DESIGN NOTE

2 Tollbridge Studios
Tollbridge Road
Bath, BA1 7DE

T 01225 852 981

Project: Holly Walk, Hampstead, London
Borough of Camden

Subject: Planning Statement Gas and Heatpump Comparison

Document Ref: 4493 DSN02

Date: 21st April 2020

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1 Introduction

This document provides information in response to the recent Planning Officer response to the planning application for the above project and has asked for the following information.

- Confirmation of whether gas is available in the house.
- If so, please provide carbon calculations which demonstrate that the air source heat pump's use for heating is more efficient than gas

We can confirm that natural gas is available at the site, and we have therefore carried out a full SAP calculation to provide a comparison as requested.

2 Carbon Calculations

The building has had a detailed SAP analysis has been carried out by an approved assessor, for two different type of system and under two different calculation methods as follows.

- A conventional high efficiency gas fired boiler to provide both heating and hot water.
- A new air sourced heatpump, with matched hot water system and provides both hot water and heating.
- Calculated under SAP 2012, which is the current version of Building Regulations Part L1.
- Calculated under SAP10, which is the proposed update for carbon emissions factors, and is the methodology preferred under the GLA London Plan.

The summary of the results are provided in the table below.

SAP 2012 Results Summary	DER (kg CO2/yr/m2		DFEE (kWh/yr/m2)	
GAS NOTIONAL (PART L MIN REQUIREMENTS)	23.12		80.42	
GAS AS DESIGNED	22.31	**-3.50%**	77.92	**-3.10%**
ASHP NOTIONAL (PART L MIN	28.49		80.42	

REQUIREMENTS)				
ASHP AS DESIGNED	20.86	**-26.80%**	77.92	**-3.10%**

SAP 10 Results Summary	**DER (kg CO2/yr/m2**		**DPER (kWh/yr/m2)**	
GAS NOTIONAL (PART L MIN REQUIREMENTS)	21.41		120.52	
GAS AS DESIGNED	20.64	**-3.60%**	116.28	**-3.50%**
ASHP NOTIONAL (PART L MIN REQUIREMENTS)	7.81		86.24	
ASHP AS DESIGNED	5.93	**-24.00%**	65.49	**-24.00%**

The results above clearly show that under both scenarios the use of air source heatpumps has a lower carbon emission than for conventional gas fire boilers.

Further details of the SAP 2012 analysis are provided in Appendix A. Unfortunately, the approved software does not support accredited output under SAP10.

3 Conclusion

The use of air source heatpumps as the primary heating and hot water source for Holly Walk has a lower carbon emissions than a conventional gas fired boiler system. This has been shown for both SAP 2012, the current Building Regulations, and under SAP10, the latest recommended factors from the GLA as part of the London Plan.

Appendix A: SAP Calculation Output

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

Design SAP
elmhurst energy

Property Reference	4554-E3-PSAP-HOLLY WALK HOUSE	**Issued on Date**	21/04/2020
Assessment Reference	GAS NOTIONAL	**Prop Type Ref**	4554-E3-PSAP-HOLLY WALK HOUSE
Property	11, Holly Walk, LONDON, NW3 6RA		

SAP Rating	78 C	**DER**	23.12	**TER**	13.36
Environmental	74 C	**% DER<TER**	-73.12		
CO_2 Emissions (t/year)	5.54	**DFEE**	80.42	**TFEE**	55.27
General Requirements Compliance	Fail	**% DFEE<TFEE**	-45.49		

Assessor Details	Mr. Michael Andrews, Energy Saving Experts Ltd, Tel: 01225 862266, mike@energy-saving-experts.com	**Assessor ID**	N388-0001
Client			

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

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DWELLING AS DESIGNED

Detached House, total floor area 290 m²

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

1a TER and DER
Fuels for main heating:Mains gas, Electricity
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 13.36 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 23.12 kgCO□/m²Fail
Excess emissions =9.76 kgCO□/m² (73.1%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)80.4 kWh/m²/yrFail
Excess energy =25.1 kWh/m²/yr (45.4%)
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2 Fabric U-values

Element	Average	Highest	
External wall	0.28 (max. 0.30)	0.28 (max. 0.70)	OK
Floor	0.25 (max. 0.25)	0.25 (max. 0.70)	OK
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	OK
Openings	1.92 (max. 2.00)	2.80 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15
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3 Air permeability
Air permeability at 50 pascals: 15.00 (assumed) OK
---
4 Heating efficiency
Main heating system 1: Boiler system with radiators or underfloor - Mains gas
Data from database
Biasi Riva Plus HE 28S ErP

Efficiency: 88.1% SEDBUK2009
Minimum: 88.0% OK

Main heating system 2: Electric underfloor heating - Electric
Underfloor heating in thin screed (standard tariff)

Secondary heating system: None
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5 Cylinder insulation
Hot water storage: Measured cylinder loss: 2.86 kWh/day
Permitted by DBSCG 2.86 OK
Primary pipework insulated: Yes OK
---
6 Controls
Space heating controls 1: Time and temperature zone control OK

Space heating controls 2: Programmer and room thermostat Fail

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock: Yes OK
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7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum: 75% OK
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8 Mechanical ventilation
Not applicable
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9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 2.53 m², No overhang
Windows facing East: 13.54 m², No overhang
Windows facing South: 14.92 m², No overhang
Windows facing West: 33.98 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
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10 Key features
None

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	60.5600 (1b)	x	2.3900 (2b)	=	144.7384	(1b) - (3b)
First floor	86.3200 (1c)	x	2.5000 (2c)	=	215.8000	(1c) - (3c)
Second floor	84.0900 (1d)	x	2.8800 (2d)	=	242.1792	(1d) - (3d)
Third floor	58.9300 (1e)	x	2.1100 (2e)	=	124.3423	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	289.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	727.0599	(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							6 * 10 =	60.0000	(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) =	60.0000 / (5) =	0.0825	(8)
Pressure test		No	
Measured/design AP50		15.0000	
Infiltration rate		0.8325	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.6452	(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	0.8226	0.8065	0.7904	0.7097	0.6936	0.6129	0.6129	0.5968	0.6452	0.6936	0.7259	0.7581	(22b)
Effective ac	0.8384	0.8252	0.8123	0.7519	0.7405	0.6879	0.6879	0.6781	0.7081	0.7405	0.7634	0.7874	(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	
Alu doors (Uw = 1.60)			36.5700	1.5038	54.9925			(27)
New timber windows (Uw = 1.60)			9.6300	1.5038	14.4812			(27)
Retained windows (Uw = 2.60)			18.7700	2.3551	44.2047			(27)
Retained entrance door			6.4300	2.8000	18.0040			(26a)
Rooflights (Uw = 1.60)			12.2100	1.5038	18.3609			(27a)
Heat Loss Floor FT1-3			60.5600	0.2500	15.1400			(28a)
Heat Loss Floor FT4-6			57.3200	0.2500	14.3300			(28a)
Heat Loss Floor FT7			4.4300	0.2500	1.1075			(28b)
External Wall WT1	34.3800	11.8300	22.5500	0.2800	6.3140			(29a)
External Wall WT7	247.9700	56.2000	191.7700	0.2800	53.6956			(29a)
External Wall WT2	28.9000	3.3700	25.5300	0.2800	7.1484			(29a)
External Wall WT3	19.5400		19.5400	0.2800	5.4712			(29a)
External Roof RT1	36.9200	2.6800	34.2400	0.1800	6.1632			(30)
External Roof RT2	6.4900		6.4900	0.1800	1.1682			(30)
External Roof RT3	76.5600	9.5300	67.0300	0.1800	12.0654			(30)
Total net area of external elements Aum(A, m2)			573.0700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		272.6468			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	85.9605	(36)
Total fabric heat loss (33) + (36) =	358.6073	(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	201.1491	197.9966	194.9066	180.3927	177.6772	165.0360	165.0360	162.6951	169.9052	177.6772	183.1706	188.9137	(38)
Heat transfer coeff	559.7564	556.6039	553.5139	539.0000	536.2844	523.6433	523.6433	521.3024	528.5125	536.2844	541.7779	547.5210	(39)
Average = Sum(39)m / 12 =												538.9869	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.9309	1.9200	1.9093	1.8593	1.8499	1.8063	1.8063	1.7982	1.8231	1.8499	1.8688	1.8887	(40)
HLP (average)												1.8592	(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	3.1188	(42)
Average daily hot water use (litres/day)	113.9700	(43)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	125.3670	120.8082	116.2494	111.6906	107.1318	102.5730	102.5730	107.1318	111.6906	116.2494	120.8082	125.3670	(44)
Energy conte	185.9156	162.6030	167.7917	146.2849	140.3638	121.1233	112.2386	128.7954	130.3336	151.8913	165.8012	180.0494	(45)
Energy content (annual)										Total = Sum(45)m =		1793.1919	(45)
Distribution loss (46)m = 0.15 x (45)m	27.8873	24.3905	25.1688	21.9427	21.0546	18.1685	16.8358	19.3193	19.5500	22.7837	24.8702	27.0074	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.8600	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.5444	(55)
Total storage loss	47.8764	43.2432	47.8764	46.3320	47.8764	46.3320	47.8764	47.8764	46.3320	47.8764	46.3320	47.8764	(56)
If cylinder contains dedicated solar storage	47.8764	43.2432	47.8764	46.3320	47.8764	46.3320	47.8764	47.8764	46.3320	47.8764	46.3320	47.8764	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	257.0544	226.8574	238.9305	215.1289	211.5026	189.9673	183.3774	199.9342	199.1776	223.0301	234.6452	251.1882	(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	257.0544	226.8574	238.9305	215.1289	211.5026	189.9673	183.3774	199.9342	199.1776	223.0301	234.6452	251.1882	(64)
								Total per year (kWh/year) = Sum(64)m =				2630.7939	(64)
Heat gains from water heating, kWh/month	118.7280	105.4690	112.7018	103.7149	103.5820	95.3487	94.2304	99.7355	98.4111	107.4149	110.2041	116.7775	(65)

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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	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	40.1208	35.6350	28.9803	21.9400	16.4004	13.8459	14.9610	19.4468	26.1015	33.1418	38.6814	41.2359	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	450.0337	454.7036	442.9355	417.8826	386.2578	356.5350	336.6783	332.0084	343.7765	368.8294	400.4542	430.1770	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	(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)	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	(71)
Water heating gains (Table 5)	159.5806	156.9479	151.4809	144.0485	139.2231	132.4288	126.6537	134.0531	136.6821	144.3748	153.0612	156.9589	(72)
Total internal gains	722.5171	720.0685	696.1787	656.6531	614.6633	575.5916	551.0750	558.2903	579.3421	619.1281	664.9788	701.1538	(73)

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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	
South	9.0700	46.7521	0.7200	0.7000	0.7700	148.1057	(78)
West	27.5000	19.6403	0.7200	0.7000	0.7700	188.6443	(80)
North	1.7200	10.6334	0.7200	0.7000	0.7700	6.3880	(74)
East	2.1500	19.6403	0.7200	0.7000	0.7700	14.7486	(76)
South	2.3900	46.7521	0.7200	0.7000	0.7700	39.0268	(78)
West	3.3700	19.6403	0.7200	0.7000	0.7700	23.1175	(80)
North	0.8100	10.6334	0.7600	0.7000	0.7700	3.1754	(74)
East	11.3900	19.6403	0.7600	0.7000	0.7700	82.4738	(76)
South	3.4600	46.7521	0.7600	0.7000	0.7700	59.6378	(78)
West	3.1100	19.6403	0.7600	0.7000	0.7700	22.5192	(80)
East	5.4300	26.4634	0.7200	0.7000	1.0000	65.1807	(82)
West	4.1000	26.4634	0.7200	0.7000	1.0000	49.2156	(82)
Horizontal	2.6800	26.0000	0.7200	0.7000	1.0000	31.6068	(82)

