

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



<b>Property Reference</b>	4907-0015-3990-019			<b>Issued on Date</b>	12/02/2020
<b>Assessment Reference</b>	019	<b>Prop Type Ref</b>	1FF Semi		
<b>Property</b>	Plot 019, 2 Bed, K, Ba, Welwyn Garden City				
<b>SAP Rating</b>	85 B	<b>DER</b>	15.63	<b>TER</b>	17.09
<b>Environmental</b>	89 B	<b>% DER&lt;TER</b>	8.54		
<b>CO<sub>2</sub> Emissions (t/year)</b>	0.81	<b>DFEE</b>	33.53	<b>TFEE</b>	37.01
<b>General Requirements Compliance</b>	Pass	<b>% DFEE&lt;TFEE</b>	9.39		
<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 62 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) 17.09 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 15.63 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)37.0 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)33.5 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	1.32 (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: 6.51 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	62.0600 (1b)	x 2.3900 (2b)	= 148.3234 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.0600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 148.3234 (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:												
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)			3.9900	1.3258	5.2898		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	43.6300	6.5100	37.1200	0.2500	9.2800	52.8000	1959.9360 (29a)
External Wall to Corridor	13.4900	2.1200	11.3700	0.2200	2.5014	52.8000	600.3360 (29a)
Total net area of external elements Aum(A, m2)			57.1200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	22.7017		(33)
AAC Party Wall			25.5800	0.0000	0.0000	52.8000	1350.6240 (32)
E-FC-4			62.0600			70.0000	4344.2000 (32d)
E-FC-4			62.0600			70.0000	4344.2000 (32b)
Metal			114.6500			14.0000	1605.1000 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 14204.3960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							228.8817 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.2111 (36)
Total fabric heat loss							(33) + (36) = 26.9128 (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	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734 (38)
Average = Sum(39)m / 12 =	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861 (39)
HLP	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280 (40)
HLP (average)												0.8280 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.0392 (42)
Average daily hot water use (litres/day)												82.6319 (43)
Daily hot water use	90.8951	87.5898	84.2846	80.9793	77.6740	74.3687	74.3687	77.6740	80.9793	84.2846	87.5898	90.8951 (44)
Energy conte	134.7948	117.8924	121.6544	106.0613	101.7683	87.8183	81.3766	93.3808	94.4961	110.1261	120.2112	130.5416 (45)

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

Energy content (annual)													Total = Sum(45)m =	1300.1221 (45)
Distribution loss (46)m = 0.15 x (45)m														
	20.2192	17.6839	18.2482	15.9092	15.2652	13.1727	12.2065	14.0071	14.1744	16.5189	18.0317	19.5812	(46)	
Water storage loss:														
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Combi loss	14.0506	12.6731	14.0026	13.5189	13.9463	13.4695	13.9018	13.9306	13.4965	13.9793	13.5655	14.0413	(61)	
Total heat required for water heating calculated for each month	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829	(62)	
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)	
Solar input (sum of months) = Sum(63)m =													0.0000 (63)	
Output from w/h	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829	(64)	
Total per year (kWh/year) = Sum(64)m =													1464.6982 (64)	
Heat gains from water heating, kWh/month	48.3319	42.3675	43.9508	38.6451	37.3245	32.5670	30.5332	34.5318	34.7941	40.1118	43.3616	46.9154	(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	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.1503	16.1209	13.1104	9.9254	7.4194	6.2637	6.7682	8.7976	11.8081	14.9931	17.4991	18.6547	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	178.1108	179.9590	175.3015	165.3863	152.8701	141.1066	133.2479	131.3997	136.0572	145.9724	158.4886	170.2521	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	(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)	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	(71)
Water heating gains (Table 5)	64.9623	63.0469	59.0736	53.6738	50.1674	45.2319	41.0392	46.4137	48.3251	53.9136	60.2245	63.0584	(72)
Total internal gains	317.8119	315.7154	304.0741	285.5741	267.0454	249.1909	237.6439	243.1995	252.7789	271.4677	292.8008	308.5538	(73)

#### 6. Solar gains

[Jan]		Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	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)					
Northeast		2.5200	11.2829	0.4300	0.0000	0.7700	9.4142	(75)					
Solar gains	24.3199	49.5039	89.1904	146.4762	196.8927	209.9085	196.3651	156.5445	108.6798	60.4977	30.6008	19.8609	(83)
Total gains	342.1319	365.2194	393.2645	432.0503	463.9382	459.0994	434.0090	399.7440	361.4587	331.9654	323.4015	328.4146	(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	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	
alpha	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	
util living area	0.9978	0.9962	0.9904	0.9644	0.8719	0.6872	0.5163	0.5814	0.8511	0.9787	0.9957	0.9983	(86)
MIT	20.1058	20.1980	20.3847	20.6451	20.8731	20.9769	20.9965	20.9931	20.9188	20.6375	20.3213	20.0735	(87)
Th 2	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	(88)
util rest of house	0.9972	0.9951	0.9874	0.9528	0.8339	0.6157	0.4283	0.4889	0.7941	0.9696	0.9942	0.9978	(89)
MIT 2	19.0193	19.1539	19.4253	19.7970	20.0989	20.2124	20.2276	20.2258	20.1584	19.7909	19.3342	18.9722	(90)
Living area fraction													fLA = Living area / (4) = 0.3896 (91)
MIT	19.4427	19.5607	19.7991	20.1274	20.4005	20.5103	20.5272	20.5248	20.4547	20.1207	19.7188	19.4013	(92)
Temperature adjustment													0.0000
adjusted MIT	19.4427	19.5607	19.7991	20.1274	20.4005	20.5103	20.5272	20.5248	20.4547	20.1207	19.7188	19.4013	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9963	0.9938	0.9853	0.9509	0.8431	0.6427	0.4627	0.5250	0.8124	0.9680	0.9928	0.9971	(94)
Useful gains	340.8721	362.9653	387.4738	410.8556	391.1645	295.0479	200.8018	209.8812	293.6335	321.3482	321.0883	327.4644	(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	778.1222	753.3571	683.3897	576.9345	447.0864	303.7069	201.8022	211.9556	326.5411	489.2331	648.4290	781.1350	(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	325.3141	262.3433	220.1614	119.5768	41.6059	0.0000	0.0000	0.0000	0.0000	124.9064	235.6853	337.5310	(98)
Space heating													1667.1241 (98)
Space heating per m <sup>2</sup>													(98) / (4) = 26.8631 (99)

