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Our Reference : DE-24

Sent By : E-Mail

19 June 2026

Dear Phil

ENERGY STATEMENT (PLANNING CONDITION 7)

Statement By :	Joe Solti Accredited SAP Assessor (EES/003578)
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Thank you for sending the drawings. We are pleased to present our report as follows.

Development Details

Site Location :	8 Southey Road, Worthing BN11 3HT
Development :	8 Residential Apartments (Change of Use of Building)
Local Authority :	Worthing & Adur District Council
Planning Reference :	AWDM/0727/25
Condition 7 :	<u>CO2</u> Minimum 20% reduction in CO2 (beyond 2013 Part L standards) <u>Energy</u> Minimum 10% of total energy requirements to be provided by renewable and/or low carbon energy production equipment <u>Rating</u> Energy rating (EPC) to be Band C or better.

Table 1 : CO2 Emissions Savings

Flat 1	Floor Area = 46.2m ²		
Base CO2 (DER) :	36.86 kg/m ² /year	Total CO2 =	1702.93 kg/m ² /year
Actual CO2 (DER) :	26.50 kg/m ² /year	Total CO2 =	1224.30 kg/m ² /year
Flat 2	Floor Area = 51.6m ²		
Base CO2 (DER) :	30.06 kg/m ² /year	Total CO2 =	1551.10 kg/m ² /year
Actual CO2 (DER) :	20.78 kg/m ² /year	Total CO2 =	1072.25 kg/m ² /year
Flat 3	Floor Area = 48.4m ²		
Base CO2 (DER) :	30.95 kg/m ² /year	Total CO2 =	1497.98 kg/m ² /year
Actual CO2 (DER) :	21.06 kg/m ² /year	Total CO2 =	1019.30 kg/m ² /year
Flat 4	Floor Area = 50.9m ²		
Base CO2 (DER) :	34.83 kg/m ² /year	Total CO2 =	1772.85 kg/m ² /year
Actual CO2 (DER) :	25.43 kg/m ² /year	Total CO2 =	1294.39 kg/m ² /year
Flat 5	Floor Area = 40.6m ²		
Base CO2 (DER) :	32.08 kg/m ² /year	Total CO2 =	1302.45 kg/m ² /year
Actual CO2 (DER) :	20.29 kg/m ² /year	Total CO2 =	823.77 kg/m ² /year
Flat 6	Floor Area = 40.3m ²		
Base CO2 (DER) :	35.76 kg/m ² /year	Total CO2 =	1441.13 kg/m ² /year
Actual CO2 (DER) :	23.88 kg/m ² /year	Total CO2 =	962.36 kg/m ² /year
Flat 7	Floor Area = 54.2m ²		
Base CO2 (DER) :	25.39 kg/m ² /year	Total CO2 =	1376.14 kg/m ² /year
Actual CO2 (DER) :	16.56 kg/m ² /year	Total CO2 =	897.55 kg/m ² /year
Flat 8	Floor Area = 43.3m ²		
Base CO2 (DER) :	33.24 kg/m ² /year	Total CO2 =	1439.29 kg/m ² /year
Actual CO2 (DER) :	22.18 kg/m ² /year	Total CO2 =	960.39 kg/m ² /year
Total Base CO2 :	12083.86 kg/m ² /year		
Total Actual CO2 :	8254.32 kg/m ² /year		
Saving (CO2) :	3829.54 kg/m²/year = 31.69 %		

Table 2 : Energy

Flat 1	Floor Area = 46.2m ²		
Total Energy :	7000.83	kWh/year	
Energy (Renewables) :	922.15	kWh/year	1.4kW Solar PV
Flat 2	Floor Area = 51.6m ²		
Total Energy :	6144.48	kWh/year	
Energy (Renewables) :	922.15	kWh/year	1.4kW Solar PV
Flat 3	Floor Area = 48.4m ²		
Total Energy :	5945.82	kWh/year	
Energy (Renewables) :	922.15	kWh/year	1.4kW Solar PV
Flat 4	Floor Area = 50.9m ²		
Total Energy :	7191.88	kWh/year	
Energy (Renewables) :	922.15	kWh/year	1.4kW Solar PV
Flat 5	Floor Area = 40.6m ²		
Total Energy :	5252.82	kWh/year	
Energy (Renewables) :	922.15	kWh/year	1.4kW Solar PV
Flat 6	Floor Area = 40.3m ²		
Total Energy :	5852.41	kWh/year	
Energy (Renewables) :	922.15	kWh/year	1.4kW Solar PV
Flat 7	Floor Area = 54.2m ²		
Total Energy :	5316.79	kWh/year	
Energy (Renewables) :	922.15	kWh/year	1.4kW Solar PV
Flat 8	Floor Area = 43.3m ²		
Total Energy :	5796.71	kWh/year	
Energy (Renewables) :	922.15	kWh/year	1.4kW Solar PV
Total Energy :	48501.74	kWh/year	
Energy (Renewables) :	7377.20	kWh/year =	15.21 %

Table 3 : Energy Ratings (Predicted)

Flat 1 =	81 (Band B)
Flat 2 =	83 (Band B)
Flat 3 =	83 (Band B)
Flat 4 =	81 (Band B)
Flat 5 =	84 (Band B)
Flat 6 =	83 (Band B)
Flat 7 =	85 (Band B)
Flat 8 =	81 (Band B)

Table 4 : Notes**Note 1**

See thermal (SAP) calculations DE2401 - DE2408 attached.

Note 2

Calculations based on SAP2012 (Building Regulations Part L 2013)

Note 3

Renewables are solar PV panels, minimum 1.4kW per flat, facing approx south-west, connected to each flat.

Construction and Insulation

<u>Element</u>	<u>U-Value</u> (W/m ² K)
<u>Exposed Wall</u> (front building) 102.5mm facing brick (or rendered/clad brick) outer leaf + 50mm clear cavity + 102.5mm brick or medium dense concrete block inner leaf + 67.5mm insulated plasterboard (55mm PIR insulation + 12.5mm plasterboard) on dabs.	0.30
<u>Exposed Wall</u> (rear building) option 1 102.5mm facing brick (or rendered/clad brick) outer leaf + 50mm clear cavity + 102.5mm brick or medium dense concrete block inner leaf + 67.5mm insulated plasterboard (55mm PIR insulation + 12.5mm plasterboard) on dabs.	0.30
<u>Exposed Wall</u> (rear building) option 2 102.5mm facing brick (or rendered/clad brick) outer leaf + 50mm cavity with blown/injected cavity insulation + 100mm medium dense concrete block inner leaf + plaster.	0.55
<u>Internal Partitions</u> Mostly metal studwork + plasterboard (some masonry).	NA
<u>Party Walls</u> Solid masonry, or cavity masonry walls fully-filled with acoustic insulation. Note 1 : Effective edge sealing at all exposed edges, and in line with insulation layers in abutting elements. Note 2 : Therm Energy Can Provide Sound Testing.	0.00
<u>Ground Floor</u> (Flat 1) 150mm PIR insulation between suspended timber floor (uninsulated).	0.17
<u>Ground Floor</u> (Flats 2-4) Solid concrete floor slab (uninsulated).	0.53
<u>Roof</u> (Flats 5-6) 300mm mineral wool insulation quilt (150mm between joists + 150mm cross-laid over joists, or 100mm + 200mm).	0.15
<u>Roof</u> (Flats 2-3 & 7-8) 140mm PIR insulation (over roof deck).	0.16
<u>Windows</u> (existing) PVC-u frame double-glazed (16mm airgap). <u>Windows/Doors/Rooflights</u> (new) PVC-u frame double-glazed (16mm argon gas-filled) + soft coat low-E glass (U-value 1.40W/m ² K or better). Note 1 : U-Value (new) must be frame + glass (not centre-pane). Note 2 : U-value certification will be required from the supplier for the new windows, doors & rooflights on completion.	2.70 1.40

Heating, Ventilation & Renewables

Main Heating System
Conventional (mains) gas-fired central heating with radiators. Condensing combi boilers.

Secondary Heating System

Not applicable.

Water Heating (mains water)

From central heating combi boiler.

Ventilation

Background ventilators + intermittent extract fans (Approved Document F1, 2021).

Renewables

1.4kW solar PV per flat, on south-east or south-west facing roof slopes (front building) and on flat roofs facing south-west (30°).
Total = 11.2kW. Export capable meters. Very little-overshading.

Note : Solar PV must feed directly to each flat otherwise there will be no benefit to the energy ratings.

Communal

Communal areas are heated.

Other

Sides Sheltered

Number of side sheltered = 4 no.

Electricity Tariff

Standard tariff electric.

Lighting

Low energy lighting with minimum luminous efficacy of 75 light source lumens/circuit-watt (per light fitting).

Water Use

Total water use < 125 litres/person/day.

Air Tightness

Material change of use - air pressure test not required.

Other Therm Energy Services (that may be relevant to this project)

> Sound Testing (Part E)

> Extract Fan Testing (Part F)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.60

Property Address: DE2401 (Base CO2)

Address : Flat 1, 8 Southey Road, Worthing, BN11 3HT

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	46.2 (1a)	3.22 (2a)	148.76 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	46.2 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	148.76 (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				2	20 (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) =	20 ÷ (5) = 0.13 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

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)

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

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 15 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.88 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 4 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.7 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.62 (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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SAP WorkSheet: New dwelling design stage

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

0.79	0.77	0.76	0.68	0.67	0.59	0.59	0.57	0.62	0.67	0.7	0.73
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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) x 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) x [1 - (23c) ÷ 100]

(24a)m= 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 (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 (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= 0.81 0.8 0.79 0.73 0.72 0.67 0.67 0.66 0.69 0.72 0.74 0.76 (24d)

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

(25)m= 0.81 0.8 0.79 0.73 0.72 0.67 0.67 0.66 0.69 0.72 0.74 0.76 (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
Windows Type 1			1.4	$\times 1/[1/(2.7) + 0.04] =$	3.41		(27)
Windows Type 2			1.4	$\times 1/[1/(2.7) + 0.04] =$	3.41		(27)
Windows Type 3			1.7	$\times 1/[1/(2.7) + 0.04] =$	4.14		(27)
Windows Type 4			7.2	$\times 1/[1/(2.7) + 0.04] =$	17.55		(27)
Windows Type 5			2.1	$\times 1/[1/(2.7) + 0.04] =$	5.12		(27)
Floor			46.2	x 0.17 =	7.854		(28)
Walls	68.2	13.8	54.4	x 0.3 =	16.32		(29)
Total area of elements, m²			114.4				(31)

* 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) = 57.8 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 9084 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 17.16 (36)

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

Total fabric heat loss (33) + (36) = 74.96 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	39.84	39.25	38.66	35.93	35.42	33.04	33.04	32.6	33.95	35.42	36.45	37.54

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

(39)m=	114.8	114.21	113.63	110.89	110.38	108	108	107.56	108.92	110.38	111.42	112.5
Average = Sum(39) _{1...12} /12=												110.89 (39)

SAP WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	2.48	2.47	2.46	2.4	2.39	2.34	2.34	2.33	2.36	2.39	2.41	2.44
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$$\text{Average} = \text{Sum}(40)_{1...12} / 12 =$$

2.4

(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

1.58

(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 ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

71.7

(43)

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

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

(44)m=	78.87	76.01	73.14	70.27	67.4	64.53	64.53	67.4	70.27	73.14	76.01	78.87
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$$\text{Total} = \text{Sum}(44)_{1...12} =$$

860.45

(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)

(45)m=	116.97	102.3	105.57	92.03	88.31	76.2	70.61	81.03	82	95.56	104.31	113.28
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$$\text{Total} = \text{Sum}(45)_{1...12} =$$

1128.18

(45)

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

(46)m=	17.55	15.35	15.83	13.81	13.25	11.43	10.59	12.15	12.3	14.33	15.65	16.99
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(46)

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

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

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(56)

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

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(57)

Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(59)

SAP WorkSheet: New dwelling design stage

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

(61)m=	40.19	34.98	37.27	34.65	34.35	31.82	32.89	34.35	34.65	37.27	37.48	40.19	(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=	157.16	137.28	142.84	126.69	122.66	108.03	103.5	115.38	116.65	132.83	141.8	153.47	(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=	157.16	137.28	142.84	126.69	122.66	108.03	103.5	115.38	116.65	132.83	141.8	153.47	
Output from water heater (annual) _{1...12}												1558.29	(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=	48.94	42.76	44.42	39.26	37.95	33.29	31.7	35.53	35.93	41.09	44.05	47.71	(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=	94.75	94.75	94.75	94.75	94.75	94.75	94.75	94.75	94.75	94.75	94.75	94.75	(66)

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

(67)m=	30.62	27.2	22.12	16.74	12.52	10.57	11.42	14.84	19.92	25.29	29.52	31.47	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	205.04	207.17	201.81	190.39	175.99	162.44	153.4	151.27	156.63	168.04	182.45	196	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	46.05	46.05	46.05	46.05	46.05	46.05	46.05	46.05	46.05	46.05	46.05	46.05	(69)
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Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-63.16	-63.16	-63.16	-63.16	-63.16	-63.16	-63.16	-63.16	-63.16	-63.16	-63.16	-63.16	(71)
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Water heating gains (Table 5)

(72)m=	65.78	63.63	59.7	54.53	51.01	46.24	42.61	47.75	49.9	55.23	61.19	64.13	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	382.08	378.63	364.26	342.31	320.15	299.89	288.06	294.5	307.09	329.2	353.8	372.23	(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)		
North	0.9x	0.77	x	1.4	x	10.63	x	0.76	x	0.7	=	5.49	(74)
North	0.9x	0.77	x	1.4	x	20.32	x	0.76	x	0.7	=	10.49	(74)
North	0.9x	0.77	x	1.4	x	34.53	x	0.76	x	0.7	=	17.82	(74)
North	0.9x	0.77	x	1.4	x	55.46	x	0.76	x	0.7	=	28.63	(74)
North	0.9x	0.77	x	1.4	x	74.72	x	0.76	x	0.7	=	38.56	(74)

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North	0.9x	0.77	x	1.4	x	79.99	x	0.76	x	0.7	=	41.28	(74)
North	0.9x	0.77	x	1.4	x	74.68	x	0.76	x	0.7	=	38.54	(74)
North	0.9x	0.77	x	1.4	x	59.25	x	0.76	x	0.7	=	30.58	(74)
North	0.9x	0.77	x	1.4	x	41.52	x	0.76	x	0.7	=	21.43	(74)
North	0.9x	0.77	x	1.4	x	24.19	x	0.76	x	0.7	=	12.49	(74)
North	0.9x	0.77	x	1.4	x	13.12	x	0.76	x	0.7	=	6.77	(74)
North	0.9x	0.77	x	1.4	x	8.86	x	0.76	x	0.7	=	4.58	(74)
Northeast	0.9x	0.77	x	1.7	x	11.28	x	0.76	x	0.7	=	7.07	(75)
Northeast	0.9x	0.77	x	1.7	x	22.97	x	0.76	x	0.7	=	14.39	(75)
Northeast	0.9x	0.77	x	1.7	x	41.38	x	0.76	x	0.7	=	25.93	(75)
Northeast	0.9x	0.77	x	1.7	x	67.96	x	0.76	x	0.7	=	42.59	(75)
Northeast	0.9x	0.77	x	1.7	x	91.35	x	0.76	x	0.7	=	57.25	(75)
Northeast	0.9x	0.77	x	1.7	x	97.38	x	0.76	x	0.7	=	61.04	(75)
Northeast	0.9x	0.77	x	1.7	x	91.1	x	0.76	x	0.7	=	57.1	(75)
Northeast	0.9x	0.77	x	1.7	x	72.63	x	0.76	x	0.7	=	45.52	(75)
Northeast	0.9x	0.77	x	1.7	x	50.42	x	0.76	x	0.7	=	31.6	(75)
Northeast	0.9x	0.77	x	1.7	x	28.07	x	0.76	x	0.7	=	17.59	(75)
Northeast	0.9x	0.77	x	1.7	x	14.2	x	0.76	x	0.7	=	8.9	(75)
Northeast	0.9x	0.77	x	1.7	x	9.21	x	0.76	x	0.7	=	5.78	(75)
Southwest	0.9x	0.77	x	2.1	x	36.79	x	0.76	x	0.7	=	28.49	(79)
Southwest	0.9x	0.77	x	2.1	x	62.67	x	0.76	x	0.7	=	48.52	(79)
Southwest	0.9x	0.77	x	2.1	x	85.75	x	0.76	x	0.7	=	66.39	(79)
Southwest	0.9x	0.77	x	2.1	x	106.25	x	0.76	x	0.7	=	82.26	(79)
Southwest	0.9x	0.77	x	2.1	x	119.01	x	0.76	x	0.7	=	92.14	(79)
Southwest	0.9x	0.77	x	2.1	x	118.15	x	0.76	x	0.7	=	91.47	(79)
Southwest	0.9x	0.77	x	2.1	x	113.91	x	0.76	x	0.7	=	88.19	(79)
Southwest	0.9x	0.77	x	2.1	x	104.39	x	0.76	x	0.7	=	80.82	(79)
Southwest	0.9x	0.77	x	2.1	x	92.85	x	0.76	x	0.7	=	71.89	(79)
Southwest	0.9x	0.77	x	2.1	x	69.27	x	0.76	x	0.7	=	53.63	(79)
Southwest	0.9x	0.77	x	2.1	x	44.07	x	0.76	x	0.7	=	34.12	(79)
Southwest	0.9x	0.77	x	2.1	x	31.49	x	0.76	x	0.7	=	24.38	(79)
West	0.9x	0.77	x	1.4	x	19.64	x	0.76	x	0.7	=	10.14	(80)
West	0.9x	0.77	x	1.4	x	38.42	x	0.76	x	0.7	=	19.83	(80)
West	0.9x	0.77	x	1.4	x	63.27	x	0.76	x	0.7	=	32.66	(80)
West	0.9x	0.77	x	1.4	x	92.28	x	0.76	x	0.7	=	47.63	(80)
West	0.9x	0.77	x	1.4	x	113.09	x	0.76	x	0.7	=	58.37	(80)
West	0.9x	0.77	x	1.4	x	115.77	x	0.76	x	0.7	=	59.75	(80)
West	0.9x	0.77	x	1.4	x	110.22	x	0.76	x	0.7	=	56.89	(80)
West	0.9x	0.77	x	1.4	x	94.68	x	0.76	x	0.7	=	48.87	(80)
West	0.9x	0.77	x	1.4	x	73.59	x	0.76	x	0.7	=	37.98	(80)
West	0.9x	0.77	x	1.4	x	45.59	x	0.76	x	0.7	=	23.53	(80)

