

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.51
Printed on 01 July 2022 at 09:53:42

Project Information:

Assessed By: Ben Tunningley (STRO027495) **Building Type:** Semi-detached House

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 88.52m²

Site Reference : Chain Road

Plot Reference: Plot 012

Address : Plot 012, Chain Road, Manchester, M9

Client Details:

Name: Great Places

Address :

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 system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 18.21 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 17.55 kg/m² **OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 54.6 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 47.8 kWh/m² **OK**

2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.09 (max. 0.20)	0.09 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals 5.00 (design value)
Maximum 10.0 **OK**

4 Heating efficiency

Main Heating system: Database: (rev 500, product index 018119):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Vaillant
Model: ecoTEC sustain 28
Model qualifier: VUW 286/7-2 (H-GB)
(Combi)
Efficiency 89.1 % SEDBUK2009
Minimum 88.0 % **OK**

Secondary heating system: None

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5 Cylinder insulation

Hot water Storage: No cylinder

6 Controls

Space heating controls: Programmer, room thermostat and TRVs **OK**
 Hot water controls: No cylinder thermostat

No cylinder
 Boiler interlock: Yes **OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings 100.0%
 Minimum 75.0% **OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (West Pennines): Slight **OK**

Based on:

Overshading: Very Little
 Windows facing: North East 6.83m²
 Windows facing: South West 9.75m²
 Windows facing: North West 2.42m²
 Ventilation rate: 4.00
 Blinds/curtains: None

10 Key features

Roofs U-value 0.09 W/m²K
 Party Walls U-value 0 W/m²K

Code for Sustainable Homes Report

For use with Nov 2010 addendum 2014 England

Assessor and House Details

Assessor Name:	Ben Tunningley	Assessor Number:	STRO027495
Property Address:	Plot 012 Chain Road Manchester M9		

Buiding regulation assessment

	kg/m ² /year
TER	18.21
DER	17.55

ENE 1 Assessment - Dwelling Emission Rate

Total Energy Type CO₂ Emissions for Codes Levels 1 - 5

	%	kg/m ² /year	
DER from SAP 2012 DER Worksheet		17.55	(ZC1)
TER		18.21	
Residual CO ₂ emissions offset from biofuel CHP		0	(ZC5)
CO ₂ emissions offset from additional allowable electricity generation		0	(ZC7)
Total CO ₂ emissions offset from SAP Section 16 allowances		0	
DER accounting for SAP Section 16 allowances		17.55	
% improvement DER/TER	3.6		

Total Energy Type CO₂ Emissions for Codes Levels 6

	kg/m ² /year	
DER accounting for SAP Section 16 allowances	17.55	(ZC1)
CO ₂ emissions from appliances, equation (L14)	15.76	(ZC2)
CO ₂ emissions from cooking, equation (L16)	2.05	(ZC3)
Net CO ₂ emissions	36.4	(ZC8)

Result:

Credits awarded for ENE 1 = 0.6

Code Level = 3

ENE 2 - Fabric energy Efficiency

Fabric energy Efficiency: 47.78

Credits awarded for ENE 2 = 6.4

ENE 7 - Low or Zero Carbon (LZC) Technologies

Reduction in CO₂ Emissions

	%	kg/m ² /year	
Standard Case CO ₂ emissions		36.43	
Standard DER		18.62	
Actual Case CO ₂ emissions		36.43	
Actual DER		18.62	
Reduction in CO ₂ emissions	0		

Credits awarded for ENE 7 = 0

Technologies eligible to contribute to achieving the requirements of this issue must produce energy from renewable sources and meet all other ancillary requirements as defined by Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

The following requirements must also be met:

- Where not provided by accredited external renewables there must be a direct supply of energy produced to the dwelling under assessment.
- Where covered by the Microgeneration Certification Scheme (MCS), technologies under 50kWe or 300kWth must be certified.
- Combined Heat and Power (CHP) schemes above 50kWe must be certified under the CHPQA standard.
- All technologies must be accounted for by SAP.

CHP schemes fuelled by mains gas are eligible to contribute to performance against this issue. Where these schemes are above 50kWe they must be certified under the CHPQA.

It is the responsibility of the Accredited OCDEA and Code Assessor to ensure all technologies use in the calculation are appropriate before awarding credits.

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name: Ben Tunningley **Stroma Number:** STRO027495
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: Plot 012

Address : Plot 012, Chain Road, Manchester, M9

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	44.26 (1a)	x	2.42 (2a)	=	107.11 (3a)
First floor	44.26 (1b)	x	2.69 (2b)	=	119.06 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	88.52 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	226.17 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				3	30 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.13 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.38 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.33 (21)
Infiltration rate modified for monthly wind speed			

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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SAP WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.41	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.38
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57
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(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57
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(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.15	x 1.4	= 3.01		(26)
Windows Type 1			6.83	x 1/[1/(1.3)+0.04]	= 8.44		(27)
Windows Type 2			9.75	x 1/[1/(1.3)+0.04]	= 12.05		(27)
Windows Type 3			2.42	x 1/[1/(1.3)+0.04]	= 2.99		(27)
Floor			44.26	x 0.15	= 6.639	75	3319.5 (28)
Walls	112.76	21.15	91.61	x 0.2	= 18.32	60	5496.6 (29)
Roof	44.26	0	44.26	x 0.09	= 3.98	9	398.34 (30)
Total area of elements, m²			201.28				(31)
Party wall			26.78	x 0	= 0	70	1874.6 (32)
Internal wall **			97.86			9	880.74 (32c)
Internal wall **			94			9	846 (32c)
Internal floor			44.26			18	796.68 (32d)
Internal ceiling			44.26			9	398.34 (32e)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 55.43 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 14010.8 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 158.28 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K

14.22 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss

(33) + (36) =

69.65 (37)

Ventilation heat loss calculated monthly

(38)m = 0.33 x (25)m x (5)

(38)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
43.74	43.49	43.24	42.09	41.88	40.88	40.88	40.7	41.27	41.88	42.31	42.77

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=

113.39	113.14	112.89	111.75	111.53	110.53	110.53	110.35	110.92	111.53	111.97	112.42
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Average = Sum(39)_{1...12} /12=

111.74 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=

1.28	1.28	1.28	1.26	1.26	1.25	1.25	1.25	1.25	1.26	1.26	1.27
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Average = Sum(40)_{1...12} /12=

1.26 (40)

Number of days in month (Table 1a)

(41)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.6

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)²)] + 0.0013 x (TFA -13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

96.07

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=

105.67	101.83	97.99	94.15	90.3	86.46	86.46	90.3	94.15	97.99	101.83	105.67
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Total = Sum(44)_{1...12} =

1152.8 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=

156.71	137.06	141.43	123.31	118.31	102.1	94.61	108.56	109.86	128.03	139.76	151.77
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Total = Sum(45)_{1...12} =

1511.5 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=

23.51	20.56	21.22	18.5	17.75	15.31	14.19	16.28	16.48	19.2	20.96	22.76
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(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

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Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0
0

(54)

Enter (50) or (54) in (55)

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=

0	0	0	0	0	0	0	0	0	0	0	0
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(56)

If cylinder contains dedicated solar storage, (57)m = (56)m × [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=

0	0	0	0	0	0	0	0	0	0	0	0
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(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=

0	0	0	0	0	0	0	0	0	0	0	0
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(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=

18.77	16.91	18.59	17.81	18.27	17.53	18.01	18.18	17.68	18.46	18.05	18.72
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(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=

175.48	153.97	160.02	141.11	136.58	119.62	112.62	126.74	127.54	146.49	157.8	170.49
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(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=

0	0	0	0	0	0	0	0	0	0	0	0
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(63)

Output from water heater

(64)m=

175.48	153.97	160.02	141.11	136.58	119.62	112.62	126.74	127.54	146.49	157.8	170.49
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Output from water heater (annual)_{1...12}

1728.46

(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=

56.8	49.8	51.67	45.45	43.91	38.33	35.96	40.64	40.95	47.18	50.98	55.14
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(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
156.29	156.29	156.29	156.29	156.29	156.29	156.29	156.29	156.29	156.29	156.29	156.29

(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=

52.67	46.78	38.05	28.8	21.53	18.18	19.64	25.53	34.27	43.51	50.78	54.14
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(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=

352.73	356.39	347.17	327.53	302.74	279.45	263.88	260.22	269.45	289.08	313.87	337.17
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(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=

53.23	53.23	53.23	53.23	53.23	53.23	53.23	53.23	53.23	53.23	53.23	53.23
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(69)

Pumps and fans gains (Table 5a)

(70)m=

3	3	3	3	3	3	3	3	3	3	3	3
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(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-104.2	-104.2	-104.2	-104.2	-104.2	-104.2	-104.2	-104.2	-104.2	-104.2	-104.2	-104.2
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(71)

Water heating gains (Table 5)

(72)m=

76.34	74.11	69.45	63.13	59.01	53.23	48.33	54.63	56.87	63.42	70.81	74.12
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(72)

Total internal gains =

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

(73)m=

590.08	585.61	563	527.79	491.62	459.19	440.19	448.71	468.92	504.34	543.79	573.75
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(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

SAP WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	1	x	6.83	x	11.28	x	0.46	x	1.11	=	35.45	(75)
Northeast 0.9x	1	x	6.83	x	22.97	x	0.46	x	1.11	=	72.16	(75)
Northeast 0.9x	1	x	6.83	x	41.38	x	0.46	x	1.11	=	130	(75)
Northeast 0.9x	1	x	6.83	x	67.96	x	0.46	x	1.11	=	213.5	(75)
Northeast 0.9x	1	x	6.83	x	91.35	x	0.46	x	1.11	=	286.99	(75)
Northeast 0.9x	1	x	6.83	x	97.38	x	0.46	x	1.11	=	305.96	(75)
Northeast 0.9x	1	x	6.83	x	91.1	x	0.46	x	1.11	=	286.22	(75)
Northeast 0.9x	1	x	6.83	x	72.63	x	0.46	x	1.11	=	228.18	(75)
Northeast 0.9x	1	x	6.83	x	50.42	x	0.46	x	1.11	=	158.41	(75)
Northeast 0.9x	1	x	6.83	x	28.07	x	0.46	x	1.11	=	88.18	(75)
Northeast 0.9x	1	x	6.83	x	14.2	x	0.46	x	1.11	=	44.6	(75)
Northeast 0.9x	1	x	6.83	x	9.21	x	0.46	x	1.11	=	28.95	(75)
Southwest 0.9x	1	x	9.75	x	36.79		0.46	x	1.11	=	165.02	(79)
Southwest 0.9x	1	x	9.75	x	62.67		0.46	x	1.11	=	281.09	(79)
Southwest 0.9x	1	x	9.75	x	85.75		0.46	x	1.11	=	384.6	(79)
Southwest 0.9x	1	x	9.75	x	106.25		0.46	x	1.11	=	476.54	(79)
Southwest 0.9x	1	x	9.75	x	119.01		0.46	x	1.11	=	533.76	(79)
Southwest 0.9x	1	x	9.75	x	118.15		0.46	x	1.11	=	529.9	(79)
Southwest 0.9x	1	x	9.75	x	113.91		0.46	x	1.11	=	510.88	(79)
Southwest 0.9x	1	x	9.75	x	104.39		0.46	x	1.11	=	468.19	(79)
Southwest 0.9x	1	x	9.75	x	92.85		0.46	x	1.11	=	416.44	(79)
Southwest 0.9x	1	x	9.75	x	69.27		0.46	x	1.11	=	310.67	(79)
Southwest 0.9x	1	x	9.75	x	44.07		0.46	x	1.11	=	197.66	(79)
Southwest 0.9x	1	x	9.75	x	31.49		0.46	x	1.11	=	141.22	(79)
Northwest 0.9x	1	x	2.42	x	11.28	x	0.46	x	1.11	=	12.56	(81)
Northwest 0.9x	1	x	2.42	x	22.97	x	0.46	x	1.11	=	25.57	(81)
Northwest 0.9x	1	x	2.42	x	41.38	x	0.46	x	1.11	=	46.06	(81)
Northwest 0.9x	1	x	2.42	x	67.96	x	0.46	x	1.11	=	75.65	(81)
Northwest 0.9x	1	x	2.42	x	91.35	x	0.46	x	1.11	=	101.69	(81)
Northwest 0.9x	1	x	2.42	x	97.38	x	0.46	x	1.11	=	108.41	(81)
Northwest 0.9x	1	x	2.42	x	91.1	x	0.46	x	1.11	=	101.41	(81)
Northwest 0.9x	1	x	2.42	x	72.63	x	0.46	x	1.11	=	80.85	(81)
Northwest 0.9x	1	x	2.42	x	50.42	x	0.46	x	1.11	=	56.13	(81)
Northwest 0.9x	1	x	2.42	x	28.07	x	0.46	x	1.11	=	31.24	(81)
Northwest 0.9x	1	x	2.42	x	14.2	x	0.46	x	1.11	=	15.8	(81)
Northwest 0.9x	1	x	2.42	x	9.21	x	0.46	x	1.11	=	10.26	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 213.03 378.81 560.67 765.69 922.44 944.27 898.52 777.22 630.98 430.09 258.06 180.43 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 803.11 964.43 1123.67 1293.48 1414.06 1403.46 1338.71 1225.93 1099.9 934.44 801.85 754.18 (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 (86)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.96	0.94	0.89	0.79	0.64	0.48	0.36	0.4	0.62	0.84	0.94	0.97	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.38	19.67	20.07	20.51	20.81	20.95	20.98	20.98	20.87	20.46	19.84	19.32	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.86	19.86	19.86	19.87	19.87	19.88	19.88	19.88	19.88	19.87	19.87	19.86	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.96	0.93	0.87	0.75	0.58	0.4	0.27	0.31	0.54	0.81	0.93	0.96	(89)
--------	------	------	------	------	------	-----	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.42	18.7	19.08	19.49	19.74	19.85	19.88	19.87	19.81	19.46	18.88	18.37	(90)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 0.19 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.6	18.89	19.28	19.69	19.95	20.06	20.09	20.09	20.01	19.66	19.06	18.55	(92)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.6	18.89	19.28	19.69	19.95	20.06	20.09	20.09	20.01	19.66	19.06	18.55	(93)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

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

Utilisation factor for gains, hm:

(94)m=	0.95	0.91	0.85	0.74	0.59	0.42	0.28	0.33	0.55	0.8	0.92	0.96	(94)
--------	------	------	------	------	------	------	------	------	------	-----	------	------	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	760.83	880.73	958.06	958.41	828.88	583.05	381.51	400.12	603.13	745.53	735.97	720.44	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	1621.86	1582.69	1442.24	1205.82	920.01	604.06	385.79	406.93	655.81	1010.09	1339.25	1613.3	(97)
--------	---------	---------	---------	---------	--------	--------	--------	--------	--------	---------	---------	--------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	640.6	471.72	360.23	178.13	67.8	0	0	0	0	196.83	434.36	664.29	(98)
--------	-------	--------	--------	--------	------	---	---	---	---	--------	--------	--------	------

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 3013.97 (98)

Space heating requirement in kWh/m²/year

34.05 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 93 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	640.6	471.72	360.23	178.13	67.8	0	0	0	0	196.83	434.36	664.29	
(211)m = {[[(98)m x (204)] } x 100 ÷ (206) (211)													
	688.82	507.22	387.34	191.54	72.91	0	0	0	0	211.65	467.05	714.29	
Total (kWh/year) =Sum(211) _{1..5,10...12} =													3240.83 (211)
Space heating fuel (secondary), kWh/month													
= {[[(98)m x (201)] } x 100 ÷ (208)													
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Total (kWh/year) =Sum(215) _{1..5,10...12} =													0 (215)
Water heating													
Output from water heater (calculated above)													
	175.48	153.97	160.02	141.11	136.58	119.62	112.62	126.74	127.54	146.49	157.8	170.49	
Efficiency of water heater													87 (216)
(217)m=	89.34	89.24	89.06	88.65	87.97	87	87	87	87	88.7	89.18	89.37	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m x 100 ÷ (217)m													
(219)m=	196.43	172.53	179.69	159.18	155.25	137.5	129.45	145.68	146.6	165.16	176.95	190.76	
Total = Sum(219a) _{1..12} =													1955.16 (219)
Annual totals													
													kWh/year
Space heating fuel used, main system 1													3240.83
Water heating fuel used													1955.16
Electricity for pumps, fans and electric keep-hot													
central heating pump:													30 (230c)
boiler with a fan-assisted flue													45 (230e)
Total electricity for the above, kWh/year													75 (231)
Electricity for lighting													372.08 (232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =													5643.07 (338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	3.48 x 0.01 =	112.78 (240)
Space heating - main system 2	(213) x	0 x 0.01 =	0 (241)
Space heating - secondary	(215) x	13.19 x 0.01 =	0 (242)
Water heating cost (other fuel)	(219)	3.48 x 0.01 =	68.04 (247)
Pumps, fans and electric keep-hot	(231)	13.19 x 0.01 =	9.89 (249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a			
Energy for lighting	(232)	13.19 x 0.01 =	49.08 (250)
Additional standing charges (Table 12)			120 (251)
Appendix Q items: repeat lines (253) and (254) as needed			
Total energy cost	(245)...(247) + (250)...(254) =		359.79 (255)

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11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	$[(255) \times (256)] \div [(4) + 45.0] =$	1.13	(257)
SAP rating (Section 12)		84.21	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	700.02	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	422.32	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1122.33	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	193.11	(268)
Total CO2, kg/year		sum of (265)...(271) =		1354.37	(272)
CO2 emissions per m²		(272) ÷ (4) =		15.3	(273)
El rating (section 14)				86	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3953.81	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2385.3	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6339.11	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	1142.29	(268)
'Total Primary Energy		sum of (265)...(271) =		7711.65	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		87.12	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Ben Tunningley **Stroma Number:** STRO027495
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: Plot 012