Solar gains	733.8403	1366.9837	2126.7861	2976.2745	3580.7893	3646.4455	3478.7271	3025.0776	2426.5224	1585.1913	901.5915	612.6650	(83)
Total gains	1456.3574	2087.0522	2822.9648	3632.9276	4195.4527	4222.0371	4029.8021	3583.3679	3005.8645	2204.3193	1566.5703	1313.8189	(84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.9655	36.1692	36.3712	37.3505	37.5397	38.4459	38.4459	38.6186	38.0917	37.5397	37.1590	36.7693	
alpha	3.3977	3.4113	3.4247	3.4900	3.5026	3.5631	3.5631	3.5746	3.5394	3.5026	3.4773	3.4513	
util living area	0.9985	0.9947	0.9817	0.9380	0.8398	0.6834	0.5355	0.6066	0.8482	0.9762	0.9966	0.9990	(86)
MIT	19.2415	19.4538	19.7996	20.2526	20.6075	20.8231	20.8926	20.8757	20.6863	20.1848	19.6399	19.2330	(87)
Th2 (88a)m	19.3798	19.3872	19.3945	19.4288	19.4353	19.4656	19.4656	19.4713	19.4539	19.4353	19.4222	19.4086	(88a)
ni2,m (89a)m	0.9979	0.9926	0.9744	0.9123	0.7735	0.5595	0.3654	0.4326	0.7556	0.9621	0.9950	0.9986	(89a)
MIT2 (90a)m	17.0865	17.4013	17.9077	18.5716	19.0374	19.2956	19.3457	19.3444	19.1652	18.4963	17.6984	17.0937	(90a)
Th2 (88b)m	20.0346	20.0400	20.0453	20.0704	20.0751	20.0969	20.0969	20.1009	20.0885	20.0751	20.0656	20.0557	(88b)
ni2,m (89b)m	0.9982	0.9935	0.9777	0.9241	0.8036	0.6147	0.4391	0.5095	0.7994	0.9689	0.9958	0.9987	(89b)
MIT2 (90b)m	18.3909	18.6071	18.9554	19.4199	19.7567	19.9596	20.0077	20.0029	19.8472	19.3632	18.8140	18.3993	(90b)
MIT 2	17.1810	17.4886	17.9836	18.6330	19.0895	19.3437	19.3936	19.3921	19.2146	18.5591	17.7792	17.1883	(90)
Living area fraction									fLA = Living area / (4) =			0.1715	(91)
MIT	17.5344	17.8257	18.2950	18.9108	19.3498	19.5975	19.6507	19.6465	19.4670	18.8379	18.0983	17.5390	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.5344	17.8257	18.2950	18.9108	19.3498	19.5975	19.6507	19.6465	19.4670	18.8379	18.0983	17.5390	(93)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9968	0.9895	0.9671	0.9011	0.7691	0.5715	0.3874	0.4547	0.7566	0.9541	0.9929	0.9978	(94)
Useful gains	1451.6984	2065.2179	2729.9628	3273.6906	3226.7705	2412.9225	1561.2702	1629.2382	2274.1450	2103.1674	1555.4512	1310.9252	(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	7408.0175	7194.4827	6528.7204	5395.8158	4102.4754	2616.8830	1597.4758	1692.4275	2836.5101	4417.8679	5958.6372	7303.3586	(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	4431.5014	3446.8659	2826.2756	1527.9301	651.5244	0.0000	0.0000	0.0000	0.0000	1722.1372	3170.2939	4458.3705	(98)
Space heating												22234.8991	(98)
Space heating per m2											(98) / (4) =	76.6985	(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)
Fraction of main heating from main system 2	0.0600	(203)
Fraction of total heating from main system 1	0.9400	(204)
Fraction of total heating from main system 2	0.0600	(205)
Efficiency of main space heating system 1 (in %)	91.5000	(206)
Efficiency of main space heating system 2 (in %)	100.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	22842.4100	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	4431.5014	3446.8659	2826.2756	1527.9301	651.5244	0.0000	0.0000	0.0000	0.0000	1722.1372	3170.2939	4458.3705	(98)
Space heating efficiency (main heating system 1)	91.5000	91.5000	91.5000	91.5000	91.5000	0.0000	0.0000	0.0000	0.0000	91.5000	91.5000	91.5000	(210)
Space heating fuel (main heating system)	4552.5807	3541.0426	2903.4963	1569.6768	669.3256	0.0000	0.0000	0.0000	0.0000	1769.1901	3256.9140	4580.1839	(211)
Space heating efficiency (main heating system 2)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(212)
Space heating fuel (main heating system 2)	265.8901	206.8120	169.5765	91.6758	39.0915	0.0000	0.0000	0.0000	0.0000	103.3282	190.2176	267.5022	(213)
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)
Space heating fuel used, main system 2												1334.0939	(213)

Water heating													
Water heating requirement	257.0544	226.8574	238.9305	215.1289	211.5026	189.9673	183.3774	199.9342	199.1776	223.0301	234.6452	251.1882	(64)
Efficiency of water heater	88.3988	88.3113	88.1078	87.5435	86.0841	78.4000	78.4000	78.4000	78.4000	87.6514	88.2212	88.4176	(216)
(217)m	290.7896	256.8837	271.1799	245.7394	245.6930	242.3053	233.8997	255.0181	254.0531	254.4511	265.9738	284.0929	(217)
Fuel for water heating, kWh/month												3100.0795	(219)
Water heating fuel used													
Annual totals kWh/year													
Space heating fuel - main system												22842.4100	(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)												708.5464	(232)
Total delivered energy for all uses												28060.1298	(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	22842.4100	0.2160	4933.9606	(261)
Space heating - main system 2	1334.0939	0.5190	692.3948	(262)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	3100.0795	0.2160	669.6172	(264)
Space and water heating			6295.9725	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	708.5464	0.5190	367.7356	(268)
Total CO2, kg/year			6702.6330	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			23.1200	(273)

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

DER		23.1200	ZC1
Total Floor Area	TFA	289.9000	
Assumed number of occupants	N	3.1188	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		9.1991	ZC2
CO2 emissions from cooking, equation (L16)		0.6687	ZC3
Total CO2 emissions		32.9877	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6

Resulting CO2 emissions offset from additional allowable electricity generation	0.0000 ZC7
Net CO2 emissions	32.9877 ZC8

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	60.5600 (1b)	x	2.3900 (2b)	=	144.7384	(1b) - (3b)
First floor	86.3200 (1c)	x	2.5000 (2c)	=	215.8000	(1c) - (3c)
Second floor	84.0900 (1d)	x	2.8800 (2d)	=	242.1792	(1d) - (3d)
Third floor	58.9300 (1e)	x	2.1100 (2e)	=	124.3423	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	289.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	727.0599	(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							4 * 10 =	40.0000	(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) =	40.0000 / (5) =	0.0550	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3050	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2364	(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	0.3014	0.2955	0.2896	0.2600	0.2541	0.2246	0.2246	0.2187	0.2364	0.2541	0.2659	0.2778	(22b)
Effective ac	0.5454	0.5437	0.5419	0.5338	0.5323	0.5252	0.5252	0.5239	0.5279	0.5323	0.5354	0.5386	(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 Semi-glazed door			6.4300	1.2000	7.7160			(26a)
TER Opening Type (Uw = 1.40)			55.5900	1.3258	73.6989			(27)
TER Room Window (Uw = 1.70)			10.4400	1.5918	16.6180			(27a)
Heat Loss Floor FT1-3			60.5600	0.1300	7.8728			(28a)
Heat Loss Floor FT4-6			57.3200	0.1300	7.4516			(28a)
Heat Loss Floor FT7			4.4300	0.1300	0.5759			(28b)
External Wall WT1	34.3800	10.1200	24.2600	0.1800	4.3668			(29a)
External Wall WT7	247.9700	49.0200	198.9500	0.1800	35.8110			(29a)
External Wall WT2	28.9000	2.8800	26.0200	0.1800	4.6836			(29a)
External Wall WT3	19.5400		19.5400	0.1800	3.5172			(29a)
External Roof RT1	36.9200	2.2900	34.6300	0.1300	4.5019			(30)
External Roof RT2	6.4900		6.4900	0.1300	0.8437			(30)
External Roof RT3	76.5600	8.1500	68.4100	0.1300	8.8933			(30)
Total net area of external elements Aum(A, m2)			573.0700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		176.5506			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	28.6535	(36)
Total fabric heat loss (33) + (36) =	205.2041	(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	130.8623	130.4391	130.0244	128.0761	127.7116	126.0148	126.0148	125.7006	126.6684	127.7116	128.4490	129.2199	(38)
Heat transfer coeff	336.0664	335.6433	335.2285	333.2803	332.9158	331.2190	331.2190	330.9047	331.8725	332.9158	333.6532	334.4241	(39)
Average = Sum(39)m / 12 =												333.2785	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1592	1.1578	1.1564	1.1496	1.1484	1.1425	1.1425	1.1414	1.1448	1.1484	1.1509	1.1536	(40)
HLP (average)												1.1496	(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	3.1188 (42)
Average daily hot water use (litres/day)	108.2715 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Daily hot water use													
	119.0986	114.7678	110.4369	106.1061	101.7752	97.4443	97.4443	101.7752	106.1061	110.4369	114.7678	119.0986	(44)
Energy conte	176.6199	154.4729	159.4021	138.9707	133.3457	115.0672	106.6266	122.3556	123.8169	144.2967	157.5111	171.0469	(45)
Energy content (annual)										Total = Sum(45)m =		1703.5323	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.4930	23.1709	23.9103	20.8456	20.0018	17.2601	15.9940	18.3533	18.5725	21.6445	23.6267	25.6570	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1127	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1409	(55)
Total storage loss													
	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(56)
If cylinder contains dedicated solar storage													
	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	235.2487	207.4279	218.0310	195.7082	191.9745	171.8047	165.2555	180.9844	180.5545	202.9255	214.2487	229.6757	(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													
	235.2487	207.4279	218.0310	195.7082	191.9745	171.8047	165.2555	180.9844	180.5545	202.9255	214.2487	229.6757	(64)
								Total per year (kWh/year) = Sum(64)m =				2393.8393	(64)
Heat gains from water heating, kWh/month													
	105.6292	93.7263	99.9043	91.5978	91.2405	83.6499	82.3564	87.5863	86.5592	94.8817	97.7625	103.7761	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	40.1208	35.6350	28.9803	21.9400	16.4004	13.8459	14.9610	19.4468	26.1015	33.1418	38.6814	41.2359	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	450.0337	454.7036	442.9355	417.8826	386.2578	356.5350	336.6783	332.0084	343.7765	368.8294	400.4542	430.1770	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	(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)													
	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	(71)
Water heating gains (Table 5)													
	141.9747	139.4736	134.2799	127.2192	122.6351	116.1804	110.6941	117.7235	120.2211	127.5292	135.7813	139.4841	(72)
Total internal gains													
	704.9112	702.5942	678.9777	639.8237	598.0753	559.3433	535.1154	541.9607	562.8811	602.2824	647.6988	683.6790	(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	
North	2.1600	10.6334	0.6300	0.7000	0.7700	7.0194	(74)
East	11.5900	19.6403	0.6300	0.7000	0.7700	69.5669	(76)
South	12.7700	46.7521	0.6300	0.7000	0.7700	182.4583	(78)
West	29.0700	19.6403	0.6300	0.7000	0.7700	174.4874	(80)
East	4.6400	26.4634	0.6300	0.7000	1.0000	48.7355	(82)
West	3.5100	26.4634	0.6300	0.7000	1.0000	36.8667	(82)
Horizontal	2.2900	26.0000	0.6300	0.7000	1.0000	23.6314	(82)

Solar gains	542.7656	1011.1629	1573.4465	2202.2870	2649.8972	2698.6103	2574.4365	2238.5143	1795.3234	1172.6416	666.8586	453.1282	(83)
Total gains	1247.6767	1713.7570	2252.4242	2842.1107	3247.9725	3257.9536	3109.5519	2780.4751	2358.2045	1774.9240	1314.5574	1136.8071	(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	59.9047	59.9802	60.0544	60.4054	60.4716	60.7814	60.7814	60.8391	60.6617	60.4716	60.3379	60.1988	
alpha	4.9936	4.9987	5.0036	5.0270	5.0314	5.0521	5.0521	5.0559	5.0441	5.0314	5.0225	5.0133	
util living area													
	0.9996	0.9978	0.9885	0.9421	0.8136	0.6227	0.4632	0.5354	0.8221	0.9828	0.9987	0.9997	(86)
MIT	19.5882	19.8050	20.1475	20.5610	20.8530	20.9704	20.9945	20.9891	20.8861	20.4433	19.9230	19.5490	(87)
Th 2	19.9527	19.9539	19.9551	19.9605	19.9615	19.9663	19.9663	19.9671	19.9644	19.9615	19.9595	19.9573	(88)
util rest of house													
	0.9994	0.9970	0.9842	0.9217	0.7581	0.5336	0.3573	0.4213	0.7456	0.9738	0.9982	0.9996	(89)
MIT 2	18.0516	18.3694	18.8681	19.4544	19.8247	19.9478	19.9643	19.9629	19.8751	19.3026	18.5465	17.9974	(90)
Living area fraction									fLA = Living area / (4) =			0.1715	(91)
MIT	18.3152	18.6157	19.0875	19.6442	20.0011	20.1232	20.1410	20.1389	20.0485	19.4983	18.7826	18.2635	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3152	18.6157	19.0875	19.6442	20.0011	20.1232	20.1410	20.1389	20.0485	19.4983	18.7826	18.2635	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9990	0.9955	0.9794	0.9141	0.7604	0.5478	0.3755	0.4408	0.7527	0.9681	0.9972	0.9994	(94)
Useful gains	1246.4698	1706.0351	2205.9477	2597.9053	2469.7811	1784.5715	1167.5374	1225.6763	1774.9825	1718.2876	1310.8433	1136.1090	(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)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Heat loss rate W													
	4710.0292	4603.5670	4219.6887	3580.8177	2763.5599	1829.3864	1172.8519	1237.2094	1974.1524	2962.3740	3897.9235	4703.1860	(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													
	2576.8882	1947.1414	1498.2233	707.6969	218.5714	0.0000	0.0000	0.0000	0.0000	925.6003	1862.6977	2653.9052	(98)
Space heating												12390.7246	(98)
Space heating per m2											(98) / (4) =	42.7414	(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)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												13252.1118	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2576.8882	1947.1414	1498.2233	707.6969	218.5714	0.0000	0.0000	0.0000	0.0000	925.6003	1862.6977	2653.9052	(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)													
	2756.0302	2082.5042	1602.3779	756.8951	233.7662	0.0000	0.0000	0.0000	0.0000	989.9468	1992.1901	2838.4013	(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													
Water heating requirement													
	235.2487	207.4279	218.0310	195.7082	191.9745	171.8047	165.2555	180.9844	180.5545	202.9255	214.2487	229.6757	(64)
Efficiency of water heater												79.8000	(216)
(217)m	89.4961	89.3466	88.9842	87.9454	85.1605	79.8000	79.8000	79.8000	79.8000	88.3694	89.2653	89.5437	(217)
Fuel for water heating, kWh/month													
	262.8590	232.1608	245.0220	222.5337	225.4267	215.2941	207.0870	226.7975	226.2588	229.6333	240.0134	256.4957	(219)
Water heating fuel used												2789.5822	(219)
Annual totals kWh/year													
Space heating fuel - main system												13252.1118	(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)												708.5464	(232)
Total delivered energy for all uses												16825.2404	(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	13252.1118	0.2160	2862.4562	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2789.5822	0.2160	602.5498	(264)
Space and water heating			3465.0059	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	708.5464	0.5190	367.7356	(268)
Total CO2, kg/m2/year			3871.6665	(272)
Emissions per m2 for space and water heating			11.9524	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.2685	(272b)
Emissions per m2 for pumps and fans			0.1343	(272c)
Target Carbon Dioxide Emission Rate (TER) = (11.9524 * 1.00) + 1.2685 + 0.1343, rounded to 2 d.p.			13.3600	(273)