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West	0.9x	0.77	x	1.4	x	24.49	x	0.76	x	0.7	=	12.64	(80)
West	0.9x	0.77	x	1.4	x	16.15	x	0.76	x	0.7	=	8.34	(80)
Northwest	0.9x	0.77	x	7.2	x	11.28	x	0.76	x	0.7	=	29.95	(81)
Northwest	0.9x	0.77	x	7.2	x	22.97	x	0.76	x	0.7	=	60.96	(81)
Northwest	0.9x	0.77	x	7.2	x	41.38	x	0.76	x	0.7	=	109.84	(81)
Northwest	0.9x	0.77	x	7.2	x	67.96	x	0.76	x	0.7	=	180.39	(81)
Northwest	0.9x	0.77	x	7.2	x	91.35	x	0.76	x	0.7	=	242.47	(81)
Northwest	0.9x	0.77	x	7.2	x	97.38	x	0.76	x	0.7	=	258.5	(81)
Northwest	0.9x	0.77	x	7.2	x	91.1	x	0.76	x	0.7	=	241.83	(81)
Northwest	0.9x	0.77	x	7.2	x	72.63	x	0.76	x	0.7	=	192.79	(81)
Northwest	0.9x	0.77	x	7.2	x	50.42	x	0.76	x	0.7	=	133.84	(81)
Northwest	0.9x	0.77	x	7.2	x	28.07	x	0.76	x	0.7	=	74.5	(81)
Northwest	0.9x	0.77	x	7.2	x	14.2	x	0.76	x	0.7	=	37.69	(81)
Northwest	0.9x	0.77	x	7.2	x	9.21	x	0.76	x	0.7	=	24.46	(81)

Solar gains in watts, calculated for each month

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

(83)m=	81.13	154.2	252.64	381.5	488.8	512.05	482.55	398.57	296.74	181.74	100.11	67.52	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	463.21	532.84	616.91	723.81	808.95	811.94	770.6	693.07	603.83	510.94	453.91	439.76	(84)
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7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.92	0.83	0.69	0.55	0.61	0.82	0.95	0.98	0.99	(86)

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

(87)m=	18.61	18.84	19.27	19.88	20.41	20.78	20.92	20.88	20.58	19.9	19.18	18.6	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.03	19.04	19.04	19.08	19.09	19.12	19.12	19.12	19.11	19.09	19.07	19.06	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.97	0.95	0.88	0.75	0.54	0.34	0.4	0.71	0.92	0.97	0.98	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.01	17.24	17.66	18.27	18.74	19.04	19.1	19.1	18.91	18.31	17.6	17.02	(90)
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fLA = Living area ÷ (4) =

0.47 (91)

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

(92)m=	17.75	17.99	18.41	19.02	19.52	19.85	19.95	19.93	19.69	19.05	18.33	17.76	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.75	17.99	18.41	19.02	19.52	19.85	19.95	19.93	19.69	19.05	18.33	17.76	(93)
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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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Utilisation factor for gains, hm:

(94)m=	0.98	0.97	0.94	0.88	0.77	0.6	0.44	0.5	0.75	0.91	0.97	0.98	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	452.8	514.79	580.31	637.16	622.49	489.55	340.35	348.46	453.16	467.43	438.65	431.21	(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=	1544.66	1494.54	1353.47	1121.86	862.66	566.48	361.5	379.72	608.31	932.54	1251.36	1525.02	(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=	812.34	658.4	575.23	348.99	178.69	0	0	0	0	346.04	585.15	813.8	(98)
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 4318.64 (98)

Space heating requirement in kWh/m²/year

93.48 (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) x [1 – (203)] =

1 (204)

Efficiency of main space heating system 1

88.8 (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)	812.34	658.4	575.23	348.99	178.69	0	0	0	0	346.04	585.15	813.8	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	914.8	741.44	647.78	393	201.22	0	0	0	0	389.69	658.96	916.44	
Total (kWh/year) = Sum(211) _{1...5,10...12} =	4863.33												(211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

Water heating

Output from water heater (calculated above)

157.16	137.28	142.84	126.69	122.66	108.03	103.5	115.38	116.65	132.83	141.8	153.47
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Efficiency of water heater

79.5 (216)

(217)m=	87.15	87.04	86.78	86.12	84.76	79.5	79.5	79.5	79.5	86.01	86.82	87.18	(217)
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	180.34	157.72	164.59	147.11	144.7	135.89	130.19	145.13	146.73	154.44	163.32	176.04	
Total = Sum(219a) _{1...12} =	1846.21												(219)

Annual totals

Space heating fuel used, main system 1

4863.33 kWh/year

Water heating fuel used

1846.21 kWh/year

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

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boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75	(231)
Electricity for lighting		216.29	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		7000.83	(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 = 169.24 (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 = 64.25 (247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 = 9.89 (249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a			
Energy for lighting	(232)	13.19	x 0.01 = 28.53 (250)
Additional standing charges (Table 12)			120 (251)

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

Total energy cost (245)...(247) + (250)...(254) = 391.91 (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] =	1.8	(257)
SAP rating (Section 12)		74.82	(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	= 1050.48 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.216	= 398.78 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1449.26 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 38.93 (267)
Electricity for lighting	(232) x	0.519	= 112.26 (268)
Total CO2, kg/year		sum of (265)...(271) =	1600.44 (272)
CO2 emissions per m²		(272) ÷ (4) =	34.64 (273)
El rating (section 14)			76 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) x	1.22	= 5933.26 (261)

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Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2252.37	(264)
Space and water heating	(261) + (262) + (263) + (264) =			8185.64	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	664.02	(268)
'Total Primary Energy	sum of (265)...(271) =			9079.91	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			196.53	(273)

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SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.60

Property Address: DE2402 (Base CO2)

Address : Flat 2, 8 Southey Road, Worthing, BN11 3HT

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	51.6 (1a)	2.3 (2a)	118.68 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.6 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	118.68 (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							2	x 10 =	20 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =									
							20	÷ (5) =	0.17 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)									
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)
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									
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									15 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)									0.92 (18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used									
Number of sides sheltered									4 (19)
Shelter factor							(20) = 1 - [0.075 x (19)] =		0.7 (20)
Infiltration rate incorporating shelter factor							(21) = (18) x (20) =		0.64 (21)

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

0.82	0.8	0.79	0.71	0.69	0.61	0.61	0.59	0.64	0.69	0.72	0.76
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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) x 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) x [1 - (23c) ÷ 100]

(24a)m= 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 (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 (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= 0.84 0.82 0.81 0.75 0.74 0.69 0.69 0.68 0.71 0.74 0.76 0.79 (24d)

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

(25)m= 0.84 0.82 0.81 0.75 0.74 0.69 0.69 0.68 0.71 0.74 0.76 0.79 (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
Windows			4.3	$\times 1/[1/(2.7) + 0.04] =$	10.48		(27)
Rooflights			1.6	$\times 1/[1/(1.4) + 0.04] =$	2.24		(27b)
Floor			51.6	$\times$ 0.53	27.348		(28)
Walls	13.3	4.3	9	$\times$ 0.55	4.95		(29)
Roof	29.7	1.6	28.1	$\times$ 0.16	4.5		(30)
Total area of elements, m²			94.6				(31)

* 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) = 49.39 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7278.9 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 14.19 (36)

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

Total fabric heat loss (33) + (36) = 63.58 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	32.74	32.23	31.73	29.38	28.94	26.89	26.89	26.51	27.68	28.94	29.83	30.76

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

(39)m=	96.33	95.81	95.31	92.96	92.52	90.47	90.47	90.09	91.26	92.52	93.41	94.34
Average = Sum(39) _{1...12} /12=												92.96 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.87	1.86	1.85	1.8	1.79	1.75	1.75	1.75	1.77	1.79	1.81	1.83		
Average = Sum(40) _{1...12} /12=													1.8	(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

1.74

(42)

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

if TFA ≤ 13.9, N = 1

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

75.46

(43)

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

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

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

(44)m=	83.01	79.99	76.97	73.95	70.93	67.91	67.91	70.93	73.95	76.97	79.99	83.01		
Total = Sum(44) _{1...12} =													905.52	(44)

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

(45)m=	123.1	107.66	111.1	96.86	92.94	80.2	74.31	85.28	86.29	100.57	109.78	119.21		
Total = Sum(45) _{1...12} =													1187.28	(45)

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

(46)m=	18.46	16.15	16.66	14.53	13.94	12.03	11.15	12.79	12.94	15.09	16.47	17.88		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

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

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m 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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

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

(61)m=	42.3	36.82	39.22	36.47	36.15	33.49	34.61	36.15	36.47	39.22	39.45	42.3	(61)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

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

(62)m=	165.39	144.48	150.32	133.32	129.08	113.69	108.92	121.42	122.76	139.79	149.22	161.51	(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=	165.39	144.48	150.32	133.32	129.08	113.69	108.92	121.42	122.76	139.79	149.22	161.51	
Output from water heater (annual) _{1...12}												1639.92	(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=	51.5	45	46.75	41.32	39.94	35.04	33.36	37.39	37.81	43.24	46.36	50.21	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	(66)

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

(67)m=	37.4	33.22	27.02	20.45	15.29	12.91	13.95	18.13	24.33	30.9	36.06	38.44	(67)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

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

(68)m=	225.95	228.3	222.39	209.81	193.93	179.01	169.04	166.69	172.6	185.18	201.06	215.98	(68)
--------	--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

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

(69)m=	47.16	47.16	47.16	47.16	47.16	47.16	47.16	47.16	47.16	47.16	47.16	47.16	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-69.49	-69.49	-69.49	-69.49	-69.49	-69.49	-69.49	-69.49	-69.49	-69.49	-69.49	-69.49	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	69.23	66.97	62.83	57.39	53.68	48.66	44.84	50.26	52.51	58.12	64.39	67.49	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	417.49	413.39	397.14	372.56	347.81	325.49	312.73	319.99	334.36	359.11	386.42	406.82	(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)	
Southwest _{0.9x}	0.77	x	4.3	x	36.79		0.76	x	0.7	=	58.33	(79)
Southwest _{0.9x}	0.77	x	4.3	x	62.67		0.76	x	0.7	=	99.36	(79)
Southwest _{0.9x}	0.77	x	4.3	x	85.75		0.76	x	0.7	=	135.94	(79)
Southwest _{0.9x}	0.77	x	4.3	x	106.25		0.76	x	0.7	=	168.44	(79)
Southwest _{0.9x}	0.77	x	4.3	x	119.01		0.76	x	0.7	=	188.67	(79)

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Southwest0.9x	0.77	x	4.3	x	118.15		0.76	x	0.7	=	187.3	(79)
Southwest0.9x	0.77	x	4.3	x	113.91		0.76	x	0.7	=	180.58	(79)
Southwest0.9x	0.77	x	4.3	x	104.39		0.76	x	0.7	=	165.49	(79)
Southwest0.9x	0.77	x	4.3	x	92.85		0.76	x	0.7	=	147.2	(79)
Southwest0.9x	0.77	x	4.3	x	69.27		0.76	x	0.7	=	109.81	(79)
Southwest0.9x	0.77	x	4.3	x	44.07		0.76	x	0.7	=	69.87	(79)
Southwest0.9x	0.77	x	4.3	x	31.49		0.76	x	0.7	=	49.92	(79)
Rooflights 0.9x	1	x	1.6	x	26	x	0.63	x	0.7	=	16.51	(82)
Rooflights 0.9x	1	x	1.6	x	54	x	0.63	x	0.7	=	34.29	(82)
Rooflights 0.9x	1	x	1.6	x	96	x	0.63	x	0.7	=	60.96	(82)
Rooflights 0.9x	1	x	1.6	x	150	x	0.63	x	0.7	=	95.26	(82)
Rooflights 0.9x	1	x	1.6	x	192	x	0.63	x	0.7	=	121.93	(82)
Rooflights 0.9x	1	x	1.6	x	200	x	0.63	x	0.7	=	127.01	(82)
Rooflights 0.9x	1	x	1.6	x	189	x	0.63	x	0.7	=	120.02	(82)
Rooflights 0.9x	1	x	1.6	x	157	x	0.63	x	0.7	=	99.7	(82)
Rooflights 0.9x	1	x	1.6	x	115	x	0.63	x	0.7	=	73.03	(82)
Rooflights 0.9x	1	x	1.6	x	66	x	0.63	x	0.7	=	41.91	(82)
Rooflights 0.9x	1	x	1.6	x	33	x	0.63	x	0.7	=	20.96	(82)
Rooflights 0.9x	1	x	1.6	x	21	x	0.63	x	0.7	=	13.34	(82)

Solar gains in watts, calculated for each month

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

(83)m=	74.84	133.65	196.91	263.7	310.6	314.31	300.6	265.19	220.23	151.72	90.82	63.25	(83)
--------	-------	--------	--------	-------	-------	--------	-------	--------	--------	--------	-------	-------	------

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

(84)m=	492.33	547.04	594.05	636.26	658.4	639.8	613.34	585.18	554.59	510.83	477.24	470.08	(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=	0.99	0.98	0.97	0.94	0.87	0.74	0.59	0.63	0.83	0.95	0.98	0.99	(86)

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

(87)m=	19.19	19.38	19.7	20.14	20.53	20.83	20.95	20.93	20.72	20.22	19.65	19.19	(87)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	19.42	19.43	19.44	19.47	19.47	19.5	19.5	19.51	19.49	19.47	19.46	19.45	(88)
--------	-------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	-------	------

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

(89)m=	0.98	0.98	0.96	0.91	0.81	0.62	0.42	0.46	0.73	0.92	0.97	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	17.86	18.05	18.37	18.82	19.18	19.43	19.49	19.49	19.35	18.9	18.34	17.87	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

fLA = Living area ÷ (4) =

0.39 (91)

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

(92)m=	18.38	18.57	18.88	19.33	19.71	19.98	20.06	20.05	19.89	19.42	18.85	18.38	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

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(93)m=	18.38	18.57	18.88	19.33	19.71	19.98	20.06	20.05	19.89	19.42	18.85	18.38	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, h_m :

(94)m=	0.98	0.97	0.95	0.91	0.83	0.67	0.49	0.53	0.76	0.92	0.97	0.98	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	483	531.63	566.22	579.37	543.37	426.67	299	310.09	423.64	470.4	462.99	462.43	(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, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	1356.16	1309.39	1180.42	969.8	740.7	486.4	312.82	328.97	528.12	815.82	1097.79	1338.11	(97)
--------	---------	---------	---------	-------	-------	-------	--------	--------	--------	--------	---------	---------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	649.63	522.65	456.96	281.11	146.81	0	0	0	0	256.99	457.05	651.5	(98)
--------	--------	--------	--------	--------	--------	---	---	---	---	--------	--------	-------	------

Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$ 3422.71

Space heating requirement in $kWh/m^2/year$

66.33 (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) = $(202) \times [1 - (203)] =$ 1 (204)

Efficiency of main space heating system 1

88.8 (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)

649.63	522.65	456.96	281.11	146.81	0	0	0	0	256.99	457.05	651.5
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	-------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

731.56	588.57	514.6	316.57	165.33	0	0	0	0	289.41	514.7	733.68
--------	--------	-------	--------	--------	---	---	---	---	--------	-------	--------

Total ($kWh/year$) = $Sum(211)_{1..5,10..12} =$ 3854.41 (211)

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

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

Water heating

Output from water heater (calculated above)

165.39	144.48	150.32	133.32	129.08	113.69	108.92	121.42	122.76	139.79	149.22	161.51
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater 79.5 (216)

(217)m=	86.74	86.61	86.3	85.58	84.19	79.5	79.5	79.5	79.5	85.29	86.31	86.78	(217)
---------	-------	-------	------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

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

(219)m=	190.68	166.82	174.18	155.79	153.32	143	137.01	152.73	154.42	163.91	172.88	186.11	(219)
---------	--------	--------	--------	--------	--------	-----	--------	--------	--------	--------	--------	--------	-------