Address : Plot 012, Chain Road, Manchester, M9

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	44.26 (1a)	x	2.42 (2a)	=	107.11 (3a)
First floor	44.26 (1b)	x	2.69 (2b)	=	119.06 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	88.52 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	226.17 (5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (6b)
Number of intermittent fans							3	x 10 =	30 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.13 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.38 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.33 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.41	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.38
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.59 0.58 0.58 0.56 0.56 0.55 0.55 0.55 0.55 0.56 0.57 0.57 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.59 0.58 0.58 0.56 0.56 0.55 0.55 0.55 0.55 0.56 0.57 0.57 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.15	x 1.4	= 3.01		(26)
Windows Type 1			6.83	x1/[1/(1.3)+0.04]	= 8.44		(27)
Windows Type 2			9.75	x1/[1/(1.3)+0.04]	= 12.05		(27)
Windows Type 3			2.42	x1/[1/(1.3)+0.04]	= 2.99		(27)
Floor			44.26	x 0.15	= 6.639	75	3319.5 (28)
Walls	112.76	21.15	91.61	x 0.2	= 18.32	60	5496.6 (29)
Roof	44.26	0	44.26	x 0.09	= 3.98	9	398.34 (30)
Total area of elements, m²			201.28				(31)
Party wall			26.78	x 0	= 0	70	1874.6 (32)
Internal wall **			97.86			9	880.74 (32c)
Internal wall **			94			9	846 (32c)
Internal floor			44.26			18	796.68 (32d)
Internal ceiling			44.26			9	398.34 (32e)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 55.43 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 14010.8 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 158.28 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K

14.22 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss

(33) + (36) =

69.65 (37)

Ventilation heat loss calculated monthly

(38)m = 0.33 x (25)m x (5)

(38)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
43.74	43.49	43.24	42.09	41.88	40.88	40.88	40.7	41.27	41.88	42.31	42.77

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=

113.39	113.14	112.89	111.75	111.53	110.53	110.53	110.35	110.92	111.53	111.97	112.42
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Average = Sum(39)_{1...12} /12=

111.74 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=

1.28	1.28	1.28	1.26	1.26	1.25	1.25	1.25	1.25	1.26	1.26	1.27
------	------	------	------	------	------	------	------	------	------	------	------

Average = Sum(40)_{1...12} /12=

1.26 (40)

Number of days in month (Table 1a)

(41)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.6

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)²)] + 0.0013 x (TFA -13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

96.07

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

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

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=

105.67	101.83	97.99	94.15	90.3	86.46	86.46	90.3	94.15	97.99	101.83	105.67
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Total = Sum(44)_{1...12} =

1152.8 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=

156.71	137.06	141.43	123.31	118.31	102.1	94.61	108.56	109.86	128.03	139.76	151.77
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Total = Sum(45)_{1...12} =

1511.5 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=

23.51	20.56	21.22	18.5	17.75	15.31	14.19	16.28	16.48	19.2	20.96	22.76
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(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

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Energy lost from water storage, kWh/year $(47) \times (51) \times (52) \times (53) =$

0
0

 (54)

Enter (50) or (54) in (55)

0

 (55)

Water storage loss calculated for each month $((56)m = (55) \times (41)m$

(56)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (56)

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (57)

Primary circuit loss (annual) from Table 3

0

 (58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (59)

Combi loss calculated for each month $(61)m = (60) \div 365 \times (41)m$

(61)m=

18.77	16.91	18.59	17.81	18.27	17.53	18.01	18.18	17.68	18.46	18.05	18.72
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (61)

Total heat required for water heating calculated for each month $(62)m = 0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

(62)m=

175.48	153.97	160.02	141.11	136.58	119.62	112.62	126.74	127.54	146.49	157.8	170.49
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------

 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63)

Output from water heater

(64)m=

175.48	153.97	160.02	141.11	136.58	119.62	112.62	126.74	127.54	146.49	157.8	170.49
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------

Output from water heater (annual) _{1...12}	1728.46
---	---------

 (64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=

56.8	49.8	51.67	45.45	43.91	38.33	35.96	40.64	40.95	47.18	50.98	55.14
------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
130.25	130.25	130.25	130.25	130.25	130.25	130.25	130.25	130.25	130.25	130.25	130.25

 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=

21.1	18.74	15.24	11.54	8.62	7.28	7.87	10.23	13.73	17.43	20.34	21.68
------	-------	-------	-------	------	------	------	-------	-------	-------	-------	-------

 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=

236.33	238.78	232.6	219.44	202.84	187.23	176.8	174.35	180.53	193.69	210.29	225.9
--------	--------	-------	--------	--------	--------	-------	--------	--------	--------	--------	-------

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=

36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m=

3	3	3	3	3	3	3	3	3	3	3	3
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-104.2	-104.2	-104.2	-104.2	-104.2	-104.2	-104.2	-104.2	-104.2	-104.2	-104.2	-104.2
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

76.34	74.11	69.45	63.13	59.01	53.23	48.33	54.63	56.87	63.42	70.81	74.12
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (72)

Total internal gains = $(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$

(73)m=

398.84	396.7	382.37	359.18	335.55	312.82	298.08	304.28	316.2	339.61	366.51	386.78
--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------

 (73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

DER WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	6.83	x	11.28	x	0.46	x	1.11	=	27.3	(75)
Northeast 0.9x	0.77	x	6.83	x	22.97	x	0.46	x	1.11	=	55.56	(75)
Northeast 0.9x	0.77	x	6.83	x	41.38	x	0.46	x	1.11	=	100.1	(75)
Northeast 0.9x	0.77	x	6.83	x	67.96	x	0.46	x	1.11	=	164.4	(75)
Northeast 0.9x	0.77	x	6.83	x	91.35	x	0.46	x	1.11	=	220.98	(75)
Northeast 0.9x	0.77	x	6.83	x	97.38	x	0.46	x	1.11	=	235.59	(75)
Northeast 0.9x	0.77	x	6.83	x	91.1	x	0.46	x	1.11	=	220.39	(75)
Northeast 0.9x	0.77	x	6.83	x	72.63	x	0.46	x	1.11	=	175.7	(75)
Northeast 0.9x	0.77	x	6.83	x	50.42	x	0.46	x	1.11	=	121.98	(75)
Northeast 0.9x	0.77	x	6.83	x	28.07	x	0.46	x	1.11	=	67.9	(75)
Northeast 0.9x	0.77	x	6.83	x	14.2	x	0.46	x	1.11	=	34.34	(75)
Northeast 0.9x	0.77	x	6.83	x	9.21	x	0.46	x	1.11	=	22.29	(75)
Southwest 0.9x	0.77	x	9.75	x	36.79		0.46	x	1.11	=	127.07	(79)
Southwest 0.9x	0.77	x	9.75	x	62.67		0.46	x	1.11	=	216.44	(79)
Southwest 0.9x	0.77	x	9.75	x	85.75		0.46	x	1.11	=	296.14	(79)
Southwest 0.9x	0.77	x	9.75	x	106.25		0.46	x	1.11	=	366.93	(79)
Southwest 0.9x	0.77	x	9.75	x	119.01		0.46	x	1.11	=	411	(79)
Southwest 0.9x	0.77	x	9.75	x	118.15		0.46	x	1.11	=	408.03	(79)
Southwest 0.9x	0.77	x	9.75	x	113.91		0.46	x	1.11	=	393.38	(79)
Southwest 0.9x	0.77	x	9.75	x	104.39		0.46	x	1.11	=	360.51	(79)
Southwest 0.9x	0.77	x	9.75	x	92.85		0.46	x	1.11	=	320.66	(79)
Southwest 0.9x	0.77	x	9.75	x	69.27		0.46	x	1.11	=	239.21	(79)
Southwest 0.9x	0.77	x	9.75	x	44.07		0.46	x	1.11	=	152.2	(79)
Southwest 0.9x	0.77	x	9.75	x	31.49		0.46	x	1.11	=	108.74	(79)
Northwest 0.9x	0.77	x	2.42	x	11.28	x	0.46	x	1.11	=	9.67	(81)
Northwest 0.9x	0.77	x	2.42	x	22.97	x	0.46	x	1.11	=	19.69	(81)
Northwest 0.9x	0.77	x	2.42	x	41.38	x	0.46	x	1.11	=	35.47	(81)
Northwest 0.9x	0.77	x	2.42	x	67.96	x	0.46	x	1.11	=	58.25	(81)
Northwest 0.9x	0.77	x	2.42	x	91.35	x	0.46	x	1.11	=	78.3	(81)
Northwest 0.9x	0.77	x	2.42	x	97.38	x	0.46	x	1.11	=	83.47	(81)
Northwest 0.9x	0.77	x	2.42	x	91.1	x	0.46	x	1.11	=	78.09	(81)
Northwest 0.9x	0.77	x	2.42	x	72.63	x	0.46	x	1.11	=	62.25	(81)
Northwest 0.9x	0.77	x	2.42	x	50.42	x	0.46	x	1.11	=	43.22	(81)
Northwest 0.9x	0.77	x	2.42	x	28.07	x	0.46	x	1.11	=	24.06	(81)
Northwest 0.9x	0.77	x	2.42	x	14.2	x	0.46	x	1.11	=	12.17	(81)
Northwest 0.9x	0.77	x	2.42	x	9.21	x	0.46	x	1.11	=	7.9	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 164.03 291.69 431.71 589.58 710.28 727.09 691.86 598.46 485.86 331.17 198.71 138.93 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 562.88 688.39 814.08 948.76 1045.83 1039.91 989.94 902.73 802.06 670.78 565.22 525.71 (84)

DER WorkSheet: New dwelling design stage

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (86)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.97	0.95	0.88	0.77	0.61	0.47	0.52	0.75	0.92	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.07	19.34	19.75	20.25	20.66	20.89	20.97	20.95	20.76	20.22	19.54	19.02	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.86	19.86	19.86	19.87	19.87	19.88	19.88	19.88	19.88	19.87	19.87	19.86	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.97	0.94	0.86	0.71	0.52	0.36	0.41	0.68	0.9	0.97	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	-----	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.11	18.37	18.78	19.27	19.63	19.82	19.87	19.86	19.74	19.25	18.59	18.06	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 0.19 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.29	18.56	18.97	19.46	19.83	20.03	20.08	20.07	19.93	19.44	18.77	18.25	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.29	18.56	18.97	19.46	19.83	20.03	20.08	20.07	19.93	19.44	18.77	18.25	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

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

Utilisation factor for gains, hm:

(94)m=	0.98	0.96	0.92	0.84	0.71	0.53	0.38	0.43	0.68	0.89	0.96	0.98	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	550.7	660.92	751.73	801.16	743.89	555.66	374.65	389.61	546.35	597.27	544.79	516.4	(95)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	1586.45	1545.43	1407.28	1179.93	906.73	599.99	384.76	405.36	647.06	985.39	1307.12	1579.22	(97)
--------	---------	---------	---------	---------	--------	--------	--------	--------	--------	--------	---------	---------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	770.6	594.39	487.73	272.72	121.15	0	0	0	0	288.76	548.87	790.73	(98)
--------	-------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------	------

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 3874.95 (99)

Space heating requirement in kWh/m²/year 43.77 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 93 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	770.6	594.39	487.73	272.72	121.15	0	0	0	0	288.76	548.87	790.73	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)													
	828.6	639.13	524.44	293.25	130.27	0	0	0	0	310.49	590.19	850.25	
Total (kWh/year) = Sum(211) _{1..5,10...12} =													4166.62 (211)
Space heating fuel (secondary), kWh/month													
= {[(98)m x (201)] } x 100 ÷ (208)													
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Total (kWh/year) = Sum(215) _{1..5,10...12} =													0 (215)
Water heating													
Output from water heater (calculated above)													
	175.48	153.97	160.02	141.11	136.58	119.62	112.62	126.74	127.54	146.49	157.8	170.49	
Efficiency of water heater													87 (216)
(217)m=	89.43	89.37	89.24	88.95	88.38	87	87	87	87	88.97	89.31	89.45	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m x 100 ÷ (217)m													
(219)m=	196.23	172.29	179.32	158.63	154.53	137.5	129.45	145.68	146.6	164.65	176.68	190.59	
Total = Sum(219a) _{1..12} =													1952.14 (219)
Annual totals													
													kWh/year
Space heating fuel used, main system 1													4166.62
Water heating fuel used													1952.14
Electricity for pumps, fans and electric keep-hot													
central heating pump:													30 (230c)
boiler with a fan-assisted flue													45 (230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =												75 (231)
Electricity for lighting													372.6 (232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =													6566.36 (338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	899.99 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	421.66 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1321.65 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	193.38 (268)
Total CO2, kg/year		sum of (265)...(271) =	1553.96 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	17.55 (273)
El rating (section 14)			84 (274)

DER WorkSheet: New dwelling design stage

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Ben Tunningley **Stroma Number:** STRO027495
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: Plot 012

Address : Plot 012, Chain Road, Manchester, M9

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	44.26 (1a) x	2.42 (2a) =	107.11 (3a)
First floor	44.26 (1b) x	2.69 (2b) =	119.06 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	88.52 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	226.17 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0 x 40 =	0 (6a)
Number of open flues	0	0	0	0 x 20 =	0 (6b)
Number of intermittent fans				3 x 10 =	30 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.13 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.38 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.33 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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TER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.41	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.38
--	------	------	-----	------	------	------	------	-----	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.59 0.58 0.58 0.56 0.56 0.55 0.55 0.55 0.55 0.56 0.57 0.57 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.59 0.58 0.58 0.56 0.56 0.55 0.55 0.55 0.55 0.56 0.57 0.57 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.15	x 1	= 2.15		(26)
Windows Type 1			6.83	x1/[1/(1.4)+ 0.04] =	9.05		(27)
Windows Type 2			9.75	x1/[1/(1.4)+ 0.04] =	12.93		(27)
Windows Type 3			2.42	x1/[1/(1.4)+ 0.04] =	3.21		(27)
Floor			44.26	x 0.13	= 5.753799		(28)
Walls	112.76	21.15	91.61	x 0.18	= 16.49		(29)
Roof	44.26	0	44.26	x 0.13	= 5.75		(30)
Total area of elements, m²			201.28				(31)
Party wall			26.78	x 0	= 0		(32)
Internal wall **			97.86				(32c)
Internal wall **			94				(32c)
Internal floor			44.26				(32d)
Internal ceiling			44.26				(32e)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 55.34 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 14010.8 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K

10.48 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss

(33) + (36) =

65.82 (37)

Ventilation heat loss calculated monthly

(38)m = 0.33 x (25)m x (5)

(38)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
43.74	43.49	43.24	42.09	41.88	40.88	40.88	40.7	41.27	41.88	42.31	42.77

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=

109.55	109.31	109.06	107.91	107.7	106.7	106.7	106.52	107.09	107.7	108.13	108.59
--------	--------	--------	--------	-------	-------	-------	--------	--------	-------	--------	--------

Average = Sum(39)_{1...12} /12=

107.91 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=

1.24	1.23	1.23	1.22	1.22	1.21	1.21	1.2	1.21	1.22	1.22	1.23
------	------	------	------	------	------	------	-----	------	------	------	------

Average = Sum(40)_{1...12} /12=

1.22 (40)

Number of days in month (Table 1a)

(41)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.6

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)²)] + 0.0013 x (TFA -13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

96.07

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

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

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=

105.67	101.83	97.99	94.15	90.3	86.46	86.46	90.3	94.15	97.99	101.83	105.67
--------	--------	-------	-------	------	-------	-------	------	-------	-------	--------	--------

Total = Sum(44)_{1...12} =

1152.8 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=

156.71	137.06	141.43	123.31	118.31	102.1	94.61	108.56	109.86	128.03	139.76	151.77
--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	--------

Total = Sum(45)_{1...12} =

1511.5 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=

23.51	20.56	21.22	18.5	17.75	15.31	14.19	16.28	16.48	19.2	20.96	22.76
-------	-------	-------	------	-------	-------	-------	-------	-------	------	-------	-------

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

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Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0
0

(54)

Enter (50) or (54) in (55)

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(56)

If cylinder contains dedicated solar storage, (57)m = (56)m × [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=

50.96	46.03	49.93	46.43	46.02	42.64	44.06	46.02	46.43	49.93	49.32	50.96
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=

207.67	183.09	191.37	169.73	164.33	144.73	138.67	154.58	156.29	177.96	189.07	202.72
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(63)

Output from water heater

(64)m=

207.67	183.09	191.37	169.73	164.33	144.73	138.67	154.58	156.29	177.96	189.07	202.72
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Output from water heater (annual)_{1...12}

2080.22

(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=

64.85	57.08	59.51	52.61	50.84	44.61	42.47	47.6	48.14	55.05	58.8	63.2
-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------	------

(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
130.25	130.25	130.25	130.25	130.25	130.25	130.25	130.25	130.25	130.25	130.25	130.25

(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=

21.1	18.74	15.24	11.54	8.62	7.28	7.87	10.23	13.73	17.43	20.34	21.68
------	-------	-------	-------	------	------	------	-------	-------	-------	-------	-------

(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=

236.33	238.78	232.6	219.44	202.84	187.23	176.8	174.35	180.53	193.69	210.29	225.9
--------	--------	-------	--------	--------	--------	-------	--------	--------	--------	--------	-------

(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=

36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(69)

Pumps and fans gains (Table 5a)

(70)m=

3	3	3	3	3	3	3	3	3	3	3	3
---	---	---	---	---	---	---	---	---	---	---	---

(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-104.2	-104.2	-104.2	-104.2	-104.2	-104.2	-104.2	-104.2	-104.2	-104.2	-104.2	-104.2
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(71)

Water heating gains (Table 5)

(72)m=

87.16	84.94	79.99	73.06	68.34	61.95	57.09	63.98	66.85	74	81.66	84.95
-------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------

(72)