#### 8c. Space cooling requirement

# FULL SAP CALCULATION PRINTOUT

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

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													1783.0204 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	325.3141	262.3433	220.1614	119.5768	41.6059	0.0000	0.0000	0.0000	0.0000	124.9064	235.6853	337.5310	(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)	347.9295	280.5810	235.4667	127.8896	44.4983	0.0000	0.0000	0.0000	0.0000	133.5897	252.0698	360.9957	(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	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829	(64)
Efficiency of water heater (217)m	89.4705	89.4109	89.2527	88.8712	88.1241	87.3000	87.3000	87.3000	87.3000	88.8763	89.3146	87.3000	(216)
Fuel for water heating, kWh/month	166.3626	146.0286	151.9921	134.5545	131.3087	116.0228	109.1391	122.9226	123.7028	139.6383	149.7815	161.5164	(219)
Water heating fuel used													1652.9700 (219)
Annual totals kWh/year													
Space heating fuel - main system													1783.0204 (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)													43.7996 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													118.7996 (231)
Electricity for lighting (calculated in Appendix L)													320.5396 (232)
Total delivered energy for all uses													3875.3296 (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	1783.0204	0.2160	385.1324	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1652.9700	0.2160	357.0415	(264)
Space and water heating			742.1739	(265)
Pumps and fans	118.7996	0.5190	61.6570	(267)
Energy for lighting	320.5396	0.5190	166.3601	(268)
Total CO2, kg/year			970.1910	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.6300	(273)

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

DER			15.6300	ZC1
Total Floor Area		TFA	62.0600	
Assumed number of occupants		N	2.0392	
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190	
CO2 emissions from appliances, equation (L14)			17.0069	ZC2
CO2 emissions from cooking, equation (L16)			2.7061	ZC3
Total CO2 emissions			35.3430	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			35.3430	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	62.0600 (1b)	x 2.3900 (2b)	= 148.3234 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.0600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 148.3234 (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) =	0.1348 (8)
Pressure test				Yes	
Measured/design AP50					5.0000
Infiltration rate					0.3848 (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) =	0.3271 (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	0.4171	0.4089	0.4007	0.3598	0.3516	0.3108	0.3108	0.3026	0.3271	0.3516	0.3680	0.3844 (22b)
	0.5870	0.5836	0.5803	0.5647	0.5618	0.5483	0.5483	0.5458	0.5535	0.5618	0.5677	0.5739 (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)			6.5100	1.3258	8.6307		(27)					
External Wall	43.6300	6.5100	37.1200	0.1800	6.6816		(29a)					
External Wall to Corridor	13.4900	2.1200	11.3700	0.1800	2.0466		(29a)					
Total net area of external elements Aum(A, m2)			57.1200				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	19.4789	(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.5835 (36)					
Total fabric heat loss							(33) + (36) =					
							24.0624 (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	28.7305	28.5651	28.4031	27.6420	27.4996	26.8368	26.8368	26.7140	27.0921	27.4996	27.7877	28.0889 (38)
Average = Sum(39)m / 12 =	52.7928	52.6275	52.4655	51.7044	51.5620	50.8992	50.8992	50.7764	51.1545	51.5620	51.8501	52.1512 (39)
	51.7037											51.7037 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.8507	0.8480	0.8454	0.8331	0.8308	0.8202	0.8202	0.8182	0.8243	0.8308	0.8355	0.8403 (40)
Days in month												0.8331 (40)
	31	28	31	30	31	30	31	31	30	31	30	31 (41)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.0392 (42)
Average daily hot water use (litres/day)												82.6319 (43)
Daily hot water use	90.8951	87.5898	84.2846	80.9793	77.6740	74.3687	74.3687	77.6740	80.9793	84.2846	87.5898	90.8951 (44)
Energy conte	134.7948	117.8924	121.6544	106.0613	101.7683	87.8183	81.3766	93.3808	94.4961	110.1261	120.2112	130.5416 (45)
Energy content (annual)												Total = Sum(45)m =
Distribution loss (46)m = 0.15 x (45)m	20.2192	17.6839	18.2482	15.9092	15.2652	13.1727	12.2065	14.0071	14.1744	16.5189	18.0317	19.5812 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
Combi loss	46.3192	40.3153	42.9505	39.9350	39.5818	36.6750	37.8975	39.5818	39.9350	42.9505	43.1950	46.3192 (61)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total heat required for water heating calculated for each month	181.1140	158.2078	164.6049	145.9963	141.3502	124.4933	119.2741	132.9627	134.4311	153.0766	163.4062	176.8608 (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	181.1140	158.2078	164.6049	145.9963	141.3502	124.4933	119.2741	132.9627	134.4311	153.0766	163.4062	176.8608 (64)
Heat gains from water heating, kWh/month	56.3991	49.2781	51.1877	45.2491	43.7334	38.3683	36.5321	40.9446	41.4037	47.3545	50.7690	54.9849 (65)
	Total per year (kWh/year) = Sum(64)m = 1795.7778 (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	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.1503	16.1209	13.1104	9.9254	7.4194	6.2637	6.7682	8.7976	11.8081	14.9931	17.4991	18.6547 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	178.1108	179.9590	175.3015	165.3863	152.8701	141.1066	133.2479	131.3997	136.0572	145.9724	158.4886	170.2521 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962 (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)	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696 (71)
Water heating gains (Table 5)	75.8052	73.3305	68.8007	62.8460	58.7815	53.2894	49.1023	55.0330	57.5051	63.6486	70.5125	73.9044 (72)
Total internal gains	328.6549	325.9990	313.8012	294.7463	275.6595	257.2483	245.7070	251.8189	261.9590	281.2026	303.0888	319.3998 (73)