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

Design SAP
elmhurst energy

Property Reference	4554-E3-PSAP-HOLLY WALK HOUSE	**Issued on Date**	17/04/2020
Assessment Reference	002 GAS	**Prop Type Ref**	4554-E3-PSAP-HOLLY WALK HOUSE
Property	11, Holly Walk, LONDON, NW3 6RA		

SAP Rating	79 C	**DER**	22.31	**TER**	13.36
Environmental	75 C	**% DER<TER**	-67.05		
CO_2 Emissions (t/year)	5.33	**DFEE**	77.92	**TFEE**	55.27
General Requirements Compliance	Fail	**% DFEE<TFEE**	-40.97		

Assessor Details	Mr. Michael Andrews, Energy Saving Experts Ltd, Tel: 01225 862266, mike@energy-saving-experts.com	**Assessor ID**	N388-0001
Client			

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

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DWELLING AS DESIGNED

Detached House, total floor area 290 m²

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

1a TER and DER
Fuels for main heating:Mains gas, Electricity
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 13.36 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 22.31 kgCO□/m²Fail
Excess emissions =8.95 kgCO□/m² (67.0%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)77.9 kWh/m²/yrFail
Excess energy =22.6 kWh/m²/yr (40.9%)
---
2 Fabric U-values

Element	Average	Highest	
External wall	0.26 (max. 0.30)	0.26 (max. 0.70)	OK
Floor	0.16 (max. 0.25)	0.23 (max. 0.70)	OK
Roof	0.28 (max. 0.20)	0.34 (max. 0.35)	Fail
Openings	1.79 (max. 2.00)	2.80 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15
---
3 Air permeability
Air permeability at 50 pascals: 15.00 (assumed) OK
---
4 Heating efficiency
Main heating system 1: Boiler system with radiators or underfloor - Mains gas
Data from database
Worcester Greenstar FS 42CDi Regular ErP

Efficiency: 88.8% SEDBUK2009
Minimum: 88.0% OK

Main heating system 2: Electric underfloor heating - Electric
Underfloor heating in thin screed (standard tariff)

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage Nominal cylinder loss: 2.55 kWh/day
Permitted by DBSCG 2.86 OK
Primary pipework insulated: Yes OK
---
6 Controls
Space heating controls 1: Time and temperature zone control OK

Space heating controls 2: Programmer and room thermostat Fail

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 2.53 m², No overhang
Windows facing East: 13.54 m², No overhang
Windows facing South: 14.92 m², No overhang
Windows facing West: 33.98 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
None

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	60.5600 (1b)	x	2.3900 (2b)	=	144.7384	(1b) - (3b)
First floor	86.3200 (1c)	x	2.5000 (2c)	=	215.8000	(1c) - (3c)
Second floor	84.0900 (1d)	x	2.8800 (2d)	=	242.1792	(1d) - (3d)
Third floor	58.9300 (1e)	x	2.1100 (2e)	=	124.3423	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	289.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	727.0599	(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							6 * 10 =	60.0000	(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) =	60.0000 / (5) =	0.0825	(8)
Pressure test		No	
Measured/design AP50		15.0000	
Infiltration rate		0.8325	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.6452	(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	0.8226	0.8065	0.7904	0.7097	0.6936	0.6129	0.6129	0.5968	0.6452	0.6936	0.7259	0.7581	(22b)
Effective ac	0.8384	0.8252	0.8123	0.7519	0.7405	0.6879	0.6879	0.6781	0.7081	0.7405	0.7634	0.7874	(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	
Alu doors (Uw = 1.40)			36.5700	1.3258	48.4830			(27)
New timber windows (Uw = 1.60)			9.6300	1.5038	14.4812			(27)
Retained windows (Uw = 2.60)			18.7700	2.3551	44.2047			(27)
Retained entrance door			6.4300	2.8000	18.0040			(26a)
Rooflights (Uw = 1.30)			12.2100	1.2357	15.0884			(27a)
Heat Loss Floor FT1-3			60.5600	0.1400	8.4784			(28a)
Heat Loss Floor FT4-6			57.3200	0.1800	10.3176			(28a)
Heat Loss Floor FT7			4.4300	0.2300	1.0189			(28b)
External Wall WT1	34.3800	11.8300	22.5500	0.2600	5.8630			(29a)
External Wall WT7	247.9700	56.2000	191.7700	0.2600	49.8602			(29a)
External Wall WT2	28.9000	3.3700	25.5300	0.2600	6.6378			(29a)
External Wall WT3	19.5400		19.5400	0.2600	5.0804			(29a)
External Roof RT1	36.9200	2.6800	34.2400	0.1700	5.8208			(30)
External Roof RT2	6.4900		6.4900	0.2300	1.4927			(30)
External Roof RT3	76.5600	9.5300	67.0300	0.3400	22.7902			(30)
Total net area of external elements Aum(A, m2)			573.0700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		257.6213			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	85.9605	(36)
Total fabric heat loss (33) + (36) =	343.5818	(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	201.1491	197.9966	194.9066	180.3927	177.6772	165.0360	165.0360	162.6951	169.9052	177.6772	183.1706	188.9137	(38)
Heat transfer coeff	544.7309	541.5784	538.4883	523.9744	521.2589	508.6178	508.6178	506.2768	513.4870	521.2589	526.7524	532.4955	(39)
Average = Sum(39)m / 12 =												523.9614	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8790	1.8682	1.8575	1.8074	1.7981	1.7545	1.7545	1.7464	1.7713	1.7981	1.8170	1.8368	(40)
HLP (average)												1.8074	(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	3.1188	(42)
Average daily hot water use (litres/day)	113.9700	(43)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	125.3670	120.8082	116.2494	111.6906	107.1318	102.5730	102.5730	107.1318	111.6906	116.2494	120.8082	125.3670	(44)
Energy conte	185.9156	162.6030	167.7917	146.2849	140.3638	121.1233	112.2386	128.7954	130.3336	151.8913	165.8012	180.0494	(45)
Energy content (annual)										Total = Sum(45)m =		1793.1919	(45)
Distribution loss (46)m = 0.15 x (45)m	27.8873	24.3905	25.1688	21.9427	21.0546	18.1685	16.8358	19.3193	19.5500	22.7837	24.8702	27.0074	(46)
Water storage loss:													
Store volume												300.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.7368	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												1.3784	(55)
Total storage loss	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(56)
If cylinder contains dedicated solar storage	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	251.9070	222.2081	233.7831	210.1475	206.3552	184.9859	178.2299	194.7868	194.1962	217.8826	229.6638	246.0407	(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	251.9070	222.2081	233.7831	210.1475	206.3552	184.9859	178.2299	194.7868	194.1962	217.8826	229.6638	246.0407	(64)
								Total per year (kWh/year) = Sum(64)m =				2570.1871	(64)
Heat gains from water heating, kWh/month	114.6101	101.7496	108.5839	99.7298	99.4641	91.3636	90.1124	95.6176	94.4260	103.2969	106.2190	112.6595	(65)

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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	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	40.1208	35.6350	28.9803	21.9400	16.4004	13.8459	14.9610	19.4468	26.1015	33.1418	38.6814	41.2359	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	450.0337	454.7036	442.9355	417.8826	386.2578	356.5350	336.6783	332.0084	343.7765	368.8294	400.4542	430.1770	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	(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)	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	(71)
Water heating gains (Table 5)	154.0458	151.4131	145.9460	138.5136	133.6883	126.8939	121.1189	128.5182	131.1473	138.8400	147.5264	151.4241	(72)
Total internal gains	716.9823	714.5336	690.6438	651.1182	609.1285	570.0568	545.5401	552.7554	573.8072	613.5932	659.4440	695.6190	(73)

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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	
South	9.0700	46.7521	0.7200	0.7000	0.7700	148.1057	(78)
West	27.5000	19.6403	0.7200	0.7000	0.7700	188.6443	(80)
North	1.7200	10.6334	0.7200	0.7000	0.7700	6.3880	(74)
East	2.1500	19.6403	0.7200	0.7000	0.7700	14.7486	(76)
South	2.3900	46.7521	0.7200	0.7000	0.7700	39.0268	(78)
West	3.3700	19.6403	0.7200	0.7000	0.7700	23.1175	(80)
North	0.8100	10.6334	0.7600	0.7000	0.7700	3.1754	(74)
East	11.3900	19.6403	0.7600	0.7000	0.7700	82.4738	(76)
South	3.4600	46.7521	0.7600	0.7000	0.7700	59.6378	(78)
West	3.1100	19.6403	0.7600	0.7000	0.7700	22.5192	(80)
East	5.4300	26.4634	0.7200	0.7000	1.0000	65.1807	(82)
West	4.1000	26.4634	0.7200	0.7000	1.0000	49.2156	(82)
Horizontal	2.6800	26.0000	0.7200	0.7000	1.0000	31.6068	(82)

Solar gains	733.8403	1366.9837	2126.7861	2976.2745	3580.7893	3646.4455	3478.7271	3025.0776	2426.5224	1585.1913	901.5915	612.6650	(83)
Total gains	1450.8225	2081.5174	2817.4299	3627.3927	4189.9178	4216.5023	4024.2672	3577.8331	3000.3297	2198.7845	1561.0354	1308.2840	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.9576	37.1727	37.3860	38.4216	38.6218	39.5817	39.5817	39.7647	39.2063	38.6218	38.2190	37.8068	
alpha	3.4638	3.4782	3.4924	3.5614	3.5748	3.6388	3.6388	3.6510	3.6138	3.5748	3.5479	3.5205	
util living area	0.9985	0.9948	0.9816	0.9365	0.8345	0.6738	0.5249	0.5961	0.8432	0.9760	0.9967	0.9990	(86)
MIT	19.2816	19.4938	19.8374	20.2856	20.6308	20.8351	20.8983	20.8830	20.7041	20.2127	19.6747	19.2737	(87)
Th2 (88a)m	19.4152	19.4227	19.4300	19.4648	19.4714	19.5021	19.5021	19.5078	19.4902	19.4714	19.4581	19.4443	(88a)
ni2,m (89a)m	0.9980	0.9928	0.9743	0.9105	0.7680	0.5522	0.3607	0.4272	0.7506	0.9620	0.9952	0.9986	(89a)
MIT2 (90a)m	17.1693	17.4842	17.9873	18.6441	19.0957	19.3404	19.3855	19.3850	19.2159	18.5621	17.7740	17.1777	(90a)
Th2 (88b)m	20.0605	20.0659	20.0713	20.0963	20.1010	20.1228	20.1228	20.1268	20.1144	20.1010	20.0915	20.0816	(88b)
ni2,m (89b)m	0.9982	0.9937	0.9777	0.9225	0.7983	0.6064	0.4319	0.5020	0.7944	0.9687	0.9959	0.9988	(89b)
MIT2 (90b)m	18.4518	18.6680	19.0139	19.4736	19.8007	19.9934	20.0368	20.0329	19.8858	19.4121	18.8696	18.4608	(90b)
MIT 2	17.2622	17.5699	18.0616	18.7042	19.1467	19.3877	19.4327	19.4319	19.2644	18.6237	17.8534	17.2707	(90)
Living area fraction										fLA = Living area / (4) =		0.1715	(91)
MIT	17.6086	17.8999	18.3662	18.9754	19.4012	19.6360	19.6840	19.6808	19.5113	18.8962	18.1658	17.6142	(92)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Temperature adjustment												0.0000	
adjusted MIT	17.6086	17.8999	18.3662	18.9754	19.4012	19.6360	19.6840	19.6808	19.5113	18.8962	18.1658	17.6142	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9970	0.9898	0.9671	0.8997	0.7644	0.5643	0.3820	0.4487	0.7522	0.9541	0.9932	0.9979	(94)
Useful gains	1446.4090	2060.2703	2724.8721	3263.4491	3202.7220	2379.4436	1537.1387	1605.4011	2256.9905	2097.9076	1550.3428	1305.5686	(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	7249.5868	7040.4589	6389.8041	5279.2533	4014.3450	2561.3853	1568.5881	1660.9993	2778.6476	4324.4665	5828.9115	7142.9984	(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	4317.5643	3346.6867	2726.7094	1451.3790	603.8475	0.0000	0.0000	0.0000	0.0000	1656.5598	3080.5695	4343.0478	(98)
Space heating												21526.3642	(98)
Space heating per m2											(98) / (4) =	74.2544	(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)
Fraction of main heating from main system 2	0.0600	(203)
Fraction of total heating from main system 1	0.9400	(204)
Fraction of total heating from main system 2	0.0600	(205)
Efficiency of main space heating system 1 (in %)	92.2000	(206)
Efficiency of main space heating system 2 (in %)	100.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	21946.6186	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	4317.5643	3346.6867	2726.7094	1451.3790	603.8475	0.0000	0.0000	0.0000	0.0000	1656.5598	3080.5695	4343.0478	(98)
Space heating efficiency (main heating system 1)	92.2000	92.2000	92.2000	92.2000	92.2000	0.0000	0.0000	0.0000	0.0000	92.2000	92.2000	92.2000	(210)
Space heating fuel (main heating system)	4401.8551	3412.0233	2779.9423	1479.7140	615.6363	0.0000	0.0000	0.0000	0.0000	1688.9005	3140.7108	4427.8362	(211)
Space heating efficiency (main heating system 2)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(212)
Space heating fuel (main heating system 2)	259.0539	200.8012	163.6026	87.0827	36.2309	0.0000	0.0000	0.0000	0.0000	99.3936	184.8342	260.5829	(213)
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)
Space heating fuel used, main system 2												1291.5818	(213)

