

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.60
Printed on 08 March 2023 at 16:24:52

Project Information:

Assessed By: Ryan Gallacher (STRO035523) **Building Type:** Semi-detached House

Dwelling Details:

NEW DWELLING AS BUILT

Total Floor Area: 124.8m²

Site Reference : Stoneham Park

Plot Reference: Plot 513 - As Built

Address : 2 Heritage Walk, EASTLEIGH, SO50 9TD

Client Details:

Name: Bargate Homes

Address : The New Barn, Vicarage Farm Business Park, Winchester Road, Fair Oak, SO50 7HD

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) 17.08 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 13.08 kg/m² **OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 57.1 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 50.9 kWh/m² **OK**

2 Fabric U-values

Element	Average	Highest	
External wall	0.28 (max. 0.30)	0.28 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.14 (max. 0.25)	0.19 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.20 (max. 0.35)	OK
Openings	1.34 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.42	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Database: (rev 512, product index 017929): Boiler systems with radiators or underfloor heating - mains gas Brand name: Ideal Model: LOGIC COMBI Model qualifier: ESP1 35 (Combi) Efficiency 89.6 % SEDBUK2009 Minimum 88.0 %	OK
Secondary heating system:	None	

Regulations Compliance Report

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

Continuous extract system (decentralised)
 Specific fan power: 0.16 0.18
 Maximum 0.7 **OK**

9 Summertime temperature

Overheating risk (South England): Slight **OK**

Based on:

Overshading: Average or unknown
 Windows facing: South West 6.85m²
 Windows facing: North East 10.7m²
 Windows facing: South East 1.5m²
 Windows facing: North East 2.1m²
 Ventilation rate: 4.00
 Blinds/curtains: None

10 Key features

Doors U-value 1 W/m²K
 Roofs U-value 0.11 W/m²K
 Party Walls U-value 0 W/m²K
 Floors U-value 0.12 W/m²K
 Photovoltaic array

Code for Sustainable Homes Report

For use with Nov 2010 addendum 2014 England

Assessor and House Details

Assessor Name: Ryan Gallacher
Property Address: 2 Heritage Walk
EASTLEIGH
SO50 9TD
Assessor Number: STRO035523

Buiding regulation assessment

TER 17.08
DER 13.08

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		13.08	(ZC1)
TER		17.08	
Residual CO2 emissions offset from biofuel CHP		0	(ZC5)
CO2 emissions offset from additional allowable electricity generation		0	(ZC7)
Total CO2 emissions offset from SAP Section 16 allowances		0	
DER accounting for SAP Section 16 allowances		13.08	
% improvement DER/TER	23.4		

Total Energy Type CO2 Emissions for Codes Levels 6

	kg/m ² /year	
DER accounting for SAP Section 16 allowances	13.08	(ZC1)
CO2 emissions from appliances, equation (L14)	13.78	(ZC2)
CO2 emissions from cooking, equation (L16)	1.51	(ZC3)
Net CO2 emissions	29.7	(ZC8)

Result:

Credits awarded for ENE 1 = 3.3

Code Level = 4

ENE 2 - Fabric energy Efficiency

Fabric energy Efficiency: 50.87

Credits awarded for ENE 2 = 5.4

ENE 7 - Low or Zero Carbon (LZC) Technologies

Reduction in CO2 Emissions

	%	kg/m ² /year	
Standard Case CO2 emissions		33.39	
Standard DER		18.1	
Actual Case CO2 emissions		29.74	
Actual DER		14.45	
Reduction in CO2 emissions	10.93		

Credits awarded for ENE 7 = 1

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 as built

User Details:

Assessor Name: Ryan Gallacher **Stroma Number:** STRO035523
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.60

Property Address: Plot 513 - As Built

Address : 2 Heritage Walk, EASTLEIGH, SO50 9TD

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	52.5 (1a)	x	2.46 (2a)	=	129.15 (3a)
First floor	72.3 (1b)	x	2.54 (2b)	=	183.64 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	124.8 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	312.79 (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				0	0 (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) =	0	÷ (5) =	0 (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			4.42000007629395 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.22 (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) =		0.19 (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 as built

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

	0.24	0.23	0.23	0.21	0.2	0.18	0.18	0.17	0.19	0.2	0.21	0.22
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (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= 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 (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 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

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

(25)m= 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 (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 Type 1			2	x 1	= 2		(26)
Doors Type 2			2	x 1	= 2		(26)
Windows Type 1			6.85	x1/[1/(1.4)+ 0.04]	= 9.08		(27)
Windows Type 2			10.7	x1/[1/(1.4)+ 0.04]	= 14.19		(27)
Windows Type 3			1.5	x1/[1/(1.4)+ 0.04]	= 1.99		(27)
Windows Type 4			2.1	x1/[1/(1.4)+ 0.04]	= 2.78		(27)
Floor Type 1			52.5	x 0.12	= 6.3	75	3937.5 (28)
Floor Type 2			18.8	x 0.19	= 3.572	20	376 (28)
Walls Type1	123.58	25.15	98.43	x 0.28	= 27.56	150	14764.5 (29)
Walls Type2	2.65	0	2.65	x 0.18	= 0.48	9	23.85 (29)
Roof Type1	69.9	0	69.9	x 0.11	= 7.69	9	629.1 (30)
Roof Type2	1.98	0	1.98	x 0.18	= 0.36	9	17.82 (30)
Roof Type3	1.5	0	1.5	x 0.2	= 0.3	9	13.5 (30)
Total area of elements, m²			270.91				(31)
Party wall			44.5	x 0	= 0	70	3115 (32)
Internal wall **			179.2			9	1612.8 (32c)
Internal wall **			42.2			75	3165 (32c)

SAP WorkSheet: New dwelling as built

Internal floor	52.5	18	945 (32d)
Internal ceiling	52.5	9	472.5 (32e)

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

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

Fabric heat loss, W/K = $S (A \times U)$ (26)...(30) + (32) = 78.29 (33)

Heat capacity $C_m = S(A \times k)$ ((28)...(30) + (32) + (32a)...(32e) = 29072.57 (34)

Thermal mass parameter (TMP = $C_m \div TFA$) in kJ/m²K = (34) $\div$ (4) = 232.95 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : $S (L \times Y)$ calculated using Appendix K 15.47 (36)

if details of thermal bridging are not known (36) = $0.05 \times (31)$

Total fabric heat loss (33) + (36) = 93.76 (37)

Ventilation heat loss calculated monthly (38)m = $0.33 \times (25)m \times (5)$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	51.61	51.61	51.61	51.61	51.61	51.61	51.61	51.61	51.61	51.61	51.61	51.61	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	145.37	145.37	145.37	145.37	145.37	145.37	145.37	145.37	145.37	145.37	145.37	145.37	
Average = $\text{Sum}(39)_{1...12} / 12 =$												145.37	(39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m $\div$ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	
Average = $\text{Sum}(40)_{1...12} / 12 =$												1.16	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.88 (42)

if $TFA > 13.9$, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if $TFA \leq 13.9$, $N = 1$

Annual average hot water usage in litres per day $V_{d, \text{average}} = (25 \times N) + 36$ 102.6 (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	
(44)m=	112.86	108.76	104.65	100.55	96.45	92.34	92.34	96.45	100.55	104.65	108.76	112.86	
Total = $\text{Sum}(44)_{1...12} =$												1231.23	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	167.37	146.38	151.06	131.69	126.36	109.04	101.04	115.95	117.33	136.74	149.26	162.09	
Total = $\text{Sum}(45)_{1...12} =$												1614.34	(45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	25.11	21.96	22.66	19.75	18.95	16.36	15.16	17.39	17.6	20.51	22.39	24.31	(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:

SAP WorkSheet: New dwelling as built

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)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) x (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 x [(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 x (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 x (41)m

(61)m=

14.16	12.78	14.12	13.63	14.05	13.55	13.98	14.02	13.59	14.08	13.67	14.15
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(61)

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

(62)m=

181.53	159.16	165.18	145.32	140.41	122.6	115.02	129.97	130.93	150.83	162.94	176.24
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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=

181.53	159.16	165.18	145.32	140.41	122.6	115.02	129.97	130.93	150.83	162.94	176.24
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Output from water heater (annual)_{1...12} 1780.12 (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=

59.19	51.87	53.76	47.2	45.53	39.65	37.09	42.06	42.41	48.99	53.05	57.43
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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
172.81	172.81	172.81	172.81	172.81	172.81	172.81	172.81	172.81	172.81	172.81	172.81

(66)

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

(67)m=

67.01	59.51	48.4	36.64	27.39	23.12	24.99	32.48	43.59	55.35	64.6	68.87
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(67)

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

(68)m=

434.83	439.34	427.97	403.77	373.21	344.49	325.31	320.79	332.16	356.37	386.93	415.65
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(68)

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

(69)m=

55.16	55.16	55.16	55.16	55.16	55.16	55.16	55.16	55.16	55.16	55.16	55.16
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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)

SAP WorkSheet: New dwelling as built

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

(71)m=

-115.2	-115.2	-115.2	-115.2	-115.2	-115.2	-115.2	-115.2	-115.2	-115.2	-115.2	-115.2
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 (71)

Water heating gains (Table 5)

(72)m=

79.56	77.18	72.25	65.55	61.19	55.06	49.86	56.53	58.91	65.84	73.68	77.19
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 (72)

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

(73)m=

697.16	691.8	664.39	621.72	577.56	538.44	515.91	525.57	550.43	593.33	640.97	677.47
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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.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c	=	Gains (W)							
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>11.28</td></tr></table>	11.28	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>41.83</td></tr></table>	41.83	(75)
0.77																		
10.7																		
11.28																		
0.45																		
1.11																		
41.83																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>11.28</td></tr></table>	11.28	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>8.21</td></tr></table>	8.21	(75)
0.77																		
2.1																		
11.28																		
0.45																		
1.11																		
8.21																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>22.97</td></tr></table>	22.97	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>85.15</td></tr></table>	85.15	(75)
0.77																		
10.7																		
22.97																		
0.45																		
1.11																		
85.15																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>22.97</td></tr></table>	22.97	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>16.71</td></tr></table>	16.71	(75)
0.77																		
2.1																		
22.97																		
0.45																		
1.11																		
16.71																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>41.38</td></tr></table>	41.38	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>153.41</td></tr></table>	153.41	(75)
0.77																		
10.7																		
41.38																		
0.45																		
1.11																		
153.41																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>41.38</td></tr></table>	41.38	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>30.11</td></tr></table>	30.11	(75)
0.77																		
2.1																		
41.38																		
0.45																		
1.11																		
30.11																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>67.96</td></tr></table>	67.96	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>251.95</td></tr></table>	251.95	(75)
0.77																		
10.7																		
67.96																		
0.45																		
1.11																		
251.95																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>67.96</td></tr></table>	67.96	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>49.45</td></tr></table>	49.45	(75)
0.77																		
2.1																		
67.96																		
0.45																		
1.11																		
49.45																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>91.35</td></tr></table>	91.35	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>338.67</td></tr></table>	338.67	(75)
0.77																		
10.7																		
91.35																		
0.45																		
1.11																		
338.67																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>91.35</td></tr></table>	91.35	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>66.47</td></tr></table>	66.47	(75)
0.77																		
2.1																		
91.35																		
0.45																		
1.11																		
66.47																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>97.38</td></tr></table>	97.38	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>361.06</td></tr></table>	361.06	(75)
0.77																		
10.7																		
97.38																		
0.45																		
1.11																		
361.06																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>97.38</td></tr></table>	97.38	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>70.86</td></tr></table>	70.86	(75)
0.77																		
2.1																		
97.38																		
0.45																		
1.11																		
70.86																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>91.1</td></tr></table>	91.1	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>337.76</td></tr></table>	337.76	(75)
0.77																		
10.7																		
91.1																		
0.45																		
1.11																		
337.76																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>91.1</td></tr></table>	91.1	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>66.29</td></tr></table>	66.29	(75)
0.77																		
2.1																		
91.1																		
0.45																		
1.11																		
66.29																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>72.63</td></tr></table>	72.63	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>269.27</td></tr></table>	269.27	(75)
0.77																		
10.7																		
72.63																		
0.45																		
1.11																		
269.27																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>72.63</td></tr></table>	72.63	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>52.85</td></tr></table>	52.85	(75)
0.77																		
2.1																		
72.63																		
0.45																		
1.11																		
52.85																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>50.42</td></tr></table>	50.42	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>186.94</td></tr></table>	186.94	(75)
0.77																		
10.7																		
50.42																		
0.45																		
1.11																		
186.94																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>50.42</td></tr></table>	50.42	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>36.69</td></tr></table>	36.69	(75)
0.77																		
2.1																		
50.42																		
0.45																		
1.11																		
36.69																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>28.07</td></tr></table>	28.07	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>104.06</td></tr></table>	104.06	(75)
0.77																		
10.7																		
28.07																		
0.45																		
1.11																		
104.06																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>28.07</td></tr></table>	28.07	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>20.42</td></tr></table>	20.42	(75)
0.77																		
2.1																		
28.07																		
0.45																		
1.11																		
20.42																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>14.2</td></tr></table>	14.2	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>52.64</td></tr></table>	52.64	(75)
0.77																		
10.7																		
14.2																		
0.45																		
1.11																		
52.64																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>14.2</td></tr></table>	14.2	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>10.33</td></tr></table>	10.33	(75)
0.77																		
2.1																		
14.2																		
0.45																		
1.11																		
10.33																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>9.21</td></tr></table>	9.21	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>34.16</td></tr></table>	34.16	(75)
0.77																		
10.7																		
9.21																		
0.45																		
1.11																		
34.16																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>9.21</td></tr></table>	9.21	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>6.7</td></tr></table>	6.7	(75)
0.77																		
2.1																		
9.21																		
0.45																		
1.11																		
6.7																		
Southeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.5</td></tr></table>	1.5	x	<table><tr><td>36.79</td></tr></table>	36.79	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>19.12</td></tr></table>	19.12	(77)
0.77																		
1.5																		
36.79																		
0.45																		
1.11																		
19.12																		
Southeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.5</td></tr></table>	1.5	x	<table><tr><td>62.67</td></tr></table>	62.67	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>32.57</td></tr></table>	32.57	(77)
0.77																		
1.5																		
62.67																		
0.45																		
1.11																		
32.57																		
Southeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.5</td></tr></table>	1.5	x	<table><tr><td>85.75</td></tr></table>	85.75	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>44.57</td></tr></table>	44.57	(77)
0.77																		
1.5																		
85.75																		
0.45																		
1.11																		
44.57																		
Southeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.5</td></tr></table>	1.5	x	<table><tr><td>106.25</td></tr></table>	106.25	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>55.22</td></tr></table>	55.22	(77)
0.77																		
1.5																		
106.25																		
0.45																		
1.11																		
55.22																		
Southeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.5</td></tr></table>	1.5	x	<table><tr><td>119.01</td></tr></table>	119.01	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>61.86</td></tr></table>	61.86	(77)
0.77																		
1.5																		
119.01																		
0.45																		
1.11																		
61.86																		
Southeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.5</td></tr></table>	1.5	x	<table><tr><td>118.15</td></tr></table>	118.15	x	<table><tr><td>0.45</td></tr></table>	0.45	x	<table><tr><td>1.11</td></tr></table>	1.11	=	<table><tr><td>61.41</td></tr></table>	61.41	(77)
0.77																		
1.5																		
118.15																		
0.45																		
1.11																		
61.41																		