Total internal gains =

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

(73)m=

409.66	407.53	392.9	369.12	344.87	321.54	306.83	313.63	326.18	350.18	377.37	397.61
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	6.83	x	11.28	x	0.63	x	0.7	=	23.55	(75)
Northeast 0.9x	0.77	x	6.83	x	22.97	x	0.63	x	0.7	=	47.94	(75)
Northeast 0.9x	0.77	x	6.83	x	41.38	x	0.63	x	0.7	=	86.37	(75)
Northeast 0.9x	0.77	x	6.83	x	67.96	x	0.63	x	0.7	=	141.85	(75)
Northeast 0.9x	0.77	x	6.83	x	91.35	x	0.63	x	0.7	=	190.67	(75)
Northeast 0.9x	0.77	x	6.83	x	97.38	x	0.63	x	0.7	=	203.27	(75)
Northeast 0.9x	0.77	x	6.83	x	91.1	x	0.63	x	0.7	=	190.16	(75)
Northeast 0.9x	0.77	x	6.83	x	72.63	x	0.63	x	0.7	=	151.6	(75)
Northeast 0.9x	0.77	x	6.83	x	50.42	x	0.63	x	0.7	=	105.24	(75)
Northeast 0.9x	0.77	x	6.83	x	28.07	x	0.63	x	0.7	=	58.59	(75)
Northeast 0.9x	0.77	x	6.83	x	14.2	x	0.63	x	0.7	=	29.63	(75)
Northeast 0.9x	0.77	x	6.83	x	9.21	x	0.63	x	0.7	=	19.23	(75)
Southwest 0.9x	0.77	x	9.75	x	36.79		0.63	x	0.7	=	109.64	(79)
Southwest 0.9x	0.77	x	9.75	x	62.67		0.63	x	0.7	=	186.75	(79)
Southwest 0.9x	0.77	x	9.75	x	85.75		0.63	x	0.7	=	255.52	(79)
Southwest 0.9x	0.77	x	9.75	x	106.25		0.63	x	0.7	=	316.6	(79)
Southwest 0.9x	0.77	x	9.75	x	119.01		0.63	x	0.7	=	354.62	(79)
Southwest 0.9x	0.77	x	9.75	x	118.15		0.63	x	0.7	=	352.05	(79)
Southwest 0.9x	0.77	x	9.75	x	113.91		0.63	x	0.7	=	339.42	(79)
Southwest 0.9x	0.77	x	9.75	x	104.39		0.63	x	0.7	=	311.05	(79)
Southwest 0.9x	0.77	x	9.75	x	92.85		0.63	x	0.7	=	276.67	(79)
Southwest 0.9x	0.77	x	9.75	x	69.27		0.63	x	0.7	=	206.4	(79)
Southwest 0.9x	0.77	x	9.75	x	44.07		0.63	x	0.7	=	131.32	(79)
Southwest 0.9x	0.77	x	9.75	x	31.49		0.63	x	0.7	=	93.83	(79)
Northwest 0.9x	0.77	x	2.42	x	11.28	x	0.63	x	0.7	=	8.34	(81)
Northwest 0.9x	0.77	x	2.42	x	22.97	x	0.63	x	0.7	=	16.99	(81)
Northwest 0.9x	0.77	x	2.42	x	41.38	x	0.63	x	0.7	=	30.6	(81)
Northwest 0.9x	0.77	x	2.42	x	67.96	x	0.63	x	0.7	=	50.26	(81)
Northwest 0.9x	0.77	x	2.42	x	91.35	x	0.63	x	0.7	=	67.56	(81)
Northwest 0.9x	0.77	x	2.42	x	97.38	x	0.63	x	0.7	=	72.02	(81)
Northwest 0.9x	0.77	x	2.42	x	91.1	x	0.63	x	0.7	=	67.38	(81)
Northwest 0.9x	0.77	x	2.42	x	72.63	x	0.63	x	0.7	=	53.71	(81)
Northwest 0.9x	0.77	x	2.42	x	50.42	x	0.63	x	0.7	=	37.29	(81)
Northwest 0.9x	0.77	x	2.42	x	28.07	x	0.63	x	0.7	=	20.76	(81)
Northwest 0.9x	0.77	x	2.42	x	14.2	x	0.63	x	0.7	=	10.5	(81)
Northwest 0.9x	0.77	x	2.42	x	9.21	x	0.63	x	0.7	=	6.81	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 141.53 251.68 372.49 508.71 612.85 627.35 596.95 516.37 419.21 285.74 171.45 119.87 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 551.19 659.21 765.39 877.83 957.72 948.89 903.78 830 745.39 635.93 548.82 517.48 (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 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.85	0.67	0.51	0.57	0.82	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.66	19.85	20.13	20.5	20.8	20.95	20.99	20.98	20.87	20.47	20	19.63	(87)
--------	-------	-------	-------	------	------	-------	-------	-------	-------	-------	----	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.89	19.89	19.9	19.91	19.92	19.92	19.92	19.91	19.91	19.9	19.9	(88)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------	------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.79	0.58	0.39	0.45	0.75	0.96	0.99	1	(89)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.12	18.39	18.8	19.33	19.72	19.89	19.91	19.91	19.81	19.3	18.61	18.08	(90)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

fLA = Living area ÷ (4) = 0.19 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.42	18.67	19.06	19.56	19.92	20.09	20.12	20.12	20.02	19.53	18.88	18.38	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.42	18.67	19.06	19.56	19.92	20.09	20.12	20.12	20.02	19.53	18.88	18.38	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

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

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.97	0.92	0.79	0.59	0.41	0.47	0.75	0.95	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	548.52	651.79	743.45	805.93	760.35	562.8	372.46	390.18	562.63	603.44	543.25	515.59	(95)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	1546.52	1504.84	1369.83	1149.93	885.81	585.9	375.61	395.98	633.41	961.46	1274.02	1539.5	(97)
--------	---------	---------	---------	---------	--------	-------	--------	--------	--------	--------	---------	--------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	742.52	573.25	466.03	247.68	93.34	0	0	0	0	266.37	526.16	761.79	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												3677.12	(98)

Space heating requirement in kWh/m²/year 41.54 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 93.4 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	742.52	573.25	466.03	247.68	93.34	0	0	0	0	266.37	526.16	761.79	
(211)m = {[[(98)m x (204)] } x 100 ÷ (206) (211)													
	794.99	613.75	498.96	265.18	99.93	0	0	0	0	285.19	563.34	815.62	
Total (kWh/year) =Sum(211) _{1..5,10...12} =													3936.96 (211)
Space heating fuel (secondary), kWh/month = {[[(98)m x (201)] } x 100 ÷ (208)													
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Total (kWh/year) =Sum(215) _{1..5,10...12} =													0 (215)
Water heating													
Output from water heater (calculated above)													
	207.67	183.09	191.37	169.73	164.33	144.73	138.67	154.58	156.29	177.96	189.07	202.72	
Efficiency of water heater													80.3 (216)
(217)m=	87.98	87.73	87.21	86	83.69	80.3	80.3	80.3	80.3	86.06	87.49	88.07	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	236.04	208.7	219.44	197.36	196.37	180.24	172.69	192.5	194.63	206.78	216.1	230.18	
Total = Sum(219a) _{1..12} =													2451.03 (219)
Annual totals													
													kWh/year
Space heating fuel used, main system 1													3936.96
Water heating fuel used													2451.03
Electricity for pumps, fans and electric keep-hot													
central heating pump:													30 (230c)
boiler with a fan-assisted flue													45 (230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =												75 (231)
Electricity for lighting													372.6 (232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =													6835.59 (338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	= 850.38 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.216	= 529.42 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1379.81 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 38.93 (267)
Electricity for lighting	(232) x	0.519	= 193.38 (268)
Total CO2, kg/year	sum of (265)...(271) =		1612.11 (272)
TER =			18.21 (273)

TER WorkSheet: New dwelling design stage

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 01 July 2022

Property Details: Plot 012

Dwelling type:	Semi-detached House
Located in:	England
Region:	West Pennines
Cross ventilation possible:	Yes
Number of storeys:	2
Front of dwelling faces:	North East
Overshading:	Very Little
Overhangs:	None
Thermal mass parameter:	Calculated 158.28
Night ventilation:	False
Blinds, curtains, shutters:	None
Ventilation rate during hot weather (ach):	4 (Windows open half the time)

Overheating Details:

Summer ventilation heat loss coefficient:	298.54	(P1)
Transmission heat loss coefficient:	69.7	
Summer heat loss coefficient:	368.19	(P2)

Overhangs:

Orientation:	Ratio:	Z_overhangs:
North East (front)	0	1
South West (rear)	0	1
North West (side)	0	1

Solar shading:

Orientation:	Z blinds:	Solar access:	Overhangs:	Z summer:	
North East (front)	1	1	1	1	(P8)
South West (rear)	1	1	1	1	(P8)
North West (side)	1	1	1	1	(P8)

Solar gains:

Orientation		Area	Flux	g_	FF	Shading	Gains
North East (front)	1 x	6.83	89.66	0.46	0	1	281.68
South West (rear)	1 x	9.75	112.1	0.46	0	1	502.77
North West (side)	1 x	2.42	89.66	0.46	0	1	99.8
Total							884.26 (P3/P4)

Internal gains:

	June	July	August
Internal gains	456.19	437.19	445.71
Total summer gains	1414.63	1321.45	1198.18 (P5)
Summer gain/loss ratio	3.84	3.59	3.25 (P6)
Mean summer external temperature (West Pennines)	14.7	16.4	16.3
Thermal mass temperature increment	0.89	0.89	0.89
Threshold temperature	19.43	20.88	20.45 (P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

Property Reference	Plot 012			Issued on Date	03/11/2023
Assessment Reference	plot 1J	Prop Type Ref	22186		
Property	1j Chain Road, MANCHESTER, M9 6AJ				
SAP Rating	84 B	DER	17.35	TER	18.21
Environmental	87 B	% DER<TER	4.73		
CO ₂ Emissions (t/year)	1.32	DFEE	46.92	TFEE	54.64
General Requirements Compliance	Pass	% DFEE<TFEE	14.12		
Assessor Details	Mr. Patrick McGuigan, JSP Sustainability Ltd, Tel: 01904 435 325, technical@jspsustainability.co.uk			Assessor ID	Y128-0001
Client					

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

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

DWELLING AS BUILT

Semi-Detached House, total floor area 89 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:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.21 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.35 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)54.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.9 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.09 (max. 0.20)	0.09 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals: 3.87 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoTEC sustain 28 VUW 286/7-2 (H-GB)
Combi boiler
Efficiency: 89.1% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation

Hot water storage No cylinder

6 Controls

Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (West Pennines (England)):Slight OK
Based on:
Overshading: Very little
Windows facing North East: 6.83 m², No overhang
Windows facing South West: 9.75 m², No overhang
Windows facing North West: 2.42 m², No overhang
Air change rate: 0.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Roof U-value 0.09 W/m²K
Air permeability 3.9 m³/m²h

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.2600 (1b)	x 2.4200 (2b)	= 107.1092 (1b) - (3b)
First floor	44.2600 (1c)	x 2.6900 (2c)	= 119.0594 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 226.1686 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1326 (8)
Pressure test					Yes
Measured/design AP50					3.8700
Infiltration rate					0.3261 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2772 (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	0.3535	0.3465	0.3396	0.3049	0.2980	0.2634	0.2634	0.2564	0.2772	0.2980	0.3119	0.3257 (22b)
Effective ac	0.5625	0.5600	0.5577	0.5465	0.5444	0.5347	0.5347	0.5329	0.5384	0.5444	0.5486	0.5531 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Front			2.1500	1.4000	3.0100		(26)
front (Uw = 1.30)			19.0000	1.2357	23.4791		(27)
gf			44.2600	0.1500	6.6390	75.0000	3319.4999 (28a)
external	112.7600	21.1500	91.6100	0.2000	18.3220	60.0000	5496.6001 (29a)
cold	44.2600		44.2600	0.0900	3.9834	9.0000	398.3400 (30)
Total net area of external elements Aum(A, m ²)			201.2800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	55.4335		(33)
party			26.7800	0.0000	0.0000	70.0000	1874.6000 (32)
gf			97.8600			9.0000	880.7400 (32c)
lf			94.0000			9.0000	846.0000 (32c)
lf			44.2600			18.0000	796.6800 (32d)
gf			44.2600			9.0000	398.3400 (32e)

Heat capacity Cm = Sum(A x k)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K
Thermal bridges (Sum(L x Psi) calculated using Appendix K)
Total fabric heat loss
(28)...(30) + (32) + (32a)...(32e) = 14010.8000 (34)
158.2784 (35)
14.2176 (36)
(33) + (36) = 69.6511 (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	41.9801	41.7990	41.6216	40.7881	40.6321	39.9062	39.9062	39.7717	40.1858	40.6321	40.9476	41.2774 (38)
Heat transfer coeff	111.6312	111.4501	111.2727	110.4392	110.2832	109.5573	109.5573	109.4228	109.8369	110.2832	110.5987	110.9285 (39)
Average = Sum(39)m / 12 =												110.4384 (39)
HLP	1.2611	1.2590	1.2570	1.2476	1.2459	1.2377	1.2377	1.2361	1.2408	1.2459	1.2494	1.2531 (40)
HLP (average)												1.2476 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6049 (42)
Average daily hot water use (litres/day)												96.0668 (43)
Daily hot water use	105.6734	101.8308	97.9881	94.1454	90.3027	86.4601	86.4601	90.3027	94.1454	97.9881	101.8308	105.6734 (44)
Energy conte	156.7106	137.0601	141.4338	123.3054	118.3145	102.0964	94.6073	108.5633	109.8599	128.0311	139.7559	151.7659 (45)
Energy content (annual)										Total = Sum(45)m =		1511.5041 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	23.5066	20.5590	21.2151	18.4958	17.7472	15.3145	14.1911	16.2845	16.4790	19.2047	20.9634	22.7649 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	18.7707	16.9089	18.5877	17.8060	18.2670	17.5251	18.0141	18.1781	17.6781	18.4550	18.0450	18.7208 (61)
Total heat required for water heating calculated for each month	175.4814	153.9690	160.0215	141.1114	136.5815	119.6214	112.6214	126.7414	127.5380	146.4861	157.8010	170.4867 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	175.4814	153.9690	160.0215	141.1114	136.5815	119.6214	112.6214	126.7414	127.5380	146.4861	157.8010	170.4867 (64)
Heat gains from water heating, kWh/month	56.7990	49.7997	51.6737	45.4505	43.9063	38.3283	35.9605	40.6418	40.9479	47.1841	50.9801	55.1424 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 1728.4607 (64)												

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.0982	18.7392	15.2398	11.5375	8.6244	7.2811	7.8675	10.2264	13.7259	17.4282	20.3413	21.6846 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	236.3284	238.7808	232.6009	219.4448	202.8375	187.2290	176.8016	174.3492	180.5291	193.6852	210.2925	225.9010 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246 (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)	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966 (71)
Water heating gains (Table 5)	76.3427	74.1067	69.4538	63.1257	59.0139	53.2338	48.3339	54.6261	56.8721	63.4195	70.8057	74.1161 (72)
Total internal gains	398.8431	396.7005	382.3683	359.1817	335.5495	312.8176	298.0767	304.2755	316.2008	339.6066	366.5132	386.7754 (73)

6. Solar gains

[Jan]												
				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d		Gains W
Northeast				6.8300	11.2829		0.4600	0.0000		0.7700		27.2955 (75)
Southwest				9.7500	36.7938		0.4600	0.0000		0.7700		127.0657 (79)
Northwest				2.4200	11.2829		0.4600	0.0000		0.7700		9.6713 (81)
Solar gains	164.0325	291.6870	431.7138	589.5820	710.2790	727.0912	691.8595	598.4586	485.8555	331.1701	198.7093	138.9307 (83)
Total gains	562.8756	688.3874	814.0821	948.7637	1045.8285	1039.9088	989.9362	902.7340	802.0563	670.7767	565.2224	525.7061 (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	34.8638	34.9205	34.9761	35.2401	35.2899	35.5238	35.5238	35.5674	35.4333	35.2899	35.1893	35.0847
alpha	3.3243	3.3280	3.3317	3.3493	3.3527	3.3683	3.3683	3.3712	3.3622	3.3527	3.3460	3.3390
util living area	0.9869	0.9742	0.9465	0.8811	0.7627	0.6034	0.4638	0.5202	0.7485	0.9239	0.9775	0.9895 (86)
MIT	19.0984	19.3664	19.7740	20.2706	20.6675	20.8922	20.9665	20.9507	20.7699	20.2310	19.5649	19.0441 (87)
Th 2	19.8714	19.8731	19.8746	19.8821	19.8835	19.8900	19.8900	19.8912	19.8875	19.8835	19.8807	19.8777 (88)
util rest of house	0.9839	0.9685	0.9345	0.8542	0.7106	0.5200	0.3563	0.4094	0.6745	0.9007	0.9715	0.9871 (89)
MIT 2	18.1505	18.4163	18.8166	19.2955	19.6511	19.8332	19.8787	19.8730	19.7492	19.2714	18.6211	18.1013 (90)
Living area fraction									fLA = Living area / (4) =			0.1931 (91)
MIT	18.3335	18.5998	19.0014	19.4837	19.8473	20.0377	20.0887	20.0811	19.9463	19.4567	18.8033	18.2833 (92)
Temperature adjustment												0.0000
adjusted MIT	18.3335	18.5998	19.0014	19.4837	19.8473	20.0377	20.0887	20.0811	19.9463	19.4567	18.8033	18.2833 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	550.7269	660.8329	751.2556	799.8302	741.1927	553.0247	372.5516	387.6644	544.5110	596.7455	544.7582	516.4358 (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	1566.5779	1526.8398	1391.0670	1168.8588	898.5107	595.7392	382.2157	402.7959	642.1349	976.7446	1294.3667	1562.2417 (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	755.7931	581.9567	476.0197	265.7006	117.0446	0.0000	0.0000	0.0000	0.0000	282.7193	539.7181	778.0796 (98)
Space heating												3797.0316 (98)
Space heating per m2												(98) / (4) = 42.8946 (99)