Water heating

Water heating requirement	251.9070	222.2081	233.7831	210.1475	206.3552	184.9859	178.2299	194.7868	194.1962	217.8826	229.6638	246.0407	(64)
Efficiency of water heater												79.1000	(216)
(217)m	89.0957	89.0057	88.7960	88.2074	86.6740	79.1000	79.1000	79.1000	79.1000	88.3333	88.9162	89.1148	(217)
Fuel for water heating, kWh/month	282.7377	249.6561	263.2812	238.2425	238.0820	233.8634	225.3223	246.2538	245.5073	246.6597	258.2926	276.0942	(219)
Water heating fuel used												3003.9928	(219)
Annual totals kWh/year													
Space heating fuel - main system												21946.6186	(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)	708.5464	(232)
Total delivered energy for all uses	27025.7396	(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	21946.6186	0.2160	4740.4696	(261)
Space heating - main system 2	1291.5818	0.5190	670.3310	(262)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	3003.9928	0.2160	648.8624	(264)
Space and water heating			6059.6630	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	708.5464	0.5190	367.7356	(268)
Total CO2, kg/year			6466.3236	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			22.3100	(273)

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

DER		22.3100	ZC1
Total Floor Area	TFA	289.9000	
Assumed number of occupants	N	3.1188	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		9.1991	ZC2
CO2 emissions from cooking, equation (L16)		0.6687	ZC3
Total CO2 emissions		32.1777	ZC4

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Residual CO2 emissions offset from biofuel CHP	0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year	0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation	0.0000	ZC7
Net CO2 emissions	32.1777	ZC8

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	60.5600 (1b)	x	2.3900 (2b)	=	144.7384	(1b) - (3b)
First floor	86.3200 (1c)	x	2.5000 (2c)	=	215.8000	(1c) - (3c)
Second floor	84.0900 (1d)	x	2.8800 (2d)	=	242.1792	(1d) - (3d)
Third floor	58.9300 (1e)	x	2.1100 (2e)	=	124.3423	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	289.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	727.0599	(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							4 * 10 =	40.0000	(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) =	40.0000 / (5) =	0.0550	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3050	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2364	(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	0.3014	0.2955	0.2896	0.2600	0.2541	0.2246	0.2246	0.2187	0.2364	0.2541	0.2659	0.2778	(22b)
Effective ac	0.5454	0.5437	0.5419	0.5338	0.5323	0.5252	0.5252	0.5239	0.5279	0.5323	0.5354	0.5386	(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 Semi-glazed door			6.4300	1.2000	7.7160			(26a)
TER Opening Type (Uw = 1.40)			55.5900	1.3258	73.6989			(27)
TER Room Window (Uw = 1.70)			10.4400	1.5918	16.6180			(27a)
Heat Loss Floor FT1-3			60.5600	0.1300	7.8728			(28a)
Heat Loss Floor FT4-6			57.3200	0.1300	7.4516			(28a)
Heat Loss Floor FT7			4.4300	0.1300	0.5759			(28b)
External Wall WT1	34.3800	10.1200	24.2600	0.1800	4.3668			(29a)
External Wall WT7	247.9700	49.0200	198.9500	0.1800	35.8110			(29a)
External Wall WT2	28.9000	2.8800	26.0200	0.1800	4.6836			(29a)
External Wall WT3	19.5400		19.5400	0.1800	3.5172			(29a)
External Roof RT1	36.9200	2.2900	34.6300	0.1300	4.5019			(30)
External Roof RT2	6.4900		6.4900	0.1300	0.8437			(30)
External Roof RT3	76.5600	8.1500	68.4100	0.1300	8.8933			(30)
Total net area of external elements Aum(A, m2)			573.0700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		176.5506			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	28.6535	(36)
Total fabric heat loss (33) + (36) =	205.2041	(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	130.8623	130.4391	130.0244	128.0761	127.7116	126.0148	126.0148	125.7006	126.6684	127.7116	128.4490	129.2199	(38)
Heat transfer coeff	336.0664	335.6433	335.2285	333.2803	332.9158	331.2190	331.2190	330.9047	331.8725	332.9158	333.6532	334.4241	(39)
Average = Sum(39)m / 12 =												333.2785	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1592	1.1578	1.1564	1.1496	1.1484	1.1425	1.1425	1.1414	1.1448	1.1484	1.1509	1.1536	(40)
HLP (average)												1.1496	(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	3.1188 (42)
Average daily hot water use (litres/day)	108.2715 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
Daily hot water use
              119.0986   114.7678   110.4369   106.1061   101.7752    97.4443    97.4443   101.7752   106.1061   110.4369   114.7678   119.0986 (44)
Energy conte  176.6199   154.4729   159.4021   138.9707   133.3457   115.0672   106.6266   122.3556   123.8169   144.2967   157.5111   171.0469 (45)
Energy content (annual)                                                                                         Total = Sum(45)m =   1703.5323 (45)
Distribution loss  (46)m = 0.15 x (45)m
               26.4930    23.1709    23.9103    20.8456    20.0018    17.2601    15.9940    18.3533    18.5725    21.6445    23.6267    25.6570 (46)
Water storage loss:
Store volume                                                                                                                       300.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                        2.1127 (48)
  Temperature factor from Table 2b                                                                                                   0.5400 (49)
Enter (49) or (54) in (55)                                                                                                           1.1409 (55)
Total storage loss
               35.3664    31.9439    35.3664    34.2256    35.3664    34.2256    35.3664    35.3664    34.2256    35.3664    34.2256    35.3664 (56)
If cylinder contains dedicated solar storage
               35.3664    31.9439    35.3664    34.2256    35.3664    34.2256    35.3664    35.3664    34.2256    35.3664    34.2256    35.3664 (57)
Primary loss   23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
              235.2487   207.4279   218.0310   195.7082   191.9745   171.8047   165.2555   180.9844   180.5545   202.9255   214.2487   229.6757 (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
              235.2487   207.4279   218.0310   195.7082   191.9745   171.8047   165.2555   180.9844   180.5545   202.9255   214.2487   229.6757 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   2393.8393 (64)
Heat gains from water heating, kWh/month
              105.6292    93.7263    99.9043    91.5978    91.2405    83.6499    82.3564    87.5863    86.5592    94.8817    97.7625   103.7761 (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         155.9400   155.9400   155.9400   155.9400   155.9400   155.9400   155.9400   155.9400   155.9400   155.9400   155.9400   155.9400 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               40.1208    35.6350    28.9803    21.9400    16.4004    13.8459    14.9610    19.4468    26.1015    33.1418    38.6814    41.2359 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              450.0337   454.7036   442.9355   417.8826   386.2578   356.5350   336.6783   332.0084   343.7765   368.8294   400.4542   430.1770 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               38.5940    38.5940    38.5940    38.5940    38.5940    38.5940    38.5940    38.5940    38.5940    38.5940    38.5940    38.5940 (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)
             -124.7520  -124.7520  -124.7520  -124.7520  -124.7520  -124.7520  -124.7520  -124.7520  -124.7520  -124.7520  -124.7520  -124.7520 (71)
Water heating gains (Table 5)
              141.9747   139.4736   134.2799   127.2192   122.6351   116.1804   110.6941   117.7235   120.2211   127.5292   135.7813   139.4841 (72)
Total internal gains
              704.9112   702.5942   678.9777   639.8237   598.0753   559.3433   535.1154   541.9607   562.8811   602.2824   647.6988   683.6790 (73)


----------------------------------------------------------------------------------------------------
6. Solar gains
----------------------------------------------------------------------------------------------------

[Jan]                                        Area         Solar flux              g                 FF              Access              Gains
                                               m2           Table 6a    Specific data     Specific data             factor                  W
                                                                W/m2      or Table 6b       or Table 6c           Table 6d
----------------------------------------------------------------------------------------------------
North                                      2.1600            10.6334           0.6300            0.7000             0.7700             7.0194 (74)
East                                      11.5900            19.6403           0.6300            0.7000             0.7700            69.5669 (76)
South                                     12.7700            46.7521           0.6300            0.7000             0.7700           182.4583 (78)
West                                      29.0700            19.6403           0.6300            0.7000             0.7700           174.4874 (80)
East                                       4.6400            26.4634           0.6300            0.7000             1.0000            48.7355 (82)
West                                       3.5100            26.4634           0.6300            0.7000             1.0000            36.8667 (82)
Horizontal                                 2.2900            26.0000           0.6300            0.7000             1.0000            23.6314 (82)
----------------------------------------------------------------------------------------------------

Solar gains   542.7656  1011.1629  1573.4465  2202.2870  2649.8972  2698.6103  2574.4365  2238.5143  1795.3234  1172.6416   666.8586   453.1282 (83)
Total gains  1247.6767  1713.7570  2252.4242  2842.1107  3247.9725  3257.9536  3109.5519  2780.4751  2358.2045  1774.9240  1314.5574  1136.8071 (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            59.9047    59.9802    60.0544    60.4054    60.4716    60.7814    60.7814    60.8391    60.6617    60.4716    60.3379    60.1988
alpha           4.9936     4.9987     5.0036     5.0270     5.0314     5.0521     5.0521     5.0559     5.0441     5.0314     5.0225     5.0133
util living area
                0.9996     0.9978     0.9885     0.9421     0.8136     0.6227     0.4632     0.5354     0.8221     0.9828     0.9987     0.9997 (86)

MIT            19.5882    19.8050    20.1475    20.5610    20.8530    20.9704    20.9945    20.9891    20.8861    20.4433    19.9230    19.5490 (87)
Th 2           19.9527    19.9539    19.9551    19.9605    19.9615    19.9663    19.9663    19.9671    19.9644    19.9615    19.9595    19.9573 (88)
util rest of house
                0.9994     0.9970     0.9842     0.9217     0.7581     0.5336     0.3573     0.4213     0.7456     0.9738     0.9982     0.9996 (89)
MIT 2          18.0516    18.3694    18.8681    19.4544    19.8247    19.9478    19.9643    19.9629    19.8751    19.3026    18.5465    17.9974 (90)
Living area fraction                                                                            fLA = Living area / (4) =     0.1715 (91)
MIT            18.3152    18.6157    19.0875    19.6442    20.0011    20.1232    20.1410    20.1389    20.0485    19.4983    18.7826    18.2635 (92)
Temperature adjustment                                                                                                        0.0000
adjusted MIT   18.3152    18.6157    19.0875    19.6442    20.0011    20.1232    20.1410    20.1389    20.0485    19.4983    18.7826    18.2635 (93)


----------------------------------------------------------------------------------------------------
8. Space heating requirement
----------------------------------------------------------------------------------------------------