Total = $Sum(219a)_{1..12} =$ 1950.85

Annual totals

$kWh/year$

$kWh/year$

Space heating fuel used, main system 1

3854.41

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Water heating fuel used		1950.85	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		264.22	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		6144.48	(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 = 134.13 (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 = 67.89 (247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 = 9.89 (249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a)			
Energy for lighting	(232)	13.19	x 0.01 = 34.85 (250)
Additional standing charges (Table 12)			120 (251)
Appendix Q items: repeat lines (253) and (254) as needed			
Total energy cost	(245)...(247) + (250)...(254) =		366.77 (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] =		1.59 (257)
SAP rating (Section 12)		77.75	(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	= 832.55 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.216	= 421.38 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1253.94 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 38.93 (267)
Electricity for lighting	(232) x	0.519	= 137.13 (268)
Total CO2, kg/year	sum of (265)...(271) =		1429.99 (272)
CO2 emissions per m²	(272) ÷ (4) =		27.71 (273)
EI rating (section 14)			80 (274)

SAP WorkSheet: New dwelling design stage

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year
Space heating (main system 1)	(211) x	1.22	=	4702.38 (261)
Space heating (secondary)	(215) x	3.07	=	0 (263)
Energy for water heating	(219) x	1.22	=	2380.04 (264)
Space and water heating	(261) + (262) + (263) + (264) =			7082.42 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25 (267)
Electricity for lighting	(232) x	0	=	811.17 (268)
'Total Primary Energy		sum of (265)...(271) =		8123.83 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =		157.44 (273)

DRAFT

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.60

Property Address: DE2402 (Actual CO2)

Address : Flat 2, 8 Southey Road, Worthing, BN11 3HT

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	51.6 (1a) x	2.3 (2a) =	118.68 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.6 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	118.68 (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				2 x 10 =	20 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) =	0.17 (8)
---	------------	----------

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0 (9)
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Additional infiltration	[(9)-1]x0.1 =	0 (10)
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Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0 (11)
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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

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)
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Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
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Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	15 (17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.92 (18)
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Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered	4 (19)
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Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7 (20)
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Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.64 (21)
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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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SAP WorkSheet: New dwelling design stage

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

0.82	0.8	0.79	0.71	0.69	0.61	0.61	0.59	0.64	0.69	0.72	0.76
------	-----	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x 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) x [1 - (23c) ÷ 100]

(24a)m= 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 (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 (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= 0.84 0.82 0.81 0.75 0.74 0.69 0.69 0.68 0.71 0.74 0.76 0.79 (24d)

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

(25)m= 0.84 0.82 0.81 0.75 0.74 0.69 0.69 0.68 0.71 0.74 0.76 0.79 (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
Windows			4.3	$\times 1/[1/(2.7) + 0.04] =$	10.48		(27)
Rooflights			1.6	$\times 1/[1/(1.4) + 0.04] =$	2.24		(27b)
Floor			51.6	$\times$ 0.53	27.348		(28)
Walls	13.3	4.3	9	$\times$ 0.55	4.95		(29)
Roof	29.7	1.6	28.1	$\times$ 0.16	4.5		(30)
Total area of elements, m²			94.6				(31)

* 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) = 49.39 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7278.9 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 14.19 (36)

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

Total fabric heat loss (33) + (36) = 63.58 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	32.74	32.23	31.73	29.38	28.94	26.89	26.89	26.51	27.68	28.94	29.83	30.76

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

(39)m=	96.33	95.81	95.31	92.96	92.52	90.47	90.47	90.09	91.26	92.52	93.41	94.34
Average = Sum(39) _{1...12} /12=												92.96 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.87	1.86	1.85	1.8	1.79	1.75	1.75	1.75	1.77	1.79	1.81	1.83		
	Average = Sum(40) _{1...12} /12=												1.8	(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

1.74

(42)

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

if TFA ≤ 13.9, N = 1

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

75.46

(43)

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

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

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

(44)m=	83.01	79.99	76.97	73.95	70.93	67.91	67.91	70.93	73.95	76.97	79.99	83.01		
	Total = Sum(44) _{1...12} =												905.52	(44)

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

(45)m=	123.1	107.66	111.1	96.86	92.94	80.2	74.31	85.28	86.29	100.57	109.78	119.21		
	Total = Sum(45) _{1...12} =												1187.28	(45)

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

(46)m=	18.46	16.15	16.66	14.53	13.94	12.03	11.15	12.79	12.94	15.09	16.47	17.88		(46)
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Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

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

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m 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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

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

(61)m=	42.3	36.82	39.22	36.47	36.15	33.49	34.61	36.15	36.47	39.22	39.45	42.3	(61)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

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

(62)m=	165.39	144.48	150.32	133.32	129.08	113.69	108.92	121.42	122.76	139.79	149.22	161.51	(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=	165.39	144.48	150.32	133.32	129.08	113.69	108.92	121.42	122.76	139.79	149.22	161.51	
Output from water heater (annual) _{1...12}												1639.92	(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=	51.5	45	46.75	41.32	39.94	35.04	33.36	37.39	37.81	43.24	46.36	50.21	(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=	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	(66)

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

(67)m=	37.4	33.22	27.02	20.45	15.29	12.91	13.95	18.13	24.33	30.9	36.06	38.44	(67)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

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

(68)m=	225.95	228.3	222.39	209.81	193.93	179.01	169.04	166.69	172.6	185.18	201.06	215.98	(68)
--------	--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

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

(69)m=	47.16	47.16	47.16	47.16	47.16	47.16	47.16	47.16	47.16	47.16	47.16	47.16	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-69.49	-69.49	-69.49	-69.49	-69.49	-69.49	-69.49	-69.49	-69.49	-69.49	-69.49	-69.49	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	69.23	66.97	62.83	57.39	53.68	48.66	44.84	50.26	52.51	58.12	64.39	67.49	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	417.49	413.39	397.14	372.56	347.81	325.49	312.73	319.99	334.36	359.11	386.42	406.82	(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)	
Southwest _{0.9x}	0.77	x	4.3	x	36.79		0.76	x	0.7	=	58.33	(79)
Southwest _{0.9x}	0.77	x	4.3	x	62.67		0.76	x	0.7	=	99.36	(79)
Southwest _{0.9x}	0.77	x	4.3	x	85.75		0.76	x	0.7	=	135.94	(79)
Southwest _{0.9x}	0.77	x	4.3	x	106.25		0.76	x	0.7	=	168.44	(79)
Southwest _{0.9x}	0.77	x	4.3	x	119.01		0.76	x	0.7	=	188.67	(79)

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Southwest	0.9x	0.77	x	4.3	x	118.15		0.76	x	0.7	=	187.3	(79)
Southwest	0.9x	0.77	x	4.3	x	113.91		0.76	x	0.7	=	180.58	(79)
Southwest	0.9x	0.77	x	4.3	x	104.39		0.76	x	0.7	=	165.49	(79)
Southwest	0.9x	0.77	x	4.3	x	92.85		0.76	x	0.7	=	147.2	(79)
Southwest	0.9x	0.77	x	4.3	x	69.27		0.76	x	0.7	=	109.81	(79)
Southwest	0.9x	0.77	x	4.3	x	44.07		0.76	x	0.7	=	69.87	(79)
Southwest	0.9x	0.77	x	4.3	x	31.49		0.76	x	0.7	=	49.92	(79)
Rooflights	0.9x	1	x	1.6	x	26	x	0.63	x	0.7	=	16.51	(82)
Rooflights	0.9x	1	x	1.6	x	54	x	0.63	x	0.7	=	34.29	(82)
Rooflights	0.9x	1	x	1.6	x	96	x	0.63	x	0.7	=	60.96	(82)
Rooflights	0.9x	1	x	1.6	x	150	x	0.63	x	0.7	=	95.26	(82)
Rooflights	0.9x	1	x	1.6	x	192	x	0.63	x	0.7	=	121.93	(82)
Rooflights	0.9x	1	x	1.6	x	200	x	0.63	x	0.7	=	127.01	(82)
Rooflights	0.9x	1	x	1.6	x	189	x	0.63	x	0.7	=	120.02	(82)
Rooflights	0.9x	1	x	1.6	x	157	x	0.63	x	0.7	=	99.7	(82)
Rooflights	0.9x	1	x	1.6	x	115	x	0.63	x	0.7	=	73.03	(82)
Rooflights	0.9x	1	x	1.6	x	66	x	0.63	x	0.7	=	41.91	(82)
Rooflights	0.9x	1	x	1.6	x	33	x	0.63	x	0.7	=	20.96	(82)
Rooflights	0.9x	1	x	1.6	x	21	x	0.63	x	0.7	=	13.34	(82)

Solar gains in watts, calculated for each month

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

(83)m=	74.84	133.65	196.91	263.7	310.6	314.31	300.6	265.19	220.23	151.72	90.82	63.25	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	492.33	547.04	594.05	636.26	658.4	639.8	613.34	585.18	554.59	510.83	477.24	470.08	(84)
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7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.94	0.87	0.74	0.59	0.63	0.83	0.95	0.98	0.99	(86)

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

(87)m=	19.19	19.38	19.7	20.14	20.53	20.83	20.95	20.93	20.72	20.22	19.65	19.19	(87)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	19.42	19.43	19.44	19.47	19.47	19.5	19.5	19.51	19.49	19.47	19.46	19.45	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.98	0.96	0.91	0.81	0.62	0.42	0.46	0.73	0.92	0.97	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.86	18.05	18.37	18.82	19.18	19.43	19.49	19.49	19.35	18.9	18.34	17.87	(90)
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fLA = Living area ÷ (4) =

0.39 (91)

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

(92)m=	18.38	18.57	18.88	19.33	19.71	19.98	20.06	20.05	19.89	19.42	18.85	18.38	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.38	18.57	18.88	19.33	19.71	19.98	20.06	20.05	19.89	19.42	18.85	18.38	(93)
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8. Space heating requirement

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

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

Utilisation factor for gains, h_m :

(94)m=	0.98	0.97	0.95	0.91	0.83	0.67	0.49	0.53	0.76	0.92	0.97	0.98	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	483	531.63	566.22	579.37	543.37	426.67	299	310.09	423.64	470.4	462.99	462.43	(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, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	1356.16	1309.39	1180.42	969.8	740.7	486.4	312.82	328.97	528.12	815.82	1097.79	1338.11	(97)
--------	---------	---------	---------	-------	-------	-------	--------	--------	--------	--------	---------	---------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	649.63	522.65	456.96	281.11	146.81	0	0	0	0	256.99	457.05	651.5	
--------	--------	--------	--------	--------	--------	---	---	---	---	--------	--------	-------	--

Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$ 3422.71 (98)

Space heating requirement in $kWh/m^2/year$

66.33 (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) = $(202) \times [1 - (203)] =$ 1 (204)

Efficiency of main space heating system 1

88.8 (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)

649.63	522.65	456.96	281.11	146.81	0	0	0	0	256.99	457.05	651.5
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	-------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

731.56	588.57	514.6	316.57	165.33	0	0	0	0	289.41	514.7	733.68
--------	--------	-------	--------	--------	---	---	---	---	--------	-------	--------

Total ($kWh/year$) = $Sum(211)_{1..5,10..12} =$ 3854.41 (211)

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		
---------	---	---	---	---	---	---	---	---	---	---	---	--	--

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

Water heating

Output from water heater (calculated above)

165.39	144.48	150.32	133.32	129.08	113.69	108.92	121.42	122.76	139.79	149.22	161.51
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Efficiency of water heater 79.5 (216)

(217)m= 86.74 86.61 86.3 85.58 84.19 79.5 79.5 79.5 79.5 85.29 86.31 86.78 (217)

Fuel for water heating, $kWh/month$

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

(219)m=	190.68	166.82	174.18	155.79	153.32	143	137.01	152.73	154.42	163.91	172.88	186.11	
---------	--------	--------	--------	--------	--------	-----	--------	--------	--------	--------	--------	--------	--

Total = $Sum(219a)_{1..12} =$ 1950.85 (219)

Annual totals

$kWh/year$

$kWh/year$

Space heating fuel used, main system 1

3854.41

SAP WorkSheet: New dwelling design stage

Water heating fuel used		1950.85	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		264.22	(232)
Electricity generated by PVs		-922.15	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		5222.33	(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 = 134.13 (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 = 67.89 (247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 = 9.89 (249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a			
Energy for lighting	(232)	13.19	x 0.01 = 34.85 (250)
Additional standing charges (Table 12)			120 (251)
	one of (233) to (235) x	13.19	x 0.01 = -121.63 (252)
Appendix Q items: repeat lines (253) and (254) as needed			
Total energy cost	(245)...(247) + (250)...(254) =		245.13 (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] =		1.07 (257)
SAP rating (Section 12)		85.13	(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	= 832.55 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.216	= 421.38 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1253.94 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 38.93 (267)
Electricity for lighting	(232) x	0.519	= 137.13 (268)
Energy saving/generation technologies			

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Item 1	0.519	=	-478.6	(269)
Total CO2, kg/year	sum of (265)...(271) =			951.4 (272)
CO2 emissions per m²	(272) ÷ (4) =			18.44 (273)
EI rating (section 14)				87 (274)

13a. Primary Energy

	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x		1.22	=	4702.38	(261)
Space heating (secondary)	(215) x		3.07	=	0	(263)
Energy for water heating	(219) x		1.22	=	2380.04	(264)
Space and water heating	(261) + (262) + (263) + (264) =				7082.42	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		3.07	=	230.25	(267)
Electricity for lighting	(232) x		0	=	811.17	(268)
Energy saving/generation technologies						
Item 1			3.07	=	-2831	(269)
'Total Primary Energy	sum of (265)...(271) =				5292.83	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =				102.57	(273)

DRAFT

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.60

Property Address: DE2403 (Base CO2)

Address : Flat 3, 8 Southey Road, Worthing, BN11 3HT

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	48.4 (1a)	2.3 (2a)	111.32 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	48.4 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	111.32 (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				2	20 (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) =	20 ÷ (5) = 0.18 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

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)

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

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 15 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.93 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 4 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.7 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.65 (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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SAP WorkSheet: New dwelling design stage

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

0.83	0.81	0.8	0.72	0.7	0.62	0.62	0.6	0.65	0.7	0.73	0.76
------	------	-----	------	-----	------	------	-----	------	-----	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x 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) x [1 - (23c) ÷ 100]

(24a)m= 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 (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 (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= 0.84 0.83 0.82 0.76 0.74 0.69 0.69 0.68 0.71 0.74 0.77 0.79 (24d)

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

(25)m= 0.84 0.83 0.82 0.76 0.74 0.69 0.69 0.68 0.71 0.74 0.77 0.79 (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
Windows Type 1			1.65	$\times 1/[1/(2.7) + 0.04] =$	4.02		(27)
Windows Type 2			1.7	$\times 1/[1/(1.4) + 0.04] =$	2.25		(27)
Windows Type 3			0.5	$\times 1/[1/(1.4) + 0.04] =$	0.66		(27)
Rooflights			1.6	$\times 1/[1/(1.4) + 0.04] =$	2.24		(27b)
Floor			48.4	x 0.53 =	25.652		(28)
Walls	19.1	3.85	15.25	x 0.55 =	8.39		(29)
Roof	27.5	1.6	25.9	x 0.16 =	4.14		(30)
Total area of elements, m²			95				(31)

* 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) = 47.24 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7844.6 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 14.25 (36)

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

Total fabric heat loss (33) + (36) = 61.49 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	31.01	30.52	30.04	27.78	27.36	25.39	25.39	25.02	26.15	27.36	28.21	29.11

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

(39)m=	92.51	92.01	91.53	89.27	88.85	86.88	86.88	86.52	87.64	88.85	89.7	90.6
Average = Sum(39) _{1...12} /12=												89.27 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.91	1.9	1.89	1.84	1.84	1.8	1.8	1.79	1.81	1.84	1.85	1.87		
Average = Sum(40) _{1...12} /12=													1.84	(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

1.64

(42)

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

if TFA ≤ 13.9, N = 1

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

73.22

(43)

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

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

(44)m=	80.55	77.62	74.69	71.76	68.83	65.9	65.9	68.83	71.76	74.69	77.62	80.55		
Total = Sum(44) _{1...12} =													878.69	(44)

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

(45)m=	119.45	104.47	107.8	93.99	90.18	77.82	72.11	82.75	83.74	97.59	106.52	115.68		
Total = Sum(45) _{1...12} =													1152.1	(45)

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

(46)m=	17.92	15.67	16.17	14.1	13.53	11.67	10.82	12.41	12.56	14.64	15.98	17.35		(46)
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Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

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

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m 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)
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SAP WorkSheet: New dwelling design stage

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

(61)m=	41.05	35.73	38.06	35.39	35.08	32.5	33.58	35.08	35.39	38.06	38.28	41.05	(61)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

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

(62)m=	160.49	140.2	145.86	129.37	125.26	110.32	105.69	117.82	119.13	135.65	144.8	156.72	(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=	160.49	140.2	145.86	129.37	125.26	110.32	105.69	117.82	119.13	135.65	144.8	156.72	
Output from water heater (annual) _{1...12}												1591.32	(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=	49.98	43.67	45.36	40.1	38.75	34	32.37	36.28	36.69	41.96	44.99	48.72	(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=	98.59	98.59	98.59	98.59	98.59	98.59	98.59	98.59	98.59	98.59	98.59	98.59	(66)

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

(67)m=	35.44	31.47	25.6	19.38	14.49	12.23	13.21	17.18	23.05	29.27	34.17	36.42	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	213.55	215.77	210.18	198.29	183.29	169.18	159.76	157.55	163.13	175.02	190.02	204.13	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-65.72	-65.72	-65.72	-65.72	-65.72	-65.72	-65.72	-65.72	-65.72	-65.72	-65.72	-65.72	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	67.17	64.98	60.97	55.69	52.09	47.22	43.51	48.77	50.96	56.4	62.48	65.49	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

