	4.7444 (81)						
Northwest	2.5200	11.2829	0.4300	0.0000	0.7700	9.4142 (81)						
Solar gains	29.0644	59.1614	106.5900	175.0514	235.3035	250.8584	234.6729	187.0839	129.8816	72.2999	36.5705	23.7354 (83)
Total gains	407.5162	434.5023	467.6951	514.2317	552.3810	547.8549	519.7325	478.2761	433.5088	398.0167	386.8396	392.2497 (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	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272
alpha	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085
util living area	0.9840	0.9751	0.9488	0.8693	0.7098	0.5182	0.3797	0.4302	0.6796	0.9058	0.9717	0.9868 (86)
MIT	20.2319	20.3409	20.5428	20.7867	20.9424	20.9912	20.9987	20.9974	20.9654	20.7647	20.4531	20.1915 (87)
Th 2	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177 (88)
util rest of house	0.9796	0.9685	0.9353	0.8383	0.6561	0.4499	0.3042	0.3490	0.6061	0.8755	0.9629	0.9832 (89)
MIT 2	19.1145	19.2706	19.5552	19.8814	20.0654	20.1121	20.1172	20.1166	20.0921	19.8617	19.4332	19.0565 (90)
Living area fraction	fLA = Living area / (4) = 0.4259 (91)											
MIT	19.5904	19.7264	19.9758	20.2670	20.4389	20.4865	20.4926	20.4918	20.4640	20.2463	19.8676	19.5400 (92)
Temperature adjustment	0.0000											
adjusted MIT	19.5904	19.7264	19.9758	20.2670	20.4389	20.4865	20.4926	20.4918	20.4640	20.2463	19.8676	19.5400 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9764	0.9650	0.9328	0.8440	0.6763	0.4787	0.3364	0.3836	0.6359	0.8804	0.9599	0.9803 (94)
Useful gains	397.9070	419.2744	436.2877	433.9870	373.5721	262.2840	174.8162	183.4753	275.6800	350.4268	371.3370	384.5157 (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	687.8239	666.9527	606.1966	511.3334	393.1132	264.7998	175.1063	184.0647	286.2802	433.9304	574.3383	690.0535 (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	215.6981	166.4398	126.4122	55.6894	14.5386	0.0000	0.0000	0.0000	0.0000	62.1267	146.1609	227.3201 (98)
Space heating	1014.3859 (98)											
Space heating per m2	(98) / (4) = 21.6241 (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

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													1084.9047 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	215.6981	166.4398	126.4122	55.6894	14.5386	0.0000	0.0000	0.0000	0.0000	62.1267	146.1609	227.3201	(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)	230.6932	178.0105	135.2002	59.5608	15.5493	0.0000	0.0000	0.0000	0.0000	66.4457	156.3219	243.1231	(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	131.7457	115.6122	120.2288	106.1315	102.8121	90.1557	84.9628	95.4724	96.0103	110.1392	118.5293	128.0227	(64)
Efficiency of water heater (217)m	89.2594	89.1604	88.9113	88.3754	87.6841	87.3000	87.3000	87.3000	87.3000	88.4276	89.0385	87.3000	(216)
Fuel for water heating, kWh/month	147.5987	129.6677	135.2233	120.0917	117.2529	103.2711	97.3228	109.3613	109.9774	124.5529	133.1214	143.3297	(219)
Water heating fuel used												1470.7709	(219)
Annual totals kWh/year													
Space heating fuel - main system													1084.9047 (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)													33.1073 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													108.1073 (231)
Electricity for lighting (calculated in Appendix L)													227.0943 (232)
Total delivered energy for all uses													2890.8772 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1084.9047	3.4800	37.7547 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1470.7709	3.4800	51.1828 (247)
Mechanical ventilation fans	33.1073	13.1900	4.3669 (249)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	227.0943	13.1900	29.9537 (250)
Additional standing charges			120.0000 (251)
Total energy cost			253.1506 (255)