#### 6. Solar gains

[Jan]		Area	Solar flux	g	FF	Access	Gains					
		m <sup>2</sup>	Table 6a	Specific data	Specific data	factor	W					
			W/m <sup>2</sup>	or Table 6b	or Table 6c	Table 6d						
Northeast		6.5100	11.2829	0.6300	0.7000	0.7700	22.4479 (75)					
Solar gains	22.4479	45.6933	82.3248	135.2009	181.7366	193.7504	181.2495	144.4942	100.3140	55.8408	28.2452	18.3321 (83)
Total gains	351.1027	371.6923	396.1260	429.9473	457.3961	450.9987	426.9565	396.3131	362.2730	337.0434	331.3340	337.7319 (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	81.6346	81.8910	82.1439	83.3531	83.5833	84.6718	84.6718	84.8765	84.2492	83.5833	83.1189	82.6389
alpha	6.4423	6.4594	6.4763	6.5569	6.5722	6.6448	6.6448	6.6584	6.6166	6.5722	6.5413	6.5093
util living area	0.9984	0.9973	0.9929	0.9716	0.8875	0.6971	0.5211	0.5821	0.8571	0.9819	0.9966	0.9988 (86)
MIT	20.1499	20.2367	20.4113	20.6661	20.8818	20.9817	20.9976	20.9953	20.9317	20.6701	20.3732	20.1358 (87)
Th 2	20.2096	20.2119	20.2142	20.2247	20.2267	20.2359	20.2359	20.2376	20.2323	20.2267	20.2227	20.2185 (88)
util rest of house	0.9979	0.9964	0.9905	0.9612	0.8502	0.6242	0.4325	0.4895	0.7987	0.9734	0.9953	0.9984 (89)
MIT 2	19.0620	19.1905	19.4464	19.8195	20.1071	20.2233	20.2349	20.2355	20.1749	19.8306	19.3983	19.0482 (90)
Living area fraction	fLA = Living area / (4) =											0.3896 (91)
MIT	19.4859	19.5981	19.8224	20.1493	20.4090	20.5188	20.5321	20.5316	20.4698	20.1577	19.7781	19.4720 (92)
Temperature adjustment												0.0000
adjusted MIT	19.4859	19.5981	19.8224	20.1493	20.4090	20.5188	20.5321	20.5316	20.4698	20.1577	19.7781	19.4720 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9972	0.9954	0.9889	0.9600	0.8598	0.6521	0.4671	0.5257	0.8185	0.9724	0.9944	0.9978 (94)
Useful gains	350.1343	369.9877	391.7238	412.7330	393.2752	294.0833	199.4463	208.3463	296.5041	327.7483	329.4637	337.0001 (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	801.7054	773.5258	698.9642	581.6406	449.0518	301.2623	200.1405	209.7863	325.8436	492.8153	657.3626	796.4538 (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	335.9689	271.1776	228.5869	121.6135	41.4978	0.0000	0.0000	0.0000	0.0000	122.8099	236.0872	341.8336 (98)
Space heating												1699.5753 (98)
Space heating per m2												(98) / (4) = 27.3860 (99)