SAP WorkSheet: New dwelling as built

Southeast	0.9x	0.77	x	1.5	x	113.91	x	0.45	x	1.11	=	59.2	(77)
Southeast	0.9x	0.77	x	1.5	x	104.39	x	0.45	x	1.11	=	54.26	(77)
Southeast	0.9x	0.77	x	1.5	x	92.85	x	0.45	x	1.11	=	48.26	(77)
Southeast	0.9x	0.77	x	1.5	x	69.27	x	0.45	x	1.11	=	36	(77)
Southeast	0.9x	0.77	x	1.5	x	44.07	x	0.45	x	1.11	=	22.91	(77)
Southeast	0.9x	0.77	x	1.5	x	31.49	x	0.45	x	1.11	=	16.37	(77)
Southwest	0.9x	0.77	x	6.85	x	36.79		0.45	x	1.11	=	87.33	(79)
Southwest	0.9x	0.77	x	6.85	x	62.67		0.45	x	1.11	=	148.76	(79)
Southwest	0.9x	0.77	x	6.85	x	85.75		0.45	x	1.11	=	203.54	(79)
Southwest	0.9x	0.77	x	6.85	x	106.25		0.45	x	1.11	=	252.19	(79)
Southwest	0.9x	0.77	x	6.85	x	119.01		0.45	x	1.11	=	282.47	(79)
Southwest	0.9x	0.77	x	6.85	x	118.15		0.45	x	1.11	=	280.43	(79)
Southwest	0.9x	0.77	x	6.85	x	113.91		0.45	x	1.11	=	270.37	(79)
Southwest	0.9x	0.77	x	6.85	x	104.39		0.45	x	1.11	=	247.77	(79)
Southwest	0.9x	0.77	x	6.85	x	92.85		0.45	x	1.11	=	220.39	(79)
Southwest	0.9x	0.77	x	6.85	x	69.27		0.45	x	1.11	=	164.41	(79)
Southwest	0.9x	0.77	x	6.85	x	44.07		0.45	x	1.11	=	104.6	(79)
Southwest	0.9x	0.77	x	6.85	x	31.49		0.45	x	1.11	=	74.74	(79)

Solar gains in watts, calculated for each month

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

(83)m=	156.5	283.19	431.63	608.81	749.47	773.76	733.62	624.15	492.27	324.89	190.47	131.97	(83)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(84)m=	853.66	975	1096.02	1230.53	1327.03	1312.2	1249.53	1149.71	1042.7	918.22	831.44	809.44	(84)
--------	--------	-----	---------	---------	---------	--------	---------	---------	--------	--------	--------	--------	------

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	0.94	0.83	0.66	0.5	0.56	0.81	0.96	0.99	1	(86)

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

(87)m=	19.75	19.91	20.18	20.52	20.8	20.95	20.99	20.98	20.87	20.5	20.05	19.7	(87)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	------	-------	------	------

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

(88)m=	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.99	0.97	0.91	0.78	0.57	0.39	0.44	0.73	0.94	0.99	1	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	18.82	18.98	19.24	19.57	19.82	19.93	19.95	19.94	19.88	19.56	19.12	18.77	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.13 (91)

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

(92)m=	18.94	19.1	19.37	19.69	19.95	20.06	20.09	20.08	20.01	19.68	19.24	18.9	(92)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

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

(93)m=	18.79	18.95	19.22	19.54	19.8	19.91	19.94	19.93	19.86	19.53	19.09	18.75	(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	
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--

SAP WorkSheet: New dwelling as built

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.96	0.9	0.77	0.57	0.39	0.44	0.72	0.93	0.98	0.99	(94)
--------	------	------	------	-----	------	------	------	------	------	------	------	------	------

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

(95)m=	846.36	959.04	1055.81	1112.92	1024.57	744.72	481.36	506.98	755.17	857.07	817.88	803.96	(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=	2106.65	2042.71	1848.58	1547.36	1177.58	772.33	484.83	513.45	837.62	1298.61	1743.43	2114.57	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	937.66	728.22	589.82	312.79	113.84	0	0	0	0	328.51	666.39	975.09	(98)
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

4652.33

Space heating requirement in kWh/m²/year

37.28

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

Space heating:

Fraction of space heat from secondary/supplementary system

0

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

1

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

1

Efficiency of main space heating system 1

90.5

Efficiency of secondary/supplementary heating system, %

0

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

Space heating requirement (calculated above)

937.66	728.22	589.82	312.79	113.84	0	0	0	0	328.51	666.39	975.09
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

(211)m = {[(98)m x (204)] } x 100 ÷ (206)

1036.08	804.67	651.74	345.63	125.78	0	0	0	0	362.99	736.34	1077.45
---------	--------	--------	--------	--------	---	---	---	---	--------	--------	---------

Total (kWh/year) =Sum(211)_{1...5,10...12} =

5140.69

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	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

Total (kWh/year) =Sum(215)_{1...5,10...12} =

0

Water heating

Output from water heater (calculated above)

181.53	159.16	165.18	145.32	140.41	122.6	115.02	129.97	130.93	150.83	162.94	176.24
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

87.3

(217)m=

89.97	89.91	89.78	89.46	88.7	87.3	87.3	87.3	87.3	89.47	89.85	90
-------	-------	-------	-------	------	------	------	------	------	-------	-------	----

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	201.78	177.03	183.98	162.45	158.29	140.43	131.76	148.88	149.98	168.58	181.34	195.83	(219)
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------

Total = Sum(219a)_{1...12} =

2000.31

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

5140.69

Water heating fuel used

2000.31

Electricity for pumps, fans and electric keep-hot

SAP WorkSheet: New dwelling as built

mechanical ventilation - balanced, extract or positive input from outside		83.78	(230a)
central heating pump:		30	(230c)
boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	158.78	(231)
Electricity for lighting		473.34	(232)
Electricity generated by PVs		-879.5	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		6893.63	(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 = 178.9 (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 = 69.61 (247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 = 20.94 (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 = 62.43 (250)
Additional standing charges (Table 12)			120 (251)
	one of (233) to (235) x	13.19	x 0.01 = -116.01 (252)
Appendix Q items: repeat lines (253) and (254) as needed			
Total energy cost	(245)...(247) + (250)...(254) =		335.88 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.83	(257)
SAP rating (Section 12)		88.41	(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	= 1110.39 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.216	= 432.07 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1542.46 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 82.41 (267)
Electricity for lighting	(232) x	0.519	= 245.67 (268)
Energy saving/generation technologies			
Item 1		0.519	= -456.46 (269)