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

(73)m=	398.53	394.59	379.11	355.73	332.23	311	298.85	305.85	319.51	343.06	369.04	388.4	(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)		
South	0.9x	0.77	x	1.65	x	46.75	x	0.76	x	0.7	=	28.44	(78)
South	0.9x	0.77	x	1.7	x	46.75	x	0.63	x	0.7	=	24.29	(78)
South	0.9x	0.77	x	1.65	x	76.57	x	0.76	x	0.7	=	46.58	(78)
South	0.9x	0.77	x	1.7	x	76.57	x	0.63	x	0.7	=	39.78	(78)
South	0.9x	0.77	x	1.65	x	97.53	x	0.76	x	0.7	=	59.33	(78)

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South	0.9x	0.77	x	1.7	x	97.53	x	0.63	x	0.7	=	50.67	(78)
South	0.9x	0.77	x	1.65	x	110.23	x	0.76	x	0.7	=	67.06	(78)
South	0.9x	0.77	x	1.7	x	110.23	x	0.63	x	0.7	=	57.27	(78)
South	0.9x	0.77	x	1.65	x	114.87	x	0.76	x	0.7	=	69.88	(78)
South	0.9x	0.77	x	1.7	x	114.87	x	0.63	x	0.7	=	59.68	(78)
South	0.9x	0.77	x	1.65	x	110.55	x	0.76	x	0.7	=	67.25	(78)
South	0.9x	0.77	x	1.7	x	110.55	x	0.63	x	0.7	=	57.43	(78)
South	0.9x	0.77	x	1.65	x	108.01	x	0.76	x	0.7	=	65.71	(78)
South	0.9x	0.77	x	1.7	x	108.01	x	0.63	x	0.7	=	56.12	(78)
South	0.9x	0.77	x	1.65	x	104.89	x	0.76	x	0.7	=	63.81	(78)
South	0.9x	0.77	x	1.7	x	104.89	x	0.63	x	0.7	=	54.5	(78)
South	0.9x	0.77	x	1.65	x	101.89	x	0.76	x	0.7	=	61.98	(78)
South	0.9x	0.77	x	1.7	x	101.89	x	0.63	x	0.7	=	52.93	(78)
South	0.9x	0.77	x	1.65	x	82.59	x	0.76	x	0.7	=	50.24	(78)
South	0.9x	0.77	x	1.7	x	82.59	x	0.63	x	0.7	=	42.91	(78)
South	0.9x	0.77	x	1.65	x	55.42	x	0.76	x	0.7	=	33.71	(78)
South	0.9x	0.77	x	1.7	x	55.42	x	0.63	x	0.7	=	28.79	(78)
South	0.9x	0.77	x	1.65	x	40.4	x	0.76	x	0.7	=	24.57	(78)
South	0.9x	0.77	x	1.7	x	40.4	x	0.63	x	0.7	=	20.99	(78)
Southwest	0.9x	0.77	x	0.5	x	36.79	x	0.63	x	0.7	=	5.62	(79)
Southwest	0.9x	0.77	x	0.5	x	62.67	x	0.63	x	0.7	=	9.58	(79)
Southwest	0.9x	0.77	x	0.5	x	85.75	x	0.63	x	0.7	=	13.1	(79)
Southwest	0.9x	0.77	x	0.5	x	106.25	x	0.63	x	0.7	=	16.24	(79)
Southwest	0.9x	0.77	x	0.5	x	119.01	x	0.63	x	0.7	=	18.19	(79)
Southwest	0.9x	0.77	x	0.5	x	118.15	x	0.63	x	0.7	=	18.05	(79)
Southwest	0.9x	0.77	x	0.5	x	113.91	x	0.63	x	0.7	=	17.41	(79)
Southwest	0.9x	0.77	x	0.5	x	104.39	x	0.63	x	0.7	=	15.95	(79)
Southwest	0.9x	0.77	x	0.5	x	92.85	x	0.63	x	0.7	=	14.19	(79)
Southwest	0.9x	0.77	x	0.5	x	69.27	x	0.63	x	0.7	=	10.58	(79)
Southwest	0.9x	0.77	x	0.5	x	44.07	x	0.63	x	0.7	=	6.73	(79)
Southwest	0.9x	0.77	x	0.5	x	31.49	x	0.63	x	0.7	=	4.81	(79)
Rooflights	0.9x	1	x	1.6	x	26	x	0.63	x	0.7	=	16.51	(82)
Rooflights	0.9x	1	x	1.6	x	54	x	0.63	x	0.7	=	34.29	(82)
Rooflights	0.9x	1	x	1.6	x	96	x	0.63	x	0.7	=	60.96	(82)
Rooflights	0.9x	1	x	1.6	x	150	x	0.63	x	0.7	=	95.26	(82)
Rooflights	0.9x	1	x	1.6	x	192	x	0.63	x	0.7	=	121.93	(82)
Rooflights	0.9x	1	x	1.6	x	200	x	0.63	x	0.7	=	127.01	(82)
Rooflights	0.9x	1	x	1.6	x	189	x	0.63	x	0.7	=	120.02	(82)
Rooflights	0.9x	1	x	1.6	x	157	x	0.63	x	0.7	=	99.7	(82)
Rooflights	0.9x	1	x	1.6	x	115	x	0.63	x	0.7	=	73.03	(82)
Rooflights	0.9x	1	x	1.6	x	66	x	0.63	x	0.7	=	41.91	(82)

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Rooflights 0.9x	1	x	1.6	x	33	x	0.63	x	0.7	=	20.96	(82)
Rooflights 0.9x	1	x	1.6	x	21	x	0.63	x	0.7	=	13.34	(82)

Solar gains in watts, calculated for each month

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

(83)m=	74.86	130.23	184.07	235.82	269.67	269.74	259.25	233.96	202.13	145.64	90.19	63.71	(83)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	473.39	524.81	563.18	591.55	601.9	580.74	558.1	539.81	521.64	488.7	459.23	452.12	(84)
--------	--------	--------	--------	--------	-------	--------	-------	--------	--------	-------	--------	--------	------

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)	21	(85)
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Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.94	0.88	0.76	0.62	0.65	0.83	0.95	0.98	0.99	(86)

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

(87)m=	19.16	19.35	19.66	20.1	20.49	20.81	20.93	20.92	20.71	20.2	19.63	19.16	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.39	19.4	19.41	19.44	19.45	19.47	19.47	19.48	19.46	19.45	19.43	19.42	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.98	0.96	0.92	0.83	0.65	0.43	0.47	0.74	0.92	0.97	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.81	18	18.31	18.75	19.12	19.39	19.46	19.46	19.32	18.86	18.3	17.82	(90)
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fLA = Living area ÷ (4) =	0.41	(91)
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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.36	18.55	18.86	19.3	19.68	19.97	20.06	20.06	19.88	19.41	18.84	18.37	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.36	18.55	18.86	19.3	19.68	19.97	20.06	20.06	19.88	19.41	18.84	18.37	(93)
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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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Utilisation factor for gains, hm:

(94)m=	0.98	0.97	0.95	0.91	0.84	0.69	0.51	0.55	0.77	0.92	0.97	0.98	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	463.81	509.24	536.48	540.82	504.27	400.29	284.72	295.31	401.28	449.08	444.69	444.23	(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=	1300.85	1256.01	1131.67	928.73	708.99	466.43	300.86	316.35	506.94	783.01	1053.39	1283.51	(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=	622.76	501.83	442.83	279.29	152.31	0	0	0	0	248.44	438.27	624.42	(98)
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Total per year (kWh/year) = Sum(98)1...5,9...12 = 3310.14 (98)

Space heating requirement in kWh/m²/year	68.39	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system	0	(201)
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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		88.8	(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)												
622.76	501.83	442.83	279.29	152.31	0	0	0	0	248.44	438.27	624.42	

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

701.3	565.12	498.68	314.52	171.52	0	0	0	0	279.78	493.55	703.18		
Total (kWh/year) =Sum(211) _{1..5,10...12} =												3727.64	(211)

Space heating fuel (secondary), kWh/month

= {[[(98)m × (201)] } × 100 ÷ (208)

(215)m=	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)

160.49	140.2	145.86	129.37	125.26	110.32	105.69	117.82	119.13	135.65	144.8	156.72		
Efficiency of water heater												79.5	(216)
(217)m=	86.72	86.59	86.3	85.63	84.35	79.5	79.5	79.5	79.5	85.28	86.29	86.76	(217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

(219)m=	185.07	161.91	169.02	151.09	148.5	138.77	132.95	148.21	149.84	159.07	167.8	180.63	
Total = Sum(219a) _{1..12} =												1892.86	(219)

Annual totals

Space heating fuel used, main system 1	3727.64	kWh/year
Water heating fuel used	1892.86	kWh/year

Electricity for pumps, fans and electric keep-hot

central heating pump: 30 (230c)

boiler with a fan-assisted flue 45 (230e)

Total electricity for the above, kWh/year sum of (230a)...(230g) = 75 (231)

Electricity for lighting 250.33 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = 5945.82 (338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) ×	3.48	× 0.01 = 129.72 (240)
Space heating - main system 2	(213) ×	0	× 0.01 = 0 (241)
Space heating - secondary	(215) ×	13.19	× 0.01 = 0 (242)
Water heating cost (other fuel)	(219)	3.48	× 0.01 = 65.87 (247)
Pumps, fans and electric keep-hot	(231)	13.19	× 0.01 = 9.89 (249)

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(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 = 33.02 (250)

Additional standing charges (Table 12) 120 (251)

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

Total energy cost (245)...(247) + (250)...(254) = 358.5 (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] = 1.61 (257)

SAP rating (Section 12) 77.51 (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 =	805.17 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	408.86 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1214.03 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	129.92 (268)
Total CO2, kg/year		sum of (265)...(271) =	1382.87 (272)
CO2 emissions per m²		(272) ÷ (4) =	28.57 (273)
El rating (section 14)			80 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) x	1.22 =	4547.72 (261)
Space heating (secondary)	(215) x	3.07 =	0 (263)
Energy for water heating	(219) x	1.22 =	2309.29 (264)
Space and water heating	(261) + (262) + (263) + (264) =		6857 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07 =	230.25 (267)
Electricity for lighting	(232) x	0 =	768.51 (268)
'Total Primary Energy		sum of (265)...(271) =	7855.77 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =	162.31 (273)

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User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.60

Property Address: DE2403 (Actual CO2)

Address : Flat 3, 8 Southey Road, Worthing, BN11 3HT

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	48.4 (1a)	2.3 (2a)	111.32 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	48.4 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	111.32 (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				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18 (8)
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If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

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)

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

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 15 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.93 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 4 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.7 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.65 (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

0.83	0.81	0.8	0.72	0.7	0.62	0.62	0.6	0.65	0.7	0.73	0.76
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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) x 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) x [1 - (23c) ÷ 100]

(24a)m= 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 (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 (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= 0.84 0.83 0.82 0.76 0.74 0.69 0.69 0.68 0.71 0.74 0.77 0.79 (24d)

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

(25)m= 0.84 0.83 0.82 0.76 0.74 0.69 0.69 0.68 0.71 0.74 0.77 0.79 (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
Windows Type 1			1.65	$\times 1/[1/(2.7) + 0.04] =$	4.02		(27)
Windows Type 2			1.7	$\times 1/[1/(1.4) + 0.04] =$	2.25		(27)
Windows Type 3			0.5	$\times 1/[1/(1.4) + 0.04] =$	0.66		(27)
Rooflights			1.6	$\times 1/[1/(1.4) + 0.04] =$	2.24		(27b)
Floor			48.4	x 0.53 =	25.652		(28)
Walls	19.1	3.85	15.25	x 0.55 =	8.39		(29)
Roof	27.5	1.6	25.9	x 0.16 =	4.14		(30)
Total area of elements, m²			95				(31)

* 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) = 47.24 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7844.6 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 14.25 (36)

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

Total fabric heat loss (33) + (36) = 61.49 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	31.01	30.52	30.04	27.78	27.36	25.39	25.39	25.02	26.15	27.36	28.21	29.11

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

(39)m=	92.51	92.01	91.53	89.27	88.85	86.88	86.88	86.52	87.64	88.85	89.7	90.6
Average = Sum(39) _{1...12} /12=												89.27 (39)

SAP WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.91	1.9	1.89	1.84	1.84	1.8	1.8	1.79	1.81	1.84	1.85	1.87		
Average = Sum(40) _{1...12} /12=													1.84	(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

1.64

(42)

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

if TFA ≤ 13.9, N = 1

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

73.22

(43)

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

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

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

(44)m=	80.55	77.62	74.69	71.76	68.83	65.9	65.9	68.83	71.76	74.69	77.62	80.55		
Total = Sum(44) _{1...12} =													878.69	(44)

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

(45)m=	119.45	104.47	107.8	93.99	90.18	77.82	72.11	82.75	83.74	97.59	106.52	115.68		
Total = Sum(45) _{1...12} =													1152.1	(45)

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

(46)m=	17.92	15.67	16.17	14.1	13.53	11.67	10.82	12.41	12.56	14.64	15.98	17.35		(46)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

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

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m 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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

SAP WorkSheet: New dwelling design stage

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

(61)m=	41.05	35.73	38.06	35.39	35.08	32.5	33.58	35.08	35.39	38.06	38.28	41.05	(61)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

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

(62)m=	160.49	140.2	145.86	129.37	125.26	110.32	105.69	117.82	119.13	135.65	144.8	156.72	(62)
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	------

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	160.49	140.2	145.86	129.37	125.26	110.32	105.69	117.82	119.13	135.65	144.8	156.72	
Output from water heater (annual) _{1...12}												1591.32	(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=	49.98	43.67	45.36	40.1	38.75	34	32.37	36.28	36.69	41.96	44.99	48.72	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	98.59	98.59	98.59	98.59	98.59	98.59	98.59	98.59	98.59	98.59	98.59	98.59	(66)

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

(67)m=	35.44	31.47	25.6	19.38	14.49	12.23	13.21	17.18	23.05	29.27	34.17	36.42	(67)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(68)m=	213.55	215.77	210.18	198.29	183.29	169.18	159.76	157.55	163.13	175.02	190.02	204.13	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-65.72	-65.72	-65.72	-65.72	-65.72	-65.72	-65.72	-65.72	-65.72	-65.72	-65.72	-65.72	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	67.17	64.98	60.97	55.69	52.09	47.22	43.51	48.77	50.96	56.4	62.48	65.49	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

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

(73)m=	398.53	394.59	379.11	355.73	332.23	311	298.85	305.85	319.51	343.06	369.04	388.4	(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 m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	1.65	x	46.75	x	0.76	x	0.7	=	28.44	(78)
South	0.9x	0.77	x	1.7	x	46.75	x	0.63	x	0.7	=	24.29	(78)
South	0.9x	0.77	x	1.65	x	76.57	x	0.76	x	0.7	=	46.58	(78)
South	0.9x	0.77	x	1.7	x	76.57	x	0.63	x	0.7	=	39.78	(78)
South	0.9x	0.77	x	1.65	x	97.53	x	0.76	x	0.7	=	59.33	(78)

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South	0.9x	0.77	x	1.7	x	97.53	x	0.63	x	0.7	=	50.67	(78)
South	0.9x	0.77	x	1.65	x	110.23	x	0.76	x	0.7	=	67.06	(78)
South	0.9x	0.77	x	1.7	x	110.23	x	0.63	x	0.7	=	57.27	(78)
South	0.9x	0.77	x	1.65	x	114.87	x	0.76	x	0.7	=	69.88	(78)
South	0.9x	0.77	x	1.7	x	114.87	x	0.63	x	0.7	=	59.68	(78)
South	0.9x	0.77	x	1.65	x	110.55	x	0.76	x	0.7	=	67.25	(78)
South	0.9x	0.77	x	1.7	x	110.55	x	0.63	x	0.7	=	57.43	(78)
South	0.9x	0.77	x	1.65	x	108.01	x	0.76	x	0.7	=	65.71	(78)
South	0.9x	0.77	x	1.7	x	108.01	x	0.63	x	0.7	=	56.12	(78)
South	0.9x	0.77	x	1.65	x	104.89	x	0.76	x	0.7	=	63.81	(78)
South	0.9x	0.77	x	1.7	x	104.89	x	0.63	x	0.7	=	54.5	(78)
South	0.9x	0.77	x	1.65	x	101.89	x	0.76	x	0.7	=	61.98	(78)
South	0.9x	0.77	x	1.7	x	101.89	x	0.63	x	0.7	=	52.93	(78)
South	0.9x	0.77	x	1.65	x	82.59	x	0.76	x	0.7	=	50.24	(78)
South	0.9x	0.77	x	1.7	x	82.59	x	0.63	x	0.7	=	42.91	(78)
South	0.9x	0.77	x	1.65	x	55.42	x	0.76	x	0.7	=	33.71	(78)
South	0.9x	0.77	x	1.7	x	55.42	x	0.63	x	0.7	=	28.79	(78)
South	0.9x	0.77	x	1.65	x	40.4	x	0.76	x	0.7	=	24.57	(78)
South	0.9x	0.77	x	1.7	x	40.4	x	0.63	x	0.7	=	20.99	(78)
Southwest	0.9x	0.77	x	0.5	x	36.79	x	0.63	x	0.7	=	5.62	(79)
Southwest	0.9x	0.77	x	0.5	x	62.67	x	0.63	x	0.7	=	9.58	(79)
Southwest	0.9x	0.77	x	0.5	x	85.75	x	0.63	x	0.7	=	13.1	(79)
Southwest	0.9x	0.77	x	0.5	x	106.25	x	0.63	x	0.7	=	16.24	(79)
Southwest	0.9x	0.77	x	0.5	x	119.01	x	0.63	x	0.7	=	18.19	(79)
Southwest	0.9x	0.77	x	0.5	x	118.15	x	0.63	x	0.7	=	18.05	(79)
Southwest	0.9x	0.77	x	0.5	x	113.91	x	0.63	x	0.7	=	17.41	(79)
Southwest	0.9x	0.77	x	0.5	x	104.39	x	0.63	x	0.7	=	15.95	(79)
Southwest	0.9x	0.77	x	0.5	x	92.85	x	0.63	x	0.7	=	14.19	(79)
Southwest	0.9x	0.77	x	0.5	x	69.27	x	0.63	x	0.7	=	10.58	(79)
Southwest	0.9x	0.77	x	0.5	x	44.07	x	0.63	x	0.7	=	6.73	(79)
Southwest	0.9x	0.77	x	0.5	x	31.49	x	0.63	x	0.7	=	4.81	(79)
Rooflights	0.9x	1	x	1.6	x	26	x	0.63	x	0.7	=	16.51	(82)
Rooflights	0.9x	1	x	1.6	x	54	x	0.63	x	0.7	=	34.29	(82)
Rooflights	0.9x	1	x	1.6	x	96	x	0.63	x	0.7	=	60.96	(82)
Rooflights	0.9x	1	x	1.6	x	150	x	0.63	x	0.7	=	95.26	(82)
Rooflights	0.9x	1	x	1.6	x	192	x	0.63	x	0.7	=	121.93	(82)
Rooflights	0.9x	1	x	1.6	x	200	x	0.63	x	0.7	=	127.01	(82)
Rooflights	0.9x	1	x	1.6	x	189	x	0.63	x	0.7	=	120.02	(82)
Rooflights	0.9x	1	x	1.6	x	157	x	0.63	x	0.7	=	99.7	(82)
Rooflights	0.9x	1	x	1.6	x	115	x	0.63	x	0.7	=	73.03	(82)
Rooflights	0.9x	1	x	1.6	x	66	x	0.63	x	0.7	=	41.91	(82)