#### 8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of main space heating system 1 (in %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													1819.6738 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	335.9689	271.1776	228.5869	121.6135	41.4978	0.0000	0.0000	0.0000	0.0000	122.8099	236.0872	341.8336	(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)	359.7097	290.3401	244.7397	130.2072	44.4302	0.0000	0.0000	0.0000	0.0000	131.4881	252.7701	365.9888	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	181.1140	158.2078	164.6049	145.9963	141.3502	124.4933	119.2741	132.9627	134.4311	153.0766	163.4062	176.8608	(64)
Efficiency of water heater (217)m	86.5855	86.3961	85.8780	84.5951	82.3891	80.3000	80.3000	80.3000	80.3000	84.5027	85.9767	86.6824	(217)
Fuel for water heating, kWh/month	209.1737	183.1190	191.6729	172.5823	171.5642	155.0353	148.5356	165.5824	167.4111	181.1500	190.0587	204.0330	(219)
Water heating fuel used													2139.9181 (219)
Annual totals kWh/year													
Space heating fuel - main system													1819.6738 (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)													320.5396 (232)
Total delivered energy for all uses													4355.1315 (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	1819.6738	0.2160	393.0495 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2139.9181	0.2160	462.2223 (264)
Space and water heating			855.2718 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	320.5396	0.5190	166.3601 (268)
Total CO2, kg/m2/year			1060.5569 (272)
Emissions per m2 for space and water heating			13.7814 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.6806 (272b)
Emissions per m2 for pumps and fans			0.6272 (272c)
Target Carbon Dioxide Emission Rate (TER) = (13.7814 * 1.00) + 2.6806 + 0.6272, rounded to 2 d.p.			17.0900 (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 (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	62.0600 (1b)	2.3900 (2b)	148.3234 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.0600		148.3234 (4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	148.3234 (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) =	0.1348 (8)
Pressure test				Yes	
Measured/design AP50				4.0000	
Infiltration rate				0.3348	(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) =	0.2846 (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	0.3629	0.3558	0.3487	0.3131	0.3060	0.2704	0.2704	0.2633	0.2846	0.3060	0.3202	0.3344 (22b)
Effective ac	0.5658	0.5633	0.5608	0.5490	0.5468	0.5366	0.5366	0.5347	0.5405	0.5468	0.5513	0.5559 (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)			3.9900	1.3258	5.2898		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	43.6300	6.5100	37.1200	0.2500	9.2800	52.8000	1959.9360 (29a)
External Wall to Corridor	13.4900	2.1200	11.3700	0.2200	2.5014	52.8000	600.3360 (29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			57.1200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	22.7017			(33)
AAC Party Wall			25.5800	0.0000	0.0000	52.8000	1350.6240 (32)
E-FC-4			62.0600			70.0000	4344.2000 (32d)
E-FC-4			62.0600			30.0000	1861.8000 (32b)
Metal			114.6500			14.0000	1605.1000 (32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 11721.9960 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K 188.8817 (35)  
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.2111 (36)  
 Total fabric heat loss (33) + (36) = 26.9128 (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	27.6961	27.5710	27.4483	26.8722	26.7644	26.2625	26.2625	26.1696	26.4558	26.7644	26.9824	27.2104 (38)
Heat transfer coeff	54.6089	54.4837	54.3611	53.7849	53.6771	53.1753	53.1753	53.0824	53.3686	53.6771	53.8952	54.1232 (39)
Average = Sum(39)m / 12 =												53.7844 (39)
HLP	0.8799	0.8779	0.8759	0.8667	0.8649	0.8568	0.8568	0.8553	0.8600	0.8649	0.8684	0.8721 (40)
HLP (average)												0.8667 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.0392 (42)
Average daily hot water use (litres/day)												82.6319 (43)
Daily hot water use	90.8951	87.5898	84.2846	80.9793	77.6740	74.3687	74.3687	77.6740	80.9793	84.2846	87.5898	90.8951 (44)
Energy conte	134.7948	117.8924	121.6544	106.0613	101.7683	87.8183	81.3766	93.3808	94.4961	110.1261	120.2112	130.5416 (45)
Energy content (annual)												Total = Sum(45)m = 1300.1221 (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	(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)
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	(59)
Heat gains from water heating, kWh/month	28.6439	25.0521	25.8516	22.5380	21.6258	18.6614	17.2925	19.8434	20.0804	23.4018	25.5449	27.7401	(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	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.1503	16.1209	13.1104	9.9254	7.4194	6.2637	6.7682	8.7976	11.8081	14.9931	17.4991	18.6547	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	178.1108	179.9590	175.3015	165.3863	152.8701	141.1066	133.2479	131.3997	136.0572	145.9724	158.4886	170.2521	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	(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)	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	(71)
Water heating gains (Table 5)	38.4999	37.2800	34.7467	31.3028	29.0669	25.9186	23.2426	26.6713	27.8895	31.4540	35.4790	37.2851	(72)
Total internal gains	288.3495	286.9485	276.7473	260.2031	242.9449	226.8776	216.8473	220.4571	229.3433	246.0081	265.0553	279.7805	(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	0.4300		0.0000		0.7700	14.9058	(75)		
Northeast			2.5200	11.2829	0.4300		0.0000		0.7700	9.4142	(75)		
Solar gains	24.3199	49.5039	89.1904	146.4762	196.8927	209.9085	196.3651	156.5445	108.6798	60.4977	30.6008	19.8609	(83)
Total gains	312.6695	336.4524	365.9376	406.6793	439.8377	436.7861	413.2124	377.0016	338.0231	306.5058	295.6561	299.6414	(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	59.6260	59.7630	59.8978	60.5395	60.6610	61.2335	61.2335	61.3407	61.0117	60.6610	60.4156	60.1611	60.1611	
alpha	4.9751	4.9842	4.9932	5.0360	5.0441	5.0822	5.0822	5.0894	5.0674	5.0441	5.0277	5.0107	5.0107	
util living area	0.9968	0.9948	0.9883	0.9627	0.8826	0.7172	0.5521	0.6208	0.8688	0.9775	0.9943	0.9974	0.9974	(86)
MIT	19.8008	19.9158	20.1470	20.4804	20.7774	20.9456	20.9883	20.9796	20.8503	20.4815	20.0882	19.7783	19.7783	(87)
Th 2	20.1846	20.1863	20.1880	20.1959	20.1974	20.2043	20.2043	20.2056	20.2017	20.1974	20.1944	20.1913	20.1913	(88)
util rest of house	0.9960	0.9935	0.9851	0.9519	0.8493	0.6479	0.4588	0.5252	0.8192	0.9691	0.9926	0.9968	0.9968	(89)
MIT 2	19.0739	19.1898	19.4209	19.7542	20.0319	20.1741	20.2001	20.1976	20.1039	19.7601	19.3686	19.0568	19.0568	(90)
Living area fraction														(91)
MIT	19.3571	19.4727	19.7038	20.0371	20.3224	20.4747	20.5072	20.5023	20.3947	20.0412	19.6490	19.3379	19.3379	(92)
Temperature adjustment														(93)
adjusted MIT	19.3571	19.4727	19.7038	20.0371	20.3224	20.4747	20.5072	20.5023	20.3947	20.0412	19.6490	19.3379	19.3379	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Useful gains	311.0863	333.7512	359.6196	386.1196	376.0852	293.7698	204.5821	211.9214	281.4356	296.4356	293.0419	298.4083	(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	822.2509	793.9725	717.7744	599.0097	462.8252	312.3900	207.7682	217.7582	335.9391	506.7751	676.3299	819.3134	(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	380.3064	309.2687	266.4671	153.2809	64.5345	0.0000	0.0000	0.0000	0.0000	156.4926	275.9674	387.5534	(98)	
Space heating												1993.8711	(98)	
Space heating per m2												(98) / (4) =	32.1281	(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	499.8479	393.4973	403.4261	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8952	0.9435	0.9206	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	447.4402	371.2578	371.4073	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	587.5919	558.6177	517.8177	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)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	100.9092	139.3958	108.9293	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling													349.2343 (104)
Cooled fraction													1.0000 (105)
Intermittency factor (Table 10b)													
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	25.2273	34.8490	27.2323	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling													87.3086 (107)
Space cooling per m2													1.4068 (108)
Energy for space heating													32.1281 (99)
Energy for space cooling													1.4068 (108)
Total													33.5350 (109)
Dwelling Fabric Energy Efficiency (DFEE)													33.5 (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	62.0600 (1b)	x 2.3900 (2b)	= 148.3234 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.0600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 148.3234 (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) =	0.1348 (8)
Pressure test				Yes	
Measured/design AP50					5.0000
Infiltration rate					0.3848 (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) =		0.3271 (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	0.4171	0.4089	0.4007	0.3598	0.3516	0.3108	0.3108	0.3026	0.3271	0.3516	0.3680	0.3844 (22b)
	0.5870	0.5836	0.5803	0.5647	0.5618	0.5483	0.5483	0.5458	0.5535	0.5618	0.5677	0.5739 (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)			6.5100	1.3258	8.6307		(27)					
External Wall	43.6300	6.5100	37.1200	0.1800	6.6816		(29a)					
External Wall to Corridor	13.4900	2.1200	11.3700	0.1800	2.0466		(29a)					
Total net area of external elements Aum(A, m2)			57.1200				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 19.4789		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.5835 (36)					
Total fabric heat loss							(33) + (36) = 24.0624 (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	28.7305	28.5651	28.4031	27.6420	27.4996	26.8368	26.8368	26.7140	27.0921	27.4996	27.7877	28.0889 (38)
Average = Sum(39)m / 12 =	52.7928	52.6275	52.4655	51.7044	51.5620	50.8992	50.8992	50.7764	51.1545	51.5620	51.8501	52.1512 (39)
												51.7037 (39)
HLP	0.8507	0.8480	0.8454	0.8331	0.8308	0.8202	0.8202	0.8182	0.8243	0.8308	0.8355	0.8403 (40)
HLP (average)												0.8331 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.0392 (42)
Average daily hot water use (litres/day)												82.6319 (43)
Daily hot water use	90.8951	87.5898	84.2846	80.9793	77.6740	74.3687	74.3687	77.6740	80.9793	84.2846	87.5898	90.8951 (44)
Energy conte	134.7948	117.8924	121.6544	106.0613	101.7683	87.8183	81.3766	93.3808	94.4961	110.1261	120.2112	130.5416 (45)
Energy content (annual)												Total = Sum(45)m = 1300.1221 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
												0.0000 (59)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