SAP WorkSheet: New dwelling as built

Total CO ₂ , kg/year	sum of (265)...(271) =	1414.07	(272)
CO₂ emissions per m²	(272) ÷ (4) =	11.33	(273)
El rating (section 14)		89	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	1.22	=	6271.65	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2440.38	(264)
Space and water heating	(261) + (262) + (263) + (264) =			8712.03	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	487.47	(267)
Electricity for lighting	(232) x	0	=	1453.17	(268)
Energy saving/generation technologies Item 1		3.07	=	-2700.07	(269)
'Total Primary Energy	sum of (265)...(271) =			7952.59	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			63.72	(273)

DER WorkSheet: New dwelling as built

User Details:

Assessor Name: Ryan Gallacher **Stroma Number:** STRO035523
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.60

Property Address: Plot 513 - As Built

Address : 2 Heritage Walk, EASTLEIGH, SO50 9TD

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	52.5 (1a) x	2.46 (2a) =	129.15 (3a)
First floor	72.3 (1b) x	2.54 (2b) =	183.64 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	124.8 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	312.79 (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				0 x 10 =	0 (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) =	0 ÷ (5) =	0 (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		4.42000007629395 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.22 (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) =	0.19 (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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DER WorkSheet: New dwelling as built

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

	0.24	0.23	0.23	0.21	0.2	0.18	0.18	0.17	0.19	0.2	0.21	0.22
--	------	------	------	------	-----	------	------	------	------	-----	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (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= 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 (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 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

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

(25)m= 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 (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 Type 1			2	x 1	= 2		(26)
Doors Type 2			2	x 1	= 2		(26)
Windows Type 1			6.85	x1/[1/(1.4)+ 0.04]	= 9.08		(27)
Windows Type 2			10.7	x1/[1/(1.4)+ 0.04]	= 14.19		(27)
Windows Type 3			1.5	x1/[1/(1.4)+ 0.04]	= 1.99		(27)
Windows Type 4			2.1	x1/[1/(1.4)+ 0.04]	= 2.78		(27)
Floor Type 1			52.5	x 0.12	= 6.3	75	3937.5 (28)
Floor Type 2			18.8	x 0.19	= 3.572	20	376 (28)
Walls Type1	123.58	25.15	98.43	x 0.28	= 27.56	150	14764.5 (29)
Walls Type2	2.65	0	2.65	x 0.18	= 0.48	9	23.85 (29)
Roof Type1	69.9	0	69.9	x 0.11	= 7.69	9	629.1 (30)
Roof Type2	1.98	0	1.98	x 0.18	= 0.36	9	17.82 (30)
Roof Type3	1.5	0	1.5	x 0.2	= 0.3	9	13.5 (30)
Total area of elements, m²			270.91				(31)
Party wall			44.5	x 0	= 0	70	3115 (32)
Internal wall **			179.2			9	1612.8 (32c)
Internal wall **			42.2			75	3165 (32c)

DER WorkSheet: New dwelling as built

Internal floor	52.5	18	945 (32d)
Internal ceiling	52.5	9	472.5 (32e)

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

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

Fabric heat loss, W/K = $S (A \times U)$ (26)...(30) + (32) = 78.29 (33)

Heat capacity $C_m = S(A \times k)$ ((28)...(30) + (32) + (32a)...(32e) = 29072.57 (34)

Thermal mass parameter (TMP = $C_m \div TFA$) in kJ/m²K = (34) $\div$ (4) = 232.95 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : $S (L \times Y)$ calculated using Appendix K 15.47 (36)

if details of thermal bridging are not known (36) = $0.05 \times (31)$

Total fabric heat loss (33) + (36) = 93.76 (37)

Ventilation heat loss calculated monthly (38)m = $0.33 \times (25)m \times (5)$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	51.61	51.61	51.61	51.61	51.61	51.61	51.61	51.61	51.61	51.61	51.61	51.61	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	145.37	145.37	145.37	145.37	145.37	145.37	145.37	145.37	145.37	145.37	145.37	145.37	
Average = $\text{Sum}(39)_{1...12} / 12 =$												145.37	(39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m $\div$ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	
Average = $\text{Sum}(40)_{1...12} / 12 =$												1.16	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.88 (42)

if $TFA > 13.9$, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if $TFA \leq 13.9$, $N = 1$

Annual average hot water usage in litres per day $V_{d, \text{average}} = (25 \times N) + 36$ 102.6 (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	
(44)m=	112.86	108.76	104.65	100.55	96.45	92.34	92.34	96.45	100.55	104.65	108.76	112.86	
Total = $\text{Sum}(44)_{1...12} =$												1231.23	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	167.37	146.38	151.06	131.69	126.36	109.04	101.04	115.95	117.33	136.74	149.26	162.09	
Total = $\text{Sum}(45)_{1...12} =$												1614.34	(45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	25.11	21.96	22.66	19.75	18.95	16.36	15.16	17.39	17.6	20.51	22.39	24.31	(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:

DER WorkSheet: New dwelling as built

a) If manufacturer's declared loss factor is known (kWh/day): (48)

0

Temperature factor from Table 2b (49)

0

Energy lost from water storage, kWh/year (48) x (49) = (50)

0

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

Hot water storage loss factor from Table 2 (kWh/litre/day) (51)

0

If community heating see section 4.3

Volume factor from Table 2a (52)

0

Temperature factor from Table 2b (53)

0

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = (54)

0

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

0

Water storage loss calculated for each month ((56)m = (55) x (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 x [(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 (58)

0

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

(61)m=

14.16	12.78	14.12	13.63	14.05	13.55	13.98	14.02	13.59	14.08	13.67	14.15
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(61)

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

(62)m=

181.53	159.16	165.18	145.32	140.41	122.6	115.02	129.97	130.93	150.83	162.94	176.24
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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
---	---	---	---	---	---	---	---	---	---	---	---

(63)

Output from water heater

(64)m=

181.53	159.16	165.18	145.32	140.41	122.6	115.02	129.97	130.93	150.83	162.94	176.24
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------

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

1780.12

(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=

59.19	51.87	53.76	47.2	45.53	39.65	37.09	42.06	42.41	48.99	53.05	57.43
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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
144.01	144.01	144.01	144.01	144.01	144.01	144.01	144.01	144.01	144.01	144.01	144.01

(66)

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

(67)m=

26.8	23.81	19.36	14.66	10.96	9.25	9.99	12.99	17.44	22.14	25.84	27.55
------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	-------

(67)

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

(68)m=

291.34	294.36	286.74	270.52	250.05	230.81	217.95	214.93	222.55	238.77	259.24	278.48
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(68)

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

(69)m=

37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4
------	------	------	------	------	------	------	------	------	------	------	------

(69)

Pumps and fans gains (Table 5a)

(70)m=

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

(70)

DER WorkSheet: New dwelling as built

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

(71)m=

-115.2	-115.2	-115.2	-115.2	-115.2	-115.2	-115.2	-115.2	-115.2	-115.2	-115.2	-115.2
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

79.56	77.18	72.25	65.55	61.19	55.06	49.86	56.53	58.91	65.84	73.68	77.19
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 (72)

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

(73)m=

466.9	464.55	447.56	419.93	391.4	364.32	347.01	353.66	368.09	395.95	427.96	452.43
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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.