                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9990     0.9955     0.9794     0.9141     0.7604     0.5478     0.3755     0.4408     0.7527     0.9681     0.9972     0.9994 (94)
Useful gains 1246.4698  1706.0351  2205.9477  2597.9053  2469.7811  1784.5715  1167.5374  1225.6763  1774.9825  1718.2876  1310.8433  1136.1090 (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)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Heat loss rate W													
	4710.0292	4603.5670	4219.6887	3580.8177	2763.5599	1829.3864	1172.8519	1237.2094	1974.1524	2962.3740	3897.9235	4703.1860	(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													
	2576.8882	1947.1414	1498.2233	707.6969	218.5714	0.0000	0.0000	0.0000	0.0000	925.6003	1862.6977	2653.9052	(98)
Space heating												12390.7246	(98)
Space heating per m2											(98) / (4) =	42.7414	(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)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												13252.1118	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2576.8882	1947.1414	1498.2233	707.6969	218.5714	0.0000	0.0000	0.0000	0.0000	925.6003	1862.6977	2653.9052	(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)													
	2756.0302	2082.5042	1602.3779	756.8951	233.7662	0.0000	0.0000	0.0000	0.0000	989.9468	1992.1901	2838.4013	(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													
Water heating requirement													
	235.2487	207.4279	218.0310	195.7082	191.9745	171.8047	165.2555	180.9844	180.5545	202.9255	214.2487	229.6757	(64)
Efficiency of water heater												79.8000	(216)
(217)m	89.4961	89.3466	88.9842	87.9454	85.1605	79.8000	79.8000	79.8000	79.8000	88.3694	89.2653	89.5437	(217)
Fuel for water heating, kWh/month													
	262.8590	232.1608	245.0220	222.5337	225.4267	215.2941	207.0870	226.7975	226.2588	229.6333	240.0134	256.4957	(219)
Water heating fuel used												2789.5822	(219)
Annual totals kWh/year													
Space heating fuel - main system												13252.1118	(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)												708.5464	(232)
Total delivered energy for all uses												16825.2404	(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	13252.1118	0.2160	2862.4562	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2789.5822	0.2160	602.5498	(264)
Space and water heating			3465.0059	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	708.5464	0.5190	367.7356	(268)
Total CO2, kg/m2/year			3871.6665	(272)
Emissions per m2 for space and water heating			11.9524	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.2685	(272b)
Emissions per m2 for pumps and fans			0.1343	(272c)
Target Carbon Dioxide Emission Rate (TER) = (11.9524 * 1.00) + 1.2685 + 0.1343, rounded to 2 d.p.			13.3600	(273)

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

Design SAP
elmhurst energy

Property Reference	4554-E3-PSAP-HOLLY WALK HOUSE	**Issued on Date**	21/04/2020
Assessment Reference	ASHP NOTIONAL	**Prop Type Ref**	4554-E3-PSAP-HOLLY WALK HOUSE
Property	11, Holly Walk, LONDON, NW3 6RA		

SAP Rating	65 D	**DER**	28.49	**TER**	19.93
Environmental	69 C	**% DER<TER**	-42.96		
CO_2 Emissions (t/year)	6.80	**DFEE**	80.42	**TFEE**	55.27
General Requirements Compliance	Fail	**% DFEE<TFEE**	-45.49		

Assessor Details	Mr. Michael Andrews, Energy Saving Experts Ltd, Tel: 01225 862266, mike@energy-saving-experts.com	**Assessor ID**	N388-0001
Client			

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Detached House, total floor area 290 m²

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:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 19.93 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 28.49 kgCO□/m²Fail
Excess emissions =8.56 kgCO□/m² (43.0%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)80.4 kWh/m²/yrFail
Excess energy =25.1 kWh/m²/yr (45.4%)
---
2 Fabric U-values

Element	Average	Highest	
External wall	0.28 (max. 0.30)	0.28 (max. 0.70)	OK
Floor	0.25 (max. 0.25)	0.25 (max. 0.70)	OK
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	OK
Openings	1.92 (max. 2.00)	2.80 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15
---
3 Air permeability
Air permeability at 50 pascals: 15.00 (assumed) OK
---
4 Heating efficiency
Main heating system 1: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Main heating system 2: Electric underfloor heating - Electric
Underfloor heating in thin screed (standard tariff)

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage Measured cylinder loss: 2.86 kWh/day
Permitted by DBSCG 2.86 OK
Primary pipework insulated: Yes OK
---
6 Controls
Space heating controls 1: Time and temperature zone control OK

Space heating controls 2: Programmer and room thermostat Fail

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 2.53 m², No overhang
Windows facing East: 13.54 m², No overhang
Windows facing South: 14.92 m², No overhang
Windows facing West: 33.98 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
None

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	60.5600 (1b)	x	2.3900 (2b)	=	144.7384	(1b) - (3b)
First floor	86.3200 (1c)	x	2.5000 (2c)	=	215.8000	(1c) - (3c)
Second floor	84.0900 (1d)	x	2.8800 (2d)	=	242.1792	(1d) - (3d)
Third floor	58.9300 (1e)	x	2.1100 (2e)	=	124.3423	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	289.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	727.0599	(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							6 * 10 =	60.0000	(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) =	60.0000 / (5) =	0.0825	(8)
Pressure test		No	
Measured/design AP50		15.0000	
Infiltration rate		0.8325	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.6452	(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	0.8226	0.8065	0.7904	0.7097	0.6936	0.6129	0.6129	0.5968	0.6452	0.6936	0.7259	0.7581	(22b)
Effective ac	0.8384	0.8252	0.8123	0.7519	0.7405	0.6879	0.6879	0.6781	0.7081	0.7405	0.7634	0.7874	(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	
Alu doors (Uw = 1.60)			36.5700	1.5038	54.9925			(27)
New timber windows (Uw = 1.60)			9.6300	1.5038	14.4812			(27)
Retained windows (Uw = 2.60)			18.7700	2.3551	44.2047			(27)
Retained entrance door			6.4300	2.8000	18.0040			(26a)
Rooflights (Uw = 1.60)			12.2100	1.5038	18.3609			(27a)
Heat Loss Floor FT1-3			60.5600	0.2500	15.1400			(28a)
Heat Loss Floor FT4-6			57.3200	0.2500	14.3300			(28a)
Heat Loss Floor FT7			4.4300	0.2500	1.1075			(28b)
External Wall WT1	34.3800	11.8300	22.5500	0.2800	6.3140			(29a)
External Wall WT7	247.9700	56.2000	191.7700	0.2800	53.6956			(29a)
External Wall WT2	28.9000	3.3700	25.5300	0.2800	7.1484			(29a)
External Wall WT3	19.5400		19.5400	0.2800	5.4712			(29a)
External Roof RT1	36.9200	2.6800	34.2400	0.1800	6.1632			(30)
External Roof RT2	6.4900		6.4900	0.1800	1.1682			(30)
External Roof RT3	76.5600	9.5300	67.0300	0.1800	12.0654			(30)
Total net area of external elements Aum(A, m2)			573.0700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		272.6468			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	85.9605	(36)
Total fabric heat loss (33) + (36) =	358.6073	(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	201.1491	197.9966	194.9066	180.3927	177.6772	165.0360	165.0360	162.6951	169.9052	177.6772	183.1706	188.9137	(38)
Heat transfer coeff	559.7564	556.6039	553.5139	539.0000	536.2844	523.6433	523.6433	521.3024	528.5125	536.2844	541.7779	547.5210	(39)
Average = Sum(39)m / 12 =												538.9869	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.9309	1.9200	1.9093	1.8593	1.8499	1.8063	1.8063	1.7982	1.8231	1.8499	1.8688	1.8887	(40)
HLP (average)												1.8592	(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	3.1188	(42)
Average daily hot water use (litres/day)	113.9700	(43)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	125.3670	120.8082	116.2494	111.6906	107.1318	102.5730	102.5730	107.1318	111.6906	116.2494	120.8082	125.3670	(44)
Energy conte	185.9156	162.6030	167.7917	146.2849	140.3638	121.1233	112.2386	128.7954	130.3336	151.8913	165.8012	180.0494	(45)
Energy content (annual)										Total = Sum(45)m =		1793.1919	(45)
Distribution loss (46)m = 0.15 x (45)m	27.8873	24.3905	25.1688	21.9427	21.0546	18.1685	16.8358	19.3193	19.5500	22.7837	24.8702	27.0074	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.8600	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.5444	(55)
Total storage loss	47.8764	43.2432	47.8764	46.3320	47.8764	46.3320	47.8764	47.8764	46.3320	47.8764	46.3320	47.8764	(56)
If cylinder contains dedicated solar storage	47.8764	43.2432	47.8764	46.3320	47.8764	46.3320	47.8764	47.8764	46.3320	47.8764	46.3320	47.8764	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	257.0544	226.8574	238.9305	215.1289	211.5026	189.9673	183.3774	199.9342	199.1776	223.0301	234.6452	251.1882	(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	257.0544	226.8574	238.9305	215.1289	211.5026	189.9673	183.3774	199.9342	199.1776	223.0301	234.6452	251.1882	(64)
								Total per year (kWh/year) = Sum(64)m =				2630.7939	(64)
Heat gains from water heating, kWh/month	118.7280	105.4690	112.7018	103.7149	103.5820	95.3487	94.2304	99.7355	98.4111	107.4149	110.2041	116.7775	(65)

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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	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	40.1208	35.6350	28.9803	21.9400	16.4004	13.8459	14.9610	19.4468	26.1015	33.1418	38.6814	41.2359	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	450.0337	454.7036	442.9355	417.8826	386.2578	356.5350	336.6783	332.0084	343.7765	368.8294	400.4542	430.1770	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	(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)	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	(71)
Water heating gains (Table 5)	159.5806	156.9479	151.4809	144.0485	139.2231	132.4288	126.6537	134.0531	136.6821	144.3748	153.0612	156.9589	(72)
Total internal gains	722.5171	720.0685	696.1787	656.6531	614.6633	575.5916	551.0750	558.2903	579.3421	619.1281	664.9788	701.1538	(73)

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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	
South	9.0700	46.7521	0.7200	0.7000	0.7700	148.1057	(78)
West	27.5000	19.6403	0.7200	0.7000	0.7700	188.6443	(80)
North	1.7200	10.6334	0.7200	0.7000	0.7700	6.3880	(74)
East	2.1500	19.6403	0.7200	0.7000	0.7700	14.7486	(76)
South	2.3900	46.7521	0.7200	0.7000	0.7700	39.0268	(78)
West	3.3700	19.6403	0.7200	0.7000	0.7700	23.1175	(80)
North	0.8100	10.6334	0.7600	0.7000	0.7700	3.1754	(74)
East	11.3900	19.6403	0.7600	0.7000	0.7700	82.4738	(76)
South	3.4600	46.7521	0.7600	0.7000	0.7700	59.6378	(78)
West	3.1100	19.6403	0.7600	0.7000	0.7700	22.5192	(80)
East	5.4300	26.4634	0.7200	0.7000	1.0000	65.1807	(82)
West	4.1000	26.4634	0.7200	0.7000	1.0000	49.2156	(82)
Horizontal	2.6800	26.0000	0.7200	0.7000	1.0000	31.6068	(82)

Solar gains	733.8403	1366.9837	2126.7861	2976.2745	3580.7893	3646.4455	3478.7271	3025.0776	2426.5224	1585.1913	901.5915	612.6650	(83)
Total gains	1456.3574	2087.0522	2822.9648	3632.9276	4195.4527	4222.0371	4029.8021	3583.3679	3005.8645	2204.3193	1566.5703	1313.8189	(84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.9655	36.1692	36.3712	37.3505	37.5397	38.4459	38.4459	38.6186	38.0917	37.5397	37.1590	36.7693	
alpha	3.3977	3.4113	3.4247	3.4900	3.5026	3.5631	3.5631	3.5746	3.5394	3.5026	3.4773	3.4513	
util living area	0.9985	0.9947	0.9817	0.9380	0.8398	0.6834	0.5355	0.6066	0.8482	0.9762	0.9966	0.9990	(86)
MIT	19.2415	19.4538	19.7996	20.2526	20.6075	20.8231	20.8926	20.8757	20.6863	20.1848	19.6399	19.2330	(87)
Th2 (88a)m	19.3798	19.3872	19.3945	19.4288	19.4353	19.4656	19.4656	19.4713	19.4539	19.4353	19.4222	19.4086	(88a)
ni2,m (89a)m	0.9979	0.9926	0.9744	0.9123	0.7735	0.5595	0.3654	0.4326	0.7556	0.9621	0.9950	0.9986	(89a)
MIT2 (90a)m	17.0865	17.4013	17.9077	18.5716	19.0374	19.2956	19.3457	19.3444	19.1652	18.4963	17.6984	17.0937	(90a)
Th2 (88b)m	20.0346	20.0400	20.0453	20.0704	20.0751	20.0969	20.0969	20.1009	20.0885	20.0751	20.0656	20.0557	(88b)
ni2,m (89b)m	0.9982	0.9935	0.9777	0.9241	0.8036	0.6147	0.4391	0.5095	0.7994	0.9689	0.9958	0.9987	(89b)
MIT2 (90b)m	18.3909	18.6071	18.9554	19.4199	19.7567	19.9596	20.0077	20.0029	19.8472	19.3632	18.8140	18.3993	(90b)
MIT 2	17.1810	17.4886	17.9836	18.6330	19.0895	19.3437	19.3936	19.3921	19.2146	18.5591	17.7792	17.1883	(90)
Living area fraction									fLA = Living area / (4) =			0.1715	(91)
MIT	17.5344	17.8257	18.2950	18.9108	19.3498	19.5975	19.6507	19.6465	19.4670	18.8379	18.0983	17.5390	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.5344	17.8257	18.2950	18.9108	19.3498	19.5975	19.6507	19.6465	19.4670	18.8379	18.0983	17.5390	(93)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9968	0.9895	0.9671	0.9011	0.7691	0.5715	0.3874	0.4547	0.7566	0.9541	0.9929	0.9978	(94)
Useful gains	1451.6984	2065.2179	2729.9628	3273.6906	3226.7705	2412.9225	1561.2702	1629.2382	2274.1450	2103.1674	1555.4512	1310.9252	(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													
	7408.0175	7194.4827	6528.7204	5395.8158	4102.4754	2616.8830	1597.4758	1692.4275	2836.5101	4417.8679	5958.6372	7303.3586	(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													
	4431.5014	3446.8659	2826.2756	1527.9301	651.5244	0.0000	0.0000	0.0000	0.0000	1722.1372	3170.2939	4458.3705	(98)
Space heating												22234.8991	(98)
Space heating per m2											(98) / (4) =	76.6985	(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)
Fraction of main heating from main system 2	0.0600	(203)
Fraction of total heating from main system 1	0.9400	(204)
Fraction of total heating from main system 2	0.0600	(205)
Efficiency of main space heating system 1 (in %)	170.0000	(206)
Efficiency of main space heating system 2 (in %)	100.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	12294.5913	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	4431.5014	3446.8659	2826.2756	1527.9301	651.5244	0.0000	0.0000	0.0000	0.0000	1722.1372	3170.2939	4458.3705	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	2450.3596	1905.9141	1562.7642	844.8555	360.2547	0.0000	0.0000	0.0000	0.0000	952.2406	1752.9860	2465.2166	(211)
Space heating efficiency (main heating system 2)													
	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(212)
Space heating fuel (main heating system 2)													
	265.8901	206.8120	169.5765	91.6758	39.0915	0.0000	0.0000	0.0000	0.0000	103.3282	190.2176	267.5022	(213)
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)
Space heating fuel used, main system 2												1334.0939	(213)
Water heating													
Water heating requirement													
	257.0544	226.8574	238.9305	215.1289	211.5026	189.9673	183.3774	199.9342	199.1776	223.0301	234.6452	251.1882	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	151.2085	133.4455	140.5474	126.5464	124.4133	111.7455	107.8690	117.6084	117.1633	131.1942	138.0266	147.7577	(219)
Water heating fuel used												1547.5258	(219)
Annual totals kWh/year													
Space heating fuel - main system												12294.5913	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												708.5464	(232)
Total delivered energy for all uses												15914.7574	(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	12294.5913	0.5190	6380.8929	(261)
Space heating - main system 2	1334.0939	0.5190	692.3948	(262)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1547.5258	0.5190	803.1659	(264)
Space and water heating			7876.4535	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	708.5464	0.5190	367.7356	(268)
Total CO2, kg/year			8259.7591	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			28.4900	(273)