Heat gains from water heating, kWh/month  
 28.6439 25.0521 25.8516 22.5380 21.6258 18.6614 17.2925 19.8434 20.0804 23.4018 25.5449 27.7401 (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	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620	101.9620 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.1503	16.1209	13.1104	9.9254	7.4194	6.2637	6.7682	8.7976	11.8081	14.9931	17.4991	18.6547 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	178.1108	179.9590	175.3015	165.3863	152.8701	141.1066	133.2479	131.3997	136.0572	145.9724	158.4886	170.2521 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962	33.1962 (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)	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696 (71)
Water heating gains (Table 5)	38.4999	37.2800	34.7467	31.3028	29.0669	25.9186	23.2426	26.6713	27.8895	31.4540	35.4790	37.2851 (72)
Total internal gains	288.3495	286.9485	276.7473	260.2031	242.9449	226.8776	216.8473	220.4571	229.3433	246.0081	265.0553	279.7805 (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	6.5100	11.2829	0.6300	0.7000	0.7700		22.4479 (75)					
Solar gains	22.4479	45.6933	82.3248	135.2009	181.7366	193.7504	181.2495	144.4942	100.3140	55.8408	28.2452	18.3321 (83)
Total gains	310.7974	332.6418	359.0720	395.4041	424.6815	420.6280	398.0969	364.9513	329.6573	301.8489	293.3005	298.1125 (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	81.6346	81.8910	82.1439	83.3531	83.5833	84.6718	84.6718	84.8765	84.2492	83.5833	83.1189	82.6389
alpha	6.4423	6.4594	6.4763	6.5569	6.5722	6.6448	6.6448	6.6584	6.6166	6.5722	6.5413	6.5093
util living area	0.9992	0.9986	0.9959	0.9813	0.9144	0.7372	0.5571	0.6278	0.8964	0.9899	0.9983	0.9994 (86)
MIT	20.0859	20.1751	20.3541	20.6184	20.8535	20.9748	20.9965	20.9928	20.9076	20.6185	20.3131	20.0727 (87)
Th 2	20.2096	20.2119	20.2142	20.2247	20.2267	20.2359	20.2359	20.2376	20.2323	20.2267	20.2227	20.2185 (88)
util rest of house	0.9990	0.9981	0.9944	0.9739	0.8825	0.6640	0.4633	0.5301	0.8462	0.9847	0.9977	0.9992 (89)
MIT 2	19.3622	19.4531	19.6334	19.9028	20.1224	20.2237	20.2349	20.2353	20.1764	19.9067	19.6002	19.3565 (90)
Living area fraction									fLA = Living area / (4) =			0.3896 (91)
MIT	19.6442	19.7344	19.9142	20.1816	20.4073	20.5163	20.5316	20.5305	20.4613	20.1840	19.8779	19.6355 (92)
Temperature adjustment												0.0000
adjusted MIT	19.6442	19.7344	19.9142	20.1816	20.4073	20.5163	20.5316	20.5305	20.4613	20.1840	19.8779	19.6355 (93)

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9987	0.9977	0.9937	0.9734	0.8908	0.6920	0.5001	0.5685	0.8630	0.9844	0.9973	0.9990 (94)
Useful gains	310.3971	331.8685	356.8058	384.8956	378.3007	291.0685	199.0814	207.4670	284.4965	297.1346	292.5073	297.8204 (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	810.0637	780.6981	703.7833	583.3082	448.9643	301.1365	200.1174	209.7307	325.4095	494.1730	662.5378	804.9822 (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	371.7519	301.6135	258.1512	142.8571	52.5737	0.0000	0.0000	0.0000	0.0000	146.5966	266.4219	377.3284 (98)
Space heating per m2										(98) / (4) =		30.8942 (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	478.4521	376.6538	385.9007	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9313	0.9708	0.9544	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	445.6020	365.6401	368.3035	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	568.7059	540.9502	503.7329	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	88.6348	130.4307	100.7595	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling Cooled fraction												319.8249 (104)
Intermittency factor (Table 10b)									fC = cooled area / (4) =			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)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	22.1587	32.6077	25.1899	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												79.9562 (107)
Energy for space heating												1.2884 (108)
Energy for space cooling												30.8942 (99)
Total												1.2884 (108)
Target Fabric Energy Efficiency (TFEE)												32.1826 (109)
												37.0 (109)

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF HEAT DEMAND 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	62.0600 (1b)	x 2.3900 (2b)	= 148.3234 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.0600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 148.3234 (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				2	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)			3.9900	1.3258	5.2898		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	43.6300	6.5100	37.1200	0.2500	9.2800	52.8000	1959.9360 (29a)
External Wall to Corridor	13.4900	2.1200	11.3700	0.2200	2.5014	52.8000	600.3360 (29a)
Total net area of external elements Aum(A, m2)			57.1200				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	22.7017	(33)
AAC Party Wall			25.5800	0.0000	0.0000	52.8000	1350.6240 (32)
E-FC-4			62.0600			70.0000	4344.2000 (32d)
E-FC-4			62.0600			70.0000	4344.2000 (32b)
Metal			114.6500			14.0000	1605.1000 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 14204.3960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							228.8817 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.2111 (36)
Total fabric heat loss							(33) + (36) = 26.9128 (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	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734 (38)
Heat transfer coeff	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861 (39)
Average = Sum(39)m / 12 =												51.3861 (39)
HLP	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280 (40)
HLP (average)												0.8280 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.0392 (42)
Average daily hot water use (litres/day)												82.6319 (43)
Daily hot water use	90.8951	87.5898	84.2846	80.9793	77.6740	74.3687	74.3687	77.6740	80.9793	84.2846	87.5898	90.8951 (44)
Energy conte	134.7948	117.8924	121.6544	106.0613	101.7683	87.8183	81.3766	93.3808	94.4961	110.1261	120.2112	130.5416 (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 =	1300.1221 (45)
Distribution loss (46)m = 0.15 x (45)m														
	20.2192	17.6839	18.2482	15.9092	15.2652	13.1727	12.2065	14.0071	14.1744	16.5189	18.0317	19.5812	19.5812	(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	14.0506	12.6731	14.0026	13.5189	13.9463	13.4695	13.9018	13.9306	13.4965	13.9793	13.5655	14.0413	14.0413	(61)
Total heat required for water heating calculated for each month	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829	144.5829	(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)
Solar input (sum of months) = Sum(63)m =													0.0000 (63)	
Output from w/h	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829	144.5829	(64)
Total per year (kWh/year) = Sum(64)m =													1464.6982 (64)	
RHI water heating demand													1465 (64)	
Heat gains from water heating, kWh/month	48.3319	42.3675	43.9508	38.6451	37.3245	32.5670	30.5332	34.5318	34.7941	40.1118	43.3616	46.9154	46.9154	(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	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.3757	40.3023	32.7760	24.8136	18.5484	15.6594	16.9205	21.9939	29.5202	37.4826	43.7478	46.6368	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	265.8370	268.5956	261.6441	246.8452	228.1643	210.6069	198.8775	196.1189	203.0704	217.8692	236.5502	254.1076	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	(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)	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	(71)
Water heating gains (Table 5)	64.9623	63.0469	59.0736	53.6738	50.1674	45.2319	41.0392	46.4137	48.3251	53.9136	60.2245	63.0584	(72)
Total internal gains	469.2344	465.0042	446.5532	418.3920	389.9396	364.5576	349.8966	357.5860	373.9751	402.3250	433.5818	456.8622	(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)						
Northeast		2.5200	12.9465	0.4300	0.0000	0.7700	10.8022 (75)						
Solar gains	27.9058	53.1289	94.2596	162.3155	209.7719	232.5890	215.6355	173.8280	121.6967	67.9281	36.0152	22.5400	(83)
Total gains	497.1402	518.1331	540.8128	580.7075	599.7115	597.1466	565.5321	531.4139	495.6718	470.2531	469.5971	479.4022	(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	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	
alpha	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	
util living area	0.9829	0.9758	0.9502	0.8669	0.6966	0.4790	0.3088	0.3285	0.6087	0.8792	0.9662	0.9857	(86)
MIT	20.3962	20.4700	20.6443	20.8486	20.9670	20.9970	20.9998	20.9998	20.9886	20.8618	20.6025	20.3683	(87)
Th 2	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	(88)
util rest of house	0.9784	0.9696	0.9372	0.8363	0.6433	0.4144	0.2389	0.2542	0.5362	0.8437	0.9561	0.9819	(89)
MIT 2	19.4395	19.5451	19.7909	20.0626	20.2003	20.2274	20.2291	20.2291	20.2217	20.0848	19.7353	19.3997	(90)
Living area fraction	19.8122	19.9055	20.1234	20.3688	20.4990	20.5273	20.5294	20.5294	20.5205	20.3875	20.0732	19.7771	(92)
Temperature adjustment	19.8122	19.9055	20.1234	20.3688	20.4990	20.5273	20.5294	20.5294	20.5205	20.3875	20.0732	0.0000	
adjusted MIT	19.8122	19.9055	20.1234	20.3688	20.4990	20.5273	20.5294	20.5294	20.5205	20.3875	20.0732	19.7771	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9755	0.9665	0.9352	0.8422	0.6625	0.4396	0.2661	0.2832	0.5641	0.8516	0.9537	0.9791	(94)
Ext temp.	484.9537	500.7684	505.7788	489.0924	397.2882	262.4824	150.4964	150.4801	279.6101	400.4905	447.8619	469.3842	(95)
Heat loss rate W	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)
Month fracti	776.5596	755.6572	674.3609	558.5076	411.0390	263.4707	150.5300	150.5281	283.6758	461.8347	635.8112	774.7530	(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	216.9548	171.2853	125.4251	49.9789	10.2305	0.0000	0.0000	0.0000	0.0000	45.6401	135.3235	227.1944	(98)
RHI space heating demand													982.0327 (98)
													982 (98)