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	10.7	x	11.28	x	0.45	x	1.11	=	41.83	(75)
Northeast 0.9x	0.77	x	2.1	x	11.28	x	0.45	x	1.11	=	8.21	(75)
Northeast 0.9x	0.77	x	10.7	x	22.97	x	0.45	x	1.11	=	85.15	(75)
Northeast 0.9x	0.77	x	2.1	x	22.97	x	0.45	x	1.11	=	16.71	(75)
Northeast 0.9x	0.77	x	10.7	x	41.38	x	0.45	x	1.11	=	153.41	(75)
Northeast 0.9x	0.77	x	2.1	x	41.38	x	0.45	x	1.11	=	30.11	(75)
Northeast 0.9x	0.77	x	10.7	x	67.96	x	0.45	x	1.11	=	251.95	(75)
Northeast 0.9x	0.77	x	2.1	x	67.96	x	0.45	x	1.11	=	49.45	(75)
Northeast 0.9x	0.77	x	10.7	x	91.35	x	0.45	x	1.11	=	338.67	(75)
Northeast 0.9x	0.77	x	2.1	x	91.35	x	0.45	x	1.11	=	66.47	(75)
Northeast 0.9x	0.77	x	10.7	x	97.38	x	0.45	x	1.11	=	361.06	(75)
Northeast 0.9x	0.77	x	2.1	x	97.38	x	0.45	x	1.11	=	70.86	(75)
Northeast 0.9x	0.77	x	10.7	x	91.1	x	0.45	x	1.11	=	337.76	(75)
Northeast 0.9x	0.77	x	2.1	x	91.1	x	0.45	x	1.11	=	66.29	(75)
Northeast 0.9x	0.77	x	10.7	x	72.63	x	0.45	x	1.11	=	269.27	(75)
Northeast 0.9x	0.77	x	2.1	x	72.63	x	0.45	x	1.11	=	52.85	(75)
Northeast 0.9x	0.77	x	10.7	x	50.42	x	0.45	x	1.11	=	186.94	(75)
Northeast 0.9x	0.77	x	2.1	x	50.42	x	0.45	x	1.11	=	36.69	(75)
Northeast 0.9x	0.77	x	10.7	x	28.07	x	0.45	x	1.11	=	104.06	(75)
Northeast 0.9x	0.77	x	2.1	x	28.07	x	0.45	x	1.11	=	20.42	(75)
Northeast 0.9x	0.77	x	10.7	x	14.2	x	0.45	x	1.11	=	52.64	(75)
Northeast 0.9x	0.77	x	2.1	x	14.2	x	0.45	x	1.11	=	10.33	(75)
Northeast 0.9x	0.77	x	10.7	x	9.21	x	0.45	x	1.11	=	34.16	(75)
Northeast 0.9x	0.77	x	2.1	x	9.21	x	0.45	x	1.11	=	6.7	(75)
Southeast 0.9x	0.77	x	1.5	x	36.79	x	0.45	x	1.11	=	19.12	(77)
Southeast 0.9x	0.77	x	1.5	x	62.67	x	0.45	x	1.11	=	32.57	(77)
Southeast 0.9x	0.77	x	1.5	x	85.75	x	0.45	x	1.11	=	44.57	(77)
Southeast 0.9x	0.77	x	1.5	x	106.25	x	0.45	x	1.11	=	55.22	(77)
Southeast 0.9x	0.77	x	1.5	x	119.01	x	0.45	x	1.11	=	61.86	(77)
Southeast 0.9x	0.77	x	1.5	x	118.15	x	0.45	x	1.11	=	61.41	(77)

DER WorkSheet: New dwelling as built

Southeast	0.9x	0.77	x	1.5	x	113.91	x	0.45	x	1.11	=	59.2	(77)
Southeast	0.9x	0.77	x	1.5	x	104.39	x	0.45	x	1.11	=	54.26	(77)
Southeast	0.9x	0.77	x	1.5	x	92.85	x	0.45	x	1.11	=	48.26	(77)
Southeast	0.9x	0.77	x	1.5	x	69.27	x	0.45	x	1.11	=	36	(77)
Southeast	0.9x	0.77	x	1.5	x	44.07	x	0.45	x	1.11	=	22.91	(77)
Southeast	0.9x	0.77	x	1.5	x	31.49	x	0.45	x	1.11	=	16.37	(77)
Southwest	0.9x	0.77	x	6.85	x	36.79		0.45	x	1.11	=	87.33	(79)
Southwest	0.9x	0.77	x	6.85	x	62.67		0.45	x	1.11	=	148.76	(79)
Southwest	0.9x	0.77	x	6.85	x	85.75		0.45	x	1.11	=	203.54	(79)
Southwest	0.9x	0.77	x	6.85	x	106.25		0.45	x	1.11	=	252.19	(79)
Southwest	0.9x	0.77	x	6.85	x	119.01		0.45	x	1.11	=	282.47	(79)
Southwest	0.9x	0.77	x	6.85	x	118.15		0.45	x	1.11	=	280.43	(79)
Southwest	0.9x	0.77	x	6.85	x	113.91		0.45	x	1.11	=	270.37	(79)
Southwest	0.9x	0.77	x	6.85	x	104.39		0.45	x	1.11	=	247.77	(79)
Southwest	0.9x	0.77	x	6.85	x	92.85		0.45	x	1.11	=	220.39	(79)
Southwest	0.9x	0.77	x	6.85	x	69.27		0.45	x	1.11	=	164.41	(79)
Southwest	0.9x	0.77	x	6.85	x	44.07		0.45	x	1.11	=	104.6	(79)
Southwest	0.9x	0.77	x	6.85	x	31.49		0.45	x	1.11	=	74.74	(79)

Solar gains in watts, calculated for each month

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

(83)m=	156.5	283.19	431.63	608.81	749.47	773.76	733.62	624.15	492.27	324.89	190.47	131.97	(83)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(84)m=	623.4	747.74	879.19	1028.74	1140.87	1138.08	1080.63	977.8	860.37	720.85	618.44	584.39	(84)
--------	-------	--------	--------	---------	---------	---------	---------	-------	--------	--------	--------	--------	------

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	1	0.99	0.97	0.89	0.73	0.57	0.64	0.88	0.98	1	1	(86)

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

(87)m=	19.57	19.73	20.02	20.39	20.73	20.92	20.98	20.97	20.81	20.36	19.89	19.53	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	1	0.99	0.95	0.84	0.64	0.44	0.51	0.82	0.98	1	1	(89)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

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

(90)m=	18.64	18.8	19.09	19.45	19.76	19.91	19.94	19.94	19.83	19.43	18.96	18.6	(90)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

fLA = Living area ÷ (4) =

0.13 (91)

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

(92)m=	18.76	18.93	19.21	19.58	19.89	20.05	20.08	20.08	19.96	19.55	19.08	18.72	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.61	18.78	19.06	19.43	19.74	19.9	19.93	19.93	19.81	19.4	18.93	18.57	(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	
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--

DER WorkSheet: New dwelling as built

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.94	0.83	0.64	0.44	0.51	0.81	0.97	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

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

(95)m=	621.89	743.31	864.3	970.64	952.1	725.59	478.2	500.62	696.75	698.85	615.2	583.34	(95)
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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=	2080.58	2017.52	1825.98	1530.34	1168.94	770.03	484.4	512.62	830.57	1279.75	1719.76	2088.98	(97)
--------	---------	---------	---------	---------	---------	--------	-------	--------	--------	---------	---------	---------	------