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4082.8297 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	755.7931	581.9567	476.0197	265.7006	117.0446	0.0000	0.0000	0.0000	0.0000	282.7193	539.7181	778.0796	(98)
Space heating efficiency (main heating system 1)	93.0000	93.0000	93.0000	93.0000	93.0000	0.0000	0.0000	0.0000	0.0000	93.0000	93.0000	93.0000	(210)
Space heating fuel (main heating system)	812.6808	625.7599	511.8491	285.6995	125.8544	0.0000	0.0000	0.0000	0.0000	303.9993	580.3420	836.6447	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	175.4814	153.9690	160.0215	141.1114	136.5815	119.6214	112.6214	126.7414	127.5380	146.4861	157.8010	170.4867	(64)
Efficiency of water heater (217)m	89.4190	89.3554	89.2259	88.9362	88.3592	87.0000	87.0000	87.0000	87.0000	88.9531	89.3033	87.0000	(216)
Fuel for water heating, kWh/month	196.2462	172.3109	179.3441	158.6658	154.5753	137.4959	129.4499	145.6797	146.5954	164.6779	176.7022	190.6036	(219)
Water heating fuel used												1952.3470	(219)
Annual totals kWh/year													
Space heating fuel - main system												4082.8297	(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)												372.6008	(232)
Total delivered energy for all uses												6482.7775	(238)

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

	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year
Space heating - main system 1	4082.8297	0.2160	881.8912 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1952.3470	0.2160	421.7069 (264)
Space and water heating			1303.5982 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	372.6008	0.5190	193.3798 (268)
Total CO ₂ , kg/year			1535.9030 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.3500 (273)

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

DER		17.3500	ZC1
Total Floor Area	TFA	88.5200	
Assumed number of occupants	N	2.6049	
CO ₂ emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO ₂ emissions from appliances, equation (L14)		15.8205	ZC2
CO ₂ emissions from cooking, equation (L16)		2.0506	ZC3
Total CO ₂ emissions		35.2211	ZC4
Residual CO ₂ emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m ² /year		0.0000	ZC6
Resulting CO ₂ emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO ₂ emissions		35.2211	ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.2600 (1b)	x 2.4200 (2b)	= 107.1092 (1b) - (3b)
First floor	44.2600 (1c)	x 2.6900 (2c)	= 119.0594 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 226.1686 (5)

2. Ventilation rate

										main	secondary	other	total	m3 per hour
										heating	heating			
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														3 * 10 = 30.0000 (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) =										30.0000 / (5) = 0.1326 (8)				
Pressure test										Yes				
Measured/design AP50										5.0000				
Infiltration rate										0.3826 (18)				
Number of sides sheltered										2 (19)				
Shelter factor										(20) = 1 - [0.075 x (19)] = 0.8500 (20)				
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) = 0.3252 (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	0.4147	0.4066	0.3984	0.3578	0.3496	0.3090	0.3090	0.3009	0.3252	0.3496	0.3659	0.3822 (22b)		
Effective ac	0.5860	0.5826	0.5794	0.5640	0.5611	0.5477	0.5477	0.5453	0.5529	0.5611	0.5669	0.5730 (25)		

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			2.1500	1.0000	2.1500		(26)					
TER Opening Type (Uw = 1.40)			19.0000	1.3258	25.1894		(27)					
gf			44.2600	0.1300	5.7538		(28a)					
external	112.7600	21.1500	91.6100	0.1800	16.4898		(29a)					
cold	44.2600		44.2600	0.1300	5.7538		(30)					
Total net area of external elements Aum(A, m2)			201.2800				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.3368		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.4827 (36)					
Total fabric heat loss						(33) + (36) =	65.8195 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 43.7353	Feb 43.4861	Mar 43.2418	Apr 42.0945	May 41.8799	Jun 40.8806	Jul 40.8806	Aug 40.6956	Sep 41.2655	Oct 41.8799	Nov 42.3141	Dec 42.7681 (38)
Heat transfer coeff	109.5548	109.3056	109.0613	107.9140	107.6994	106.7001	106.7001	106.5151	107.0850	107.6994	108.1336	108.5876 (39)
Average = Sum(39)m / 12 =												107.9130 (39)
HLP	Jan 1.2376	Feb 1.2348	Mar 1.2321	Apr 1.2191	May 1.2167	Jun 1.2054	Jul 1.2054	Aug 1.2033	Sep 1.2097	Oct 1.2167	Nov 1.2216	Dec 1.2267 (40)
HLP (average)												1.2191 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6049 (42)
Average daily hot water use (litres/day)												96.0668 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	105.6734	101.8308	97.9881	94.1454	90.3027	86.4601	86.4601	90.3027	94.1454	97.9881	101.8308	105.6734 (44)
Energy conte	156.7106	137.0601	141.4338	123.3054	118.3145	102.0964	94.6073	108.5633	109.8599	128.0311	139.7559	151.7659 (45)
Energy content (annual)												1511.5041 (45)
Distribution loss	Total = Sum(45)m =											
	$(46)m = 0.15 \times (45)m$											
	23.5066	20.5590	21.2151	18.4958	17.7472	15.3145	14.1911	16.2845	16.4790	19.2047	20.9634	22.7649 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Total heat required for water heating calculated for each month	50.9589	46.0274	49.9337	46.4279	46.0173	42.6378	44.0591	46.0173	46.4279	49.9337	49.3151	50.9589 (61)
Solar input	207.6695	183.0875	191.3674	169.7333	164.3317	144.7342	138.6664	154.5806	156.2877	177.9647	189.0710	202.7248 (62)
Output from w/h	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)
Heat gains from water heating, kWh/month	207.6695	183.0875	191.3674	169.7333	164.3317	144.7342	138.6664	154.5806	156.2877	177.9647	189.0710	202.7248 (64)
	64.8460	57.0793	59.5101	52.6060	50.8439	44.6065	42.4717	47.6016	48.1354	55.0537	58.7976	63.2019 (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	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.0982	18.7392	15.2398	11.5375	8.6244	7.2811	7.8675	10.2264	13.7259	17.4282	20.3413	21.6846	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	236.3284	238.7808	232.6009	219.4448	202.8375	187.2290	176.8016	174.3492	180.5291	193.6852	210.2925	225.9010	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	(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)	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	(71)
Water heating gains (Table 5)	87.1586	84.9395	79.9868	73.0639	68.3385	61.9535	57.0856	63.9807	66.8547	73.9970	81.6634	84.9488	(72)
Total internal gains	409.6590	407.5332	392.9012	369.1199	344.8742	321.5373	306.8284	313.6300	326.1834	350.1841	377.3708	397.6081	(73)

6. Solar gains

[Jan]														
	Area m2				Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W	
Northeast	6.8300				11.2829		0.6300		0.7000		0.7700		23.5513 (75)	
Southwest	9.7500				36.7938		0.6300		0.7000		0.7700		109.6356 (79)	
Northwest	2.4200				11.2829		0.6300		0.7000		0.7700		8.3447 (81)	
Solar gains	141.5315	251.6751	372.4939	508.7067	612.8473	627.3532	596.9544	516.3656	419.2088	285.7422	171.4515	119.8731	(83)	
Total gains	551.1905	659.2083	765.3951	877.8266	957.7215	948.8905	903.7828	829.9957	745.3921	635.9263	548.8224	517.4811	(84)	

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.1109	56.2389	56.3648	56.9641	57.0776	57.6121	57.6121	57.7122	57.4051	57.0776	56.8484	56.6107	
alpha	4.7407	4.7493	4.7577	4.7976	4.8052	4.8408	4.8408	4.8475	4.8270	4.8052	4.7899	4.7740	
util living area	0.9976	0.9941	0.9834	0.9458	0.8457	0.6716	0.5087	0.5706	0.8247	0.9704	0.9949	0.9982	(86)
MIT	19.6636	19.8460	20.1337	20.5018	20.7991	20.9521	20.9898	20.9828	20.8697	20.4728	19.9977	19.6317	(87)
Th 2	19.8900	19.8923	19.8944	19.9048	19.9067	19.9157	19.9157	19.9174	19.9122	19.9067	19.9028	19.8987	(88)
util rest of house	0.9968	0.9920	0.9775	0.9260	0.7929	0.5768	0.3889	0.4461	0.7463	0.9558	0.9928	0.9976	(89)
MIT 2	18.1180	18.3853	18.8033	19.3297	19.7156	19.8851	19.9122	19.9106	19.8106	19.3010	18.6150	18.0774	(90)
Living area fraction	18.4164	18.6673	19.0602	19.5560	19.9248	20.0911	20.1202	20.1176	20.0151	19.5272	18.8819	18.3775	(91)
MIT	18.4164	18.6673	19.0602	19.5560	19.9248	20.0911	20.1202	20.1176	20.0151	19.5272	18.8819	18.3775	(92)
Temperature adjustment	18.4164	18.6673	19.0602	19.5560	19.9248	20.0911	20.1202	20.1176	20.0151	19.5272	18.8819	18.3775	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9952	0.9888	0.9713	0.9181	0.7939	0.5931	0.4121	0.4701	0.7548	0.9489	0.9898	0.9963	(94)
Ext temp.	548.5177	651.7944	743.4461	805.9286	760.3549	562.7985	372.4586	390.1762	562.6301	603.4366	543.2485	515.5917	(95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Month fracti	1546.5231	1504.8405	1369.8294	1149.9309	885.8064	585.9020	375.6069	395.9824	633.4134	961.4568	1274.0224	1539.5006	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating	742.5160	573.2470	466.0292	247.6817	93.3359	0.0000	0.0000	0.0000	0.0000	266.3670	526.1572	761.7882	(98)
Space heating per m2												3677.1223	(98)
												41.5400	(99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)												93.4000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												3936.9617 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	742.5160	573.2470	466.0292	247.6817	93.3359	0.0000	0.0000	0.0000	0.0000	266.3670	526.1572	761.7882 (98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000 (210)
Space heating fuel (main heating system)	794.9850	613.7548	498.9606	265.1838	99.9314	0.0000	0.0000	0.0000	0.0000	285.1896	563.3375	815.6191 (211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating requirement	207.6695	183.0875	191.3674	169.7333	164.3317	144.7342	138.6664	154.5806	156.2877	177.9647	189.0710	202.7248 (64)
Efficiency of water heater (217)m	87.9814	87.7289	87.2070	86.0014	83.6869	80.3000	80.3000	80.3000	80.3000	86.0643	87.4910	80.3000 (216)
Fuel for water heating, kWh/month	236.0380	208.6970	219.4404	197.3610	196.3650	180.2419	172.6854	192.5038	194.6298	206.7810	216.1035	230.1816 (219)
Water heating fuel used												2451.0283 (219)
Annual totals kWh/year												
Space heating fuel - main system												3936.9617 (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)												372.6008 (232)
Total delivered energy for all uses												6835.5909 (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	3936.9617	0.2160	850.3837 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2451.0283	0.2160	529.4221 (264)
Space and water heating			1379.8059 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	372.6008	0.5190	193.3798 (268)
Total CO2, kg/m2/year			1612.1107 (272)
Emissions per m2 for space and water heating			15.5875 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.1846 (272b)
Emissions per m2 for pumps and fans			0.4397 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.5875 * 1.00) + 2.1846 + 0.4397, rounded to 2 d.p.			18.2100 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.2600 (1b)	x 2.4200 (2b)	= 107.1092 (1b) - (3b)
First floor	44.2600 (1c)	x 2.6900 (2c)	= 119.0594 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 226.1686 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1326 (8)
Pressure test					Yes
Measured/design AP50					3.8700
Infiltration rate					0.3261 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2772 (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	0.3535	0.3465	0.3396	0.3049	0.2980	0.2634	0.2634	0.2564	0.2772	0.2980	0.3119	0.3257 (22b)
Effective ac	0.5625	0.5600	0.5577	0.5465	0.5444	0.5347	0.5347	0.5329	0.5384	0.5444	0.5486	0.5531 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Front			2.1500	1.4000	3.0100		(26)
front (Uw = 1.30)			19.0000	1.2357	23.4791		(27)
gf			44.2600	0.1500	6.6390	75.0000	3319.4999 (28a)
external	112.7600	21.1500	91.6100	0.2000	18.3220	60.0000	5496.6001 (29a)
cold	44.2600		44.2600	0.0900	3.9834	9.0000	398.3400 (30)
Total net area of external elements Aum(A, m ²)			201.2800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	55.4335		(33)
party			26.7800	0.0000	0.0000	70.0000	1874.6000 (32)
gf			97.8600			9.0000	880.7400 (32c)
lf			94.0000			9.0000	846.0000 (32c)
lf			44.2600			18.0000	796.6800 (32d)
gf			44.2600			9.0000	398.3400 (32e)

Heat capacity Cm = Sum(A x k)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K
Thermal bridges (Sum(L x Psi) calculated using Appendix K)
Total fabric heat loss
(28)...(30) + (32) + (32a)...(32e) = 14010.8000 (34)
158.2784 (35)
14.2176 (36)
(33) + (36) = 69.6511 (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	41.9801	41.7990	41.6216	40.7881	40.6321	39.9062	39.9062	39.7717	40.1858	40.6321	40.9476	41.2774 (38)
Heat transfer coeff	111.6312	111.4501	111.2727	110.4392	110.2832	109.5573	109.5573	109.4228	109.8369	110.2832	110.5987	110.9285 (39)
Average = Sum(39)m / 12 =												110.4384 (39)
HLP	1.2611	1.2590	1.2570	1.2476	1.2459	1.2377	1.2377	1.2361	1.2408	1.2459	1.2494	1.2531 (40)
HLP (average)												1.2476 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6049 (42)
Average daily hot water use (litres/day)												96.0668 (43)
Daily hot water use	105.6734	101.8308	97.9881	94.1454	90.3027	86.4601	86.4601	90.3027	94.1454	97.9881	101.8308	105.6734 (44)
Energy conte	156.7106	137.0601	141.4338	123.3054	118.3145	102.0964	94.6073	108.5633	109.8599	128.0311	139.7559	151.7659 (45)
Energy content (annual)										Total = Sum(45)m =		1511.5041 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	33.3010	29.1253	30.0547	26.2024	25.1418	21.6955	20.1041	23.0697	23.3452	27.2066	29.6981	32.2503 (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	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.0982	18.7392	15.2398	11.5375	8.6244	7.2811	7.8675	10.2264	13.7259	17.4282	20.3413	21.6846	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	236.3284	238.7808	232.6009	219.4448	202.8375	187.2290	176.8016	174.3492	180.5291	193.6852	210.2925	225.9010	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	(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)	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	(71)
Water heating gains (Table 5)	44.7594	43.3412	40.3961	36.3922	33.7928	30.1326	27.0216	31.0077	32.4239	36.5680	41.2474	43.3471	(72)
Total internal gains	364.2598	362.9349	350.3105	329.4482	307.3284	286.7164	273.7643	277.6570	288.7526	309.7551	333.9549	353.0064	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
Northeast					6.8300	11.2829	0.4600	0.0000	0.7700		27.2955 (75)	
Southwest					9.7500	36.7938	0.4600	0.0000	0.7700		127.0657 (79)	
Northwest					2.4200	11.2829	0.4600	0.0000	0.7700		9.6713 (81)	
Solar gains	164.0325	291.6870	431.7138	589.5820	710.2790	727.0912	691.8595	598.4586	485.8555	331.1701	198.7093	138.9307 (83)
Total gains	528.2923	654.6219	782.0243	919.0302	1017.6075	1013.8076	965.6239	876.1156	774.6081	640.9252	532.6642	491.9371 (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	34.8638	34.9205	34.9761	35.2401	35.2899	35.5238	35.5238	35.5674	35.4333	35.2899	35.1893	35.0847
alpha	3.3243	3.3280	3.3317	3.3493	3.3527	3.3683	3.3683	3.3712	3.3622	3.3527	3.3460	3.3390
util living area	0.9891	0.9776	0.9518	0.8891	0.7733	0.6146	0.4739	0.5331	0.7623	0.9319	0.9810	0.9914 (86)
MIT	19.0505	19.3218	19.7359	20.2431	20.6518	20.8859	20.9643	20.9470	20.7555	20.1983	19.5212	18.9969 (87)
Th 2	19.8714	19.8731	19.8746	19.8821	19.8835	19.8900	19.8900	19.8912	19.8875	19.8835	19.8807	19.8777 (88)
util rest of house	0.9866	0.9725	0.9407	0.8635	0.7220	0.5309	0.3647	0.4206	0.6896	0.9106	0.9759	0.9894 (89)
MIT 2	18.1031	18.3727	18.7801	19.2708	19.6388	19.8296	19.8779	19.8715	19.7392	19.2414	18.5783	18.0544 (90)
Living area fraction	18.2860	18.5559	18.9646	19.4585	19.8344	20.0335	20.0876	20.0791	fLA = Living area / (4) = 19.9354	19.4262	18.7604	0.1931 (91)
MIT	18.2860	18.5559	18.9646	19.4585	19.8344	20.0335	20.0876	20.0791	19.9354	19.4262	18.7604	18.2364 (92)
Temperature adjustment												0.0000
adjusted MIT	18.2860	18.5559	18.9646	19.4585	19.8344	20.0335	20.0876	20.0791	19.9354	19.4262	18.7604	18.2364 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9818	0.9647	0.9295	0.8520	0.7195	0.5425	0.3850	0.4408	0.6931	0.8996	0.9689	0.9853 (94)
Useful gains	518.6740	631.5136	726.8576	783.0289	732.2102	549.9618	371.7468	386.2144	536.9089	576.5524	516.0836	484.7069 (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	1561.2784	1521.9524	1386.9709	1166.0760	897.0881	595.2818	382.0954	402.5798	640.9464	973.3793	1289.6209	1557.0322 (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	775.6977	598.3749	491.1243	275.7939	122.6691	0.0000	0.0000	0.0000	0.0000	295.2392	556.9468	797.8101 (98)
Space heating												3913.6560 (98)
Space heating per m2										(98) / (4) =		44.2121 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												
	0.0000	0.0000	0.0000	0.0000	0.0000	1029.8383	810.7238	831.6135	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8475	0.8991	0.8707	0.0000	0.0000	0.0000	0.0000 (101)

