

SAP WorkSheet: New dwelling design stage

User Details

Assessor Name: Nicholas Jones **Stroma Number:** STRO000971
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.10

Property Address: Plot 31

Address : Plot 31, Pagham Road, Pagham, PO21 3PX

1. General dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	45.46 (1a)	x	2.37 (2a)	=	107.74 (3a)
First floor	45.46 (1b)	x	2.59 (2b)	=	117.65 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.92 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	225.39 (5)

2. Ventilation rate

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.13 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - {0.2 x (14) ÷ 100} =		0 (15)
Infiltration rate	{8} + {10} + {11} + {12} + {13} + {15} =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.38 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			3 (19)
Shelter factor	{20} = 1 - {0.075 x (19)} =		0.78 (20)
Infiltration rate incorporating shelter factor	{21} = {18} x {20} =		0.3 (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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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

	0.38	0.37	0.36	0.33	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(23c)

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

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

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

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

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

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

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

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

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

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56
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(24d)

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

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56
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(25)

3 Thermal losses and heat capacity parameter

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² ·K	A X k kJ/K
Doors			2.01	1.2	2.412		(26)
Windows Type 1			4.3	$\times 1/[1/(1.4) + 0.04]$	5.7		(27)
Windows Type 2			7.84	$\times 1/[1/(1.4) + 0.04]$	10.39		(27)
Windows Type 3			1.44	$\times 1/[1/(1.4) + 0.04]$	1.91		(27)
Floor			45.46	0.15	6.819		(28)
Walls	96.95	15.59	81.36	0.19	15.46		(29)
Roof	45.46	0	45.46	0.11	5		(30)
Total area of elements, m ²			187.87				(31)
Party wall			43.23	0	0		(32)

* 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 x U) (26)...(30) + (32) = 47.69 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 3647.42 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 x Y) calculated using Appendix K 12.17 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 59.87 (37)

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

(57)m=	22.1	19.96	22.1	21.38	22.1	21.38	22.1	22.1	21.38	22.1	21.38	22.1	(57)
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Primary circuit loss (annual) from Table 3 0 (58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	203.36	179.15	187.95	168.21	164.64	146.83	140.74	154.81	154.66	174.44	184.8	198.37	(62)
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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)
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Output from water heater

(64)m=	203.36	179.15	187.95	168.21	164.64	146.83	140.74	154.81	154.66	174.44	184.8	198.37	
Output from water heater (annual) × 1.12												2057.97	(64)

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

(65)m=	88.82	78.72	83.7	76.45	75.95	69.34	68	72.68	71.94	79.21	81.97	87.16	(65)
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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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	158.29	158.29	158.29	158.29	158.29	158.29	158.29	158.29	158.29	158.29	158.29	158.29	(66)

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

(67)m=	55.26	49.08	39.91	30.22	22.59	19.07	20.61	26.78	35.95	45.65	53.28	56.79	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	359.34	363.07	353.68	333.67	308.42	284.69	268.83	265.1	274.5	294.5	319.76	343.49	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	53.47	53.47	53.47	53.47	53.47	53.47	53.47	53.47	53.47	53.47	53.47	53.47	(69)
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Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-105.52	-105.52	-105.52	-105.52	-105.52	-105.52	-105.52	-105.52	-105.52	-105.52	-105.52	-105.52	(71)
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Water heating gains (Table 5)