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

(98)m=	1085.27	856.27	715.49	402.98	161.33	0	0	0	0	432.19	795.29	1120.2	(98)
--------	---------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------	------

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

5569

Space heating requirement in kWh/m²/year

44.62

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

Space heating:

Fraction of space heat from secondary/supplementary system

0

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

1

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

1

Efficiency of main space heating system 1

90.5

Efficiency of secondary/supplementary heating system, %

0

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

Space heating requirement (calculated above)

1085.27	856.27	715.49	402.98	161.33	0	0	0	0	432.19	795.29	1120.2
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(211)m = {[(98)m x (204)] } x 100 ÷ (206)

1199.19	946.15	790.59	445.29	178.26	0	0	0	0	477.55	878.77	1237.79
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Total (kWh/year) =Sum(211)_{1...5,10...12} =

6153.6

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	(215)
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Total (kWh/year) =Sum(215)_{1...5,10...12} =

0

Water heating

Output from water heater (calculated above)

181.53	159.16	165.18	145.32	140.41	122.6	115.02	129.97	130.93	150.83	162.94	176.24
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Efficiency of water heater

87.3

(217)m=

90.03	89.98	89.88	89.63	88.98	87.3	87.3	87.3	87.3	89.65	89.94	90.05
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	201.64	176.88	183.77	162.14	157.8	140.43	131.76	148.88	149.98	168.24	181.16	195.71	(219)
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Total = Sum(219a)_{1...12} =

1998.38

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

6153.6

Water heating fuel used

1998.38

Electricity for pumps, fans and electric keep-hot

DER WorkSheet: New dwelling as built

mechanical ventilation - balanced, extract or positive input from outside	83.78	(230a)
central heating pump:	30	(230c)
boiler with a fan-assisted flue	45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	158.78 (231)
Electricity for lighting		473.34 (232)
Electricity generated by PVs		-879.5 (233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		7904.6 (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	=	1329.18 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	431.65 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1760.83 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	82.41 (267)
Electricity for lighting	(232) x	0.519	=	245.67 (268)
Energy saving/generation technologies Item 1		0.519	=	-456.46 (269)
Total CO2, kg/year		sum of (265)...(271) =		1632.44 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		13.08 (273)
El rating (section 14)				87 (274)

TER WorkSheet: New dwelling as built

User Details:

Assessor Name: Ryan Gallacher **Stroma Number:** STRO035523
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.60

Property Address: Plot 513 - As Built

Address : 2 Heritage Walk, EASTLEIGH, SO50 9TD

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	52.5 (1a) x	2.46 (2a) =	129.15 (3a)
First floor	72.3 (1b) x	2.54 (2b) =	183.64 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	124.8 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	312.79 (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				4 x 10 =	40 (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) =	40 ÷ (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) =	0.32 (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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TER WorkSheet: New dwelling as built

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	0.4	0.39	0.35	0.35	0.31	0.31	0.3	0.32	0.35	0.36	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= 0.58 0.58 0.58 0.56 0.56 0.55 0.55 0.54 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= 0.58 0.58 0.58 0.56 0.56 0.55 0.55 0.54 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 Type 1			2	x 1	= 2		(26)
Doors Type 2			2	x 1	= 2		(26)
Windows Type 1			6.85	x1/[1/(1.4)+ 0.04]	= 9.08		(27)
Windows Type 2			10.7	x1/[1/(1.4)+ 0.04]	= 14.19		(27)
Windows Type 3			1.5	x1/[1/(1.4)+ 0.04]	= 1.99		(27)
Windows Type 4			2.1	x1/[1/(1.4)+ 0.04]	= 2.78		(27)
Floor Type 1			52.5	x 0.13	= 6.825		(28)
Floor Type 2			18.8	x 0.13	= 2.444		(28)
Walls Type1	123.58	25.15	98.43	x 0.18	= 17.72		(29)
Walls Type2	2.65	0	2.65	x 0.18	= 0.48		(29)
Roof Type1	69.9	0	69.9	x 0.13	= 9.09		(30)
Roof Type2	1.98	0	1.98	x 0.13	= 0.26		(30)
Roof Type3	1.5	0	1.5	x 0.13	= 0.19		(30)
Total area of elements, m²			270.91				(31)
Party wall			44.5	x 0	= 0		(32)
Internal wall **			179.2				(32c)
Internal wall **			42.2				(32c)

TER WorkSheet: New dwelling as built

Internal floor	52.5		(32d)
Internal ceiling	52.5		(32e)

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

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

Fabric heat loss, W/K = $S(A \times U)$ (26)...(30) + (32) = 69.04 (33)

Heat capacity $C_m = S(A \times k)$ ((28)...(30) + (32) + (32a)...(32e) = 29072.57 (34)

Thermal mass parameter (TMP = $C_m \div TFA$) 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 can be used instead of a detailed calculation.

Thermal bridges : $S(L \times Y)$ calculated using Appendix K 17.71 (36)

if details of thermal bridging are not known (36) = $0.05 \times (31)$

Total fabric heat loss (33) + (36) = 86.75 (37)

Ventilation heat loss calculated monthly (38)m = $0.33 \times (25)m \times (5)$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	60.27	59.93	59.6	58.05	57.76	56.42	56.42	56.17	56.94	57.76	58.35	58.96	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	147.02	146.68	146.36	144.81	144.52	143.17	143.17	142.92	143.69	144.52	145.1	145.72	
Average = $\text{Sum}(39)_{1...12} / 12 =$												144.81	(39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.18	1.18	1.17	1.16	1.16	1.15	1.15	1.15	1.15	1.16	1.16	1.17	
Average = $\text{Sum}(40)_{1...12} / 12 =$												1.16	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.88 (42)

if $TFA > 13.9$, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if $TFA \leq 13.9$, $N = 1$

Annual average hot water usage in litres per day $V_{d, \text{average}} = (25 \times N) + 36$ 102.6 (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	
(44)m=	112.86	108.76	104.65	100.55	96.45	92.34	92.34	96.45	100.55	104.65	108.76	112.86	
Total = $\text{Sum}(44)_{1...12} =$												1231.23	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	167.37	146.38	151.06	131.69	126.36	109.04	101.04	115.95	117.33	136.74	149.26	162.09	
Total = $\text{Sum}(45)_{1...12} =$												1614.34	(45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	25.11	21.96	22.66	19.75	18.95	16.36	15.16	17.39	17.6	20.51	22.39	24.31	(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:

TER WorkSheet: New dwelling as built

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)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) x (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 x [(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 x (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 x (41)m

(61)m=

50.96	46.03	50.96	49.32	49.15	45.54	47.06	49.15	49.32	50.96	49.32	50.96
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(61)

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

(62)m=

218.33	192.41	202.01	181.01	175.51	154.58	148.1	165.1	166.65	187.7	198.58	213.05
--------	--------	--------	--------	--------	--------	-------	-------	--------	-------	--------	--------

(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=

218.33	192.41	202.01	181.01	175.51	154.58	148.1	165.1	166.65	187.7	198.58	213.05
--------	--------	--------	--------	--------	--------	-------	-------	--------	-------	--------	--------

Output from water heater (annual)_{1...12} 2203.04 (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=