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Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	872.7863	728.9202	724.1093	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1282.9612	1224.5729	1121.6262	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	295.3259	368.7656	295.7525	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												959.8440 (104)
Cooled fraction									FC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	73.8315	92.1914	73.9381	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												239.9610 (107)
Space cooling per m2												2.7108 (108)
Energy for space heating												44.2121 (99)
Energy for space cooling												2.7108 (108)
Total												46.9229 (109)
Dwelling Fabric Energy Efficiency (DFEE)												46.9 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.2600 (1b)	x 2.4200 (2b)	= 107.1092 (1b) - (3b)
First floor	44.2600 (1c)	x 2.6900 (2c)	= 119.0594 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 226.1686 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1326 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3826 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3252 (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	0.4147	0.4066	0.3984	0.3578	0.3496	0.3090	0.3090	0.3009	0.3252	0.3496	0.3659	0.3822 (22b)
Effective ac	0.5860	0.5826	0.5794	0.5640	0.5611	0.5477	0.5477	0.5453	0.5529	0.5611	0.5669	0.5730 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			2.1500	1.0000	2.1500		(26)					
TER Opening Type (Uw = 1.40)			19.0000	1.3258	25.1894		(27)					
gf			44.2600	0.1300	5.7538		(28a)					
external	112.7600	21.1500	91.6100	0.1800	16.4898		(29a)					
cold	44.2600		44.2600	0.1300	5.7538		(30)					
Total net area of external elements Aum(A, m2)			201.2800				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26) ... (30) + (32) =		55.3368		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.4827 (36)					
Total fabric heat loss						(33) + (36) =	65.8195 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 43.7353	Feb 43.4861	Mar 43.2418	Apr 42.0945	May 41.8799	Jun 40.8806	Jul 40.8806	Aug 40.6956	Sep 41.2655	Oct 41.8799	Nov 42.3141	Dec 42.7681 (38)
Heat transfer coeff	109.5548	109.3056	109.0613	107.9140	107.6994	106.7001	106.7001	106.5151	107.0850	107.6994	108.1336	108.5876 (39)
Average = Sum(39)m / 12 =												107.9130 (39)
HLP	Jan 1.2376	Feb 1.2348	Mar 1.2321	Apr 1.2191	May 1.2167	Jun 1.2054	Jul 1.2054	Aug 1.2033	Sep 1.2097	Oct 1.2167	Nov 1.2216	Dec 1.2267 (40)
HLP (average)												1.2191 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6049 (42)
Average daily hot water use (litres/day)												96.0668 (43)
Daily hot water use	Jan 105.6734	Feb 101.8308	Mar 97.9881	Apr 94.1454	May 90.3027	Jun 86.4601	Jul 86.4601	Aug 90.3027	Sep 94.1454	Oct 97.9881	Nov 101.8308	Dec 105.6734 (44)
Energy conte	156.7106	137.0601	141.4338	123.3054	118.3145	102.0964	94.6073	108.5633	109.8599	128.0311	139.7559	151.7659 (45)
Energy content (annual)										Total = Sum(45)m =		1511.5041 (45)
Distribution loss (46)m = 0.15 x (45)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
If cylinder contains dedicated solar storage												

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Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Heat gains from water heating, kWh/month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
	33.3010	29.1253	30.0547	26.2024	25.1418	21.6955	20.1041	23.0697	23.3452	27.2066	29.6981	32.2503 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458	130.2458 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	21.0982	18.7392	15.2398	11.5375	8.6244	7.2811	7.8675	10.2264	13.7259	17.4282	20.3413	21.6846 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	236.3284	238.7808	232.6009	219.4448	202.8375	187.2290	176.8016	174.3492	180.5291	193.6852	210.2925	225.9010 (68)
Pumps, fans	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246	36.0246 (69)
Losses e.g. evaporation (negative values) (Table 5)	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)
Water heating gains (Table 5)	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966 (71)
Total internal gains	44.7594	43.3412	40.3961	36.3922	33.7928	30.1326	27.0216	31.0077	32.4239	36.5680	41.2474	43.3471 (72)
	364.2598	362.9349	350.3105	329.4482	307.3284	286.7164	273.7643	277.6570	288.7526	309.7551	333.9549	353.0064 (73)

6. Solar gains												

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d	Gains W
Northeast				6.8300	11.2829		0.6300		0.7000		0.7700	23.5513 (75)
Southwest				9.7500	36.7938		0.6300		0.7000		0.7700	109.6356 (79)
Northwest				2.4200	11.2829		0.6300		0.7000		0.7700	8.3447 (81)

Solar gains	141.5315	251.6751	372.4939	508.7067	612.8473	627.3532	596.9544	516.3656	419.2088	285.7422	171.4515	119.8731 (83)
Total gains	505.7913	614.6100	722.8044	838.1549	920.1757	914.0697	870.7188	794.0227	707.9614	595.4973	505.4064	472.8795 (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)												
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	56.1109	56.2389	56.3648	56.9641	57.0776	57.6121	57.6121	57.7122	57.4051	57.0776	56.8484	56.6107
util living area	4.7407	4.7493	4.7577	4.7976	4.8052	4.8408	4.8408	4.8475	4.8270	4.8052	4.7899	4.7740
	0.9984	0.9956	0.9868	0.9538	0.8609	0.6908	0.5263	0.5929	0.8456	0.9769	0.9964	0.9988 (86)
MIT	19.6167	19.8006	20.0925	20.4695	20.7804	20.9459	20.9883	20.9798	20.8528	20.4357	19.9533	19.5854 (87)
Th 2	19.8900	19.8923	19.8944	19.9048	19.9067	19.9157	19.9157	19.9174	19.9122	19.9067	19.9028	19.8987 (88)
util rest of house	0.9978	0.9940	0.9819	0.9363	0.8107	0.5956	0.4032	0.4652	0.7711	0.9650	0.9949	0.9984 (89)
MIT 2	18.6334	18.8184	19.1093	19.4827	19.7621	19.8918	19.9129	19.9118	19.8319	19.4584	18.9795	18.6090 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.8233	19.0080	19.2991	19.6732	19.9587	20.0953	20.1205	20.1180	20.0290	19.6471	19.1675	18.7975 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.8233	19.0080	19.2991	19.6732	19.9587	20.0953	20.1205	20.1180	20.0290	19.6471	19.1675	18.7975 (93)

8. Space heating requirement												

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9970	0.9923	0.9785	0.9317	0.8134	0.6125	0.4272	0.4900	0.7804	0.9613	0.9935	0.9978 (94)
Ext temp.	504.2818	609.9044	707.2344	780.8911	748.4646	559.8637	371.9603	389.0956	552.4830	572.4432	502.0986	471.8480 (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	1591.0948	1542.0873	1395.8899	1162.5780	889.4599	586.3497	375.6361	396.0267	634.9087	974.3672	1304.9016	1585.1108 (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	808.5889	626.4269	512.3597	274.8146	104.9005	0.0000	0.0000	0.0000	0.0000	299.0315	578.0181	828.2675 (98)
Space heating												4032.4078 (98)
Space heating per m2	(98) / (4) =											45.5536 (99)

8c. Space cooling requirement												

Calculated for June, July and August. See Table 10b												
Ext. temp.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
	0.0000	0.0000	0.0000	0.0000	0.0000	1002.9811	789.5809	809.5145	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8848	0.9364	0.9107	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	887.4753	739.3610	737.2333	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1166.3843	1113.6449	1025.6734	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	200.8145	278.4672	214.5994	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												693.8811 (104)

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Cooled fraction											FC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	50.2036	69.6168	53.6499	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												173.4703 (107)
Space cooling per m2												1.9597 (108)
Energy for space heating												45.5536 (99)
Energy for space cooling												1.9597 (108)
Total												47.5133 (109)
Target Fabric Energy Efficiency (TFEE)												54.6 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.2600 (1b)	x 2.4200 (2b)	= 107.1092 (1b) - (3b)
First floor	44.2600 (1c)	x 2.6900 (2c)	= 119.0594 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 226.1686 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1326 (8)
Pressure test					Yes
Measured/design AP50					3.8700
Infiltration rate					0.3261 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2772 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.6000	4.5000	4.5000	4.1000	4.2000	3.7000	3.5000	3.5000	3.7000	4.1000	4.1000	4.2000 (22)
Wind factor	1.1500	1.1250	1.1250	1.0250	1.0500	0.9250	0.8750	0.8750	0.9250	1.0250	1.0250	1.0500 (22a)
Adj infilt rate												
Effective ac	0.3188	0.3119	0.3119	0.2842	0.2911	0.2564	0.2426	0.2426	0.2564	0.2842	0.2842	0.2911 (22b)
	0.5508	0.5486	0.5486	0.5404	0.5424	0.5329	0.5294	0.5294	0.5329	0.5404	0.5404	0.5424 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Front			2.1500	1.4000	3.0100		(26)
front (Uw = 1.30)			19.0000	1.2357	23.4791		(27)
gf			44.2600	0.1500	6.6390	75.0000	3319.4999 (28a)
external	112.7600	21.1500	91.6100	0.2000	18.3220	60.0000	5496.6001 (29a)
cold	44.2600		44.2600	0.0900	3.9834	9.0000	398.3400 (30)
Total net area of external elements Aum(A, m ²)			201.2800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	55.4335		(33)
party			26.7800	0.0000	0.0000	70.0000	1874.6000 (32)
gf			97.8600			9.0000	880.7400 (32c)
lf			94.0000			9.0000	846.0000 (32c)
lf			44.2600			18.0000	796.6800 (32d)
gf			44.2600			9.0000	398.3400 (32e)

Heat capacity Cm = Sum(A x k)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K
Thermal bridges (Sum(L x Psi) calculated using Appendix K)
Total fabric heat loss
(28)...(30) + (32) + (32a)...(32e) = 14010.8000 (34)
158.2784 (35)
14.2176 (36)
(33) + (36) = 69.6511 (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	41.1107	40.9476	40.9476	40.3310	40.4798	39.7717	39.5136	39.5136	39.7717	40.3310	40.3310	40.4798 (38)
Heat transfer coeff	110.7618	110.5987	110.5987	109.9821	110.1309	109.4228	109.1647	109.1647	109.4228	109.9821	109.9821	110.1309 (39)
Average = Sum(39)m / 12 =												109.9452 (39)
HLP	1.2513	1.2494	1.2494	1.2425	1.2441	1.2361	1.2332	1.2332	1.2361	1.2425	1.2425	1.2441 (40)
HLP (average)												1.2420 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6049 (42)
Average daily hot water use (litres/day)												96.0668 (43)
Daily hot water use	105.6734	101.8308	97.9881	94.1454	90.3027	86.4601	86.4601	90.3027	94.1454	97.9881	101.8308	105.6734 (44)
Energy conte	156.7106	137.0601	141.4338	123.3054	118.3145	102.0964	94.6073	108.5633	109.8599	128.0311	139.7559	151.7659 (45)
Energy content (annual)										Total = Sum(45)m =		1511.5041 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	23.5066	20.5590	21.2151	18.4958	17.7472	15.3145	14.1911	16.2845	16.4790	19.2047	20.9634	22.7649 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	18.7707	16.9089	18.5877	17.8060	18.2670	17.5251	18.0141	18.1781	17.6781	18.4550	18.0450	18.7208 (61)
Total heat required for water heating calculated for each month	175.4814	153.9690	160.0215	141.1114	136.5815	119.6214	112.6214	126.7414	127.5380	146.4861	157.8010	170.4867 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	175.4814	153.9690	160.0215	141.1114	136.5815	119.6214	112.6214	126.7414	127.5380	146.4861	157.8010	170.4867 (64)
RHI water heating demand												
Heat gains from water heating, kWh/month	56.7990	49.7997	51.6737	45.4505	43.9063	38.3283	35.9605	40.6418	40.9479	47.1841	50.9801	55.1424 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 1728 (64)												

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.6721	46.7829	38.0464	28.8036	21.5310	18.1774	19.6413	25.5305	34.2670	43.5099	50.7824	54.1360 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	352.7290	356.3892	347.1656	327.5295	302.7425	279.4463	263.8829	260.2227	269.4463	289.0824	313.8694	337.1656 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344 (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)	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966 (71)
Water heating gains (Table 5)	76.3427	74.1067	69.4538	63.1257	59.0139	53.2338	48.3339	54.6261	56.8721	63.4195	70.8057	74.1161 (72)
Total internal gains	590.0765	585.6116	562.9985	527.7916	491.6201	459.1901	440.1909	448.7121	468.9182	504.3445	543.7902	573.7505 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	6.8300	9.5471	0.4600	0.0000	1.0000	29.9951 (75)
Southwest	9.7500	31.1332	0.4600	0.0000	1.0000	139.6326 (79)
Northwest	2.4200	9.5471	0.4600	0.0000	1.0000	10.6278 (81)

Solar gains	180.2555	336.7238	525.6256	729.9586	859.9834	897.0605	836.7160	712.8632	598.0604	397.5084	226.7835	163.2458 (83)
Total gains	770.3321	922.3353	1088.6241	1257.7502	1351.6036	1356.2507	1276.9069	1161.5753	1066.9786	901.8528	770.5737	736.9962 (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	35.1375	35.1893	35.1893	35.3866	35.3388	35.5674	35.6515	35.6515	35.5674	35.3866	35.3866	35.3388
alpha	3.3425	3.3460	3.3460	3.3591	3.3559	3.3712	3.3768	3.3768	3.3712	3.3591	3.3591	3.3559
util living area	0.9659	0.9397	0.8887	0.7793	0.6251	0.4615	0.3674	0.4092	0.6249	0.8465	0.9436	0.9702 (86)
MIT	19.4541	19.7327	20.1052	20.5524	20.8348	20.9552	20.9836	20.9768	20.8710	20.4769	19.8941	19.4079 (87)
Th 2	19.8792	19.8807	19.8807	19.8862	19.8849	19.8912	19.8935	19.8935	19.8912	19.8862	19.8862	19.8849 (88)
util rest of house	0.9587	0.9276	0.8674	0.7400	0.5645	0.3840	0.2788	0.3143	0.5475	0.8084	0.9301	0.9638 (89)
MIT 2	18.5061	18.7775	19.1324	19.5452	19.7793	19.8702	19.8883	19.8857	19.8188	19.4917	18.9438	18.4651 (90)
Living area fraction									fLA = Living area / (4) =			0.1931 (91)
MIT	18.6891	18.9619	19.3202	19.7397	19.9831	20.0797	20.0997	20.0963	20.0219	19.6819	19.1273	18.6471 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6891	18.9619	19.3202	19.7397	19.9831	20.0797	20.0997	20.0963	20.0219	19.6819	19.1273	18.6471 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9489	0.9154	0.8549	0.7343	0.5701	0.3976	0.2956	0.3322	0.5573	0.8004	0.9186	0.9547 (94)
Ext temp.	730.9719	844.3041	930.7097	923.5710	770.6060	539.2829	377.4731	385.8659	594.5918	721.8026	707.8146	703.6316 (95)
Heat loss rate W	4.7000	5.3000	6.7000	9.3000	12.3000	15.0000	16.6000	16.5000	14.1000	10.8000	7.5000	4.6000 (96)
Month fracti	1549.4560	1510.9882	1395.7776	1148.1788	846.1420	555.8345	382.0478	392.5922	647.9963	976.8510	1278.7939	1547.0232 (97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating	608.9522	448.0118	346.0105	161.7176	56.1988	0.0000	0.0000	0.0000	0.0000	189.7560	411.1051	627.4834 (98)
RHI space heating demand												2849.2354 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.2600 (1b)	x 2.4200 (2b)	= 107.1092 (1b) - (3b)
First floor	44.2600 (1c)	x 2.6900 (2c)	= 119.0594 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 226.1686 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1326 (8)
Pressure test					Yes
Measured/design AP50					3.8700
Infiltration rate					0.3261 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2772 (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	0.3535	0.3465	0.3396	0.3049	0.2980	0.2634	0.2634	0.2564	0.2772	0.2980	0.3119	0.3257 (22b)
Effective ac	0.5625	0.5600	0.5577	0.5465	0.5444	0.5347	0.5347	0.5329	0.5384	0.5444	0.5486	0.5531 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Front			2.1500	1.4000	3.0100		(26)
front (Uw = 1.30)			19.0000	1.2357	23.4791		(27)
gf			44.2600	0.1500	6.6390	75.0000	3319.4999 (28a)
external	112.7600	21.1500	91.6100	0.2000	18.3220	60.0000	5496.6001 (29a)
cold	44.2600		44.2600	0.0900	3.9834	9.0000	398.3400 (30)
Total net area of external elements Aum(A, m ²)			201.2800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	55.4335		(33)
party			26.7800	0.0000	0.0000	70.0000	1874.6000 (32)
gf			97.8600			9.0000	880.7400 (32c)
lf			94.0000			9.0000	846.0000 (32c)
lf			44.2600			18.0000	796.6800 (32d)
gf			44.2600			9.0000	398.3400 (32e)