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

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	1.1568 (257)
SAP value		83.8624
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	1084.9047	0.2160	234.3394 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1470.7709	0.2160	317.6865 (264)
Space and water heating			552.0259 (265)
Pumps and fans	108.1073	0.5190	56.1077 (267)
Energy for lighting	227.0943	0.5190	117.8619 (268)
Total kg/year			725.9956 (272)
CO2 emissions per m2			15.4800 (273)
EI value			89.4154
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	$3.48 / 0.8828 = 3.942$ , stars = 4
Water heating environmental impact	$0.216 / 0.8828 = 0.2447$ , 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	46.9100 (1b)	2.3900 (2b)	112.1149 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	46.9100		112.1149 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 112.1149 (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					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.1700 (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	0.2083	0.2040	0.1998	0.1785	0.1785	0.1573	0.1615	0.1615	0.1700	0.1785	0.1828	0.1913 (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)			5.2600	1.3258	6.9735		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	34.9900	7.7800	27.2100	0.2500	6.8025	52.8000	1436.6880 (29a)
External Wall to Corridor	3.6000	2.1200	1.4800	0.2200	0.3256	52.8000	78.1440 (29a)
External Wall to Stairwell	11.9300		11.9300	0.2000	2.3860	52.8000	629.9040 (29a)
Total net area of external elements Aum(A, m2)			50.5200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	22.1181		(33)
AAC Party Wall			23.1000	0.0000	0.0000	52.8000	1219.6800 (32)
E-FC-4			46.9100			70.0000	3283.7000 (32d)
E-FC-4			46.9100			70.0000	3283.7000 (32b)
Metal			72.8500			14.0000	1019.9000 (32c)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	10951.7160 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							233.4623 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.3670 (36)
Total fabric heat loss						(33) + (36) =	26.4851 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990	18.4990 (38)
Heat transfer coeff	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840	44.9840 (39)
Average = Sum(39)m / 12 =												44.9840 (39)
HLP	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589	0.9589 (40)
HLP (average)												0.9589 (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												1.5997 (42)
Average daily hot water use (litres/day)												72.1921 (43)
Daily hot water use	79.4113	76.5236	73.6359	70.7483	67.8606	64.9729	64.9729	67.8606	70.7483	73.6359	76.5236	79.4113 (44)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

Energy conte	117.7647	102.9977	106.2844	92.6614	88.9108	76.7232	71.0954	81.5830	82.5573	96.2126	105.0236	114.0488 (45)
Energy content (annual)	Total = Sum(45)m = 1135.8629 (45)											
Distribution loss (46)m = 0.15 x (45)m	17.6647	15.4497	15.9427	13.8992	13.3366	11.5085	10.6643	12.2374	12.3836	14.4319	15.7535	17.1073 (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	13.9810	12.6144	13.9444	13.4701	13.9014	13.4324	13.8674	13.8894	13.4530	13.9266	13.5057	13.9739 (61)
Total heat required for water heating calculated for each month	131.7457	115.6122	120.2288	106.1315	102.8121	90.1557	84.9628	95.4724	96.0103	110.1392	118.5293	128.0227 (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	131.7457	115.6122	120.2288	106.1315	102.8121	90.1557	84.9628	95.4724	96.0103	110.1392	118.5293	128.0227 (64)
Heat gains from water heating, kWh/month	42.6520	37.4004	38.8257	34.1774	33.0382	28.8686	27.1061	30.5987	30.8136	35.4723	38.2968	41.4147 (65)
Total per year (kWh/year) = Sum(64)m = 1299.8227 (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	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801	95.9801 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.1475	28.5532	23.2210	17.5798	13.1411	11.0943	11.9877	15.5821	20.9143	26.5555	30.9942	33.0410 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	207.7853	209.9415	204.5080	192.9408	178.3393	164.6160	155.4479	153.2918	158.7252	170.2924	184.8939	198.6173 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977	46.1977 (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)	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867	-63.9867 (71)
Water heating gains (Table 5)	57.3280	55.6553	52.1851	47.4687	44.4061	40.0953	36.4329	41.1273	42.7966	47.6779	53.1899	55.6649 (72)
Total internal gains	378.4518	375.3409	361.1051	339.1803	317.0776	296.9965	285.0596	291.1922	303.6272	325.7168	350.2691	368.5142 (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)						
Northwest	1.2700	12.9465	0.4300	0.0000	0.7700	5.4440 (81)						
Northwest	2.5200	12.9465	0.4300	0.0000	0.7700	10.8022 (81)						
Solar gains	33.3497	63.4935	112.6482	193.9807	250.6951	277.9635	257.7026	207.7391	145.4378	81.1798	43.0412	26.9372 (83)
Total gains	411.8016	438.8345	473.7533	533.1610	567.7727	574.9600	542.7622	498.9313	449.0650	406.8966	393.3103	395.4514 (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	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272	67.6272
alpha	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085	5.5085
util living area	0.9813	0.9719	0.9388	0.8333	0.6465	0.4355	0.2816	0.3062	0.5860	0.8704	0.9636	0.9844 (86)
MIT	20.2782	20.3767	20.5942	20.8398	20.9664	20.9967	20.9998	20.9997	20.9852	20.8296	20.5191	20.2457 (87)
Th 2	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177	20.1177 (88)
util rest of house	0.9762	0.9644	0.9227	0.7963	0.5881	0.3681	0.2086	0.2269	0.5063	0.8303	0.9523	0.9800 (89)
MIT 2	19.1812	19.3216	19.6263	19.9472	20.0896	20.1159	20.1176	20.1176	20.1085	19.9433	19.5265	19.1348 (90)
Living area fraction	fLA = Living area / (4) = 0.4259 (91)											
MIT	19.6484	19.7710	20.0386	20.3274	20.4631	20.4911	20.4934	20.4933	20.4819	20.3208	19.9493	19.6079 (92)
Temperature adjustment	0.0000											
adjusted MIT	19.6484	19.7710	20.0386	20.3274	20.4631	20.4911	20.4934	20.4933	20.4819	20.3208	19.9493	19.6079 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9729	0.9609	0.9210	0.8056	0.6115	0.3968	0.2397	0.2607	0.5398	0.8404	0.9497	0.9769 (94)
Useful gains	400.6282	421.6649	436.3358	429.5386	347.2050	228.1488	130.1170	130.0932	242.4195	341.9661	373.5359	386.3134 (95)
Ext temp.	4.7000	5.2000	7.0000	9.5000	12.5000	15.0000	17.6000	17.6000	15.0000	11.4000	7.7000	4.7000 (96)
Heat loss rate W	672.4412	655.4615	586.5277	487.0588	358.2105	229.0162	130.1550	130.1519	246.5971	401.2927	551.0223	670.6193 (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	202.2289	157.1113	111.7428	41.4145	8.1881	0.0000	0.0000	0.0000	0.0000	44.1390	127.7902	211.5236 (98)
Space heating	904.1384 (98)											
Space heating per m2	(98) / (4) = 19.2739 (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