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



CALCULATION OF HEAT DEMAND 09 Jan 2014

# 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	62.0600 (1b)	2.3900 (2b)	148.3234 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.0600		148.3234 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 148.3234 (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				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				2	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:												
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)			3.9900	1.3258	5.2898		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	43.6300	6.5100	37.1200	0.2500	9.2800	52.8000	1959.9360 (29a)
External Wall to Corridor	13.4900	2.1200	11.3700	0.2200	2.5014	52.8000	600.3360 (29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			57.1200				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	22.7017	(33)
AAC Party Wall			25.5800	0.0000	0.0000	52.8000	1350.6240 (32)
E-FC-4			62.0600			70.0000	4344.2000 (32d)
E-FC-4			62.0600			70.0000	4344.2000 (32b)
Metal			114.6500			14.0000	1605.1000 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 14204.3960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							228.8817 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.2111 (36)
Total fabric heat loss							(33) + (36) = 26.9128 (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	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734 (38)
Heat transfer coeff	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861 (39)
Average = Sum(39)m / 12 =												51.3861 (39)
HLP	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280 (40)
HLP (average)												0.8280 (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	2.0392 (42)											
Average daily hot water use (litres/day)	82.6319 (43)											
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	90.8951	87.5898	84.2846	80.9793	77.6740	74.3687	74.3687	77.6740	80.9793	84.2846	87.5898	90.8951 (44)
	134.7948	117.8924	121.6544	106.0613	101.7683	87.8183	81.3766	93.3808	94.4961	110.1261	120.2112	130.5416 (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 =	1300.1221 (45)
Distribution loss (46)m = 0.15 x (45)m														
	20.2192	17.6839	18.2482	15.9092	15.2652	13.1727	12.2065	14.0071	14.1744	16.5189	18.0317	19.5812	19.5812	(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	14.0506	12.6731	14.0026	13.5189	13.9463	13.4695	13.9018	13.9306	13.4965	13.9793	13.5655	14.0413	14.0413	(61)
Total heat required for water heating calculated for each month	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829	144.5829	(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)
Solar input (sum of months) = Sum(63)m =													0.0000 (63)	
Output from w/h	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829	144.5829	(64)
Total per year (kWh/year) = Sum(64)m =													1464.6982 (64)	
Heat gains from water heating, kWh/month	48.3319	42.3675	43.9508	38.6451	37.3245	32.5670	30.5332	34.5318	34.7941	40.1118	43.3616	46.9154	46.9154	(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	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.3757	40.3023	32.7760	24.8136	18.5484	15.6594	16.9205	21.9939	29.5202	37.4826	43.7478	46.6368	46.6368	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	265.8370	268.5956	261.6441	246.8452	228.1643	210.6069	198.8775	196.1189	203.0704	217.8692	236.5502	254.1076	254.1076	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	(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)	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	(71)
Water heating gains (Table 5)	64.9623	63.0469	59.0736	53.6738	50.1674	45.2319	41.0392	46.4137	48.3251	53.9136	60.2245	63.0584	63.0584	(72)
Total internal gains	469.2344	465.0042	446.5532	418.3920	389.9396	364.5576	349.8966	357.5860	373.9751	402.3250	433.5818	456.8622	456.8622	(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)							
Northeast		2.5200	11.2829	0.4300	0.0000	0.7700	9.4142 (75)							
Solar gains	24.3199	49.5039	89.1904	146.4762	196.8927	209.9085	196.3651	156.5445	108.6798	60.4977	30.6008	19.8609	19.8609	(83)
Total gains	493.5544	514.5081	535.7435	564.8682	586.8323	574.4661	546.2617	514.1305	482.6549	462.8227	464.1826	476.7231	476.7231	(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	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	
alpha	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	
util living area	0.9853	0.9786	0.9587	0.8972	0.7583	0.5643	0.4128	0.4576	0.7014	0.9133	0.9737	0.9880	0.9880	(86)
MIT	20.3566	20.4397	20.5995	20.8011	20.9431	20.9918	20.9990	20.9981	20.9722	20.8067	20.5462	20.3212	20.3212	(87)
Th 2	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	(88)
util rest of house	0.9815	0.9731	0.9480	0.8721	0.7106	0.4997	0.3411	0.3820	0.6351	0.8866	0.9660	0.9849	0.9849	(89)
MIT 2	19.3824	19.5017	19.7284	20.0023	20.1752	20.2236	20.2287	20.2283	20.2078	20.0150	19.6557	19.3315	19.3315	(90)
Living area fraction													fLA = Living area / (4) = 0.3896 (91)	
MIT	19.7620	19.8671	20.0678	20.3135	20.4744	20.5229	20.5288	20.5282	20.5056	20.3235	20.0026	19.7171	19.7171	(92)
Temperature adjustment													0.0000	
adjusted MIT	19.7620	19.8671	20.0678	20.3135	20.4744	20.5229	20.5288	20.5282	20.5056	20.3235	20.0026	19.7171	19.7171	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	0.9787	0.9700	0.9454	0.8752	0.7264	0.5246	0.3690	0.4115	0.6597	0.8902	0.9632	0.9823	0.9823	(94)
Useful gains	483.0493	499.0737	506.5066	494.3444	426.2900	301.3897	201.5978	211.5781	318.3912	412.0061	447.1230	468.2702	468.2702	(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	4.2000	(96)
Heat loss rate W	794.5307	769.1036	697.1950	586.4964	450.8839	304.3565	201.8861	212.1324	329.1597	499.6510	663.0164	797.3654	797.3654	(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	231.7422	181.4601	141.8722	66.3495	18.2979	0.0000	0.0000	0.0000	0.0000	65.2078	155.4432	244.8468	244.8468	(98)
Space heating													1105.2197 (98)	
Space heating per m2													(98) / (4) = 17.8089 (99)	