Heat capacity Cm = Sum(A x k)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K
Thermal bridges (Sum(L x Psi) calculated using Appendix K)
Total fabric heat loss
(28)...(30) + (32) + (32a)...(32e) = 14010.8000 (34)
158.2784 (35)
14.2176 (36)
(33) + (36) = 69.6511 (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	41.9801	41.7990	41.6216	40.7881	40.6321	39.9062	39.9062	39.7717	40.1858	40.6321	40.9476	41.2774 (38)
Heat transfer coeff	111.6312	111.4501	111.2727	110.4392	110.2832	109.5573	109.5573	109.4228	109.8369	110.2832	110.5987	110.9285 (39)
Average = Sum(39)m / 12 =												110.4384 (39)
HLP	1.2611	1.2590	1.2570	1.2476	1.2459	1.2377	1.2377	1.2361	1.2408	1.2459	1.2494	1.2531 (40)
HLP (average)												1.2476 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6049 (42)
Average daily hot water use (litres/day)												96.0668 (43)
Daily hot water use	105.6734	101.8308	97.9881	94.1454	90.3027	86.4601	86.4601	90.3027	94.1454	97.9881	101.8308	105.6734 (44)
Energy conte	156.7106	137.0601	141.4338	123.3054	118.3145	102.0964	94.6073	108.5633	109.8599	128.0311	139.7559	151.7659 (45)
Energy content (annual)										Total = Sum(45)m =		1511.5041 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	23.5066	20.5590	21.2151	18.4958	17.7472	15.3145	14.1911	16.2845	16.4790	19.2047	20.9634	22.7649 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	18.7707	16.9089	18.5877	17.8060	18.2670	17.5251	18.0141	18.1781	17.6781	18.4550	18.0450	18.7208 (61)
Total heat required for water heating calculated for each month	175.4814	153.9690	160.0215	141.1114	136.5815	119.6214	112.6214	126.7414	127.5380	146.4861	157.8010	170.4867 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	175.4814	153.9690	160.0215	141.1114	136.5815	119.6214	112.6214	126.7414	127.5380	146.4861	157.8010	170.4867 (64)
Heat gains from water heating, kWh/month	56.7990	49.7997	51.6737	45.4505	43.9063	38.3283	35.9605	40.6418	40.9479	47.1841	50.9801	55.1424 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 1728.4607 (64)												

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.6721	46.7829	38.0464	28.8036	21.5310	18.1774	19.6413	25.5305	34.2670	43.5099	50.7824	54.1360	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	352.7290	356.3892	347.1656	327.5295	302.7425	279.4463	263.8829	260.2227	269.4463	289.0824	313.8694	337.1656	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	(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)	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	(71)
Water heating gains (Table 5)	76.3427	74.1067	69.4538	63.1257	59.0139	53.2338	48.3339	54.6261	56.8721	63.4195	70.8057	74.1161	(72)
Total internal gains	590.0765	585.6116	562.9985	527.7916	491.6201	459.1901	440.1909	448.7121	468.9182	504.3445	543.7902	573.7505	(73)

6. Solar gains

[Jan]			Area m2		Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
Northeast			6.8300		11.2829		0.4600		0.0000		1.0000		35.4487 (75)
Southwest			9.7500		36.7938		0.4600		0.0000		1.0000		165.0203 (79)
Northwest			2.4200		11.2829		0.4600		0.0000		1.0000		12.5602 (81)
Solar gains	213.0293	378.8142	560.6673	765.6909	922.4403	944.2743	898.5189	777.2189	630.9811	430.0910	258.0640		180.4295 (83)
Total gains	803.1058	964.4258	1123.6658	1293.4824	1414.0605	1403.4644	1338.7098	1225.9310	1099.8993	934.4355	801.8542		754.1800 (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	34.8638	34.9205	34.9761	35.2401	35.2899	35.5238	35.5238	35.5674	35.4333	35.2899	35.1893	35.0847	
alpha	3.3243	3.3280	3.3317	3.3493	3.3527	3.3683	3.3683	3.3712	3.3622	3.3527	3.3460	3.3390	
util living area	0.9644	0.9371	0.8851	0.7825	0.6351	0.4742	0.3526	0.3983	0.6128	0.8420	0.9424	0.9704 (86)	
MIT	19.4167	19.7054	20.0998	20.5273	20.8140	20.9480	20.9854	20.9780	20.8775	20.4748	19.8610	19.3523 (87)	
Th 2	19.8714	19.8731	19.8746	19.8821	19.8835	19.8900	19.8900	19.8912	19.8875	19.8835	19.8807	19.8777 (88)	
util rest of house	0.9572	0.9249	0.8635	0.7447	0.5785	0.4004	0.2669	0.3074	0.5354	0.8041	0.9290	0.9643 (89)	
MIT 2	18.4627	18.7439	19.1214	19.5182	19.7604	19.8642	19.8853	19.8836	19.8192	19.4861	18.9064	18.4046 (90)	
Living area fraction									fLA = Living area / (4) =			0.1931 (91)	
MIT	18.6469	18.9296	19.3103	19.7130	19.9638	20.0734	20.0977	20.0949	20.0235	19.6770	19.0907	18.5875 (92)	
Temperature adjustment												0.0000	
adjusted MIT	18.6469	18.9296	19.3103	19.7130	19.9638	20.0734	20.0977	20.0949	20.0235	19.6770	19.0907	18.5875 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9471	0.9124	0.8510	0.7384	0.5829	0.4130	0.2832	0.3245	0.5455	0.7960	0.9173	0.9551 (94)
Useful gains	760.5955	879.9862	956.2295	955.1339	824.1903	579.5766	379.1365	397.8150	600.0205	743.8329	735.5207	720.3136 (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	1601.5603	1563.5963	1425.4350	1194.1834	911.3594	599.6519	383.2008	404.3052	650.6236	1001.0419	1326.1553	1595.9873 (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	625.6778	459.3860	349.0889	172.1156	64.8539	0.0000	0.0000	0.0000	0.0000	191.3635	425.2569	651.5012 (98)
Space heating												2939.2437 (98)
Space heating per m2										(98) / (4) =		33.2043 (99)

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3160.4771 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	625.6778	459.3860	349.0889	172.1156	64.8539	0.0000	0.0000	0.0000	0.0000	191.3635	425.2569	651.5012	(98)
Space heating efficiency (main heating system 1)	93.0000	93.0000	93.0000	93.0000	93.0000	0.0000	0.0000	0.0000	0.0000	93.0000	93.0000	93.0000	(210)
Space heating fuel (main heating system)	672.7718	493.9634	375.3644	185.0705	69.7353	0.0000	0.0000	0.0000	0.0000	205.7672	457.2655	700.5390	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	175.4814	153.9690	160.0215	141.1114	136.5815	119.6214	112.6214	126.7414	127.5380	146.4861	157.8010	170.4867	(64)
Efficiency of water heater (217)m	89.3253	89.2276	89.0350	88.6233	87.9438	87.0000	87.0000	87.0000	87.0000	88.6742	89.1678	87.0000	(216)
Fuel for water heating, kWh/month	196.4520	172.5576	179.7287	159.2261	155.3054	137.4959	129.4499	145.6797	146.5954	165.1958	176.9707	190.7844	(219)
Water heating fuel used												1955.4417	(219)
Annual totals kWh/year													
Space heating fuel - main system												3160.4771	(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)												372.0825	(232)
Total delivered energy for all uses												5563.0013	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3160.4771	3.4800	109.9846 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1955.4417	3.4800	68.0494 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	372.0825	13.1900	49.0777 (250)
Additional standing charges			120.0000 (251)
Total energy cost			357.0042 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	1.1230 (257)
SAP value		84.3343
SAP rating (Section 12)		84 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3160.4771	0.2160	682.6631 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1955.4417	0.2160	422.3754 (264)
Space and water heating			1105.0385 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	372.0825	0.5190	193.1108 (268)
Total kg/year			1337.0743 (272)
CO2 emissions per m2			15.1000 (273)
EI value			86.5812
EI rating			87 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9000 = 3.867$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9000 = 0.2400$, stars = 4
Water heating energy efficiency	$3.48 / 0.8828 = 3.942$, stars = 4
Water heating environmental impact	$0.216 / 0.8828 = 0.2447$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.2600 (1b)	x 2.4200 (2b)	= 107.1092 (1b) - (3b)
First floor	44.2600 (1c)	x 2.6900 (2c)	= 119.0594 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 226.1686 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1326 (8)
Pressure test					Yes
Measured/design AP50					3.8700
Infiltration rate					0.3261 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2772 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.6000	4.5000	4.5000	4.1000	4.2000	3.7000	3.5000	3.5000	3.7000	4.1000	4.1000	4.2000 (22)
Wind factor	1.1500	1.1250	1.1250	1.0250	1.0500	0.9250	0.8750	0.8750	0.9250	1.0250	1.0250	1.0500 (22a)
Adj infilt rate												
Effective ac	0.3188	0.3119	0.3119	0.2842	0.2911	0.2564	0.2426	0.2426	0.2564	0.2842	0.2842	0.2911 (22b)
	0.5508	0.5486	0.5486	0.5404	0.5424	0.5329	0.5294	0.5294	0.5329	0.5404	0.5404	0.5424 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Front			2.1500	1.4000	3.0100		(26)
front (Uw = 1.30)			19.0000	1.2357	23.4791		(27)
gf			44.2600	0.1500	6.6390	75.0000	3319.4999 (28a)
external	112.7600	21.1500	91.6100	0.2000	18.3220	60.0000	5496.6001 (29a)
cold	44.2600		44.2600	0.0900	3.9834	9.0000	398.3400 (30)
Total net area of external elements Aum(A, m ²)			201.2800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	55.4335		(33)
party			26.7800	0.0000	0.0000	70.0000	1874.6000 (32)
gf			97.8600			9.0000	880.7400 (32c)
1f			94.0000			9.0000	846.0000 (32c)
1f			44.2600			18.0000	796.6800 (32d)
gf			44.2600			9.0000	398.3400 (32e)

Heat capacity Cm = Sum(A x k)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K
Thermal bridges (Sum(L x Psi) calculated using Appendix K)
Total fabric heat loss
(28)...(30) + (32) + (32a)...(32e) = 14010.8000 (34)
158.2784 (35)
14.2176 (36)
(33) + (36) = 69.6511 (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	41.1107	40.9476	40.9476	40.3310	40.4798	39.7717	39.5136	39.5136	39.7717	40.3310	40.3310	40.4798 (38)
Heat transfer coeff	110.7618	110.5987	110.5987	109.9821	110.1309	109.4228	109.1647	109.1647	109.4228	109.9821	109.9821	110.1309 (39)
Average = Sum(39)m / 12 =												109.9452 (39)
HLP	1.2513	1.2494	1.2494	1.2425	1.2441	1.2361	1.2332	1.2332	1.2361	1.2425	1.2425	1.2441 (40)
HLP (average)												1.2420 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6049 (42)
Average daily hot water use (litres/day)												96.0668 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	105.6734	101.8308	97.9881	94.1454	90.3027	86.4601	86.4601	90.3027	94.1454	97.9881	101.8308	105.6734 (44)
Energy conte	156.7106	137.0601	141.4338	123.3054	118.3145	102.0964	94.6073	108.5633	109.8599	128.0311	139.7559	151.7659 (45)
Energy content (annual)										Total = Sum(45)m =		1511.5041 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Distribution loss (46)m = 0.15 x (45)m	23.5066	20.5590	21.2151	18.4958	17.7472	15.3145	14.1911	16.2845	16.4790	19.2047	20.9634	22.7649 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	18.7707	16.9089	18.5877	17.8060	18.2670	17.5251	18.0141	18.1781	17.6781	18.4550	18.0450	18.7208 (61)
Total heat required for water heating calculated for each month	175.4814	153.9690	160.0215	141.1114	136.5815	119.6214	112.6214	126.7414	127.5380	146.4861	157.8010	170.4867 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	175.4814	153.9690	160.0215	141.1114	136.5815	119.6214	112.6214	126.7414	127.5380	146.4861	157.8010	170.4867 (64)
Heat gains from water heating, kWh/month	56.7990	49.7997	51.6737	45.4505	43.9063	38.3283	35.9605	40.6418	40.9479	47.1841	50.9801	55.1424 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 1728.4607 (64)												

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.6721	46.7829	38.0464	28.8036	21.5310	18.1774	19.6413	25.5305	34.2670	43.5099	50.7824	54.1360 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	352.7290	356.3892	347.1656	327.5295	302.7425	279.4463	263.8829	260.2227	269.4463	289.0824	313.8694	337.1656 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344 (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)	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966 (71)
Water heating gains (Table 5)	76.3427	74.1067	69.4538	63.1257	59.0139	53.2338	48.3339	54.6261	56.8721	63.4195	70.8057	74.1161 (72)
Total internal gains	590.0765	585.6116	562.9985	527.7916	491.6201	459.1901	440.1909	448.7121	468.9182	504.3445	543.7902	573.7505 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d		Gains W
Northeast				6.8300	9.5471		0.4600	0.0000		1.0000		29.9951 (75)
Southwest				9.7500	31.1332		0.4600	0.0000		1.0000		139.6326 (79)
Northwest				2.4200	9.5471		0.4600	0.0000		1.0000		10.6278 (81)
Solar gains	180.2555	336.7238	525.6256	729.9586	859.9834	897.0605	836.7160	712.8632	598.0604	397.5084	226.7835	163.2458 (83)
Total gains	770.3321	922.3353	1088.6241	1257.7502	1351.6036	1356.2507	1276.9069	1161.5753	1066.9786	901.8528	770.5737	736.9962 (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	35.1375	35.1893	35.1893	35.3866	35.3388	35.5674	35.6515	35.6515	35.5674	35.3866	35.3866	35.3388
alpha	3.3425	3.3460	3.3460	3.3591	3.3559	3.3712	3.3768	3.3768	3.3712	3.3591	3.3591	3.3559
util living area	0.9659	0.9397	0.8887	0.7793	0.6251	0.4615	0.3674	0.4092	0.6249	0.8465	0.9436	0.9702 (86)
MIT	19.4541	19.7327	20.1052	20.5524	20.8348	20.9552	20.9836	20.9768	20.8710	20.4769	19.8941	19.4079 (87)
Th 2	19.8792	19.8807	19.8807	19.8862	19.8849	19.8912	19.8935	19.8935	19.8912	19.8862	19.8862	19.8849 (88)
util rest of house	0.9587	0.9276	0.8674	0.7400	0.5645	0.3840	0.2788	0.3143	0.5475	0.8084	0.9301	0.9638 (89)
MIT 2	18.5061	18.7775	19.1324	19.5452	19.7793	19.8702	19.8883	19.8857	19.8188	19.4917	18.9438	18.4651 (90)
Living area fraction									fLA = Living area / (4) =			0.1931 (91)
MIT	18.6891	18.9619	19.3202	19.7397	19.9831	20.0797	20.0997	20.0963	20.0219	19.6819	19.1273	18.6471 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6891	18.9619	19.3202	19.7397	19.9831	20.0797	20.0997	20.0963	20.0219	19.6819	19.1273	18.6471 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	730.9719	844.3041	930.7097	923.5710	770.6060	539.2829	377.4731	385.8659	594.5918	721.8026	707.8146	703.6316 (94)
Ext temp.	4.7000	5.3000	6.7000	9.3000	12.3000	15.0000	16.6000	16.5000	14.1000	10.8000	7.5000	4.6000 (96)
Heat loss rate W	1549.4560	1510.9882	1395.7776	1148.1788	846.1420	555.8345	382.0478	392.5922	647.9963	976.8510	1278.7939	1547.0232 (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	608.9522	448.0118	346.0105	161.7176	56.1988	0.0000	0.0000	0.0000	0.0000	189.7560	411.1051	627.4834 (98)
Space heating												2849.2354 (98)
Space heating per m2										(98) / (4) =		32.1875 (99)

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3063.6940 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	608.9522	448.0118	346.0105	161.7176	56.1988	0.0000	0.0000	0.0000	0.0000	189.7560	411.1051	627.4834	(98)
Space heating efficiency (main heating system 1)	93.0000	93.0000	93.0000	93.0000	93.0000	0.0000	0.0000	0.0000	0.0000	93.0000	93.0000	93.0000	(210)
Space heating fuel (main heating system)	654.7873	481.7331	372.0544	173.8899	60.4288	0.0000	0.0000	0.0000	0.0000	204.0388	442.0485	674.7133	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	175.4814	153.9690	160.0215	141.1114	136.5815	119.6214	112.6214	126.7414	127.5380	146.4861	157.8010	170.4867	(64)
Efficiency of water heater (217)m	89.3111	89.2132	89.0292	88.5767	87.8537	87.0000	87.0000	87.0000	87.0000	88.6680	89.1473	87.0000	(216)
Fuel for water heating, kWh/month	196.4834	172.5855	179.7404	159.3097	155.4647	137.4959	129.4499	145.6797	146.5954	165.2075	177.0114	190.8252	(219)
Water heating fuel used												1955.8488	(219)
Annual totals kWh/year													
Space heating fuel - main system												3063.6940	(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)												372.0825	(232)
Total delivered energy for all uses												5466.6253	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3063.6940	10.2300	313.4159 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1955.8488	10.2300	200.0833 (247)
Pumps and fans for heating	75.0000	36.7200	27.5400 (249)
Energy for lighting	372.0825	36.7200	136.6287 (250)
Additional standing charges			103.0000 (251)
Total energy cost			780.6679 (255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3063.6940	0.2160	661.7579 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1955.8488	0.2160	422.4633 (264)
Space and water heating			1084.2213 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	372.0825	0.5190	193.1108 (268)
Total kg/year			1316.2571 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	3063.6940	1.2200	3737.7067 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1955.8488	1.2200	2386.1356 (264)
Space and water heating			6123.8423 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	372.0825	3.0700	1142.2932 (268)
Primary energy kWh/year			7496.3855 (272)
Primary energy kWh/m2/year			84.6858 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 84
Current environmental impact rating: B 87

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 79	-180 kg (13.6%)
U Solar photovoltaic panels	+ 10.0	-£ 589	-833 kg (73.3%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£79	2.03 kg/m²	B 86 B 88
Solar photovoltaic panels	£589	9.41 kg/m²	A 96 A 97
Total Savings	£668	11.44 kg/m²	

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, West Pennines (England)):