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													966.9929 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	202.2289	157.1113	111.7428	41.4145	8.1881	0.0000	0.0000	0.0000	0.0000	44.1390	127.7902	211.5236	(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)	216.2876	168.0335	119.5110	44.2936	8.7573	0.0000	0.0000	0.0000	0.0000	47.2075	136.6741	226.2284	(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	131.7457	115.6122	120.2288	106.1315	102.8121	90.1557	84.9628	95.4724	96.0103	110.1392	118.5293	128.0227	(64)
Efficiency of water heater (217)m	89.2101	89.1153	88.8127	88.1751	87.5283	87.3000	87.3000	87.3000	87.3000	88.1922	88.9314	87.3000	(216)
Fuel for water heating, kWh/month	147.6803	129.7333	135.3734	120.3644	117.4616	103.2711	97.3228	109.3613	109.9774	124.8855	133.2817	143.4167	(219)
Water heating fuel used													1472.1295 (219)
Annual totals kWh/year													
Space heating fuel - main system													966.9929 (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)													33.1073 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													108.1073 (231)
Electricity for lighting (calculated in Appendix L)													227.0943 (232)
Total delivered energy for all uses													2774.3241 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	966.9929	3.9200	37.9061	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1472.1295	3.9200	57.7075	(247)
Mechanical ventilation fans	33.1073	16.9600	5.6150	(249)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	227.0943	16.9600	38.5152	(250)
Additional standing charges			88.0000	(251)
Total energy cost			240.4638	(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	966.9929	0.2160	208.8705	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1472.1295	0.2160	317.9800	(264)
Space and water heating			526.8505	(265)
Pumps and fans	108.1073	0.5190	56.1077	(267)
Energy for lighting	227.0943	0.5190	117.8619	(268)
Total kg/year			700.8201	(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	966.9929	1.2200	1179.7314	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1472.1295	1.2200	1795.9980	(264)
Space and water heating			2975.7294	(265)
Pumps and fans	108.1073	3.0700	331.8895	(267)
Energy for lighting	227.0943	3.0700	697.1795	(268)
Primary energy kWh/year			4004.7984	(272)
Primary energy kWh/m2/year			85.3720	(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

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	£57	£57	£0
Mains gas	£184	£184	£0
Space heating	£144	£144	£0
Water heating	£58	£58	£0
Lighting	£39	£39	£0
Total cost of fuels	£241	£241	£0
Total cost of uses	£241	£241	£0
Delivered energy	59 kWh/m <sup>2</sup>	59 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.7 tonnes	0.7 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	85 kWh/m <sup>2</sup>	85 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	SemiDetached Flat
Number of storeys	1
Cross ventilation possible	No
SAP Region	East Anglia
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	233.5 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows fully open)

#### Overheating Calculation

Summer ventilation heat loss coefficient	147.99 (P1)
Transmission heat loss coefficient	26.49 (37)
Summer heat loss coefficient	174.48 (P2)

Overhangs	Ratio	Z_overhangs	Overhang type
Orientation			
North East	0.000	1.000	None
North 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)
North 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
North West	1.2700	100.0415	0.4300	0.0000	0.9000	49.1694
North West	2.5200	100.0415	0.4300	0.0000	0.9000	97.5644

total: 301.2108

	Jun	Jul	Aug
Solar gains	325	301	243
Internal gains	294	282	288
Total summer gains	619	583	531

	3.55	3.34	3.04
Summer gain/loss ratio			
Summer external temperature	15.40	17.60	17.60
Thermal mass temperature increment (TMP = 233.5)	0.37	0.37	0.37
Threshold temperature	19.31	21.31	21.01
Likelihood of high internal temperature	Not significant	Slight	Slight

Assessment of likelihood of high internal temperature: Slight