#### 8c. Space cooling requirement

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

Not applicable

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

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													1182.0532 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	231.7422	181.4601	141.8722	66.3495	18.2979	0.0000	0.0000	0.0000	0.0000	65.2078	155.4432	244.8468	(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)	247.8526	194.0750	151.7349	70.9620	19.5699	0.0000	0.0000	0.0000	0.0000	69.7410	166.2495	261.8682	(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	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829	(64)
Efficiency of water heater (217)m	89.2210	89.1329	88.9070	88.4156	87.7235	87.3000	87.3000	87.3000	87.3000	88.3764	88.9912	87.3000	(216)
Fuel for water heating, kWh/month	166.8279	146.4842	152.5831	135.2478	131.9083	116.0228	109.1391	122.9226	123.7028	140.4283	150.3258	161.9343	(219)
Water heating fuel used													1657.5269 (219)
Annual totals kWh/year													
Space heating fuel - main system													1182.0532 (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)													43.7996 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													118.7996 (231)
Electricity for lighting (calculated in Appendix L)													320.5396 (232)
Total delivered energy for all uses													3278.9193 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1182.0532	3.4800	41.1354 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1657.5269	3.4800	57.6819 (247)
Mechanical ventilation fans	43.7996	13.1900	5.7772 (249)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	320.5396	13.1900	42.2792 (250)
Additional standing charges			120.0000 (251)
Total energy cost			276.7662 (255)

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

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	1.0858 (257)
SAP value		84.8536
SAP rating (Section 12)		85 (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	1182.0532	0.2160	255.3235 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1657.5269	0.2160	358.0258 (264)
Space and water heating			613.3493 (265)
Pumps and fans	118.7996	0.5190	61.6570 (267)
Energy for lighting	320.5396	0.5190	166.3601 (268)
Total kg/year			841.3664 (272)
CO2 emissions per m2			13.5600 (273)
EI value			89.4692
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	$3.48 / 0.8827 = 3.942$ , stars = 4
Water heating environmental impact	$0.216 / 0.8827 = 0.2447$ , 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	62.0600 (1b)	x 2.3900 (2b)	= 148.3234 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.0600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 148.3234 (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				2	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)			3.9900	1.3258	5.2898		(27)
French Door (Uw = 1.40)			2.5200	1.3258	3.3409		(27)
External Wall	43.6300	6.5100	37.1200	0.2500	9.2800	52.8000	1959.9360 (29a)
External Wall to Corridor	13.4900	2.1200	11.3700	0.2200	2.5014	52.8000	600.3360 (29a)
Total net area of external elements Aum(A, m2)			57.1200				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	22.7017	(33)
AAC Party Wall			25.5800	0.0000	0.0000	52.8000	1350.6240 (32)
E-FC-4			62.0600			70.0000	4344.2000 (32d)
E-FC-4			62.0600			70.0000	4344.2000 (32b)
Metal			114.6500			14.0000	1605.1000 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 14204.3960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							228.8817 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.2111 (36)
Total fabric heat loss							(33) + (36) = 26.9128 (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	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734	24.4734 (38)
Heat transfer coeff	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861	51.3861 (39)
Average = Sum(39)m / 12 =												51.3861 (39)
HLP	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280	0.8280 (40)
HLP (average)												0.8280 (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	2.0392 (42)											
Average daily hot water use (litres/day)	82.6319 (43)											
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	90.8951	87.5898	84.2846	80.9793	77.6740	74.3687	74.3687	77.6740	80.9793	84.2846	87.5898	90.8951 (44)
Energy conte	134.7948	117.8924	121.6544	106.0613	101.7683	87.8183	81.3766	93.3808	94.4961	110.1261	120.2112	130.5416 (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 =	1300.1221 (45)
Distribution loss (46)m = 0.15 x (45)m														
	20.2192	17.6839	18.2482	15.9092	15.2652	13.1727	12.2065	14.0071	14.1744	16.5189	18.0317	19.5812	(46)	
Water storage loss:														
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Combi loss	14.0506	12.6731	14.0026	13.5189	13.9463	13.4695	13.9018	13.9306	13.4965	13.9793	13.5655	14.0413	(61)	
Total heat required for water heating calculated for each month	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829	(62)	
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)	
Solar input (sum of months) = Sum(63)m =	0.0000 (63)													
Output from w/h	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829	(64)	
Total per year (kWh/year) = Sum(64)m =	1464.6982 (64)													
Heat gains from water heating, kWh/month	48.3319	42.3675	43.9508	38.6451	37.3245	32.5670	30.5332	34.5318	34.7941	40.1118	43.3616	46.9154	(65)	

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

Metabolic gains (Table 5), Watts													
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	122.3544	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.3757	40.3023	32.7760	24.8136	18.5484	15.6594	16.9205	21.9939	29.5202	37.4826	43.7478	46.6368	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	265.8370	268.5956	261.6441	246.8452	228.1643	210.6069	198.8775	196.1189	203.0704	217.8692	236.5502	254.1076	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	49.2747	(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)	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	-81.5696	(71)
Water heating gains (Table 5)	64.9623	63.0469	59.0736	53.6738	50.1674	45.2319	41.0392	46.4137	48.3251	53.9136	60.2245	63.0584	(72)
Total internal gains	469.2344	465.0042	446.5532	418.3920	389.9396	364.5576	349.8966	357.5860	373.9751	402.3250	433.5818	456.8622	(73)