(72)m=	119.38	117.15	112.5	106.18	102.08	96.31	91.4	97.69	99.92	106.46	113.84	117.16	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	640.21	635.53	612.32	576.3	539.32	506.29	487.07	495.8	516.6	552.84	593.1	623.67	(73)
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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)
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North	0.9x	0.77	x	4.3	x	10.63	x	0.63	x	0.7	=	13.97	(74)
North	0.9x	0.77	x	4.3	x	20.32	x	0.63	x	0.7	=	26.7	(74)
North	0.9x	0.77	x	4.3	x	34.53	x	0.63	x	0.7	=	45.38	(74)
North	0.9x	0.77	x	4.3	x	55.46	x	0.63	x	0.7	=	72.89	(74)
North	0.9x	0.77	x	4.3	x	74.72	x	0.63	x	0.7	=	98.19	(74)
North	0.9x	0.77	x	4.3	x	79.99	x	0.63	x	0.7	=	105.11	(74)
North	0.9x	0.77	x	4.3	x	74.68	x	0.63	x	0.7	=	98.14	(74)
North	0.9x	0.77	x	4.3	x	59.25	x	0.63	x	0.7	=	77.86	(74)
North	0.9x	0.77	x	4.3	x	41.52	x	0.63	x	0.7	=	54.56	(74)
North	0.9x	0.77	x	4.3	x	24.19	x	0.63	x	0.7	=	31.79	(74)
North	0.9x	0.77	x	4.3	x	13.12	x	0.63	x	0.7	=	17.24	(74)
North	0.9x	0.77	x	4.3	x	8.86	x	0.63	x	0.7	=	11.65	(74)
East	0.9x	1	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(76)
East	0.9x	1	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(76)
East	0.9x	1	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(76)
East	0.9x	1	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(76)
East	0.9x	1	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(76)
East	0.9x	1	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(76)
East	0.9x	1	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(76)
East	0.9x	1	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(76)
East	0.9x	1	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(76)
East	0.9x	1	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(76)
East	0.9x	1	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(76)
East	0.9x	1	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(76)
South	0.9x	0.77	x	7.84	x	46.75	x	0.63	x	0.7	=	112.02	(78)
South	0.9x	0.77	x	7.84	x	76.57	x	0.63	x	0.7	=	183.46	(78)
South	0.9x	0.77	x	7.84	x	97.53	x	0.63	x	0.7	=	233.69	(78)
South	0.9x	0.77	x	7.84	x	110.23	x	0.63	x	0.7	=	264.12	(78)
South	0.9x	0.77	x	7.84	x	114.87	x	0.63	x	0.7	=	275.23	(78)
South	0.9x	0.77	x	7.84	x	110.55	x	0.63	x	0.7	=	264.87	(78)
South	0.9x	0.77	x	7.84	x	108.01	x	0.63	x	0.7	=	258.8	(78)
South	0.9x	0.77	x	7.84	x	104.89	x	0.63	x	0.7	=	251.33	(78)
South	0.9x	0.77	x	7.84	x	101.89	x	0.63	x	0.7	=	244.12	(78)
South	0.9x	0.77	x	7.84	x	82.59	x	0.63	x	0.7	=	197.88	(78)
South	0.9x	0.77	x	7.84	x	55.42	x	0.63	x	0.7	=	132.78	(78)
South	0.9x	0.77	x	7.84	x	40.4	x	0.63	x	0.7	=	96.79	(78)

Solar gains in watts, calculated for each month

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

(83)m=	134.64	227.07	306.91	377.62	423.19	420.93	405.44	370.85	331.06	249.73	160.8	115.55	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	774.85	862.6	919.23	953.92	962.51	927.23	892.5	866.66	847.66	802.57	753.9	739.22	(84)
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7. Heating 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
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(86)m=	0.93	0.9	0.87	0.81	0.72	0.58	0.45	0.48	0.65	0.82	0.9	0.94	(86)
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Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	21	21	21	21	21	21	21	21	21	21	21	21	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.98	19.98	19.98	19.99	19.99	20	20	20	20	19.99	19.99	19.99	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.92	0.89	0.85	0.78	0.67	0.52	0.36	0.39	0.59	0.78	0.89	0.93	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.98	19.98	19.98	19.99	19.99	20	20	20	20	19.99	19.99	19.99	(90)
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$$fLA = \text{Living area} \div (4) = 0.22 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	20.2	20.21	20.21	20.21	20.22	20.22	20.22	20.22	20.22	20.22	20.21	20.21	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	20.2	20.21	20.21	20.21	20.22	20.22	20.22	20.22	20.22	20.22	20.21	20.21	(93)
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4. 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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Utilisation factor for gains, hm:

(94)m=	0.92	0.9	0.86	0.79	0.68	0.53	0.38	0.41	0.6	0.79	0.89	0.93	(94)
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Useful gains, hmGm, W = (94)m x (84)m

(95)m=	713.79	772.25	787.01	752.93	659.14	493.55	342.35	356.91	511.25	635.78	671.29	686.68	(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)
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Heat loss rate for mean internal temperature, Lm, W = [(39)m x ((93)m - (96)m)]

(97)m=	1628.43	1563.98	1397.86	1143.02	858.76	562.23	362.2	381.73	613.97	969.69	1327.12	1626.39	(97)
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Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	680.49	532.04	454.47	280.87	148.52	0	0	0	0	248.43	472.2	699.14	(98)
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$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..12} = 3516.16 \quad (99)$$

Space heating requirement in kWh/m²/year

$$38.67 \quad (99)$$

5a. 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) x [1 - (203)] = 1 (204)

Efficiency of main space heating system 1 346.71 (206)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

680.49	532.04	454.47	280.87	148.52	0	0	0	0	248.43	472.2	699.14
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(211)m = [(98)m x (204)] x 100 ÷ (206) (211)

196.27	153.45	131.08	81.01	42.84	0	0	0	0	71.65	136.19	201.65
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$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..12} = 1014.14 \quad (211)$$

SAP WorkSheet: New dwelling design stage

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215) _{1..5,10...12} =													0	(215)

Water heating

Output from water heater (calculated above)

	203.36	179.15	187.95	168.21	164.64	146.83	140.74	154.81	154.66	174.44	184.8	198.37		
Efficiency of water heater													133.85	(216)
(217)m=	133.85	133.85	133.85	133.85	133.85	133.85	133.85	133.85	133.85	133.85	133.85	133.85		(217)

Fuel for water heating, kWh/month

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	151.92	133.84	140.42	125.67	123	109.69	105.15	115.66	115.54	130.32	138.06	148.2		
Total = Sum(219a) _{1..12} =													1537.47	(219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Electricity for pumps, fans and electric keep-hot

Total electricity for the above, kWh/year

$$\text{sum of (230a)...(230g) =}$$

Electricity for lighting

													0	(231)
													390.35	(232)

12a Fuel costs - individual heating systems

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	13.19	133.77 (240)
Space heating - main system 2	(213) x	0	0 (241)
Space heating - secondary	(215) x	13.19	0 (242)
Water heating cost (other fuel)	(219)	13.19	202.79 (247)
Pumps, fans and electric keep-hot	(231)	13.19	0 (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	51.49 (250)
Additional standing charges (Table 12)			0 (251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)...(254) =	388.04	(255)
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12a SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.2	(257)
SAP rating (Section 12)		83.27	(258)

12a CO2 emissions - individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
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SAP WorkSheet: New dwelling design stage

Space heating (main system 1)	{211} x	0.519	=	526.34	{261}
Space heating (secondary)	{215} x	0.519	=	0	{263}
Water heating	{219} x	0.519	=	797.94	{264}
Space and water heating	{261} + {262} + {263} + {264} =			1324.29	{265}
Electricity for pumps, fans and electric keep-hot	{231} x	0.519	=	0	{267}
Electricity for lighting	{232} x	0.519	=	202.59	{268}
Total CO ₂ , kg/year		sum of {265}...{271} =		1526.88	{272}
CO₂ emissions per m²		{272} ÷ (4) =		16.79	{273}
El rating (section 14)				85	{274}

13a Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	{211} x	3.07	=	3113.42	{261}
Space heating (secondary)	{215} x	3.07	=	0	{263}
Energy for water heating	{219} x	3.07	=	4720.02	{264}
Space and water heating	{261} + {262} + {263} + {264} =			7833.44	{265}
Electricity for pumps, fans and electric keep-hot	{231} x	3.07	=	0	{267}
Electricity for lighting	{232} x	0	=	1198.36	{268}
'Total Primary Energy		sum of {265}...{271} =		9031.81	{272}
Primary energy kWh/m²/year		{272} ÷ (4) =		99.34	{273}