68.39	60.18	62.97	56.12	54.3	47.64	45.36	50.84	51.34	58.21	61.96	66.63
-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------

(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
144.01	144.01	144.01	144.01	144.01	144.01	144.01	144.01	144.01	144.01	144.01	144.01

(66)

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

(67)m=

26.8	23.81	19.36	14.66	10.96	9.25	9.99	12.99	17.44	22.14	25.84	27.55
------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	-------

(67)

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

(68)m=

291.34	294.36	286.74	270.52	250.05	230.81	217.95	214.93	222.55	238.77	259.24	278.48
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(68)

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

(69)m=

37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4
------	------	------	------	------	------	------	------	------	------	------	------

(69)

Pumps and fans gains (Table 5a)

(70)m=

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

(70)

TER WorkSheet: New dwelling as built

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

(71)m=

-115.2	-115.2	-115.2	-115.2	-115.2	-115.2	-115.2	-115.2	-115.2	-115.2	-115.2	-115.2
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

91.92	89.55	84.63	77.94	72.99	66.17	60.97	68.33	71.31	78.23	86.05	89.56
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (72)

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

(73)m=

479.26	476.92	459.94	432.32	403.2	375.43	358.12	365.46	380.5	408.34	440.34	464.8
--------	--------	--------	--------	-------	--------	--------	--------	-------	--------	--------	-------

 (73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)							
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>11.28</td></tr></table>	11.28	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>36.9</td></tr></table>	36.9	(75)
0.77																		
10.7																		
11.28																		
0.63																		
0.7																		
36.9																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>11.28</td></tr></table>	11.28	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>7.24</td></tr></table>	7.24	(75)
0.77																		
2.1																		
11.28																		
0.63																		
0.7																		
7.24																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>22.97</td></tr></table>	22.97	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>75.1</td></tr></table>	75.1	(75)
0.77																		
10.7																		
22.97																		
0.63																		
0.7																		
75.1																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>22.97</td></tr></table>	22.97	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>14.74</td></tr></table>	14.74	(75)
0.77																		
2.1																		
22.97																		
0.63																		
0.7																		
14.74																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>41.38</td></tr></table>	41.38	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>135.31</td></tr></table>	135.31	(75)
0.77																		
10.7																		
41.38																		
0.63																		
0.7																		
135.31																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>41.38</td></tr></table>	41.38	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>26.56</td></tr></table>	26.56	(75)
0.77																		
2.1																		
41.38																		
0.63																		
0.7																		
26.56																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>67.96</td></tr></table>	67.96	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>222.22</td></tr></table>	222.22	(75)
0.77																		
10.7																		
67.96																		
0.63																		
0.7																		
222.22																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>67.96</td></tr></table>	67.96	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>43.61</td></tr></table>	43.61	(75)
0.77																		
2.1																		
67.96																		
0.63																		
0.7																		
43.61																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>91.35</td></tr></table>	91.35	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>298.71</td></tr></table>	298.71	(75)
0.77																		
10.7																		
91.35																		
0.63																		
0.7																		
298.71																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>91.35</td></tr></table>	91.35	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>58.62</td></tr></table>	58.62	(75)
0.77																		
2.1																		
91.35																		
0.63																		
0.7																		
58.62																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>97.38</td></tr></table>	97.38	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>318.45</td></tr></table>	318.45	(75)
0.77																		
10.7																		
97.38																		
0.63																		
0.7																		
318.45																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>97.38</td></tr></table>	97.38	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>62.5</td></tr></table>	62.5	(75)
0.77																		
2.1																		
97.38																		
0.63																		
0.7																		
62.5																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>91.1</td></tr></table>	91.1	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>297.91</td></tr></table>	297.91	(75)
0.77																		
10.7																		
91.1																		
0.63																		
0.7																		
297.91																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>91.1</td></tr></table>	91.1	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>58.47</td></tr></table>	58.47	(75)
0.77																		
2.1																		
91.1																		
0.63																		
0.7																		
58.47																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>72.63</td></tr></table>	72.63	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>237.49</td></tr></table>	237.49	(75)
0.77																		
10.7																		
72.63																		
0.63																		
0.7																		
237.49																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>72.63</td></tr></table>	72.63	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>46.61</td></tr></table>	46.61	(75)
0.77																		
2.1																		
72.63																		
0.63																		
0.7																		
46.61																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>50.42</td></tr></table>	50.42	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>164.88</td></tr></table>	164.88	(75)
0.77																		
10.7																		
50.42																		
0.63																		
0.7																		
164.88																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>50.42</td></tr></table>	50.42	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>32.36</td></tr></table>	32.36	(75)
0.77																		
2.1																		
50.42																		
0.63																		
0.7																		
32.36																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>28.07</td></tr></table>	28.07	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>91.78</td></tr></table>	91.78	(75)
0.77																		
10.7																		
28.07																		
0.63																		
0.7																		
91.78																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>28.07</td></tr></table>	28.07	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>18.01</td></tr></table>	18.01	(75)
0.77																		
2.1																		
28.07																		
0.63																		
0.7																		
18.01																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>14.2</td></tr></table>	14.2	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>46.42</td></tr></table>	46.42	(75)
0.77																		
10.7																		
14.2																		
0.63																		
0.7																		
46.42																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>14.2</td></tr></table>	14.2	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>9.11</td></tr></table>	9.11	(75)
0.77																		
2.1																		
14.2																		
0.63																		
0.7																		
9.11																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>10.7</td></tr></table>	10.7	x	<table><tr><td>9.21</td></tr></table>	9.21	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>30.13</td></tr></table>	30.13	(75)
0.77																		
10.7																		
9.21																		
0.63																		
0.7																		
30.13																		
Northeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.1</td></tr></table>	2.1	x	<table><tr><td>9.21</td></tr></table>	9.21	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>5.91</td></tr></table>	5.91	(75)
0.77																		
2.1																		
9.21																		
0.63																		
0.7																		
5.91																		
Southeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.5</td></tr></table>	1.5	x	<table><tr><td>36.79</td></tr></table>	36.79	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>16.87</td></tr></table>	16.87	(77)
0.77																		
1.5																		
36.79																		
0.63																		
0.7																		
16.87																		
Southeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.5</td></tr></table>	1.5	x	<table><tr><td>62.67</td></tr></table>	62.67	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>28.73</td></tr></table>	28.73	(77)
0.77																		
1.5																		
62.67																		
0.63																		
0.7																		
28.73																		
Southeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.5</td></tr></table>	1.5	x	<table><tr><td>85.75</td></tr></table>	85.75	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>39.31</td></tr></table>	39.31	(77)
0.77																		
1.5																		
85.75																		
0.63																		
0.7																		
39.31																		
Southeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.5</td></tr></table>	1.5	x	<table><tr><td>106.25</td></tr></table>	106.25	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>48.71</td></tr></table>	48.71	(77)
0.77																		
1.5																		
106.25																		
0.63																		
0.7																		
48.71																		
Southeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.5</td></tr></table>	1.5	x	<table><tr><td>119.01</td></tr></table>	119.01	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>54.56</td></tr></table>	54.56	(77)
0.77																		
1.5																		
119.01																		
0.63																		
0.7																		
54.56																		
Southeast 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.5</td></tr></table>	1.5	x	<table><tr><td>118.15</td></tr></table>	118.15	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>54.16</td></tr></table>	54.16	(77)
0.77																		
1.5																		
118.15																		
0.63																		
0.7																		
54.16																		