	Current	Potential	Saving
Electricity	£164	£183	-£18
Mains gas	£616	£519	£97
Space heating	£444	£444	£0
Water heating	£200	£121	£79
Lighting	£137	£137	£0
Generated (PV)	-£0	-£589	£589
Total cost of fuels	£780	£113	£668
Total cost of uses	£781	£113	£668
Delivered energy	62 kWh/m²	33 kWh/m²	28 kWh/m²
Carbon dioxide emissions	1.3 tonnes	0.3 tonnes	1.0 tonnes
CO2 emissions per m²	15 kg/m²	3 kg/m²	11 kg/m²
Primary energy	85 kWh/m²	18 kWh/m²	67 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.2600 (1b)	x 2.4200 (2b)	= 107.1092 (1b) - (3b)
First floor	44.2600 (1c)	x 2.6900 (2c)	= 119.0594 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 226.1686 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1326 (8)
Pressure test					Yes
Measured/design AP50					3.8700
Infiltration rate					0.3261 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2772 (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	0.3535	0.3465	0.3396	0.3049	0.2980	0.2634	0.2634	0.2564	0.2772	0.2980	0.3119	0.3257 (22b)
Effective ac	0.5625	0.5600	0.5577	0.5465	0.5444	0.5347	0.5347	0.5329	0.5384	0.5444	0.5486	0.5531 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Front			2.1500	1.4000	3.0100		(26)
front (Uw = 1.30)			19.0000	1.2357	23.4791		(27)
gf			44.2600	0.1500	6.6390	75.0000	3319.4999 (28a)
external	112.7600	21.1500	91.6100	0.2000	18.3220	60.0000	5496.6001 (29a)
cold	44.2600		44.2600	0.0900	3.9834	9.0000	398.3400 (30)
Total net area of external elements Aum(A, m ²)			201.2800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	55.4335		(33)
party			26.7800	0.0000	0.0000	70.0000	1874.6000 (32)
gf			97.8600			9.0000	880.7400 (32c)
lf			94.0000			9.0000	846.0000 (32c)
lf			44.2600			18.0000	796.6800 (32d)
gf			44.2600			9.0000	398.3400 (32e)

Heat capacity Cm = Sum(A x k)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K
Thermal bridges (Sum(L x Psi) calculated using Appendix K)
Total fabric heat loss
(28)...(30) + (32) + (32a)...(32e) = 14010.8000 (34)
158.2784 (35)
14.2176 (36)
(33) + (36) = 69.6511 (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	41.9801	41.7990	41.6216	40.7881	40.6321	39.9062	39.9062	39.7717	40.1858	40.6321	40.9476	41.2774 (38)
Heat transfer coeff	111.6312	111.4501	111.2727	110.4392	110.2832	109.5573	109.5573	109.4228	109.8369	110.2832	110.5987	110.9285 (39)
Average = Sum(39)m / 12 =												110.4384 (39)
HLP	1.2611	1.2590	1.2570	1.2476	1.2459	1.2377	1.2377	1.2361	1.2408	1.2459	1.2494	1.2531 (40)
HLP (average)												1.2476 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6049 (42)
Average daily hot water use (litres/day)												96.0668 (43)
Daily hot water use	105.6734	101.8308	97.9881	94.1454	90.3027	86.4601	86.4601	90.3027	94.1454	97.9881	101.8308	105.6734 (44)
Energy conte	156.7106	137.0601	141.4338	123.3054	118.3145	102.0964	94.6073	108.5633	109.8599	128.0311	139.7559	151.7659 (45)
Energy content (annual)										Total = Sum(45)m =		1511.5041 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	23.5066	20.5590	21.2151	18.4958	17.7472	15.3145	14.1911	16.2845	16.4790	19.2047	20.9634	22.7649 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	18.7707	16.9089	18.5877	17.8060	18.2670	17.5251	18.0141	18.1781	17.6781	18.4550	18.0450	18.7208 (61)
Total heat required for water heating calculated for each month	175.4814	153.9690	160.0215	141.1114	136.5815	119.6214	112.6214	126.7414	127.5380	146.4861	157.8010	170.4867 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1079.5246 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1813.6014 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.1999 (H8)
Utilisation factor												0.5654 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												96.0668 (H14)
Volume ratio Veff/V												0.7807 (H15)
Solar storage volume factor												0.9505 (H16)
Solar input	-24.8530	-41.4726	-70.6325	-94.6615	-116.9463	-114.9768	-113.4574	-99.1283	-77.6373	-53.0172	-29.4793	-857.0598 (H17)
Solar input (sum of months) = Sum (63)m =												-857.0598 (63)
Output from w/h	150.6283	112.4965	89.3890	46.4499	19.6352	4.6446	0.0000	27.6131	49.9007	93.4690	128.3217	149.6889 (64)
Total per year (kWh/year) = Sum (64)m =												872.2368 (64)
Heat gains from water heating, kWh/month	56.7990	49.7997	51.6737	45.4505	43.9063	38.3283	35.9605	40.6418	40.9479	47.1841	50.9801	55.1424 (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)
(66)m	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.6721	46.7829	38.0464	28.8036	21.5310	18.1774	19.6413	25.5305	34.2670	43.5099	50.7824	54.1360	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	352.7290	356.3892	347.1656	327.5295	302.7425	279.4463	263.8829	260.2227	269.4463	289.0824	313.8694	337.1656	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	(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)	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	(71)
Water heating gains (Table 5)	76.3427	74.1067	69.4538	63.1257	59.0139	53.2338	48.3339	54.6261	56.8721	63.4195	70.8057	74.1161	(72)
Total internal gains	590.0765	585.6116	562.9985	527.7916	491.6201	459.1901	440.1909	448.7121	468.9182	504.3445	543.7902	573.7505	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W				
Northeast					6.8300	11.2829		0.4600	0.0000	1.0000		35.4487 (75)				
Southwest					9.7500	36.7938		0.4600	0.0000	1.0000		165.0203 (79)				
Northwest					2.4200	11.2829		0.4600	0.0000	1.0000		12.5602 (81)				
Solar gains					213.0293	378.8142	560.6673	765.6909	922.4403	944.2743	898.5189	777.2189	630.9811	430.0910	258.0640	180.4295 (83)
Total gains					803.1058	964.4258	1123.6658	1293.4824	1414.0605	1403.4644	1338.7098	1225.9310	1099.8993	934.4355	801.8542	754.1800 (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	34.8638	34.9205	34.9761	35.2401	35.2899	35.5238	35.5238	35.5674	35.4333	35.2899	35.1893	35.0847	
alpha	3.3243	3.3280	3.3317	3.3493	3.3527	3.3683	3.3683	3.3712	3.3622	3.3527	3.3460	3.3390	
util living area	0.9644	0.9371	0.8851	0.7825	0.6351	0.4742	0.3526	0.3983	0.6128	0.8420	0.9424	0.9704	(86)
MIT	19.4167	19.7054	20.0998	20.5273	20.8140	20.9480	20.9854	20.9780	20.8775	20.4748	19.8610	19.3523	(87)
Th 2	19.8714	19.8731	19.8746	19.8821	19.8835	19.8900	19.8900	19.8912	19.8875	19.8835	19.8807	19.8777	(88)
util rest of house	0.9572	0.9249	0.8635	0.7447	0.5785	0.4004	0.2669	0.3074	0.5354	0.8041	0.9290	0.9643	(89)
MIT 2	18.4627	18.7439	19.1214	19.5182	19.7604	19.8642	19.8853	19.8836	19.8192	19.4861	18.9064	18.4046	(90)
Living area fraction									fLA = Living area / (4) =			0.1931	(91)
MIT	18.6469	18.9296	19.3103	19.7130	19.9638	20.0734	20.0977	20.0949	20.0235	19.6770	19.0907	18.5875	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6469	18.9296	19.3103	19.7130	19.9638	20.0734	20.0977	20.0949	20.0235	19.6770	19.0907	18.5875	(93)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9471	0.9124	0.8510	0.7384	0.5829	0.4130	0.2832	0.3245	0.5455	0.7960	0.9173	0.9551	(94)
Useful gains	760.5955	879.9862	956.2295	955.1339	824.1903	579.5766	379.1365	397.8150	600.0205	743.8329	735.5207	720.3136	(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	1601.5603	1563.5963	1425.4350	1194.1834	911.3594	599.6519	383.2008	404.3052	650.6236	1001.0419	1326.1553	1595.9873	(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	625.6778	459.3860	349.0889	172.1156	64.8539	0.0000	0.0000	0.0000	0.0000	191.3635	425.2569	651.5012	(98)
Space heating												2939.2437	(98)
Space heating per m2											(98) / (4) =	33.2043	(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 %)													93.0000	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													3160.4771	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	625.6778	459.3860	349.0889	172.1156	64.8539	0.0000	0.0000	0.0000	0.0000	191.3635	425.2569	651.5012	(98)	
Space heating efficiency (main heating system 1)	93.0000	93.0000	93.0000	93.0000	93.0000	0.0000	0.0000	0.0000	0.0000	93.0000	93.0000	93.0000	(210)	
Space heating fuel (main heating system)	672.7718	493.9634	375.3644	185.0705	69.7353	0.0000	0.0000	0.0000	0.0000	205.7672	457.2655	700.5390	(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	150.6283	112.4965	89.3890	46.4499	19.6352	4.6446	0.0000	27.6131	49.9007	93.4690	128.3217	149.6889	(64)	
Efficiency of water heater	(217)m	89.4018	89.3936	89.3717	89.3452	89.2845	87.0000	87.0000	87.0000	88.9930	89.2863	89.4239	(217)	
Fuel for water heating, kWh/month	168.4846	125.8440	100.0193	51.9892	21.9917	5.3386	0.0000	31.7392	57.3571	105.0296	143.7193	167.3926	(219)	
Water heating fuel used												978.9051	(219)	
Annual totals kWh/year														
Space heating fuel - main system												3160.4771	(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)
pump for solar water heating													50.0000	(230g)
Total electricity for the above, kWh/year													125.0000	(231)
Electricity for lighting (calculated in Appendix L)													372.0825	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)	
Total delivered energy for all uses													2909.2253	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3160.4771	3.4800	109.9846	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	978.9051	3.4800	34.0659	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	372.0825	13.1900	49.0777	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			101.7928	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):			0.4200	(256)
Energy cost factor (ECF)		[(255) x (256)] / [(4) + 45.0] =	0.3202	(257)
SAP value			95.5332	
SAP rating (Section 12)			96	(258)
SAP band			A	

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

Energy	Emission factor	Emissions
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	kWh/year	kg CO2/kWh	kg CO2/year
Space heating - main system 1	3160.4771	0.2160	682.6631 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	978.9051	0.2160	211.4435 (264)
Space and water heating			894.1066 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	372.0825	0.5190	193.1108 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			255.6551 (272)
CO2 emissions per m2			2.8900 (273)
EI value			97.4343
EI rating			97 (274)
EI band			A

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.2600 (1b)	x 2.4200 (2b)	= 107.1092 (1b) - (3b)
First floor	44.2600 (1c)	x 2.6900 (2c)	= 119.0594 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 226.1686 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				30.0000 / (5) = 0.1326 (8)
Pressure test					Yes
Measured/design AP50					3.8700
Infiltration rate					0.3261 (18)
Number of sides sheltered					2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.2772 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.6000	4.5000	4.5000	4.1000	4.2000	3.7000	3.5000	3.5000	3.7000	4.1000	4.1000	4.2000 (22)
Wind factor	1.1500	1.1250	1.1250	1.0250	1.0500	0.9250	0.8750	0.8750	0.9250	1.0250	1.0250	1.0500 (22a)
Adj infilt rate												
Effective ac	0.3188	0.3119	0.3119	0.2842	0.2911	0.2564	0.2426	0.2426	0.2564	0.2842	0.2842	0.2911 (22b)
	0.5508	0.5486	0.5486	0.5404	0.5424	0.5329	0.5294	0.5294	0.5329	0.5404	0.5404	0.5424 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Front			2.1500	1.4000	3.0100		(26)
front (Uw = 1.30)			19.0000	1.2357	23.4791		(27)
gf			44.2600	0.1500	6.6390	75.0000	3319.4999 (28a)
external	112.7600	21.1500	91.6100	0.2000	18.3220	60.0000	5496.6001 (29a)
cold	44.2600		44.2600	0.0900	3.9834	9.0000	398.3400 (30)
Total net area of external elements Aum(A, m ²)			201.2800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	55.4335		(33)
party			26.7800	0.0000	0.0000	70.0000	1874.6000 (32)
gf			97.8600			9.0000	880.7400 (32c)
lf			94.0000			9.0000	846.0000 (32c)
lf			44.2600			18.0000	796.6800 (32d)
gf			44.2600			9.0000	398.3400 (32e)

Heat capacity Cm = Sum(A x k)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K
Thermal bridges (Sum(L x Psi) calculated using Appendix K)
Total fabric heat loss
(28)...(30) + (32) + (32a)...(32e) = 14010.8000 (34)
158.2784 (35)
14.2176 (36)
(33) + (36) = 69.6511 (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	41.1107	40.9476	40.9476	40.3310	40.4798	39.7717	39.5136	39.5136	39.7717	40.3310	40.3310	40.4798 (38)
Heat transfer coeff	110.7618	110.5987	110.5987	109.9821	110.1309	109.4228	109.1647	109.1647	109.4228	109.9821	109.9821	110.1309 (39)
Average = Sum(39)m / 12 =												109.9452 (39)
HLP	1.2513	1.2494	1.2494	1.2425	1.2441	1.2361	1.2332	1.2332	1.2361	1.2425	1.2425	1.2441 (40)
HLP (average)												1.2420 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6049 (42)
Average daily hot water use (litres/day)												96.0668 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	105.6734	101.8308	97.9881	94.1454	90.3027	86.4601	86.4601	90.3027	94.1454	97.9881	101.8308	105.6734 (44)
Energy conte	156.7106	137.0601	141.4338	123.3054	118.3145	102.0964	94.6073	108.5633	109.8599	128.0311	139.7559	151.7659 (45)
Energy content (annual)										Total = Sum(45)m =		1511.5041 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	23.5066	20.5590	21.2151	18.4958	17.7472	15.3145	14.1911	16.2845	16.4790	19.2047	20.9634	22.7649 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	18.7707	16.9089	18.5877	17.8060	18.2670	17.5251	18.0141	18.1781	17.6781	18.4550	18.0450	18.7208 (61)
Total heat required for water heating calculated for each month	175.4814	153.9690	160.0215	141.1114	136.5815	119.6214	112.6214	126.7414	127.5380	146.4861	157.8010	170.4867 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1003.2404 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1685.4438 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.1151 (H8)
Utilisation factor												0.5921 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												96.0668 (H14)
Volume ratio Veff/V												0.7807 (H15)
Solar storage volume factor												0.9505 (H16)
Solar input	-22.0219	-38.6042	-69.3429	-94.5027	-114.1733	-114.3827	-110.6394	-95.2109	-77.0594	-51.3131	-27.1286	-834.0842 (H17)
Solar input (sum of months) = Sum (63)m =												-834.0842 (63)
Output from w/h	153.4595	115.3648	90.6785	46.6086	22.4082	5.2388	1.9820	31.5305	50.4786	95.1730	130.6724	150.7817 (64)
Total per year (kWh/year) = Sum (64)m =												894.3765 (64)
Heat gains from water heating, kWh/month	56.7990	49.7997	51.6737	45.4505	43.9063	38.3283	35.9605	40.6418	40.9479	47.1841	50.9801	55.1424 (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)
(66)m	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	156.2950	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.6721	46.7829	38.0464	28.8036	21.5310	18.1774	19.6413	25.5305	34.2670	43.5099	50.7824	54.1360	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	352.7290	356.3892	347.1656	327.5295	302.7425	279.4463	263.8829	260.2227	269.4463	289.0824	313.8694	337.1656	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	53.2344	(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)	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	-104.1966	(71)
Water heating gains (Table 5)	76.3427	74.1067	69.4538	63.1257	59.0139	53.2338	48.3339	54.6261	56.8721	63.4195	70.8057	74.1161	(72)
Total internal gains	590.0765	585.6116	562.9985	527.7916	491.6201	459.1901	440.1909	448.7121	468.9182	504.3445	543.7902	573.7505	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
Northeast				6.8300	9.5471		0.4600	0.0000	1.0000		29.9951 (75)	
Southwest				9.7500	31.1332		0.4600	0.0000	1.0000		139.6326 (79)	
Northwest				2.4200	9.5471		0.4600	0.0000	1.0000		10.6278 (81)	
Solar gains	180.2555	336.7238	525.6256	729.9586	859.9834	897.0605	836.7160	712.8632	598.0604	397.5084	226.7835	163.2458 (83)
Total gains	770.3321	922.3353	1088.6241	1257.7502	1351.6036	1356.2507	1276.9069	1161.5753	1066.9786	901.8528	770.5737	736.9962 (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	35.1375	35.1893	35.1893	35.3866	35.3388	35.5674	35.6515	35.6515	35.5674	35.3866	35.3866	35.3388	
alpha	3.3425	3.3460	3.3460	3.3591	3.3559	3.3712	3.3768	3.3768	3.3712	3.3591	3.3591	3.3559	
util living area	0.9659	0.9397	0.8887	0.7793	0.6251	0.4615	0.3674	0.4092	0.6249	0.8465	0.9436	0.9702	(86)
MIT	19.4541	19.7327	20.1052	20.5524	20.8348	20.9552	20.9836	20.9768	20.8710	20.4769	19.8941	19.4079	(87)
Th 2	19.8792	19.8807	19.8807	19.8862	19.8849	19.8912	19.8935	19.8935	19.8912	19.8862	19.8862	19.8849	(88)
util rest of house	0.9587	0.9276	0.8674	0.7400	0.5645	0.3840	0.2788	0.3143	0.5475	0.8084	0.9301	0.9638	(89)
MIT 2	18.5061	18.7775	19.1324	19.5452	19.7793	19.8702	19.8883	19.8857	19.8188	19.4917	18.9438	18.4651	(90)
Living area fraction									fLA = Living area / (4) =			0.1931	(91)
MIT	18.6891	18.9619	19.3202	19.7397	19.9831	20.0797	20.0997	20.0963	20.0219	19.6819	19.1273	18.6471	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6891	18.9619	19.3202	19.7397	19.9831	20.0797	20.0997	20.0963	20.0219	19.6819	19.1273	18.6471	(93)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9489	0.9154	0.8549	0.7343	0.5701	0.3976	0.2956	0.3322	0.5573	0.8004	0.9186	0.9547	(94)
Useful gains	730.9719	844.3041	930.7097	923.5710	770.6060	539.2829	377.4731	385.8659	594.5918	721.8026	707.8146	703.6316	(95)
Ext temp.	4.7000	5.3000	6.7000	9.3000	12.3000	15.0000	16.6000	16.5000	14.1000	10.8000	7.5000	4.6000	(96)
Heat loss rate W	1549.4560	1510.9882	1395.7776	1148.1788	846.1420	555.8345	382.0478	392.5922	647.9963	976.8510	1278.7939	1547.0232	(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	608.9522	448.0118	346.0105	161.7176	56.1988	0.0000	0.0000	0.0000	0.0000	189.7560	411.1051	627.4834	(98)
Space heating												2849.2354	(98)
Space heating per m2											(98) / (4) =	32.1875	(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 %)													93.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3063.6940 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	608.9522	448.0118	346.0105	161.7176	56.1988	0.0000	0.0000	0.0000	0.0000	189.7560	411.1051	627.4834	(98)
Space heating efficiency (main heating system 1)	93.0000	93.0000	93.0000	93.0000	93.0000	0.0000	0.0000	0.0000	0.0000	93.0000	93.0000	93.0000	(210)
Space heating fuel (main heating system)	654.7873	481.7331	372.0544	173.8899	60.4288	0.0000	0.0000	0.0000	0.0000	204.0388	442.0485	674.7133	(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	153.4595	115.3648	90.6785	46.6086	22.4082	5.2388	1.9820	31.5305	50.4786	95.1730	130.6724	150.7817	(64)
Efficiency of water heater	89.3796	89.3690	89.3602	89.3110	89.1239	87.0000	87.0000	87.0000	87.0000	88.9752	89.2576	89.4027	(216)
(217)m	89.3796	89.3690	89.3602	89.3110	89.1239	87.0000	87.0000	87.0000	87.0000	88.9752	89.2576	89.4027	(217)
Fuel for water heating, kWh/month	171.6940	129.0883	101.4754	52.1869	25.1427	6.0216	2.2782	36.2419	58.0214	106.9658	146.3991	168.6544	(219)
Water heating fuel used												1004.1695	(219)
Annual totals kWh/year													
Space heating fuel - main system												3063.6940	(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)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												372.0825	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1003 * 0.80) =									-1605.1846			-1605.1846	(233)
Total delivered energy for all uses												2959.7614	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3063.6940	10.2300	313.4159	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1004.1695	10.2300	102.7265	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	372.0825	36.7200	136.6287	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1605.1846	36.7200	-589.4238	(252)
Total energy cost			112.2473	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3063.6940	0.2160	661.7579	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1004.1695	0.2160	216.9006	(264)
Space and water heating			878.6585	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	372.0825	0.5190	193.1108	(268)
Energy saving/generation technologies				
PV Unit	-1605.1846	0.5190	-833.0908	(269)
Total kg/year			303.5535	(272)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	3063.6940	1.2200	3737.7067 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1004.1695	1.2200	1225.0869 (264)
Space and water heating			4962.7935 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	372.0825	3.0700	1142.2932 (268)
Energy saving/generation technologies			
PV Unit	-1605.1846	3.0700	-4927.9167 (269)
Primary energy kWh/year			1560.9200 (272)
Primary energy kWh/m2/year			17.6335 (273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	West Pennines
Front of dwelling faces	North East
Overshading	Very little
Thermal mass parameter	158.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	298.54 (P1)
Transmission heat loss coefficient	69.65 (37)
Summer heat loss coefficient	368.19 (P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North East	1.000	1.00	1.000	1.000 (P8)
South West	1.000	1.00	1.000	1.000 (P8)
North West	1.000	1.00	1.000	1.000 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	6.8300	89.6552	0.4600	0.0000	1.0000	281.6786
South West	9.7500	112.1012	0.4600	0.0000	1.0000	502.7740
North West	2.4200	89.6552	0.4600	0.0000	1.0000	99.8041