#### 6. Solar gains

[Jan]			Area	Solar flux	Specific data	Specific data	FF	Access	Gains				
			m <sup>2</sup>	Table 6a	g	Specific data		factor	W				
				W/m <sup>2</sup>	or Table 6b	or Table 6c		Table 6d					
Northeast			3.9900	12.9465	0.4300	0.0000	0.7700	17.1035	(75)				
Northeast			2.5200	12.9465	0.4300	0.0000	0.7700	10.8022	(75)				
Solar gains	27.9058	53.1289	94.2596	162.3155	209.7719	232.5890	215.6355	173.8280	121.6967	67.9281	36.0152	22.5400	(83)
Total gains	497.1402	518.1331	540.8128	580.7075	599.7115	597.1466	565.5321	531.4139	495.6718	470.2531	469.5971	479.4022	(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	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	76.7847	
alpha	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	6.1190	
util living area	0.9829	0.9758	0.9502	0.8669	0.6966	0.4790	0.3088	0.3285	0.6087	0.8792	0.9662	0.9857	(86)
MIT	20.3962	20.4700	20.6443	20.8486	20.9670	20.9970	20.9998	20.9998	20.9886	20.8618	20.6025	20.3683	(87)
Th 2	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	20.2291	(88)
util rest of house	0.9784	0.9696	0.9372	0.8363	0.6433	0.4144	0.2389	0.2542	0.5362	0.8437	0.9561	0.9819	(89)
MIT 2	19.4395	19.5451	19.7909	20.0626	20.2003	20.2274	20.2291	20.2291	20.2217	20.0848	19.7353	19.3997	(90)
Living area fraction	fLA = Living area / (4) =												0.3896 (91)
MIT	19.8122	19.9055	20.1234	20.3688	20.4990	20.5273	20.5294	20.5294	20.5205	20.3875	20.0732	19.7771	(92)
Temperature adjustment													0.0000
adjusted MIT	19.8122	19.9055	20.1234	20.3688	20.4990	20.5273	20.5294	20.5294	20.5205	20.3875	20.0732	19.7771	(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9755	0.9665	0.9352	0.8422	0.6625	0.4396	0.2661	0.2832	0.5641	0.8516	0.9537	0.9791	
Useful gains	484.9537	500.7684	505.7788	489.0924	397.2882	262.4824	150.4964	150.4801	279.6101	400.4905	447.8619	469.3842	
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	
Heat loss rate W	776.5596	755.6572	674.3609	558.5076	411.0390	263.4707	150.5300	150.5281	283.6758	461.8347	635.8112	774.7530	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	
Space heating kWh	216.9548	171.2853	125.4251	49.9789	10.2305	0.0000	0.0000	0.0000	0.0000	45.6401	135.3235	227.1944	
Space heating													982.0327 (98)
Space heating per m2													(98) / (4) = 15.8239 (99)

#### 8c. Space cooling requirement

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

Not applicable

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

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													1050.3023 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	216.9548	171.2853	125.4251	49.9789	10.2305	0.0000	0.0000	0.0000	0.0000	45.6401	135.3235	227.1944	(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)	232.0373	183.1928	134.1445	53.4534	10.9418	0.0000	0.0000	0.0000	0.0000	48.8130	144.7310	242.9886	(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	148.8455	130.5655	135.6571	119.5802	115.7146	101.2879	95.2784	107.3115	107.9925	124.1054	133.7767	144.5829	(64)
Efficiency of water heater (217)m	89.1700	89.0875	88.8086	88.2195	87.5515	87.3000	87.3000	87.3000	87.3000	88.1379	88.8804	87.3000	(216)
Fuel for water heating, kWh/month	166.9232	146.5588	152.7522	135.5486	132.1675	116.0228	109.1391	122.9226	123.7028	140.8082	150.5132	162.0376	(219)
Water heating fuel used													1659.0965 (219)
Annual totals kWh/year													
Space heating fuel - main system													1050.3023 (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)													43.7996 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													118.7996 (231)
Electricity for lighting (calculated in Appendix L)													320.5396 (232)
Total delivered energy for all uses													3148.7380 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1050.3023	3.9200	41.1719 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1659.0965	3.9200	65.0366 (247)
Mechanical ventilation fans	43.7996	16.9600	7.4284 (249)
Pumps and fans for heating	75.0000	16.9600	12.7200 (249)
Energy for lighting	320.5396	16.9600	54.3635 (250)
Additional standing charges			88.0000 (251)
Total energy cost			268.7204 (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	1050.3023	0.2160	226.8653 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1659.0965	0.2160	358.3648 (264)
Space and water heating			585.2301 (265)
Pumps and fans	118.7996	0.5190	61.6570 (267)
Energy for lighting	320.5396	0.5190	166.3601 (268)
Total kg/year			813.2472 (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	1050.3023	1.2200	1281.3688 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1659.0965	1.2200	2024.0977 (264)
Space and water heating			3305.4665 (265)
Pumps and fans	118.7996	3.0700	364.7148 (267)
Energy for lighting	320.5396	3.0700	984.0566 (268)
Primary energy kWh/year			4654.2379 (272)
Primary energy kWh/m2/year			74.9958 (273)

#### SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:

B 85



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

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 85  
 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	£75	£75	£0
Mains gas	£194	£194	£0
Space heating	£149	£149	£0
Water heating	£65	£65	£0
Lighting	£54	£54	£0
Total cost of fuels	£269	£269	£0
Total cost of uses	£268	£268	£0
Delivered energy	51 kWh/m <sup>2</sup>	51 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>	13 kg/m <sup>2</sup>	13 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>
Primary energy	75 kWh/m <sup>2</sup>	75 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	228.9 (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	195.79 (P1)
Transmission heat loss coefficient	26.91 (37)
Summer heat loss coefficient	222.70 (P2)

Overhangs	Ratio	Z_overhangs	Overhang type
Orientation			
North East	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)

[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 East	2.5200	100.0415	0.4300	0.0000	0.9000	97.5644
total:						252.0415

	Jun	Jul	Aug
Solar gains	272	252	(P4)
Internal gains	362	347	
Total summer gains	633	599	(P5)
Summer gain/loss ratio	2.84	2.69	(P6)
Summer external temperature	15.40	17.60	
Thermal mass temperature increment (TMP = 228.9)	0.40	0.40	
Threshold temperature	18.64	20.69	(P7)
Likelihood of high internal temperature	Not significant	Slight	
Assessment of likelihood of high internal temperature:	Slight		