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

DER		28.4900	ZC1
Total Floor Area	TFA	289.9000	
Assumed number of occupants	N	3.1188	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		9.1991	ZC2
CO2 emissions from cooking, equation (L16)		0.6687	ZC3
Total CO2 emissions		38.3577	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7

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Net CO2 emissions	38.3577 ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	60.5600 (1b)	x	2.3900 (2b)	=	144.7384	(1b) - (3b)
First floor	86.3200 (1c)	x	2.5000 (2c)	=	215.8000	(1c) - (3c)
Second floor	84.0900 (1d)	x	2.8800 (2d)	=	242.1792	(1d) - (3d)
Third floor	58.9300 (1e)	x	2.1100 (2e)	=	124.3423	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	289.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	727.0599	(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							4 * 10 =	40.0000	(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) =	40.0000 / (5) =	0.0550	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3050	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2364	(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	0.3014	0.2955	0.2896	0.2600	0.2541	0.2246	0.2246	0.2187	0.2364	0.2541	0.2659	0.2778	(22b)
Effective ac	0.5454	0.5437	0.5419	0.5338	0.5323	0.5252	0.5252	0.5239	0.5279	0.5323	0.5354	0.5386	(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 Semi-glazed door			6.4300	1.2000	7.7160			(26a)
TER Opening Type (Uw = 1.40)			55.5900	1.3258	73.6989			(27)
TER Room Window (Uw = 1.70)			10.4400	1.5918	16.6180			(27a)
Heat Loss Floor FT1-3			60.5600	0.1300	7.8728			(28a)
Heat Loss Floor FT4-6			57.3200	0.1300	7.4516			(28a)
Heat Loss Floor FT7			4.4300	0.1300	0.5759			(28b)
External Wall WT1	34.3800	10.1200	24.2600	0.1800	4.3668			(29a)
External Wall WT7	247.9700	49.0200	198.9500	0.1800	35.8110			(29a)
External Wall WT2	28.9000	2.8800	26.0200	0.1800	4.6836			(29a)
External Wall WT3	19.5400		19.5400	0.1800	3.5172			(29a)
External Roof RT1	36.9200	2.2900	34.6300	0.1300	4.5019			(30)
External Roof RT2	6.4900		6.4900	0.1300	0.8437			(30)
External Roof RT3	76.5600	8.1500	68.4100	0.1300	8.8933			(30)
Total net area of external elements Aum(A, m2)			573.0700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		176.5506			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	28.6535	(36)
Total fabric heat loss (33) + (36) =	205.2041	(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	130.8623	130.4391	130.0244	128.0761	127.7116	126.0148	126.0148	125.7006	126.6684	127.7116	128.4490	129.2199	(38)
Heat transfer coeff	336.0664	335.6433	335.2285	333.2803	332.9158	331.2190	331.2190	330.9047	331.8725	332.9158	333.6532	334.4241	(39)
Average = Sum(39)m / 12 =												333.2785	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1592	1.1578	1.1564	1.1496	1.1484	1.1425	1.1425	1.1414	1.1448	1.1484	1.1509	1.1536	(40)
HLP (average)												1.1496	(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	3.1188 (42)
Average daily hot water use (litres/day)	108.2715 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
Daily hot water use
               119.0986   114.7678   110.4369   106.1061   101.7752    97.4443    97.4443   101.7752   106.1061   110.4369   114.7678   119.0986 (44)
Energy conte   176.6199   154.4729   159.4021   138.9707   133.3457   115.0672   106.6266   122.3556   123.8169   144.2967   157.5111   171.0469 (45)
Energy content (annual)                                                                                         Total = Sum(45)m =        1703.5323 (45)
Distribution loss  (46)m = 0.15 x (45)m
                26.4930    23.1709    23.9103    20.8456    20.0018    17.2601    15.9940    18.3533    18.5725    21.6445    23.6267    25.6570 (46)
Water storage loss:
Store volume                                                                                                                           300.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                            2.1127 (48)
  Temperature factor from Table 2b                                                                                                       0.5400 (49)
Enter (49) or (54) in (55)                                                                                                               1.1409 (55)
Total storage loss
                35.3664    31.9439    35.3664    34.2256    35.3664    34.2256    35.3664    35.3664    34.2256    35.3664    34.2256    35.3664 (56)
If cylinder contains dedicated solar storage
                35.3664    31.9439    35.3664    34.2256    35.3664    34.2256    35.3664    35.3664    34.2256    35.3664    34.2256    35.3664 (57)
Primary loss    23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
               235.2487   207.4279   218.0310   195.7082   191.9745   171.8047   165.2555   180.9844   180.5545   202.9255   214.2487   229.6757 (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
               235.2487   207.4279   218.0310   195.7082   191.9745   171.8047   165.2555   180.9844   180.5545   202.9255   214.2487   229.6757 (64)
                                                                                               Total per year (kWh/year) = Sum(64)m =  2393.8393 (64)
Heat gains from water heating, kWh/month
               105.6292    93.7263    99.9043    91.5978    91.2405    83.6499    82.3564    87.5863    86.5592    94.8817    97.7625   103.7761 (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          155.9400   155.9400   155.9400   155.9400   155.9400   155.9400   155.9400   155.9400   155.9400   155.9400   155.9400   155.9400 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                40.1208    35.6350    28.9803    21.9400    16.4004    13.8459    14.9610    19.4468    26.1015    33.1418    38.6814    41.2359 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               450.0337   454.7036   442.9355   417.8826   386.2578   356.5350   336.6783   332.0084   343.7765   368.8294   400.4542   430.1770 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                38.5940    38.5940    38.5940    38.5940    38.5940    38.5940    38.5940    38.5940    38.5940    38.5940    38.5940    38.5940 (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)
              -124.7520  -124.7520  -124.7520  -124.7520  -124.7520  -124.7520  -124.7520  -124.7520  -124.7520  -124.7520  -124.7520  -124.7520 (71)
Water heating gains (Table 5)
               141.9747   139.4736   134.2799   127.2192   122.6351   116.1804   110.6941   117.7235   120.2211   127.5292   135.7813   139.4841 (72)
Total internal gains
               704.9112   702.5942   678.9777   639.8237   598.0753   559.3433   535.1154   541.9607   562.8811   602.2824   647.6988   683.6790 (73)


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6. Solar gains
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[Jan]                                        Area        Solar flux              g               FF            Access               Gains
                                               m2          Table 6a    Specific data   Specific data           factor                   W
                                                               W/m2      or Table 6b     or Table 6c         Table 6d
----------------------------------------------------------------------------------------------------
North                                      2.1600           10.6334           0.6300          0.7000           0.7700              7.0194 (74)
East                                      11.5900           19.6403           0.6300          0.7000           0.7700             69.5669 (76)
South                                     12.7700           46.7521           0.6300          0.7000           0.7700            182.4583 (78)
West                                      29.0700           19.6403           0.6300          0.7000           0.7700            174.4874 (80)
East                                       4.6400           26.4634           0.6300          0.7000           1.0000             48.7355 (82)
West                                       3.5100           26.4634           0.6300          0.7000           1.0000             36.8667 (82)
Horizontal                                 2.2900           26.0000           0.6300          0.7000           1.0000             23.6314 (82)
----------------------------------------------------------------------------------------------------

Solar gains    542.7656  1011.1629  1573.4465  2202.2870  2649.8972  2698.6103  2574.4365  2238.5143  1795.3234  1172.6416   666.8586   453.1282 (83)
Total gains   1247.6767  1713.7570  2252.4242  2842.1107  3247.9725  3257.9536  3109.5519  2780.4751  2358.2045  1774.9240  1314.5574  1136.8071 (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             59.9047    59.9802    60.0544    60.4054    60.4716    60.7814    60.7814    60.8391    60.6617    60.4716    60.3379    60.1988
alpha            4.9936     4.9987     5.0036     5.0270     5.0314     5.0521     5.0521     5.0559     5.0441     5.0314     5.0225     5.0133
util living area
                 0.9996     0.9978     0.9885     0.9421     0.8136     0.6227     0.4632     0.5354     0.8221     0.9828     0.9987     0.9997 (86)

MIT             19.5882    19.8050    20.1475    20.5610    20.8530    20.9704    20.9945    20.9891    20.8861    20.4433    19.9230    19.5490 (87)
Th 2            19.9527    19.9539    19.9551    19.9605    19.9615    19.9663    19.9663    19.9671    19.9644    19.9615    19.9595    19.9573 (88)
util rest of house
                 0.9994     0.9970     0.9842     0.9217     0.7581     0.5336     0.3573     0.4213     0.7456     0.9738     0.9982     0.9996 (89)
MIT 2           18.0516    18.3694    18.8681    19.4544    19.8247    19.9478    19.9643    19.9629    19.8751    19.3026    18.5465    17.9974 (90)
Living area fraction                                                                                   fLA = Living area / (4) =         0.1715 (91)
MIT             18.3152    18.6157    19.0875    19.6442    20.0011    20.1232    20.1410    20.1389    20.0485    19.4983    18.7826    18.2635 (92)
Temperature adjustment                                                                                                                   0.0000
adjusted MIT    18.3152    18.6157    19.0875    19.6442    20.0011    20.1232    20.1410    20.1389    20.0485    19.4983    18.7826    18.2635 (93)


----------------------------------------------------------------------------------------------------
8. Space heating requirement
----------------------------------------------------------------------------------------------------