total: 884.2567

	Jun	Jul	Aug	
Solar gains	958	884	752	(P4)
Internal gains	456	437	446	
Total summer gains	1415	1321	1198	(P5)

Summer gain/loss ratio	3.84	3.59	3.25	(P6)
Summer external temperature	14.70	16.40	16.30	
Thermal mass temperature increment (TMP = 158.3)	0.89	0.89	0.89	
Threshold temperature	19.43	20.88	20.45	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

Assessment of likelihood of high internal temperature: Slight

BASIC COMPLIANCE REPORT

Calculation Type: New Build (As Built)

Property Reference	Plot 012	Issued on Date	03/11/2023
Assessment Reference	plot 1J	Prop Type Ref	22186
Property	1j Chain Road, MANCHESTER, M9 6AJ		
SAP Rating	84 B	DER	17.35
Environmental	87 B	TER	18.21
CO ₂ Emissions (t/year)	1.32	% DER<TER	4.73
General Requirements Compliance	Pass	DfEE	46.92
		TfEE	54.64
		% DfEE<TfEE	14.12
Assessor Details	Mr. Patrick McGuigan, JSP Sustainability Ltd, Tel: 01904 435 325, technical@jspsustainability.co.uk		Assessor ID
			Y128-0001
Client			

SUMMARY FOR INPUT DATA FOR New Build (As Built)

Criterion 1 – Achieving the TER and TfEE rate

1a TER and DER

Fuel for main heating	Mains gas		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	18.21	kgCO ₂ /m ²	
Dwelling Carbon Dioxide Emission Rate (DER)	17.35	kgCO ₂ /m ²	Pass
	-0.86 (-4.7%)	kgCO ₂ /m ²	

1b TfEE and DfEE

Target Fabric Energy Efficiency (TfEE)	54.64	kWh/m ² /yr	
Dwelling Fabric Energy Efficiency (DfEE)	46.92	kWh/m ² /yr	
	-7.7 (-14.1%)	kWh/m ² /yr	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	Pass
Roof	0.09 (max. 0.20)	0.09 (max. 0.35)	Pass
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	3.87 (measured in this dwelling)	
Maximum	10.0	Pass

Limiting System Efficiencies

4 Heating efficiency

BASIC COMPLIANCE REPORT

Calculation Type: New Build (As Built)

Main heating system

Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoTEC sustain 28 VUW 286/7-2 (H-GB)
Combi boiler
Efficiency: 89.1% SEDBUK2009
Minimum: 88.0%

Pass

Secondary heating system

None

5 Cylinder insulation

Hot water storage

No cylinder

6 Controls

Space heating controls

Programmer, room thermostat and TRVs

Pass

Hot water controls

No cylinder

Boiler interlock

Yes

Pass

7 Low energy lights

Percentage of fixed lights with low-energy fittings

100 %

Minimum

75 %

Pass

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (West Pennines (England))

Slight

Pass

Based on:

Overshading

Very little

Windows facing North East

6.83 m², No overhang

Windows facing South West

9.75 m², No overhang

Windows facing North West

2.42 m², No overhang

Air change rate

0.00 ach

Blinds/curtains

None

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

Type

U-value

Filled Cavity with Edge Sealing

0.00

W/m²K

Pass

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals

3.87 (measured in this dwelling)

Maximum

10.0

Pass

10 Key features

Party wall U-value

0.00

W/m²K

Roof U-value

0.09

W/m²K

Air permeability

3.9

m³/m²h

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Built)

Property Reference	Plot 012	Issued on Date	03/11/2023
Assessment Reference	plot 1J	Prop Type Ref	22186
Property	1j Chain Road, MANCHESTER, M9 6AJ		
SAP Rating	84 B	DER	17.35
Environmental	87 B	TER	18.21
CO ₂ Emissions (t/year)	1.32	% DER<TER	4.73
General Requirements Compliance	Pass	DFEE	46.92
		TFEE	54.64
		% DFEE<TFEE	14.12
Assessor Details	Mr. Patrick McGuigan, JSP Sustainability Ltd, Tel: 01904 435 325, technical@jpsustainability.co.uk		Assessor ID
			Y128-0001
Client			

SUMMARY FOR INPUT DATA FOR: New Build (As Built)

Orientation	North East						
Property Tenure	Unknown						
Transaction Type	None of the above						
Terrain Type	Suburban						
1.0 Property Type	House, Semi-Detached						
2.0 Number of Storeys	2						
3.0 Date Built	2022						
4.0 Sheltered Sides	2						
5.0 Sunlight/Shade	Very little						
6.0 Measurements							
		Heat Loss Perimeter		Internal Floor Area		Average Storey Height	
		Ground Floor:		1.00 m		44.26 m ²	
		1st Storey:		1.00 m		44.26 m ²	
						2.42 m	
						2.69 m	
7.0 Living Area	17.09			m ²			
8.0 Thermal Mass Parameter	Precise calculation						
Thermal Mass	158.28			kJ/m ² K			
9.0 External Walls							
Description	Type	Construction		U-Value (W/m ² K)	Kappa (kJ/m ² K)	Gross Area (m ²)	Nett Area (m ²)
external	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, filled cavity, any outside structure		0.20	60.00	112.76	91.61
9.1 Party Walls							
Description	Type	Construction		U-Value (W/m ² K)	Kappa (kJ/m ² K)	Area (m ²)	
party	Filled Cavity with Edge Sealing	Single plasterboard on dabs on both sides, dense blocks, cavity or cavity fill		0.00	70.00	26.78	
9.2 Internal Walls							
Description	Construction				Kappa (kJ/m ² K)	Area (m ²)	
gf	Plasterboard on timber frame				9.00	97.86	
1f	Plasterboard on timber frame				9.00	94.00	
10.0 External Roofs							
Description	Type	Construction		U-Value (W/m ² K)	Kappa (kJ/m ² K)	Gross Area (m ²)	Nett Area (m ²)
cold	External Slope Roof	Plasterboard, insulated at ceiling level		0.09	9.00	44.26	44.26

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Built)

10.2 Internal Ceilings

Description	Construction	Kappa (kJ/m ² K)	Area (m ²)
gf	Other	9.00	44.26

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m ² K)	Kappa (kJ/m ² K)	Area (m ²)
gf	Ground Floor - Solid	Suspended concrete floor, carpeted	0.15	75.00	44.26

11.2 Internal Floors

Description	Construction	Kappa (kJ/m ² K)	Area (m ²)
1f	Plasterboard ceiling, carpeted chipboard floor	18.00	44.26

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m ² K)
Front	BFRC data	Solid Door							1.40
front	BFRC data	Window	Double Low-E Soft 0.05			0.46			1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m ²)	Curtain Closed
Front	Solid Door	[1] external	North East							2.15	
front	Window	[1] external	North East	None	0.00					6.83	
rear	Window	[1] external	South West	None	0.00					9.75	
side	Window	[1] external	North West	None	0.00					2.42	

14.0 Conservatory

None

15.0 Draught Proofing

100 %

16.0 Draught Lobby

No

17.0 Thermal Bridging

Calculate Bridges

17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported
Independently assessed	E1 Steel lintel with perforated steel base plate	13.94	0.358	No
Independently assessed	E3 Sill	9.63	0.020	No
Independently assessed	E4 Jamb	37.20	0.016	No
Independently assessed	E5 Ground floor (normal)	22.11	0.108	No
Independently assessed	E6 Intermediate floor within a dwelling	22.11	0.000	No
Independently assessed	E10 Eaves (insulation at ceiling level)	16.86	0.122	No
Independently assessed	E12 Gable (insulation at ceiling level)	5.25	0.108	No
Independently assessed	E16 Corner (normal)	10.20	0.068	No
Independently assessed	E18 Party wall between dwellings	10.20	0.092	No
Table K1 - Default	P1 Party wall - Ground floor	5.25	0.160	No
Table K1 - Default	P2 Party wall - Intermediate floor within a dwelling	5.25	0.000	No
Independently assessed	P4 Party wall - Roof (insulation at ceiling level)	5.25	0.182	No

Y-value 0.071 W/m²K

18.0 Pressure Testing

Designed AP ₅₀	Yes	
Property Tested ?	5.00	m ³ /(h.m ²) @ 50 Pa
As Built AP ₅₀	Yes	
	3.87	m ³ /(h.m ²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating
Windows open in hot weather
Windows half open

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Built)

Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	0.00

Mechanical Ventilation

Mechanical Ventilation System Present	No
---------------------------------------	----

20.0 Fans, Open Fireplaces, Flues

	MHS	SHS	Other	Total
Number of Chimneys	0		0	0
Number of open flues	0		0	0
Number of intermittent fans				3
Number of passive vents				0
Number of flueless gas fires				0

21.0 Fixed Cooling System

No

22.0 Lighting

Internal

Total number of light fittings	1	
Total number of L.E.L. fittings	1	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No
------------------------	----

23.0 Electricity Tariff

Standard

24.0 Main Heating 1

Database		
Percentage of Heat	100	%
Database Ref. No.	18119	
Fuel Type	Mains gas	
Main Heating	BGW	
SAP Code	104	
In Winter	90.0	
In Summer	87.0	
Controls	CBE Programmer, room thermostat and TRVs	
PCDF Controls	0	
Delayed Start Stat	No	
Sap Code	2106	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	<= 35°C	
Combi boiler type	Standard Combi	
Combi keep hot type	None	

25.0 Main Heating 2

None

Community Heating	None
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28.0 Water Heating

0 Water Heating	HWP From main heating 1
Water Heating	Main Heating 1

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Built)

Flue Gas Heat Recovery System	No
Waste Water Heat Recovery Instantaneous System 1	No
Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No
Water use <= 125 litres/person/day	Yes
SAP Code	901
29.0 Hot Water Cylinder	None

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

	Typical Cost	Typical savings per year	Ratings after improvement	
			SAP rating	Environmental Impact
Solar water heating	£4,000 - £6,000	£79	B 86	
	Typical Cost	Typical savings per year	Ratings after improvement	
			SAP rating	Environmental Impact
Solar photovoltaic panels, 2.5 kWp	£3,500 - £5,500	£589	A 96	

Energy performance certificate (EPC)

1j Chain Road
MANCHESTER
M9 6AJ

Energy rating

B

Valid until:

2 November 2033

Certificate
number:

9300-3997-6390-2807-4151

Property type

Semi-detached house

Total floor area

89 square metres

Rules on letting this property

Properties can be let if they have an energy rating from A to E.

You can read [guidance for landlords on the regulations and exemptions \(https://www.gov.uk/guidance/domestic-private-rented-property-minimum-energy-efficiency-standard-landlord-guidance\)](https://www.gov.uk/guidance/domestic-private-rented-property-minimum-energy-efficiency-standard-landlord-guidance).

Energy rating and score

This property's current energy rating is B. It has the potential to be A.

[See how to improve this property's energy efficiency.](#)

The graph shows this property's current and potential energy rating.

Properties get a rating from A (best) to G (worst) and a score. The better the rating and score, the lower your energy bills are likely to be.

For properties in England and Wales:

the average energy rating is D
the average energy score is 60

Score	Energy rating	Current	Potential
92+	A		96 A
81-91	B	84 B	
69-80	C		
55-68	D		
39-54	E		
21-38	F		
1-20	G		

Breakdown of property's energy performance

Features in this property

Features get a rating from very good to very poor, based on how energy efficient they are. Ratings are not based on how well features work or their condition.

Assumed ratings are based on the property's age and type. They are used for features the assessor could not inspect.

Feature	Description	Rating
Walls	Average thermal transmittance 0.20 W/m²K	Very good
Roof	Average thermal transmittance 0.09 W/m²K	Very good
Floor	Average thermal transmittance 0.15 W/m²K	Very good
Windows	High performance glazing	Very good
Main heating	Boiler and radiators, mains gas	Good
Main heating control	Programmer, room thermostat and TRVs	Good
Hot water	From main system	Good
Lighting	Low energy lighting in all fixed outlets	Very good
Air tightness	Air permeability 3.9 m³/h.m² (as tested)	Good
Secondary heating	None	N/A

Primary energy use

The primary energy use for this property per year is 85 kilowatt hours per square metre (kWh/m²).

How this affects your energy bills

An average household would need to spend **£781 per year on heating, hot water and lighting** in this property. These costs usually make up the majority of your energy bills.

You could **save £79 per year** if you complete the suggested steps for improving this property's energy rating.

This is **based on average costs in 2023** when this EPC was created. People living at the property may use different amounts of energy for heating, hot water and lighting.

Heating this property

Estimated energy needed in this property is:

- 2,849 kWh per year for heating
- 1,728 kWh per year for hot water

Impact on the environment

This property's current environmental impact rating is B. It has the potential to be A.

Properties get a rating from A (best) to G (worst) on how much carbon dioxide (CO₂) they produce each year. CO₂ harms the environment.

Carbon emissions

An average household produces	6 tonnes of CO ₂
This property produces	1.3 tonnes of CO ₂
This property's potential production	0.3 tonnes of CO ₂

You could improve this property's CO₂ emissions by making the suggested changes. This will help to protect the environment.

These ratings are based on assumptions about average occupancy and energy use. People living at the property may use different amounts of energy.

Changes you could make

Step	Typical installation cost	Typical yearly saving
1. Solar water heating	£4,000 - £6,000	£79
2. Solar photovoltaic panels	£3,500 - £5,500	£589

Help paying for energy improvements

You might be able to get a grant from the [Boiler Upgrade Scheme \(https://www.gov.uk/apply-boiler-upgrade-scheme\)](https://www.gov.uk/apply-boiler-upgrade-scheme). This will help you buy a more efficient, low carbon heating system for this property.

More ways to save energy

Find ways to save energy in your home by visiting www.gov.uk/improve-energy-efficiency.

Who to contact about this certificate

Contacting the assessor

If you're unhappy about your property's energy assessment or certificate, you can complain to the assessor who created it.

Assessor's name	Patrick McGuigan
Telephone	01904 432 325
Email	technical@jspsustainability.co.uk

Contacting the accreditation scheme

If you're still unhappy after contacting the assessor, you should contact the assessor's accreditation scheme.

Accreditation scheme	Elmhurst Energy Systems Ltd
Assessor's ID	EES/027210
Telephone	01455 883 250
Email	enquiries@elmhurstenergy.co.uk

About this assessment

Assessor's declaration	No related party
Date of assessment	3 November 2023
Date of certificate	3 November 2023
Type of assessment	SAP