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Rooflights 0.9x	1	x	1.6	x	33	x	0.63	x	0.7	=	20.96	(82)
Rooflights 0.9x	1	x	1.6	x	21	x	0.63	x	0.7	=	13.34	(82)

Solar gains in watts, calculated for each month

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

(83)m=	74.86	130.23	184.07	235.82	269.67	269.74	259.25	233.96	202.13	145.64	90.19	63.71	(83)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	473.39	524.81	563.18	591.55	601.9	580.74	558.1	539.81	521.64	488.7	459.23	452.12	(84)
--------	--------	--------	--------	--------	-------	--------	-------	--------	--------	-------	--------	--------	------

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)	21	(85)
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Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.94	0.88	0.76	0.62	0.65	0.83	0.95	0.98	0.99	(86)

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

(87)m=	19.16	19.35	19.66	20.1	20.49	20.81	20.93	20.92	20.71	20.2	19.63	19.16	(87)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	------	-------	-------	------

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

(88)m=	19.39	19.4	19.41	19.44	19.45	19.47	19.47	19.48	19.46	19.45	19.43	19.42	(88)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.98	0.98	0.96	0.92	0.83	0.65	0.43	0.47	0.74	0.92	0.97	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	17.81	18	18.31	18.75	19.12	19.39	19.46	19.46	19.32	18.86	18.3	17.82	(90)
--------	-------	----	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

fLA = Living area ÷ (4) =	0.41	(91)
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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.36	18.55	18.86	19.3	19.68	19.97	20.06	20.06	19.88	19.41	18.84	18.37	(92)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.36	18.55	18.86	19.3	19.68	19.97	20.06	20.06	19.88	19.41	18.84	18.37	(93)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.98	0.97	0.95	0.91	0.84	0.69	0.51	0.55	0.77	0.92	0.97	0.98	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(95)m=	463.81	509.24	536.48	540.82	504.27	400.29	284.72	295.31	401.28	449.08	444.69	444.23	(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=	1300.85	1256.01	1131.67	928.73	708.99	466.43	300.86	316.35	506.94	783.01	1053.39	1283.51	(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=	622.76	501.83	442.83	279.29	152.31	0	0	0	0	248.44	438.27	624.42	(98)
--------	--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------	------

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 3310.14 (98)

Space heating requirement in kWh/m ² /year	68.39	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system	0	(201)
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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		88.8	(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)												
622.76	501.83	442.83	279.29	152.31	0	0	0	0	248.44	438.27	624.42	

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

701.3	565.12	498.68	314.52	171.52	0	0	0	0	279.78	493.55	703.18	
Total (kWh/year) = Sum(211) _{1..5,10...12} =												3727.64 (211)

Space heating fuel (secondary), kWh/month

= {[[(98)m × (201)] } × 100 ÷ (208)

(215)m=	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)

160.49	140.2	145.86	129.37	125.26	110.32	105.69	117.82	119.13	135.65	144.8	156.72	
Efficiency of water heater												79.5 (216)

(217)m=	86.72	86.59	86.3	85.63	84.35	79.5	79.5	79.5	79.5	85.28	86.29	86.76 (217)
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Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

(219)m=	185.07	161.91	169.02	151.09	148.5	138.77	132.95	148.21	149.84	159.07	167.8	180.63		
Total = Sum(219a) _{1..12} =													1892.86	(219)

Annual totals

Space heating fuel used, main system 1	3727.64	kWh/year
Water heating fuel used	1892.86	kWh/year

Electricity for pumps, fans and electric keep-hot

central heating pump:	30	(230c)
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boiler with a fan-assisted flue	45	(230e)
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Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75 (231)
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Electricity for lighting	250.33 (232)
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Electricity generated by PVs	-922.15 (233)
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Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	5023.67 (338)
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10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) ×	3.48 × 0.01 =	129.72 (240)
Space heating - main system 2	(213) ×	0 × 0.01 =	0 (241)
Space heating - secondary	(215) ×	13.19 × 0.01 =	0 (242)
Water heating cost (other fuel)	(219)	3.48 × 0.01 =	65.87 (247)

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Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a)					
Energy for lighting	(232)	13.19	x 0.01 =	33.02	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x	13.19	x 0.01 =	-121.63	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)...(254) =			236.87	(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] =	1.07	(257)
SAP rating (Section 12)		85.14	(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	805.17 (261)
Space heating (secondary)	(215) x	0.519	0 (263)
Water heating	(219) x	0.216	408.86 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1214.03 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	38.93 (267)
Electricity for lighting	(232) x	0.519	129.92 (268)
Energy saving/generation technologies Item 1		0.519	-478.6 (269)
Total CO2, kg/year		sum of (265)...(271) =	904.28 (272)
CO2 emissions per m²		(272) ÷ (4) =	18.68 (273)
El rating (section 14)			87 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) x	1.22	4547.72 (261)
Space heating (secondary)	(215) x	3.07	0 (263)
Energy for water heating	(219) x	1.22	2309.29 (264)
Space and water heating	(261) + (262) + (263) + (264) =		6857 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	230.25 (267)
Electricity for lighting	(232) x	0	768.51 (268)
Energy saving/generation technologies Item 1		3.07	-2831 (269)
'Total Primary Energy		sum of (265)...(271) =	5024.76 (272)

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Primary energy kWh/m²/year

(272) ÷ (4) =

103.82

(273)

DRAFT

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User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.60

Property Address: DE2404 (Base CO2)

Address : Flat 4, 8 Southey Road, Worthing, BN11 3HT

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	50.9 (1a)	2.3 (2a)	117.07 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.9 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	117.07 (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				2	20 (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) =	0.17 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

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)

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

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 15 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.92 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 4 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.7 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.64 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

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

0.82	0.81	0.79	0.71	0.69	0.61	0.61	0.6	0.64	0.69	0.73	0.76
------	------	------	------	------	------	------	-----	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x 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) x [1 - (23c) ÷ 100]

(24a)m= 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 (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 (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= 0.84 0.82 0.81 0.75 0.74 0.69 0.69 0.68 0.71 0.74 0.76 0.79 (24d)

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

(25)m= 0.84 0.82 0.81 0.75 0.74 0.69 0.69 0.68 0.71 0.74 0.76 0.79 (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
Windows Type 1			0.9	$\times 1/[1/(2.7) + 0.04] =$	2.19		(27)
Windows Type 2			1	$\times 1/[1/(2.7) + 0.04] =$	2.44		(27)
Windows Type 3			2.8	$\times 1/[1/(1.4) + 0.04] =$	3.71		(27)
Windows Type 4			2.65	$\times 1/[1/(2.7) + 0.04] =$	6.46		(27)
Floor			50.9	x 0.53 =	26.977		(28)
Walls	49.2	7.35	41.85	x 0.55 =	23.02		(29)
Total area of elements, m²			100.1				(31)

* 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) = 64.79 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 11876.5 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 15.02 (36)

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

Total fabric heat loss (33) + (36) = 79.81 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	32.36	31.86	31.36	29.03	28.59	26.56	26.56	26.18	27.34	28.59	29.47	30.4

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

(39)m=	112.17	111.67	111.17	108.84	108.4	106.37	106.37	105.99	107.15	108.4	109.28	110.21
Average = Sum(39) _{1...12} /12=												108.83 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	2.2	2.19	2.18	2.14	2.13	2.09	2.09	2.08	2.11	2.13	2.15	2.17		
	Average = Sum(40) _{1...12} /12=												2.14	(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

1.72

(42)

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

if TFA ≤ 13.9, N = 1

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

74.97

(43)

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

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

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

(44)m=	82.47	79.47	76.47	73.47	70.47	67.47	67.47	70.47	73.47	76.47	79.47	82.47		
	Total = Sum(44) _{1...12} =												899.64	(44)

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

(45)m=	122.3	106.96	110.37	96.23	92.33	79.68	73.83	84.72	85.73	99.91	109.06	118.44		
	Total = Sum(45) _{1...12} =												1179.57	(45)

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

(46)m=	18.34	16.04	16.56	14.43	13.85	11.95	11.07	12.71	12.86	14.99	16.36	17.77		(46)
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Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

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

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m 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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

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

(61)m=	42.02	36.58	38.97	36.23	35.91	33.27	34.38	35.91	36.23	38.97	39.19	42.02	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(62)m=	164.32	143.54	149.34	132.46	128.24	112.95	108.21	120.63	121.97	138.88	148.25	160.46	(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=	164.32	143.54	149.34	132.46	128.24	112.95	108.21	120.63	121.97	138.88	148.25	160.46	
Output from water heater (annual) _{1...12}												1629.26	(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=	51.17	44.71	46.44	41.05	39.68	34.81	33.14	37.15	37.56	42.96	46.06	49.89	(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=	103	103	103	103	103	103	103	103	103	103	103	103	(66)

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

(67)m=	35.52	31.55	25.66	19.43	14.52	12.26	13.25	17.22	23.11	29.35	34.25	36.51	(67)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(68)m=	223.24	225.56	219.72	207.29	191.6	176.86	167.01	164.69	170.53	182.96	198.65	213.39	(68)
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	47.02	47.02	47.02	47.02	47.02	47.02	47.02	47.02	47.02	47.02	47.02	47.02	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-68.66	-68.66	-68.66	-68.66	-68.66	-68.66	-68.66	-68.66	-68.66	-68.66	-68.66	-68.66	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	68.78	66.53	62.42	57.02	53.33	48.35	44.55	49.93	52.17	57.75	63.97	67.05	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	411.89	407.99	392.15	368.09	343.81	321.82	309.16	316.19	330.16	354.4	381.22	401.3	(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)		
North	0.9x	0.77	x	0.9	x	10.63	x	0.76	x	0.7	=	3.53	(74)
North	0.9x	0.77	x	0.9	x	20.32	x	0.76	x	0.7	=	6.74	(74)
North	0.9x	0.77	x	0.9	x	34.53	x	0.76	x	0.7	=	11.46	(74)
North	0.9x	0.77	x	0.9	x	55.46	x	0.76	x	0.7	=	18.4	(74)
North	0.9x	0.77	x	0.9	x	74.72	x	0.76	x	0.7	=	24.79	(74)

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North	0.9x	0.77	x	0.9	x	79.99	x	0.76	x	0.7	=	26.54	(74)
North	0.9x	0.77	x	0.9	x	74.68	x	0.76	x	0.7	=	24.78	(74)
North	0.9x	0.77	x	0.9	x	59.25	x	0.76	x	0.7	=	19.66	(74)
North	0.9x	0.77	x	0.9	x	41.52	x	0.76	x	0.7	=	13.78	(74)
North	0.9x	0.77	x	0.9	x	24.19	x	0.76	x	0.7	=	8.03	(74)
North	0.9x	0.77	x	0.9	x	13.12	x	0.76	x	0.7	=	4.35	(74)
North	0.9x	0.77	x	0.9	x	8.86	x	0.76	x	0.7	=	2.94	(74)
East	0.9x	0.77	x	2.8	x	19.64	x	0.63	x	0.7	=	16.81	(76)
East	0.9x	0.77	x	2.65	x	19.64	x	0.76	x	0.7	=	19.19	(76)
East	0.9x	0.77	x	2.8	x	38.42	x	0.63	x	0.7	=	32.88	(76)
East	0.9x	0.77	x	2.65	x	38.42	x	0.76	x	0.7	=	37.54	(76)
East	0.9x	0.77	x	2.8	x	63.27	x	0.63	x	0.7	=	54.14	(76)
East	0.9x	0.77	x	2.65	x	63.27	x	0.76	x	0.7	=	61.82	(76)
East	0.9x	0.77	x	2.8	x	92.28	x	0.63	x	0.7	=	78.97	(76)
East	0.9x	0.77	x	2.65	x	92.28	x	0.76	x	0.7	=	90.16	(76)
East	0.9x	0.77	x	2.8	x	113.09	x	0.63	x	0.7	=	96.78	(76)
East	0.9x	0.77	x	2.65	x	113.09	x	0.76	x	0.7	=	110.49	(76)
East	0.9x	0.77	x	2.8	x	115.77	x	0.63	x	0.7	=	99.07	(76)
East	0.9x	0.77	x	2.65	x	115.77	x	0.76	x	0.7	=	113.11	(76)
East	0.9x	0.77	x	2.8	x	110.22	x	0.63	x	0.7	=	94.32	(76)
East	0.9x	0.77	x	2.65	x	110.22	x	0.76	x	0.7	=	107.68	(76)
East	0.9x	0.77	x	2.8	x	94.68	x	0.63	x	0.7	=	81.02	(76)
East	0.9x	0.77	x	2.65	x	94.68	x	0.76	x	0.7	=	92.5	(76)
East	0.9x	0.77	x	2.8	x	73.59	x	0.63	x	0.7	=	62.97	(76)
East	0.9x	0.77	x	2.65	x	73.59	x	0.76	x	0.7	=	71.9	(76)
East	0.9x	0.77	x	2.8	x	45.59	x	0.63	x	0.7	=	39.01	(76)
East	0.9x	0.77	x	2.65	x	45.59	x	0.76	x	0.7	=	44.54	(76)
East	0.9x	0.77	x	2.8	x	24.49	x	0.63	x	0.7	=	20.96	(76)
East	0.9x	0.77	x	2.65	x	24.49	x	0.76	x	0.7	=	23.93	(76)
East	0.9x	0.77	x	2.8	x	16.15	x	0.63	x	0.7	=	13.82	(76)
East	0.9x	0.77	x	2.65	x	16.15	x	0.76	x	0.7	=	15.78	(76)
South	0.9x	0.77	x	1	x	46.75	x	0.76	x	0.7	=	17.24	(78)
South	0.9x	0.77	x	1	x	76.57	x	0.76	x	0.7	=	28.23	(78)
South	0.9x	0.77	x	1	x	97.53	x	0.76	x	0.7	=	35.96	(78)
South	0.9x	0.77	x	1	x	110.23	x	0.76	x	0.7	=	40.64	(78)
South	0.9x	0.77	x	1	x	114.87	x	0.76	x	0.7	=	42.35	(78)
South	0.9x	0.77	x	1	x	110.55	x	0.76	x	0.7	=	40.76	(78)
South	0.9x	0.77	x	1	x	108.01	x	0.76	x	0.7	=	39.82	(78)
South	0.9x	0.77	x	1	x	104.89	x	0.76	x	0.7	=	38.67	(78)
South	0.9x	0.77	x	1	x	101.89	x	0.76	x	0.7	=	37.56	(78)
South	0.9x	0.77	x	1	x	82.59	x	0.76	x	0.7	=	30.45	(78)

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South	0.9x	0.77	x	1	x	55.42	x	0.76	x	0.7	=	20.43	(78)
South	0.9x	0.77	x	1	x	40.4	x	0.76	x	0.7	=	14.89	(78)

Solar gains in watts, calculated for each month

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

(83)m=	56.76	105.38	163.38	228.17	274.41	279.47	266.6	231.84	186.21	122.03	69.66	47.44	(83)
--------	-------	--------	--------	--------	--------	--------	-------	--------	--------	--------	-------	-------	------

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

(84)m=	468.65	513.37	555.53	596.25	618.21	601.29	575.75	548.04	516.37	476.43	450.88	448.74	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)	21	(85)
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Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.95	0.91	0.81	0.68	0.72	0.88	0.96	0.98	0.99	(86)