TER WorkSheet: New dwelling as built

Southeast	0.9x	0.77	x	1.5	x	113.91	x	0.63	x	0.7	=	52.22	(77)
Southeast	0.9x	0.77	x	1.5	x	104.39	x	0.63	x	0.7	=	47.85	(77)
Southeast	0.9x	0.77	x	1.5	x	92.85	x	0.63	x	0.7	=	42.57	(77)
Southeast	0.9x	0.77	x	1.5	x	69.27	x	0.63	x	0.7	=	31.75	(77)
Southeast	0.9x	0.77	x	1.5	x	44.07	x	0.63	x	0.7	=	20.2	(77)
Southeast	0.9x	0.77	x	1.5	x	31.49	x	0.63	x	0.7	=	14.43	(77)
Southwest	0.9x	0.77	x	6.85	x	36.79		0.63	x	0.7	=	77.03	(79)
Southwest	0.9x	0.77	x	6.85	x	62.67		0.63	x	0.7	=	131.2	(79)
Southwest	0.9x	0.77	x	6.85	x	85.75		0.63	x	0.7	=	179.52	(79)
Southwest	0.9x	0.77	x	6.85	x	106.25		0.63	x	0.7	=	222.43	(79)
Southwest	0.9x	0.77	x	6.85	x	119.01		0.63	x	0.7	=	249.14	(79)
Southwest	0.9x	0.77	x	6.85	x	118.15		0.63	x	0.7	=	247.34	(79)
Southwest	0.9x	0.77	x	6.85	x	113.91		0.63	x	0.7	=	238.46	(79)
Southwest	0.9x	0.77	x	6.85	x	104.39		0.63	x	0.7	=	218.54	(79)
Southwest	0.9x	0.77	x	6.85	x	92.85		0.63	x	0.7	=	194.38	(79)
Southwest	0.9x	0.77	x	6.85	x	69.27		0.63	x	0.7	=	145.01	(79)
Southwest	0.9x	0.77	x	6.85	x	44.07		0.63	x	0.7	=	92.26	(79)
Southwest	0.9x	0.77	x	6.85	x	31.49		0.63	x	0.7	=	65.92	(79)

Solar gains in watts, calculated for each month

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

(83)m=	138.03	249.78	380.7	536.97	661.03	682.46	647.06	550.5	434.18	286.56	168	116.4	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	617.3	726.7	840.63	969.3	1064.23	1057.89	1005.18	915.95	814.68	694.9	608.34	581.19	(84)
--------	-------	-------	--------	-------	---------	---------	---------	--------	--------	-------	--------	--------	------

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	1	0.99	0.98	0.91	0.77	0.6	0.67	0.9	0.99	1	1	(86)

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

(87)m=	19.62	19.77	20.04	20.39	20.72	20.92	20.98	20.97	20.81	20.39	19.94	19.6	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

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

(88)m=	19.94	19.94	19.94	19.95	19.95	19.96	19.96	19.96	19.96	19.95	19.95	19.95	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	1	0.99	0.97	0.88	0.68	0.47	0.54	0.85	0.98	1	1	(89)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

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

(90)m=	18.09	18.31	18.7	19.22	19.67	19.91	19.96	19.95	19.79	19.22	18.57	18.06	(90)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 0.13 (91)

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

(92)m=	18.3	18.51	18.88	19.38	19.81	20.04	20.09	20.09	19.93	19.37	18.75	18.27	(92)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.3	18.51	18.88	19.38	19.81	20.04	20.09	20.09	19.93	19.37	18.75	18.27	(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	
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TER WorkSheet: New dwelling as built

Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.96	0.87	0.69	0.49	0.56	0.85	0.98	1	1	(94)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

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

(95)m=	616.15	723.55	830.43	929.14	926.64	727.1	492.51	512.68	688.55	678.92	605.94	580.4	(95)
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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=	2057.92	1996.35	1811.35	1517.34	1171.9	779.45	500.09	526.96	837.43	1267.96	1690.58	2050.05	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	1072.68	855.32	729.8	423.5	182.47	0	0	0	0	438.24	780.94	1093.42	(98)
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 5576.38 (98)

Space heating requirement in kWh/m²/year

44.68 (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)

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

Space heating requirement (calculated above)

1072.68	855.32	729.8	423.5	182.47	0	0	0	0	438.24	780.94	1093.42
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(211)m = {[(98)m x (204)] } x 100 ÷ (206)

(211)

1148.48	915.76	781.37	453.43	195.37	0	0	0	0	469.21	836.12	1170.68
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Total (kWh/year) =Sum(211)_{1...5,10...12} = 5970.43 (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
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Total (kWh/year) =Sum(215)_{1...5,10...12} = 0 (215)

Water heating

Output from water heater (calculated above)

218.33	192.41	202.01	181.01	175.51	154.58	148.1	165.1	166.65	187.7	198.58	213.05
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Efficiency of water heater

80.3 (216)

(217)m=	88.52	88.36	88	87.12	85.15	80.3	80.3	80.3	80.3	87.11	88.15	88.58	(217)
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	246.65	217.76	229.56	207.77	206.12	192.5	184.43	205.6	207.53	215.46	225.27	240.51
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Total = Sum(219a)_{1...12} = 2579.19 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

5970.43

Water heating fuel used

2579.19

Electricity for pumps, fans and electric keep-hot

TER WorkSheet: New dwelling as built

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		473.34	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		9097.96	(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	=	1289.61	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	557.1	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1846.72	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	245.67	(268)
Total CO2, kg/year		sum of (265)...(271) =			2131.31	(272)
 TER =					 17.08	 (273)

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 08 March 2023

Property Details: Plot 513 - As Built

Dwelling type:	Semi-detached House
Located in:	England
Region:	South England
Cross ventilation possible:	Yes
Number of storeys:	2
Front of dwelling faces:	South West
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Calculated 232.95
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:	412.89	(P1)
Transmission heat loss coefficient:	93.8	
Summer heat loss coefficient:	506.65	(P2)

Overhangs:

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

Solar shading:

Orientation:	Z blinds:	Solar access:	Overhangs:	Z summer:	
South West (front)	1	0.9	1	0.9	(P8)
North East (rear)	1	0.9	1	0.9	(P8)
South East (side)	1	0.9	1	0.9	(P8)
North East (rear dormer)	1	0.9	1	0.9	(P8)

Solar gains:

Orientation	Area	Flux	g_	FF	Shading	Gains	
South West (front)	0.9 x	6.85	127.31	0.45	0	0.9	353.19
North East (rear)	0.9 x	10.7	106.05	0.45	0	0.9	459.57
South East (side)	0.9 x	1.5	127.31	0.45	0	0.9	77.34
North East (rear dormer)	0.9 x	2.1	106.05	0.45	0	0.9	90.2
Total						980.3	(P3/P4)

Internal gains:

	June	July	August	
Internal gains	535.44	512.91	522.57	
Total summer gains	1594.81	1493.21	1373.24	(P5)
Summer gain/loss ratio	3.15	2.95	2.71	(P6)
Mean summer external temperature (South England)	15.4	17.3	17.3	
Thermal mass temperature increment	0.37	0.37	0.37	
Threshold temperature	18.92	20.62	20.38	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

SAP 2012 Overheating Assessment

Assessment of likelihood of high internal temperature: Slight