                    Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9990     0.9955     0.9794     0.9141     0.7604     0.5478     0.3755     0.4408     0.7527     0.9681     0.9972     0.9994 (94)
Useful gains  1246.4698  1706.0351  2205.9477  2597.9053  2469.7811  1784.5715  1167.5374  1225.6763  1774.9825  1718.2876  1310.8433  1136.1090 (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)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Heat loss rate W													
	4710.0292	4603.5670	4219.6887	3580.8177	2763.5599	1829.3864	1172.8519	1237.2094	1974.1524	2962.3740	3897.9235	4703.1860	(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													
	2576.8882	1947.1414	1498.2233	707.6969	218.5714	0.0000	0.0000	0.0000	0.0000	925.6003	1862.6977	2653.9052	(98)
Space heating												12390.7246	(98)
Space heating per m2											(98) / (4) =	42.7414	(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)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												13252.1118	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2576.8882	1947.1414	1498.2233	707.6969	218.5714	0.0000	0.0000	0.0000	0.0000	925.6003	1862.6977	2653.9052	(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)													
	2756.0302	2082.5042	1602.3779	756.8951	233.7662	0.0000	0.0000	0.0000	0.0000	989.9468	1992.1901	2838.4013	(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													
Water heating requirement													
	235.2487	207.4279	218.0310	195.7082	191.9745	171.8047	165.2555	180.9844	180.5545	202.9255	214.2487	229.6757	(64)
Efficiency of water heater												79.8000	(216)
(217)m	89.4961	89.3466	88.9842	87.9454	85.1605	79.8000	79.8000	79.8000	79.8000	88.3694	89.2653	89.5437	(217)
Fuel for water heating, kWh/month													
	262.8590	232.1608	245.0220	222.5337	225.4267	215.2941	207.0870	226.7975	226.2588	229.6333	240.0134	256.4957	(219)
Water heating fuel used												2789.5822	(219)
Annual totals kWh/year													
Space heating fuel - main system												13252.1118	(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)												708.5464	(232)
Total delivered energy for all uses												16825.2404	(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	13252.1118	0.2160	2862.4562	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2789.5822	0.2160	602.5498	(264)
Space and water heating			3465.0059	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	708.5464	0.5190	367.7356	(268)
Total CO2, kg/m2/year			3871.6665	(272)
Emissions per m2 for space and water heating			11.9524	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.2685	(272b)
Emissions per m2 for pumps and fans			0.1343	(272c)
Target Carbon Dioxide Emission Rate (TER) = (11.9524 * 1.55) + 1.2685 + 0.1343, rounded to 2 d.p.			19.9300	(273)

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

Design SAP
elmhurst energy

Property Reference	4554-E3-PSAP-HOLLY WALK HOUSE	**Issued on Date**	21/04/2020
Assessment Reference	001 ASHP	**Prop Type Ref**	4554-E3-PSAP-HOLLY WALK HOUSE
Property	11, Holly Walk, LONDON, NW3 6RA		

SAP Rating	74 C	**DER**	20.86	**TER**	19.93
Environmental	77 C	**% DER<TER**	-4.67		
CO_2 Emissions (t/year)	5.09	**DFEE**	77.92	**TFEE**	55.27
General Requirements Compliance	Fail	**% DFEE<TFEE**	-40.97		

Assessor Details	Mr. Michael Andrews, Energy Saving Experts Ltd, Tel: 01225 862266, mike@energy-saving-experts.com	**Assessor ID**	N388-0001
Client			

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Detached House, total floor area 290 m²

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:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 19.93 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 20.86 kgCO□/m²Fail
Excess emissions =0.93 kgCO□/m² (4.7%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)77.9 kWh/m²/yrFail
Excess energy =22.6 kWh/m²/yr (40.9%)
---
2 Fabric U-values

Element	Average	Highest	
External wall	0.26 (max. 0.30)	0.26 (max. 0.70)	OK
Floor	0.16 (max. 0.25)	0.23 (max. 0.70)	OK
Roof	0.28 (max. 0.20)	0.34 (max. 0.35)	Fail
Openings	1.79 (max. 2.00)	2.80 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15
---
3 Air permeability
Air permeability at 50 pascals: 15.00 (assumed) OK
---
4 Heating efficiency
Main heating system 1: Heat pump with radiators or underfloor - Electric
Mitsubishi ECODAN 14kW PUHZ-HW140-VHA(2)-BS

Main heating system 2: Electric underfloor heating - Electric
Underfloor heating in thin screed (standard tariff)

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage Nominal cylinder loss: 2.55 kWh/day
Permitted by DBSCG 2.86 OK
Primary pipework insulated: Yes OK
---
6 Controls
Space heating controls 1: Time and temperature zone control OK

Space heating controls 2: Programmer and room thermostat Fail

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 2.53 m², No overhang
Windows facing East: 13.54 m², No overhang
Windows facing South: 14.92 m², No overhang
Windows facing West: 33.98 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
None

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	60.5600 (1b)	x	2.3900 (2b)	=	144.7384	(1b) - (3b)
First floor	86.3200 (1c)	x	2.5000 (2c)	=	215.8000	(1c) - (3c)
Second floor	84.0900 (1d)	x	2.8800 (2d)	=	242.1792	(1d) - (3d)
Third floor	58.9300 (1e)	x	2.1100 (2e)	=	124.3423	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	289.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	727.0599	(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							6 * 10 =	60.0000	(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) =	60.0000 / (5) =	0.0825	(8)
Pressure test		No	
Measured/design AP50		15.0000	
Infiltration rate		0.8325	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.6452	(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	0.8226	0.8065	0.7904	0.7097	0.6936	0.6129	0.6129	0.5968	0.6452	0.6936	0.7259	0.7581	(22b)
Effective ac	0.8384	0.8252	0.8123	0.7519	0.7405	0.6879	0.6879	0.6781	0.7081	0.7405	0.7634	0.7874	(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	
Alu doors (Uw = 1.40)			36.5700	1.3258	48.4830			(27)
New timber windows (Uw = 1.60)			9.6300	1.5038	14.4812			(27)
Retained windows (Uw = 2.60)			18.7700	2.3551	44.2047			(27)
Retained entrance door			6.4300	2.8000	18.0040			(26a)
Rooflights (Uw = 1.30)			12.2100	1.2357	15.0884			(27a)
Heat Loss Floor FT1-3			60.5600	0.1400	8.4784			(28a)
Heat Loss Floor FT4-6			57.3200	0.1800	10.3176			(28a)
Heat Loss Floor FT7			4.4300	0.2300	1.0189			(28b)
External Wall WT1	34.3800	11.8300	22.5500	0.2600	5.8630			(29a)
External Wall WT7	247.9700	56.2000	191.7700	0.2600	49.8602			(29a)
External Wall WT2	28.9000	3.3700	25.5300	0.2600	6.6378			(29a)
External Wall WT3	19.5400		19.5400	0.2600	5.0804			(29a)
External Roof RT1	36.9200	2.6800	34.2400	0.1700	5.8208			(30)
External Roof RT2	6.4900		6.4900	0.2300	1.4927			(30)
External Roof RT3	76.5600	9.5300	67.0300	0.3400	22.7902			(30)
Total net area of external elements Aum(A, m2)			573.0700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		257.6213			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	85.9605	(36)
Total fabric heat loss (33) + (36) =	343.5818	(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	201.1491	197.9966	194.9066	180.3927	177.6772	165.0360	165.0360	162.6951	169.9052	177.6772	183.1706	188.9137	(38)
Heat transfer coeff	544.7309	541.5784	538.4883	523.9744	521.2589	508.6178	508.6178	506.2768	513.4870	521.2589	526.7524	532.4955	(39)
Average = Sum(39)m / 12 =												523.9614	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8790	1.8682	1.8575	1.8074	1.7981	1.7545	1.7545	1.7464	1.7713	1.7981	1.8170	1.8368	(40)
HLP (average)												1.8074	(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	3.1188	(42)
Average daily hot water use (litres/day)	113.9700	(43)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	125.3670	120.8082	116.2494	111.6906	107.1318	102.5730	102.5730	107.1318	111.6906	116.2494	120.8082	125.3670	(44)
Energy conte	185.9156	162.6030	167.7917	146.2849	140.3638	121.1233	112.2386	128.7954	130.3336	151.8913	165.8012	180.0494	(45)
Energy content (annual)										Total = Sum(45)m =		1793.1919	(45)
Distribution loss (46)m = 0.15 x (45)m	27.8873	24.3905	25.1688	21.9427	21.0546	18.1685	16.8358	19.3193	19.5500	22.7837	24.8702	27.0074	(46)
Water storage loss:													
Store volume												300.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.7368	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												1.3784	(55)
Total storage loss	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(56)
If cylinder contains dedicated solar storage	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	251.9070	222.2081	233.7831	210.1475	206.3552	184.9859	178.2299	194.7868	194.1962	217.8826	229.6638	246.0407	(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	251.9070	222.2081	233.7831	210.1475	206.3552	184.9859	178.2299	194.7868	194.1962	217.8826	229.6638	246.0407	(64)
								Total per year (kWh/year) = Sum(64)m =				2570.1871	(64)
Heat gains from water heating, kWh/month	114.6101	101.7496	108.5839	99.7298	99.4641	91.3636	90.1124	95.6176	94.4260	103.2969	106.2190	112.6595	(65)

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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	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	40.1208	35.6350	28.9803	21.9400	16.4004	13.8459	14.9610	19.4468	26.1015	33.1418	38.6814	41.2359	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	450.0337	454.7036	442.9355	417.8826	386.2578	356.5350	336.6783	332.0084	343.7765	368.8294	400.4542	430.1770	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	(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)	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	(71)
Water heating gains (Table 5)	154.0458	151.4131	145.9460	138.5136	133.6883	126.8939	121.1189	128.5182	131.1473	138.8400	147.5264	151.4241	(72)
Total internal gains	713.9823	711.5336	687.6438	648.1182	606.1285	567.0568	542.5401	549.7554	570.8072	610.5932	656.4440	692.6190	(73)

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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	
South	9.0700	46.7521	0.7200	0.7000	0.7700	148.1057	(78)
West	27.5000	19.6403	0.7200	0.7000	0.7700	188.6443	(80)
North	1.7200	10.6334	0.7200	0.7000	0.7700	6.3880	(74)
East	2.1500	19.6403	0.7200	0.7000	0.7700	14.7486	(76)
South	2.3900	46.7521	0.7200	0.7000	0.7700	39.0268	(78)
West	3.3700	19.6403	0.7200	0.7000	0.7700	23.1175	(80)
North	0.8100	10.6334	0.7600	0.7000	0.7700	3.1754	(74)
East	11.3900	19.6403	0.7600	0.7000	0.7700	82.4738	(76)
South	3.4600	46.7521	0.7600	0.7000	0.7700	59.6378	(78)
West	3.1100	19.6403	0.7600	0.7000	0.7700	22.5192	(80)
East	5.4300	26.4634	0.7200	0.7000	1.0000	65.1807	(82)
West	4.1000	26.4634	0.7200	0.7000	1.0000	49.2156	(82)
Horizontal	2.6800	26.0000	0.7200	0.7000	1.0000	31.6068	(82)

Solar gains	733.8403	1366.9837	2126.7861	2976.2745	3580.7893	3646.4455	3478.7271	3025.0776	2426.5224	1585.1913	901.5915	612.6650	(83)
Total gains	1447.8225	2078.5174	2814.4299	3624.3927	4186.9178	4213.5023	4021.2672	3574.8331	2997.3297	2195.7845	1558.0354	1305.2840	(84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.9576	37.1727	37.3860	38.4216	38.6218	39.5817	39.5817	39.7647	39.2063	38.6218	38.2190	37.8068	
alpha	3.4638	3.4782	3.4924	3.5614	3.5748	3.6388	3.6388	3.6510	3.6138	3.5748	3.5479	3.5205	
util living area	0.9986	0.9948	0.9817	0.9366	0.8347	0.6741	0.5252	0.5965	0.8435	0.9761	0.9967	0.9990	(86)
Tweekday	18.2236	18.4696	18.8637	19.3850	19.7579	19.9749	20.0246	20.0196	19.8532	19.3140	18.6961	18.2309	
Tweekend	19.8887	20.0259	20.2481	20.5378	20.7611	20.8933	20.9342	20.9243	20.8085	20.4907	20.1428	19.8836	
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9	
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th2 (88a)m	19.4152	19.4227	19.4300	19.4648	19.4714	19.5021	19.5021	19.5078	19.4902	19.4714	19.4581	19.4443	(88a)
ni2,m (89a)m	0.9980	0.9928	0.9744	0.9107	0.7683	0.5525	0.3609	0.4275	0.7510	0.9621	0.9952	0.9987	(89a)
MIT2 (90a)m	19.4152	19.4227	19.4300	19.4648	19.4714	19.5021	19.5021	19.5078	19.4902	19.4714	19.4581	19.4443	(90a)
Th2 (88b)m	20.0605	20.0659	20.0713	20.0963	20.1010	20.1228	20.1228	20.1268	20.1144	20.1010	20.0915	20.0816	(88b)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

ni2,m (89b)m	0.9983	0.9937	0.9777	0.9226	0.7986	0.6067	0.4322	0.5023	0.7948	0.9688	0.9959	0.9988	(89b)
MIT2 (90b)m	18.4512	18.6673	19.0133	19.4731	19.8004	19.9933	20.0368	20.0329	19.8856	19.4115	18.8690	18.4602	(90b)
Tweekday	18.2236	18.4696	18.8637	19.3850	19.7579	19.9749	20.0246	20.0196	19.8532	19.3140	18.6961	18.2309	
Tweekend	19.0201	19.1618	19.3873	19.6934	19.9067	20.0390	20.0672	20.0661	19.9664	19.6553	19.3012	19.0334	
MIT 2	19.3454	19.3680	19.3999	19.4654	19.4952	19.5376	19.5408	19.5458	19.5188	19.4670	19.4154	19.3731	(90)
Living area fraction										fLA = Living area / (4) =		0.1715	(91)
MIT	19.6292	19.6479	19.6743	19.7286	19.7533	19.7884	19.7910	19.7952	19.7729	19.7299	19.6872	19.6521	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6292	19.6479	19.6743	19.7286	19.7533	19.7884	19.7910	19.7952	19.7729	19.7299	19.6872	19.6521	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9981	0.9931	0.9757	0.9159	0.7824	0.5782	0.3946	0.4630	0.7719	0.9651	0.9955	0.9987	(94)
Useful gains	1445.0539	2064.2475	2746.1111	3319.6101	3275.9588	2436.1087	1586.8366	1655.2052	2313.7457	2119.0863	1551.0315	1303.6019	(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	8350.2676	7987.1331	7094.2005	5673.9089	4197.8407	2638.9293	1623.0226	1718.9137	2912.9373	4759.0617	6630.3436	8228.1704	(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	5137.4790	3980.1791	3234.9785	1695.0952	685.8802	0.0000	0.0000	0.0000	0.0000	1964.1417	3657.1047	5151.8790	(98)
Space heating												25506.7373	(98)
Space heating per m2											(98) / (4) =	87.9846	(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)
Fraction of main heating from main system 2	0.0600	(203)
Fraction of total heating from main system 1	0.9400	(204)
Fraction of total heating from main system 2	0.0600	(205)
Efficiency of main space heating system 1 (in %)	334.1939	(206)
Efficiency of main space heating system 2 (in %)	100.0000	(207)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	7174.3770	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	5137.4790	3980.1791	3234.9785	1695.0952	685.8802	0.0000	0.0000	0.0000	0.0000	1964.1417	3657.1047	5151.8790	(98)
Space heating efficiency (main heating system 1)	334.1939	334.1939	334.1939	334.1939	334.1939	0.0000	0.0000	0.0000	0.0000	334.1939	334.1939	334.1939	(210)
Space heating fuel (main heating system)	1445.0382	1119.5201	909.9147	476.7859	192.9201	0.0000	0.0000	0.0000	0.0000	552.4616	1028.6477	1449.0886	(211)
Space heating efficiency (main heating system 2)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(212)
Space heating fuel (main heating system 2)	308.2487	238.8107	194.0987	101.7057	41.1528	0.0000	0.0000	0.0000	0.0000	117.8485	219.4263	309.1127	(213)
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)
Space heating fuel used, main system 2												1530.4042	(213)