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

(87)m=	18.82	19	19.34	19.83	20.3	20.69	20.88	20.85	20.55	19.95	19.32	18.81	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.2	19.21	19.21	19.24	19.25	19.27	19.27	19.28	19.26	19.25	19.24	19.23	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.93	0.85	0.69	0.47	0.52	0.79	0.94	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.33	17.51	17.85	18.35	18.79	19.14	19.25	19.24	19.03	18.48	17.85	17.34	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.4 (91)

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

(92)m=	17.93	18.11	18.45	18.95	19.4	19.77	19.91	19.89	19.65	19.08	18.45	17.93	(92)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	17.93	18.11	18.45	18.95	19.4	19.77	19.91	19.89	19.65	19.08	18.45	17.93	(93)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.98	0.98	0.96	0.93	0.86	0.73	0.56	0.6	0.81	0.94	0.97	0.98	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	460.28	500.65	533.65	553.06	531.73	437.49	319.8	328.37	419.52	445.93	438.93	441.74	(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=	1529.09	1475.33	1328.94	1093.82	835	549.8	351.94	370.34	594.4	918.83	1240.15	1513.47	(97)
--------	---------	---------	---------	---------	-----	-------	--------	--------	-------	--------	---------	---------	------

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

(98)m=	795.2	654.98	591.69	389.35	225.64	0	0	0	0	351.84	576.88	797.37	(98)
--------	-------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------	------

Total per year (kWh/year) = Sum(98)1...5,9...12 = 4382.95 (98)

Space heating requirement in kWh/m²/year

86.11 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

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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		88.8	(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)												
795.2	654.98	591.69	389.35	225.64	0	0	0	0	351.84	576.88	797.37	

(211)m = {[(98)m x (204)] } x 100 ÷ (206)											(211)	
895.49	737.6	666.32	438.45	254.09	0	0	0	0	396.22	649.64	897.94	
Total (kWh/year) =Sum(211) _{1..5,10...12} =											4935.75	(211)

Space heating fuel (secondary), kWh/month
= {[(98)m × (201)] } × 100 ÷ (208)

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

Water heating

Output from water heater (calculated above)

	164.32	143.54	149.34	132.46	128.24	112.95	108.21	120.63	121.97	138.88	148.25	160.46		
Efficiency of water heater													79.5	(216)
(217)m=	87.06	86.97	86.75	86.24	85.19	79.5	79.5	79.5	79.5	85.95	86.73	87.09	(217)	

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m													
(219)m=	188.75	165.04	172.14	153.59	150.54	142.07	136.12	151.74	153.42	161.58	170.95	184.24	
Total = Sum(219a) _{1..12} =												1930.18	(219)

Annual totals

Space heating fuel used, main system 1	4935.75	kWh/year
Water heating fuel used	1930.18	kWh/year

Electricity for pumps, fans and electric keep-hot

central heating pump:	30	(230c)
boiler with a fan-assisted flue	45	(230e)

Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75	(231)
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Electricity for lighting	250.95	(232)
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Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	7191.88	(338)
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10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) ×	3.48	× 0.01 = 171.76 (240)
Space heating - main system 2	(213) ×	0	× 0.01 = 0 (241)
Space heating - secondary	(215) ×	13.19	× 0.01 = 0 (242)
Water heating cost (other fuel)	(219)	3.48	× 0.01 = 67.17 (247)
Pumps, fans and electric keep-hot	(231)	13.19	× 0.01 = 9.89 (249)

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(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 = 33.1 (250)

Additional standing charges (Table 12) 120 (251)

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

Total energy cost (245)...(247) + (250)...(254) = 401.93 (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] = 1.76 (257)

SAP rating (Section 12) 75.44 (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 =	1066.12 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	416.92 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1483.04 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	130.24 (268)
Total CO2, kg/year		sum of (265)...(271) =	1652.21 (272)
CO2 emissions per m²		(272) ÷ (4) =	32.46 (273)
El rating (section 14)			77 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) x	1.22 =	6021.61 (261)
Space heating (secondary)	(215) x	3.07 =	0 (263)
Energy for water heating	(219) x	1.22 =	2354.82 (264)
Space and water heating	(261) + (262) + (263) + (264) =		8376.44 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07 =	230.25 (267)
Electricity for lighting	(232) x	0 =	770.42 (268)
'Total Primary Energy		sum of (265)...(271) =	9377.11 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =	184.23 (273)

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User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.60

Property Address: DE2404 (Actual CO2)

Address : Flat 4, 8 Southey Road, Worthing, BN11 3HT

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	50.9 (1a)	2.3 (2a)	117.07 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.9 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	117.07 (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				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				20	0.17 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)					
Number of storeys in the dwelling (ns)					0 (9)
Additional infiltration					0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction					0 (11)
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					
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					15 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)					0.92 (18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used					
Number of sides sheltered					4 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.7 (20)
Infiltration rate incorporating shelter factor				(21) = (18) x (20) =	0.64 (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

0.82	0.81	0.79	0.71	0.69	0.61	0.61	0.6	0.64	0.69	0.73	0.76
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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) x 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) x [1 - (23c) ÷ 100]

(24a)m= 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 (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 (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= 0.84 0.82 0.81 0.75 0.74 0.69 0.69 0.68 0.71 0.74 0.76 0.79 (24d)

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

(25)m= 0.84 0.82 0.81 0.75 0.74 0.69 0.69 0.68 0.71 0.74 0.76 0.79 (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
Windows Type 1			0.9	$\times 1/[1/(2.7) + 0.04] =$	2.19		(27)
Windows Type 2			1	$\times 1/[1/(2.7) + 0.04] =$	2.44		(27)
Windows Type 3			2.8	$\times 1/[1/(1.4) + 0.04] =$	3.71		(27)
Windows Type 4			2.65	$\times 1/[1/(2.7) + 0.04] =$	6.46		(27)
Floor			50.9	x 0.53 =	26.977		(28)
Walls	49.2	7.35	41.85	x 0.55 =	23.02		(29)
Total area of elements, m²			100.1				(31)

* 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) = 64.79 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 11876.5 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 15.02 (36)

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

Total fabric heat loss (33) + (36) = 79.81 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	32.36	31.86	31.36	29.03	28.59	26.56	26.56	26.18	27.34	28.59	29.47	30.4

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

(39)m=	112.17	111.67	111.17	108.84	108.4	106.37	106.37	105.99	107.15	108.4	109.28	110.21
Average = Sum(39) _{1...12} /12=												108.83 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	2.2	2.19	2.18	2.14	2.13	2.09	2.09	2.08	2.11	2.13	2.15	2.17		
	Average = Sum(40) _{1...12} /12=												2.14	(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

1.72

(42)

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

if TFA ≤ 13.9, N = 1

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

74.97

(43)

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

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

(44)m=	82.47	79.47	76.47	73.47	70.47	67.47	67.47	70.47	73.47	76.47	79.47	82.47		
	Total = Sum(44) _{1...12} =												899.64	(44)

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

(45)m=	122.3	106.96	110.37	96.23	92.33	79.68	73.83	84.72	85.73	99.91	109.06	118.44		
	Total = Sum(45) _{1...12} =												1179.57	(45)

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

(46)m=	18.34	16.04	16.56	14.43	13.85	11.95	11.07	12.71	12.86	14.99	16.36	17.77		(46)
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Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

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

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
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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)
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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)
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SAP WorkSheet: New dwelling design stage

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

(61)m=	42.02	36.58	38.97	36.23	35.91	33.27	34.38	35.91	36.23	38.97	39.19	42.02	(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=	164.32	143.54	149.34	132.46	128.24	112.95	108.21	120.63	121.97	138.88	148.25	160.46	(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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	164.32	143.54	149.34	132.46	128.24	112.95	108.21	120.63	121.97	138.88	148.25	160.46	
Output from water heater (annual) _{1...12}												1629.26	(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=	51.17	44.71	46.44	41.05	39.68	34.81	33.14	37.15	37.56	42.96	46.06	49.89	(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=	103	103	103	103	103	103	103	103	103	103	103	103	(66)

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

(67)m=	35.52	31.55	25.66	19.43	14.52	12.26	13.25	17.22	23.11	29.35	34.25	36.51	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	223.24	225.56	219.72	207.29	191.6	176.86	167.01	164.69	170.53	182.96	198.65	213.39	(68)
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	47.02	47.02	47.02	47.02	47.02	47.02	47.02	47.02	47.02	47.02	47.02	47.02	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-68.66	-68.66	-68.66	-68.66	-68.66	-68.66	-68.66	-68.66	-68.66	-68.66	-68.66	-68.66	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	68.78	66.53	62.42	57.02	53.33	48.35	44.55	49.93	52.17	57.75	63.97	67.05	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	411.89	407.99	392.15	368.09	343.81	321.82	309.16	316.19	330.16	354.4	381.22	401.3	(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 m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	0.9	x	10.63	x	0.76	x	0.7	=	3.53	(74)
North	0.9x	0.77	x	0.9	x	20.32	x	0.76	x	0.7	=	6.74	(74)
North	0.9x	0.77	x	0.9	x	34.53	x	0.76	x	0.7	=	11.46	(74)
North	0.9x	0.77	x	0.9	x	55.46	x	0.76	x	0.7	=	18.4	(74)
North	0.9x	0.77	x	0.9	x	74.72	x	0.76	x	0.7	=	24.79	(74)

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North	0.9x	0.77	x	0.9	x	79.99	x	0.76	x	0.7	=	26.54	(74)
North	0.9x	0.77	x	0.9	x	74.68	x	0.76	x	0.7	=	24.78	(74)
North	0.9x	0.77	x	0.9	x	59.25	x	0.76	x	0.7	=	19.66	(74)
North	0.9x	0.77	x	0.9	x	41.52	x	0.76	x	0.7	=	13.78	(74)
North	0.9x	0.77	x	0.9	x	24.19	x	0.76	x	0.7	=	8.03	(74)
North	0.9x	0.77	x	0.9	x	13.12	x	0.76	x	0.7	=	4.35	(74)
North	0.9x	0.77	x	0.9	x	8.86	x	0.76	x	0.7	=	2.94	(74)
East	0.9x	0.77	x	2.8	x	19.64	x	0.63	x	0.7	=	16.81	(76)
East	0.9x	0.77	x	2.65	x	19.64	x	0.76	x	0.7	=	19.19	(76)
East	0.9x	0.77	x	2.8	x	38.42	x	0.63	x	0.7	=	32.88	(76)
East	0.9x	0.77	x	2.65	x	38.42	x	0.76	x	0.7	=	37.54	(76)
East	0.9x	0.77	x	2.8	x	63.27	x	0.63	x	0.7	=	54.14	(76)
East	0.9x	0.77	x	2.65	x	63.27	x	0.76	x	0.7	=	61.82	(76)
East	0.9x	0.77	x	2.8	x	92.28	x	0.63	x	0.7	=	78.97	(76)
East	0.9x	0.77	x	2.65	x	92.28	x	0.76	x	0.7	=	90.16	(76)
East	0.9x	0.77	x	2.8	x	113.09	x	0.63	x	0.7	=	96.78	(76)
East	0.9x	0.77	x	2.65	x	113.09	x	0.76	x	0.7	=	110.49	(76)
East	0.9x	0.77	x	2.8	x	115.77	x	0.63	x	0.7	=	99.07	(76)
East	0.9x	0.77	x	2.65	x	115.77	x	0.76	x	0.7	=	113.11	(76)
East	0.9x	0.77	x	2.8	x	110.22	x	0.63	x	0.7	=	94.32	(76)
East	0.9x	0.77	x	2.65	x	110.22	x	0.76	x	0.7	=	107.68	(76)
East	0.9x	0.77	x	2.8	x	94.68	x	0.63	x	0.7	=	81.02	(76)
East	0.9x	0.77	x	2.65	x	94.68	x	0.76	x	0.7	=	92.5	(76)
East	0.9x	0.77	x	2.8	x	73.59	x	0.63	x	0.7	=	62.97	(76)
East	0.9x	0.77	x	2.65	x	73.59	x	0.76	x	0.7	=	71.9	(76)
East	0.9x	0.77	x	2.8	x	45.59	x	0.63	x	0.7	=	39.01	(76)
East	0.9x	0.77	x	2.65	x	45.59	x	0.76	x	0.7	=	44.54	(76)
East	0.9x	0.77	x	2.8	x	24.49	x	0.63	x	0.7	=	20.96	(76)
East	0.9x	0.77	x	2.65	x	24.49	x	0.76	x	0.7	=	23.93	(76)
East	0.9x	0.77	x	2.8	x	16.15	x	0.63	x	0.7	=	13.82	(76)
East	0.9x	0.77	x	2.65	x	16.15	x	0.76	x	0.7	=	15.78	(76)
South	0.9x	0.77	x	1	x	46.75	x	0.76	x	0.7	=	17.24	(78)
South	0.9x	0.77	x	1	x	76.57	x	0.76	x	0.7	=	28.23	(78)
South	0.9x	0.77	x	1	x	97.53	x	0.76	x	0.7	=	35.96	(78)
South	0.9x	0.77	x	1	x	110.23	x	0.76	x	0.7	=	40.64	(78)
South	0.9x	0.77	x	1	x	114.87	x	0.76	x	0.7	=	42.35	(78)
South	0.9x	0.77	x	1	x	110.55	x	0.76	x	0.7	=	40.76	(78)
South	0.9x	0.77	x	1	x	108.01	x	0.76	x	0.7	=	39.82	(78)
South	0.9x	0.77	x	1	x	104.89	x	0.76	x	0.7	=	38.67	(78)
South	0.9x	0.77	x	1	x	101.89	x	0.76	x	0.7	=	37.56	(78)
South	0.9x	0.77	x	1	x	82.59	x	0.76	x	0.7	=	30.45	(78)

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South	0.9x	0.77	x	1	x	55.42	x	0.76	x	0.7	=	20.43	(78)
South	0.9x	0.77	x	1	x	40.4	x	0.76	x	0.7	=	14.89	(78)

Solar gains in watts, calculated for each month

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

(83)m=	56.76	105.38	163.38	228.17	274.41	279.47	266.6	231.84	186.21	122.03	69.66	47.44	(83)
--------	-------	--------	--------	--------	--------	--------	-------	--------	--------	--------	-------	-------	------

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

(84)m=	468.65	513.37	555.53	596.25	618.21	601.29	575.75	548.04	516.37	476.43	450.88	448.74	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)	21	(85)
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Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.95	0.91	0.81	0.68	0.72	0.88	0.96	0.98	0.99	(86)

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

(87)m=	18.82	19	19.34	19.83	20.3	20.69	20.88	20.85	20.55	19.95	19.32	18.81	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.2	19.21	19.21	19.24	19.25	19.27	19.27	19.28	19.26	19.25	19.24	19.23	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.93	0.85	0.69	0.47	0.52	0.79	0.94	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.33	17.51	17.85	18.35	18.79	19.14	19.25	19.24	19.03	18.48	17.85	17.34	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.4	(91)
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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.93	18.11	18.45	18.95	19.4	19.77	19.91	19.89	19.65	19.08	18.45	17.93	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.93	18.11	18.45	18.95	19.4	19.77	19.91	19.89	19.65	19.08	18.45	17.93	(93)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.98	0.98	0.96	0.93	0.86	0.73	0.56	0.6	0.81	0.94	0.97	0.98	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	460.28	500.65	533.65	553.06	531.73	437.49	319.8	328.37	419.52	445.93	438.93	441.74	(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=	1529.09	1475.33	1328.94	1093.82	835	549.8	351.94	370.34	594.4	918.83	1240.15	1513.47	(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=	795.2	654.98	591.69	389.35	225.64	0	0	0	0	351.84	576.88	797.37	(98)
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

4382.95	(98)
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Space heating requirement in kWh/m²/year

86.11	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
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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		88.8	(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)												
795.2	654.98	591.69	389.35	225.64	0	0	0	0	351.84	576.88	797.37	

(211)m = {[(98)m x (204)] } x 100 ÷ (206)											(211)	
895.49	737.6	666.32	438.45	254.09	0	0	0	0	396.22	649.64	897.94	
Total (kWh/year) =Sum(211) _{1..5,10...12} =											4935.75	(211)

Space heating fuel (secondary), kWh/month
= {[(98)m × (201)] } × 100 ÷ (208)

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

Water heating

Output from water heater (calculated above)

	164.32	143.54	149.34	132.46	128.24	112.95	108.21	120.63	121.97	138.88	148.25	160.46		
Efficiency of water heater													79.5	(216)
(217)m=	87.06	86.97	86.75	86.24	85.19	79.5	79.5	79.5	79.5	85.95	86.73	87.09	(217)	

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m														
(219)m=	188.75	165.04	172.14	153.59	150.54	142.07	136.12	151.74	153.42	161.58	170.95	184.24		
Total = Sum(219a) _{1..12} =													1930.18	(219)

Annual totals

Space heating fuel used, main system 1	4935.75	kWh/year
Water heating fuel used	1930.18	kWh/year

Electricity for pumps, fans and electric keep-hot

central heating pump:	30	(230c)
boiler with a fan-assisted flue	45	(230e)

Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75	(231)
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Electricity for lighting	250.95	(232)
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Electricity generated by PVs	-922.15	(233)
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Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	6269.73	(338)
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10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) ×	3.48	× 0.01 = 171.76 (240)
Space heating - main system 2	(213) ×	0	× 0.01 = 0 (241)
Space heating - secondary	(215) ×	13.19	× 0.01 = 0 (242)
Water heating cost (other fuel)	(219)	3.48	× 0.01 = 67.17 (247)

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Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a)					
Energy for lighting	(232)	13.19	x 0.01 =	33.1	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x	13.19	x 0.01 =	-121.63	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)...(254) =			280.3	(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] =	1.23	(257)
SAP rating (Section 12)		82.88	(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	1066.12 (261)
Space heating (secondary)	(215) x	0.519	0 (263)
Water heating	(219) x	0.216	416.92 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1483.04 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	38.93 (267)
Electricity for lighting	(232) x	0.519	130.24 (268)
Energy saving/generation technologies Item 1		0.519	-478.6 (269)
Total CO2, kg/year		sum of (265)...(271) =	1173.61 (272)
CO2 emissions per m²		(272) ÷ (4) =	23.06 (273)
El rating (section 14)			84 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) x	1.22	6021.61 (261)
Space heating (secondary)	(215) x	3.07	0 (263)
Energy for water heating	(219) x	1.22	2354.82 (264)
Space and water heating	(261) + (262) + (263) + (264) =		8376.44 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	230.25 (267)
Electricity for lighting	(232) x	0	770.42 (268)
Energy saving/generation technologies Item 1		3.07	-2831 (269)
'Total Primary Energy		sum of (265)...(271) =	6546.11 (272)

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Primary energy kWh/m²/year

(272) ÷ (4) =

128.61

(273)

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SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.60

Property Address: DE2405 (Base CO2)

Address : Flat 5, 8 Southey Road, Worthing, BN11 3HT

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	40.6 (1a) x	2.95 (2a) =	119.77 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	40.6 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	119.77 (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				2 x 10 =	20 (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) =	20 ÷ (5) = 0.17 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

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)

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

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 15 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.92 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 4 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.7 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.64 (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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SAP WorkSheet: New dwelling design stage

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

0.82	0.8	0.79	0.71	0.69	0.61	0.61	0.59	0.64	0.69	0.72	0.75
------	-----	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x 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) x [1 - (23c) ÷ 100]

(24a)m= 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 (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 (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= 0.83 0.82 0.81 0.75 0.74 0.69 0.69 0.68 0.71 0.74 0.76 0.78 (24d)

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

(25)m= 0.83 0.82 0.81 0.75 0.74 0.69 0.69 0.68 0.71 0.74 0.76 0.78 (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
Windows Type 1			0.55	$\times 1/[1/(2.7) + 0.04] =$	1.34		(27)
Windows Type 2			1.9	$\times 1/[1/(1.4) + 0.04] =$	2.52		(27)
Windows Type 3			1.2	$\times 1/[1/(2.7) + 0.04] =$	2.92		(27)
Windows Type 4			7.5	$\times 1/[1/(2.7) + 0.04] =$	18.28		(27)
Walls	47.8	11.15	36.65	x 0.3	11		(29)
Roof	40.6	0	40.6	x 0.15	6.09		(30)
Total area of elements, m²			88.4				(31)

* 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) = 42.14 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5862.9 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 13.26 (36)

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

Total fabric heat loss (33) + (36) = 55.4 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	33	32.48	31.98	29.61	29.17	27.11	27.11	26.73	27.9	29.17	30.07	31

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

(39)m=	88.4	87.89	87.39	85.02	84.58	82.52	82.52	82.13	83.31	84.58	85.47	86.41
Average = Sum(39) _{1...12} /12=												85.02 (39)

SAP WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	2.18	2.16	2.15	2.09	2.08	2.03	2.03	2.02	2.05	2.08	2.11	2.13		
	Average = Sum(40) _{1...12} /12=												2.09	(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

1.42

(42)

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

if TFA ≤ 13.9, N = 1

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

67.98

(43)

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

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

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

(44)m=	74.78	72.06	69.34	66.62	63.9	61.18	61.18	63.9	66.62	69.34	72.06	74.78		
	Total = Sum(44) _{1...12} =												815.78	(44)

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

(45)m=	110.9	96.99	100.09	87.26	83.72	72.25	66.95	76.82	77.74	90.6	98.9	107.4		
	Total = Sum(45) _{1...12} =												1069.61	(45)

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

(46)m=	16.63	14.55	15.01	13.09	12.56	10.84	10.04	11.52	11.66	13.59	14.83	16.11		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

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

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m 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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

SAP WorkSheet: New dwelling design stage

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

(61)m=	38.11	33.17	35.34	32.85	32.56	30.17	31.18	32.56	32.85	35.34	35.54	38.11	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(62)m=	149	130.16	135.42	120.11	116.29	102.42	98.13	109.39	110.6	125.94	134.43	145.5	(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=	149	130.16	135.42	120.11	116.29	102.42	98.13	109.39	110.6	125.94	134.43	145.5	
Output from water heater (annual) _{1...12}												1477.39	(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=	46.4	40.54	42.11	37.23	35.98	31.57	30.05	33.69	34.06	38.96	41.77	45.24	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	85.34	85.34	85.34	85.34	85.34	85.34	85.34	85.34	85.34	85.34	85.34	85.34	(66)

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

(67)m=	27.42	24.36	19.81	15	11.21	9.46	10.23	13.29	17.84	22.65	26.44	28.19	(67)
--------	-------	-------	-------	----	-------	------	-------	-------	-------	-------	-------	-------	------

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

(68)m=	183.65	185.56	180.75	170.53	157.62	145.49	137.39	135.49	140.29	150.51	163.42	175.55	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	44.96	44.96	44.96	44.96	44.96	44.96	44.96	44.96	44.96	44.96	44.96	44.96	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-56.89	-56.89	-56.89	-56.89	-56.89	-56.89	-56.89	-56.89	-56.89	-56.89	-56.89	-56.89	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	62.37	60.33	56.6	51.7	48.36	43.84	40.4	45.28	47.31	52.36	58.01	60.8	(72)
--------	-------	-------	------	------	-------	-------	------	-------	-------	-------	-------	------	------

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

(73)m=	349.84	346.65	333.57	313.63	293.6	275.2	264.42	270.46	281.84	301.93	324.27	340.94	(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)	
Southeast 0.9x	0.77	x	1.2	x	36.79	x	0.76	x	0.7	=	16.28	(77)
Southeast 0.9x	0.77	x	1.2	x	62.67	x	0.76	x	0.7	=	27.73	(77)
Southeast 0.9x	0.77	x	1.2	x	85.75	x	0.76	x	0.7	=	37.94	(77)
Southeast 0.9x	0.77	x	1.2	x	106.25	x	0.76	x	0.7	=	47.01	(77)
Southeast 0.9x	0.77	x	1.2	x	119.01	x	0.76	x	0.7	=	52.65	(77)

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Southeast 0.9x	0.77	x	1.2	x	118.15	x	0.76	x	0.7	=	52.27	(77)
Southeast 0.9x	0.77	x	1.2	x	113.91	x	0.76	x	0.7	=	50.39	(77)
Southeast 0.9x	0.77	x	1.2	x	104.39	x	0.76	x	0.7	=	46.18	(77)
Southeast 0.9x	0.77	x	1.2	x	92.85	x	0.76	x	0.7	=	41.08	(77)
Southeast 0.9x	0.77	x	1.2	x	69.27	x	0.76	x	0.7	=	30.64	(77)
Southeast 0.9x	0.77	x	1.2	x	44.07	x	0.76	x	0.7	=	19.5	(77)
Southeast 0.9x	0.77	x	1.2	x	31.49	x	0.76	x	0.7	=	13.93	(77)
Southwest 0.9x	0.77	x	7.5	x	36.79		0.76	x	0.7	=	101.74	(79)
Southwest 0.9x	0.77	x	7.5	x	62.67		0.76	x	0.7	=	173.3	(79)
Southwest 0.9x	0.77	x	7.5	x	85.75		0.76	x	0.7	=	237.11	(79)
Southwest 0.9x	0.77	x	7.5	x	106.25		0.76	x	0.7	=	293.79	(79)
Southwest 0.9x	0.77	x	7.5	x	119.01		0.76	x	0.7	=	329.07	(79)
Southwest 0.9x	0.77	x	7.5	x	118.15		0.76	x	0.7	=	326.69	(79)
Southwest 0.9x	0.77	x	7.5	x	113.91		0.76	x	0.7	=	314.97	(79)
Southwest 0.9x	0.77	x	7.5	x	104.39		0.76	x	0.7	=	288.65	(79)
Southwest 0.9x	0.77	x	7.5	x	92.85		0.76	x	0.7	=	256.74	(79)
Southwest 0.9x	0.77	x	7.5	x	69.27		0.76	x	0.7	=	191.53	(79)
Southwest 0.9x	0.77	x	7.5	x	44.07		0.76	x	0.7	=	121.86	(79)
Southwest 0.9x	0.77	x	7.5	x	31.49		0.76	x	0.7	=	87.07	(79)
Northwest 0.9x	0.77	x	0.55	x	11.28	x	0.76	x	0.7	=	2.29	(81)
Northwest 0.9x	0.77	x	1.9	x	11.28	x	0.63	x	0.7	=	6.55	(81)
Northwest 0.9x	0.77	x	0.55	x	22.97	x	0.76	x	0.7	=	4.66	(81)
Northwest 0.9x	0.77	x	1.9	x	22.97	x	0.63	x	0.7	=	13.34	(81)
Northwest 0.9x	0.77	x	0.55	x	41.38	x	0.76	x	0.7	=	8.39	(81)
Northwest 0.9x	0.77	x	1.9	x	41.38	x	0.63	x	0.7	=	24.03	(81)
Northwest 0.9x	0.77	x	0.55	x	67.96	x	0.76	x	0.7	=	13.78	(81)
Northwest 0.9x	0.77	x	1.9	x	67.96	x	0.63	x	0.7	=	39.46	(81)
Northwest 0.9x	0.77	x	0.55	x	91.35	x	0.76	x	0.7	=	18.52	(81)
Northwest 0.9x	0.77	x	1.9	x	91.35	x	0.63	x	0.7	=	53.04	(81)
Northwest 0.9x	0.77	x	0.55	x	97.38	x	0.76	x	0.7	=	19.75	(81)
Northwest 0.9x	0.77	x	1.9	x	97.38	x	0.63	x	0.7	=	56.55	(81)
Northwest 0.9x	0.77	x	0.55	x	91.1	x	0.76	x	0.7	=	18.47	(81)
Northwest 0.9x	0.77	x	1.9	x	91.1	x	0.63	x	0.7	=	52.9	(81)
Northwest 0.9x	0.77	x	0.55	x	72.63	x	0.76	x	0.7	=	14.73	(81)
Northwest 0.9x	0.77	x	1.9	x	72.63	x	0.63	x	0.7	=	42.17	(81)
Northwest 0.9x	0.77	x	0.55	x	50.42	x	0.76	x	0.7	=	10.22	(81)
Northwest 0.9x	0.77	x	1.9	x	50.42	x	0.63	x	0.7	=	29.28	(81)
Northwest 0.9x	0.77	x	0.55	x	28.07	x	0.76	x	0.7	=	5.69	(81)
Northwest 0.9x	0.77	x	1.9	x	28.07	x	0.63	x	0.7	=	16.3	(81)
Northwest 0.9x	0.77	x	0.55	x	14.2	x	0.76	x	0.7	=	2.88	(81)
Northwest 0.9x	0.77	x	1.9	x	14.2	x	0.63	x	0.7	=	8.24	(81)

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Northwest 0.9x

0.77

 x

0.55

 x

9.21

 x

0.76

 x

0.7

 =

1.87

 (81)

Northwest 0.9x

0.77

 x

1.9

 x

9.21

 x

0.63

 x

0.7

 =

5.35

 (81)

Solar gains in watts, calculated for each month

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

(83)m=

126.85	219.02	307.47	394.04	453.29	455.26	436.73	391.73	337.32	244.16	152.48	108.22
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (83)

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

(84)m=

476.7	565.66	641.04	707.67	746.89	730.46	701.15	662.19	619.17	546.1	476.75	449.15
-------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------

 (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)

(86)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.98	0.97	0.94	0.88	0.78	0.63	0.49	0.53	0.74	0.91	0.97	0.98

 (86)

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

(87)m=

19.03	19.3	19.7	20.2	20.6	20.87	20.96	20.94	20.76	20.24	19.57	19.02
-------	------	------	------	------	-------	-------	-------	-------	-------	-------	-------

 (87)

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

(88)m=

19.22	19.23	19.23	19.27	19.28	19.31	19.31	19.32	19.3	19.28	19.26	19.25
-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------

 (88)

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

(89)m=

0.97	0.95	0.92	0.84	0.7	0.5	0.31	0.35	0.62	0.86	0.95	0.98
------	------	------	------	-----	-----	------	------	------	------	------	------

 (89)

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

(90)m=

17.55	17.82	18.21	18.7	19.05	19.26	19.3	19.31	19.2	18.76	18.11	17.56
-------	-------	-------	------	-------	-------	------	-------	------	-------	-------	-------

 (90)

fLA = Living area ÷ (4) =

0.44

 (91)

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

(92)m=

18.2	18.47	18.86	19.36	19.72	19.96	20.03	20.02	19.88	19.4	18.75	18.19
------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------

 (92)

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

(93)m=

18.2	18.47	18.86	19.36	19.72	19.96	20.03	20.02	19.88	19.4	18.75	18.19
------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------

 (93)

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=

0.97	0.95	0.91	0.84	0.73	0.55	0.39	0.43	0.66	0.87	0.95	0.97
------	------	------	------	------	------	------	------	------	------	------	------

 (94)

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

(95)m=

461.27	535.67	584.13	595.25	541.82	404.22	273.85	285.2	409.63	472.65	452.06	436.79
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------

 (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
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 (96)

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

(97)m=

1228.61	1192.41	1079.84	888.93	678.69	442.41	282.62	297.38	481.44	744.55	995.42	1209.2
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 (97)

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

(98)m=

570.91	441.33	368.8	211.45	101.84	0	0	0	0	202.3	391.22	574.67
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

2862.51

 (98)

Space heating requirement in kWh/m²/year

70.51

 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system

0

 (201)

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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		88.8	(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)												
570.91	441.33	368.8	211.45	101.84	0	0	0	0	202.3	391.22	574.67	

(211)m = {[(98)m x (204)] } x 100 ÷ (206)											(211)	
642.91	496.99	415.32	238.12	114.68	0	0	0	0	227.81	440.56	647.15	
Total (kWh/year) =Sum(211) _{1..5,10...12} =											3223.54	(211)

Space heating fuel (secondary), kWh/month
= {[(98)m × (201)] } × 100 ÷ (208)

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

Water heating

Output from water heater (calculated above)

	149	130.16	135.42	120.11	116.29	102.42	98.13	109.39	110.6	125.94	134.43	145.5		
Efficiency of water heater													79.5	(216)
(217)m=	86.7	86.5	86.1	85.19	83.59	79.5	79.5	79.5	79.5	84.99	86.22	86.75	(217)	

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m													
(219)m=	171.86	150.48	157.29	140.99	139.12	128.83	123.43	137.6	139.12	148.19	155.92	167.73	
Total = Sum(219a) _{1..12} =												1760.55	(219)

Annual totals

Space heating fuel used, main system 1	3223.54	kWh/year
Water heating fuel used	1760.55	kWh/year

Electricity for pumps, fans and electric keep-hot

central heating pump:	30	(230c)
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boiler with a fan-assisted flue	45	(230e)
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Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75	(231)
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Electricity for lighting	193.73	(232)
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Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	5252.82	(338)
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10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) ×	3.48	× 0.01 = 112.18 (240)
Space heating - main system 2	(213) ×	0	× 0.01 = 0 (241)
Space heating - secondary	(215) ×	13.19	× 0.01 = 0 (242)
Water heating cost (other fuel)	(219)	3.48	× 0.01 = 61.27 (247)
Pumps, fans and electric keep-hot	(231)	13.19	× 0.01 = 9.89 (249)

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(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 = 25.55 (250)

Additional standing charges (Table 12) 120 (251)

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

Total energy cost (245)...(247) + (250)...(254) = 328.89 (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] = 1.61 (257)

SAP rating (Section 12) 77.49 (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 =	696.29 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	380.28 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1076.56 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	100.54 (268)
Total CO2, kg/year		sum of (265)...(271) =	1216.03 (272)
CO2 emissions per m²		(272) ÷ (4) =	29.95 (273)
El rating (section 14)			81 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) x	1.22 =	3932.72 (261)
Space heating (secondary)	(215) x	3.07 =	0 (263)
Energy for water heating	(219) x	1.22 =	2147.87 (264)
Space and water heating	(261) + (262) + (263) + (264) =		6080.59 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07 =	230.25 (267)
Electricity for lighting	(232) x	0 =	594.74 (268)
'Total Primary Energy		sum of (265)...(271) =	6905.58 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =	170.09 (273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.60

Property Address: DE2405 (Actual CO2)

Address : Flat 5, 8 Southey Road, Worthing, BN11 3HT

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	40.6 (1a)	2.95 (2a)	119.77 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	40.6 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	119.77 (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				2	20 (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) =	20 ÷ (5) = 0.17 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

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)

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

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 15 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.92 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 4 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.7 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.64 (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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SAP WorkSheet: New dwelling design stage

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

0.82	0.8	0.79	0.71	0.69	0.61	0.61	0.59	0.64	0.69	0.72	0.75
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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) x 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) x [1 - (23c) ÷ 100]

(24a)m= 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 (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 (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= 0.83 0.82 0.81 0.75 0.74 0.69 0.69 0.68 0.71 0.74 0.76 0.78 (24d)