Water heating													
Water heating requirement	251.9070	222.2081	233.7831	210.1475	206.3552	184.9859	178.2299	194.7868	194.1962	217.8826	229.6638	246.0407	(64)
Efficiency of water heater												114.8400	(216)
(217)m	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	(217)
Fuel for water heating, kWh/month	219.3548	193.4937	203.5729	182.9916	179.6893	161.0815	155.1985	169.6158	169.1016	189.7271	199.9859	214.2466	(219)
Water heating fuel used												2238.0591	(219)
Annual totals kWh/year													
Space heating fuel - main system												7174.3770	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												708.5464	(232)
Total delivered energy for all uses												11651.3867	(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	7174.3770	0.5190	3723.5016	(261)
Space heating - main system 2	1530.4042	0.5190	794.2798	(262)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	2238.0591	0.5190	1161.5527	(264)
Space and water heating			5679.3341	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	708.5464	0.5190	367.7356	(268)
Total CO2, kg/year			6047.0697	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			20.8600	(273)

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

DER	20.8600	ZC1
Total Floor Area	TFA 289.9000	

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Assumed number of occupants	N	3.1188	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		9.1991	ZC2
CO2 emissions from cooking, equation (L16)		0.6687	ZC3
Total CO2 emissions		30.7277	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		30.7277	ZC8

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	60.5600 (1b)	x	2.3900 (2b)	=	144.7384	(1b) - (3b)
First floor	86.3200 (1c)	x	2.5000 (2c)	=	215.8000	(1c) - (3c)
Second floor	84.0900 (1d)	x	2.8800 (2d)	=	242.1792	(1d) - (3d)
Third floor	58.9300 (1e)	x	2.1100 (2e)	=	124.3423	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	289.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	727.0599	(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							4 * 10 =	40.0000	(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) =	40.0000 / (5) =	0.0550	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3050	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2364	(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	0.3014	0.2955	0.2896	0.2600	0.2541	0.2246	0.2246	0.2187	0.2364	0.2541	0.2659	0.2778	(22b)
Effective ac	0.5454	0.5437	0.5419	0.5338	0.5323	0.5252	0.5252	0.5239	0.5279	0.5323	0.5354	0.5386	(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 Semi-glazed door			6.4300	1.2000	7.7160			(26a)
TER Opening Type (Uw = 1.40)			55.5900	1.3258	73.6989			(27)
TER Room Window (Uw = 1.70)			10.4400	1.5918	16.6180			(27a)
Heat Loss Floor FT1-3			60.5600	0.1300	7.8728			(28a)
Heat Loss Floor FT4-6			57.3200	0.1300	7.4516			(28a)
Heat Loss Floor FT7			4.4300	0.1300	0.5759			(28b)
External Wall WT1	34.3800	10.1200	24.2600	0.1800	4.3668			(29a)
External Wall WT7	247.9700	49.0200	198.9500	0.1800	35.8110			(29a)
External Wall WT2	28.9000	2.8800	26.0200	0.1800	4.6836			(29a)
External Wall WT3	19.5400		19.5400	0.1800	3.5172			(29a)
External Roof RT1	36.9200	2.2900	34.6300	0.1300	4.5019			(30)
External Roof RT2	6.4900		6.4900	0.1300	0.8437			(30)
External Roof RT3	76.5600	8.1500	68.4100	0.1300	8.8933			(30)
Total net area of external elements Aum(A, m2)			573.0700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		176.5506			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	28.6535	(36)
Total fabric heat loss (33) + (36) =	205.2041	(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	130.8623	130.4391	130.0244	128.0761	127.7116	126.0148	126.0148	125.7006	126.6684	127.7116	128.4490	129.2199	(38)
Heat transfer coeff	336.0664	335.6433	335.2285	333.2803	332.9158	331.2190	331.2190	330.9047	331.8725	332.9158	333.6532	334.4241	(39)
Average = Sum(39)m / 12 =												333.2785	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1592	1.1578	1.1564	1.1496	1.1484	1.1425	1.1425	1.1414	1.1448	1.1484	1.1509	1.1536	(40)
HLP (average)												1.1496	(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	3.1188 (42)
Average daily hot water use (litres/day)	108.2715 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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Daily hot water use													
	119.0986	114.7678	110.4369	106.1061	101.7752	97.4443	97.4443	101.7752	106.1061	110.4369	114.7678	119.0986	(44)
Energy conte	176.6199	154.4729	159.4021	138.9707	133.3457	115.0672	106.6266	122.3556	123.8169	144.2967	157.5111	171.0469	(45)
Energy content (annual)										Total = Sum(45)m =		1703.5323	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.4930	23.1709	23.9103	20.8456	20.0018	17.2601	15.9940	18.3533	18.5725	21.6445	23.6267	25.6570	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1127	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1409	(55)
Total storage loss													
	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(56)
If cylinder contains dedicated solar storage													
	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	235.2487	207.4279	218.0310	195.7082	191.9745	171.8047	165.2555	180.9844	180.5545	202.9255	214.2487	229.6757	(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													
	235.2487	207.4279	218.0310	195.7082	191.9745	171.8047	165.2555	180.9844	180.5545	202.9255	214.2487	229.6757	(64)
								Total per year (kWh/year) = Sum(64)m =				2393.8393	(64)
Heat gains from water heating, kWh/month													
	105.6292	93.7263	99.9043	91.5978	91.2405	83.6499	82.3564	87.5863	86.5592	94.8817	97.7625	103.7761	(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	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	155.9400	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	40.1208	35.6350	28.9803	21.9400	16.4004	13.8459	14.9610	19.4468	26.1015	33.1418	38.6814	41.2359	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	450.0337	454.7036	442.9355	417.8826	386.2578	356.5350	336.6783	332.0084	343.7765	368.8294	400.4542	430.1770	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	38.5940	(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)													
	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	-124.7520	(71)
Water heating gains (Table 5)													
	141.9747	139.4736	134.2799	127.2192	122.6351	116.1804	110.6941	117.7235	120.2211	127.5292	135.7813	139.4841	(72)
Total internal gains													
	704.9112	702.5942	678.9777	639.8237	598.0753	559.3433	535.1154	541.9607	562.8811	602.2824	647.6988	683.6790	(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	
North	2.1600	10.6334	0.6300	0.7000	0.7700	7.0194	(74)
East	11.5900	19.6403	0.6300	0.7000	0.7700	69.5669	(76)
South	12.7700	46.7521	0.6300	0.7000	0.7700	182.4583	(78)
West	29.0700	19.6403	0.6300	0.7000	0.7700	174.4874	(80)
East	4.6400	26.4634	0.6300	0.7000	1.0000	48.7355	(82)
West	3.5100	26.4634	0.6300	0.7000	1.0000	36.8667	(82)
Horizontal	2.2900	26.0000	0.6300	0.7000	1.0000	23.6314	(82)

Solar gains	542.7656	1011.1629	1573.4465	2202.2870	2649.8972	2698.6103	2574.4365	2238.5143	1795.3234	1172.6416	666.8586	453.1282	(83)
Total gains	1247.6767	1713.7570	2252.4242	2842.1107	3247.9725	3257.9536	3109.5519	2780.4751	2358.2045	1774.9240	1314.5574	1136.8071	(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	59.9047	59.9802	60.0544	60.4054	60.4716	60.7814	60.7814	60.8391	60.6617	60.4716	60.3379	60.1988	
alpha	4.9936	4.9987	5.0036	5.0270	5.0314	5.0521	5.0521	5.0559	5.0441	5.0314	5.0225	5.0133	
util living area													
	0.9996	0.9978	0.9885	0.9421	0.8136	0.6227	0.4632	0.5354	0.8221	0.9828	0.9987	0.9997	(86)
MIT	19.5882	19.8050	20.1475	20.5610	20.8530	20.9704	20.9945	20.9891	20.8861	20.4433	19.9230	19.5490	(87)
Th 2	19.9527	19.9539	19.9551	19.9605	19.9615	19.9663	19.9663	19.9671	19.9644	19.9615	19.9595	19.9573	(88)
util rest of house													
	0.9994	0.9970	0.9842	0.9217	0.7581	0.5336	0.3573	0.4213	0.7456	0.9738	0.9982	0.9996	(89)
MIT 2	18.0516	18.3694	18.8681	19.4544	19.8247	19.9478	19.9643	19.9629	19.8751	19.3026	18.5465	17.9974	(90)
Living area fraction									fLA = Living area / (4) =			0.1715	(91)
MIT	18.3152	18.6157	19.0875	19.6442	20.0011	20.1232	20.1410	20.1389	20.0485	19.4983	18.7826	18.2635	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3152	18.6157	19.0875	19.6442	20.0011	20.1232	20.1410	20.1389	20.0485	19.4983	18.7826	18.2635	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9990	0.9955	0.9794	0.9141	0.7604	0.5478	0.3755	0.4408	0.7527	0.9681	0.9972	0.9994	(94)
Useful gains	1246.4698	1706.0351	2205.9477	2597.9053	2469.7811	1784.5715	1167.5374	1225.6763	1774.9825	1718.2876	1310.8433	1136.1090	(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)

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Heat loss rate W													
	4710.0292	4603.5670	4219.6887	3580.8177	2763.5599	1829.3864	1172.8519	1237.2094	1974.1524	2962.3740	3897.9235	4703.1860	(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													
	2576.8882	1947.1414	1498.2233	707.6969	218.5714	0.0000	0.0000	0.0000	0.0000	925.6003	1862.6977	2653.9052	(98)
Space heating												12390.7246	(98)
Space heating per m2											(98) / (4) =	42.7414	(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)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												13252.1118	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2576.8882	1947.1414	1498.2233	707.6969	218.5714	0.0000	0.0000	0.0000	0.0000	925.6003	1862.6977	2653.9052	(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)													
	2756.0302	2082.5042	1602.3779	756.8951	233.7662	0.0000	0.0000	0.0000	0.0000	989.9468	1992.1901	2838.4013	(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													
Water heating requirement													
	235.2487	207.4279	218.0310	195.7082	191.9745	171.8047	165.2555	180.9844	180.5545	202.9255	214.2487	229.6757	(64)
Efficiency of water heater												79.8000	(216)
(217)m	89.4961	89.3466	88.9842	87.9454	85.1605	79.8000	79.8000	79.8000	79.8000	88.3694	89.2653	89.5437	(217)
Fuel for water heating, kWh/month													
	262.8590	232.1608	245.0220	222.5337	225.4267	215.2941	207.0870	226.7975	226.2588	229.6333	240.0134	256.4957	(219)
Water heating fuel used												2789.5822	(219)
Annual totals kWh/year													
Space heating fuel - main system												13252.1118	(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)												708.5464	(232)
Total delivered energy for all uses												16825.2404	(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	13252.1118	0.2160	2862.4562	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2789.5822	0.2160	602.5498	(264)
Space and water heating			3465.0059	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	708.5464	0.5190	367.7356	(268)
Total CO2, kg/m2/year			3871.6665	(272)
Emissions per m2 for space and water heating			11.9524	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.2685	(272b)
Emissions per m2 for pumps and fans			0.1343	(272c)
Target Carbon Dioxide Emission Rate (TER) = (11.9524 * 1.55) + 1.2685 + 0.1343, rounded to 2 d.p.			19.9300	(273)