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

(25)m= 0.83 0.82 0.81 0.75 0.74 0.69 0.69 0.68 0.71 0.74 0.76 0.78 (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
Windows Type 1			0.55	$\times 1/[1/(2.7) + 0.04] =$	1.34		(27)
Windows Type 2			1.9	$\times 1/[1/(1.4) + 0.04] =$	2.52		(27)
Windows Type 3			1.2	$\times 1/[1/(2.7) + 0.04] =$	2.92		(27)
Windows Type 4			7.5	$\times 1/[1/(2.7) + 0.04] =$	18.28		(27)
Walls	47.8	11.15	36.65	x 0.3	11		(29)
Roof	40.6	0	40.6	x 0.15	6.09		(30)
Total area of elements, m²			88.4				(31)

* 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) = 42.14 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5862.9 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 13.26 (36)

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

Total fabric heat loss (33) + (36) = 55.4 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	33	32.48	31.98	29.61	29.17	27.11	27.11	26.73	27.9	29.17	30.07	31

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

(39)m=	88.4	87.89	87.39	85.02	84.58	82.52	82.52	82.13	83.31	84.58	85.47	86.41
Average = Sum(39) _{1...12} /12=												85.02 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	2.18	2.16	2.15	2.09	2.08	2.03	2.03	2.02	2.05	2.08	2.11	2.13		
	Average = Sum(40) _{1...12} /12=												2.09	(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

1.42

(42)

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

if TFA ≤ 13.9, N = 1

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

67.98

(43)

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

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

(44)m=	74.78	72.06	69.34	66.62	63.9	61.18	61.18	63.9	66.62	69.34	72.06	74.78		
	Total = Sum(44) _{1...12} =												815.78	(44)

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

(45)m=	110.9	96.99	100.09	87.26	83.72	72.25	66.95	76.82	77.74	90.6	98.9	107.4		
	Total = Sum(45) _{1...12} =												1069.61	(45)

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

(46)m=	16.63	14.55	15.01	13.09	12.56	10.84	10.04	11.52	11.66	13.59	14.83	16.11		(46)
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Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

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

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m 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)
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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)
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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	38.11	33.17	35.34	32.85	32.56	30.17	31.18	32.56	32.85	35.34	35.54	38.11	(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=	149	130.16	135.42	120.11	116.29	102.42	98.13	109.39	110.6	125.94	134.43	145.5	(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=	149	130.16	135.42	120.11	116.29	102.42	98.13	109.39	110.6	125.94	134.43	145.5	
Output from water heater (annual) _{1...12}												1477.39	(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=	46.4	40.54	42.11	37.23	35.98	31.57	30.05	33.69	34.06	38.96	41.77	45.24	(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=	85.34	85.34	85.34	85.34	85.34	85.34	85.34	85.34	85.34	85.34	85.34	85.34	(66)

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

(67)m=	27.42	24.36	19.81	15	11.21	9.46	10.23	13.29	17.84	22.65	26.44	28.19	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	183.65	185.56	180.75	170.53	157.62	145.49	137.39	135.49	140.29	150.51	163.42	175.55	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	44.96	44.96	44.96	44.96	44.96	44.96	44.96	44.96	44.96	44.96	44.96	44.96	(69)
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Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-56.89	-56.89	-56.89	-56.89	-56.89	-56.89	-56.89	-56.89	-56.89	-56.89	-56.89	-56.89	(71)
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Water heating gains (Table 5)

(72)m=	62.37	60.33	56.6	51.7	48.36	43.84	40.4	45.28	47.31	52.36	58.01	60.8	(72)
--------	-------	-------	------	------	-------	-------	------	-------	-------	-------	-------	------	------

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

(73)m=	349.84	346.65	333.57	313.63	293.6	275.2	264.42	270.46	281.84	301.93	324.27	340.94	(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)	
Southeast 0.9x	0.77	x	1.2	x	36.79	x	0.76	x	0.7	=	16.28	(77)
Southeast 0.9x	0.77	x	1.2	x	62.67	x	0.76	x	0.7	=	27.73	(77)
Southeast 0.9x	0.77	x	1.2	x	85.75	x	0.76	x	0.7	=	37.94	(77)
Southeast 0.9x	0.77	x	1.2	x	106.25	x	0.76	x	0.7	=	47.01	(77)
Southeast 0.9x	0.77	x	1.2	x	119.01	x	0.76	x	0.7	=	52.65	(77)

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Southeast 0.9x	0.77	x	1.2	x	118.15	x	0.76	x	0.7	=	52.27	(77)
Southeast 0.9x	0.77	x	1.2	x	113.91	x	0.76	x	0.7	=	50.39	(77)
Southeast 0.9x	0.77	x	1.2	x	104.39	x	0.76	x	0.7	=	46.18	(77)
Southeast 0.9x	0.77	x	1.2	x	92.85	x	0.76	x	0.7	=	41.08	(77)
Southeast 0.9x	0.77	x	1.2	x	69.27	x	0.76	x	0.7	=	30.64	(77)
Southeast 0.9x	0.77	x	1.2	x	44.07	x	0.76	x	0.7	=	19.5	(77)
Southeast 0.9x	0.77	x	1.2	x	31.49	x	0.76	x	0.7	=	13.93	(77)
Southwest 0.9x	0.77	x	7.5	x	36.79		0.76	x	0.7	=	101.74	(79)
Southwest 0.9x	0.77	x	7.5	x	62.67		0.76	x	0.7	=	173.3	(79)
Southwest 0.9x	0.77	x	7.5	x	85.75		0.76	x	0.7	=	237.11	(79)
Southwest 0.9x	0.77	x	7.5	x	106.25		0.76	x	0.7	=	293.79	(79)
Southwest 0.9x	0.77	x	7.5	x	119.01		0.76	x	0.7	=	329.07	(79)
Southwest 0.9x	0.77	x	7.5	x	118.15		0.76	x	0.7	=	326.69	(79)
Southwest 0.9x	0.77	x	7.5	x	113.91		0.76	x	0.7	=	314.97	(79)
Southwest 0.9x	0.77	x	7.5	x	104.39		0.76	x	0.7	=	288.65	(79)
Southwest 0.9x	0.77	x	7.5	x	92.85		0.76	x	0.7	=	256.74	(79)
Southwest 0.9x	0.77	x	7.5	x	69.27		0.76	x	0.7	=	191.53	(79)
Southwest 0.9x	0.77	x	7.5	x	44.07		0.76	x	0.7	=	121.86	(79)
Southwest 0.9x	0.77	x	7.5	x	31.49		0.76	x	0.7	=	87.07	(79)
Northwest 0.9x	0.77	x	0.55	x	11.28	x	0.76	x	0.7	=	2.29	(81)
Northwest 0.9x	0.77	x	1.9	x	11.28	x	0.63	x	0.7	=	6.55	(81)
Northwest 0.9x	0.77	x	0.55	x	22.97	x	0.76	x	0.7	=	4.66	(81)
Northwest 0.9x	0.77	x	1.9	x	22.97	x	0.63	x	0.7	=	13.34	(81)
Northwest 0.9x	0.77	x	0.55	x	41.38	x	0.76	x	0.7	=	8.39	(81)
Northwest 0.9x	0.77	x	1.9	x	41.38	x	0.63	x	0.7	=	24.03	(81)
Northwest 0.9x	0.77	x	0.55	x	67.96	x	0.76	x	0.7	=	13.78	(81)
Northwest 0.9x	0.77	x	1.9	x	67.96	x	0.63	x	0.7	=	39.46	(81)
Northwest 0.9x	0.77	x	0.55	x	91.35	x	0.76	x	0.7	=	18.52	(81)
Northwest 0.9x	0.77	x	1.9	x	91.35	x	0.63	x	0.7	=	53.04	(81)
Northwest 0.9x	0.77	x	0.55	x	97.38	x	0.76	x	0.7	=	19.75	(81)
Northwest 0.9x	0.77	x	1.9	x	97.38	x	0.63	x	0.7	=	56.55	(81)
Northwest 0.9x	0.77	x	0.55	x	91.1	x	0.76	x	0.7	=	18.47	(81)
Northwest 0.9x	0.77	x	1.9	x	91.1	x	0.63	x	0.7	=	52.9	(81)
Northwest 0.9x	0.77	x	0.55	x	72.63	x	0.76	x	0.7	=	14.73	(81)
Northwest 0.9x	0.77	x	1.9	x	72.63	x	0.63	x	0.7	=	42.17	(81)
Northwest 0.9x	0.77	x	0.55	x	50.42	x	0.76	x	0.7	=	10.22	(81)
Northwest 0.9x	0.77	x	1.9	x	50.42	x	0.63	x	0.7	=	29.28	(81)
Northwest 0.9x	0.77	x	0.55	x	28.07	x	0.76	x	0.7	=	5.69	(81)
Northwest 0.9x	0.77	x	1.9	x	28.07	x	0.63	x	0.7	=	16.3	(81)
Northwest 0.9x	0.77	x	0.55	x	14.2	x	0.76	x	0.7	=	2.88	(81)
Northwest 0.9x	0.77	x	1.9	x	14.2	x	0.63	x	0.7	=	8.24	(81)

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Northwest 0.9x

0.77

 x

0.55

 x

9.21

 x

0.76

 x

0.7

 =

1.87

 (81)

Northwest 0.9x

0.77

 x

1.9

 x

9.21

 x

0.63

 x

0.7

 =

5.35

 (81)

Solar gains in watts, calculated for each month

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

(83)m=

126.85	219.02	307.47	394.04	453.29	455.26	436.73	391.73	337.32	244.16	152.48	108.22
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (83)

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

(84)m=

476.7	565.66	641.04	707.67	746.89	730.46	701.15	662.19	619.17	546.1	476.75	449.15
-------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------

 (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)

(86)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.98	0.97	0.94	0.88	0.78	0.63	0.49	0.53	0.74	0.91	0.97	0.98

 (86)

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

(87)m=

19.03	19.3	19.7	20.2	20.6	20.87	20.96	20.94	20.76	20.24	19.57	19.02
-------	------	------	------	------	-------	-------	-------	-------	-------	-------	-------

 (87)

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

(88)m=

19.22	19.23	19.23	19.27	19.28	19.31	19.31	19.32	19.3	19.28	19.26	19.25
-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------

 (88)

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

(89)m=

0.97	0.95	0.92	0.84	0.7	0.5	0.31	0.35	0.62	0.86	0.95	0.98
------	------	------	------	-----	-----	------	------	------	------	------	------

 (89)

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

(90)m=

17.55	17.82	18.21	18.7	19.05	19.26	19.3	19.31	19.2	18.76	18.11	17.56
-------	-------	-------	------	-------	-------	------	-------	------	-------	-------	-------

 (90)

fLA = Living area ÷ (4) =

0.44

 (91)

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

(92)m=

18.2	18.47	18.86	19.36	19.72	19.96	20.03	20.02	19.88	19.4	18.75	18.19
------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------

 (92)

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

(93)m=

18.2	18.47	18.86	19.36	19.72	19.96	20.03	20.02	19.88	19.4	18.75	18.19
------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------

 (93)

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=

0.97	0.95	0.91	0.84	0.73	0.55	0.39	0.43	0.66	0.87	0.95	0.97
------	------	------	------	------	------	------	------	------	------	------	------

 (94)

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

(95)m=

461.27	535.67	584.13	595.25	541.82	404.22	273.85	285.2	409.63	472.65	452.06	436.79
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------

 (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=

1228.61	1192.41	1079.84	888.93	678.69	442.41	282.62	297.38	481.44	744.55	995.42	1209.2
---------	---------	---------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (97)

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

(98)m=

570.91	441.33	368.8	211.45	101.84	0	0	0	0	202.3	391.22	574.67
--------	--------	-------	--------	--------	---	---	---	---	-------	--------	--------

 (98)

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

2862.51

 (98)

Space heating requirement in kWh/m²/year

70.51

 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system

0

 (201)

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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		88.8	(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)												
570.91	441.33	368.8	211.45	101.84	0	0	0	0	202.3	391.22	574.67	

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

642.91	496.99	415.32	238.12	114.68	0	0	0	0	227.81	440.56	647.15	
Total (kWh/year) =Sum(211) _{1..5,10...12} =												3223.54 (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	
Total (kWh/year) =Sum(215) _{1..5,10...12} =												0 (215)

Water heating

Output from water heater (calculated above)

149	130.16	135.42	120.11	116.29	102.42	98.13	109.39	110.6	125.94	134.43	145.5	
Efficiency of water heater												79.5 (216)
(217)m=	86.7	86.5	86.1	85.19	83.59	79.5	79.5	79.5	79.5	84.99	86.22	86.75 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	171.86	150.48	157.29	140.99	139.12	128.83	123.43	137.6	139.12	148.19	155.92	167.73		
Total = Sum(219a) _{1..12} =													1760.55	(219)

Annual totals

Space heating fuel used, main system 1	3223.54	kWh/year
Water heating fuel used	1760.55	kWh/year

Electricity for pumps, fans and electric keep-hot

central heating pump: 30 (230c)

boiler with a fan-assisted flue 45 (230e)

Total electricity for the above, kWh/year sum of (230a)...(230g) = 75 (231)

Electricity for lighting 193.73 (232)

Electricity generated by PVs -922.15 (233)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = 4330.67 (338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	3.48 x 0.01 =	112.18 (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 =	61.27 (247)

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Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a)					
Energy for lighting	(232)	13.19	x 0.01 =	25.55	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x	13.19	x 0.01 =	-121.63	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)...(254) =			207.26	(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] =	1.02	(257)
SAP rating (Section 12)		85.81	(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	696.29 (261)
Space heating (secondary)	(215) x	0.519	0 (263)
Water heating	(219) x	0.216	380.28 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1076.56 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	38.93 (267)
Electricity for lighting	(232) x	0.519	100.54 (268)
Energy saving/generation technologies Item 1		0.519	-478.6 (269)
Total CO2, kg/year		sum of (265)...(271) =	737.44 (272)
CO2 emissions per m²		(272) ÷ (4) =	18.16 (273)
El rating (section 14)			88 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) x	1.22	3932.72 (261)
Space heating (secondary)	(215) x	3.07	0 (263)
Energy for water heating	(219) x	1.22	2147.87 (264)
Space and water heating	(261) + (262) + (263) + (264) =		6080.59 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	230.25 (267)
Electricity for lighting	(232) x	0	594.74 (268)
Energy saving/generation technologies Item 1		3.07	-2831 (269)
'Total Primary Energy		sum of (265)...(271) =	4074.58 (272)

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Primary energy kWh/m²/year

(272) ÷ (4) =

100.36

(273)

DRAFT

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.60

Property Address: DE2406 (Base CO2)

Address : Flat 6, 8 Southey Road, Worthing, BN11 3HT

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	40.3 (1a)	2.95 (2a)	118.88 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	40.3 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	118.88 (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				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.17 (8)
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If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0	(9)
--	---	-----

Additional infiltration	[(9)-1]x0.1 =	0 (10)
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Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0	(11)
--	---	------

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

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)
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Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
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Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	15	(17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.92	(18)
--	------	------

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered	4	(19)
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Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7 (20)
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Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.64 (21)
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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
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

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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SAP WorkSheet: New dwelling design stage

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

0.82	0.8	0.79	0.71	0.69	0.61	0.61	0.59	0.64	0.69	0.72	0.76
------	-----	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x 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) x [1 - (23c) ÷ 100]

(24a)m= 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 (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 (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= 0.84 0.82 0.81 0.75 0.74 0.69 0.69 0.68 0.71 0.74 0.76 0.79 (24d)

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

(25)m= 0.84 0.82 0.81 0.75 0.74 0.69 0.69 0.68 0.71 0.74 0.76 0.79 (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
Windows Type 1			0.55	$\times 1/[1/(2.7) + 0.04] =$	1.34		
Windows Type 2			8.25	$\times 1/[1/(2.7) + 0.04] =$	20.1		
Windows Type 3			0.55	$\times 1/[1/(2.7) + 0.04] =$	1.34		
Walls	58.1	9.35	48.75	x 0.3	14.63		
Roof	40.3	0	40.3	x 0.15	6.05		
Total area of elements, m²			98.4				

* 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) = 43.45 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7675.2 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 14.76 (36)

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

Total fabric heat loss (33) + (36) = 58.21 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	32.79	32.28	31.78	29.42	28.98	26.93	26.93	26.55	27.72	28.98	29.87	30.8

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

(39)m=	91	90.49	89.99	87.64	87.2	85.14	85.14	84.76	85.93	87.2	88.09	89.02
Average = Sum(39) _{1...12} /12=												87.63

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	2.26	2.25	2.23	2.17	2.16	2.11	2.11	2.1	2.13	2.16	2.19	2.21		
	Average = Sum(40) _{1...12} /12=												2.17	(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

1.41

(42)

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

if TFA ≤ 13.9, N = 1

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

67.79

(43)

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

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

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

(44)m=	74.57	71.86	69.15	66.43	63.72	61.01	61.01	63.72	66.43	69.15	71.86	74.57		
	Total = Sum(44) _{1...12} =												813.48	(44)

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

(45)m=	110.58	96.72	99.8	87.01	83.49	72.05	66.76	76.61	77.52	90.35	98.62	107.09		
	Total = Sum(45) _{1...12} =												1066.61	(45)

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

(46)m=	16.59	14.51	14.97	13.05	12.52	10.81	10.01	11.49	11.63	13.55	14.79	16.06		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

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

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m 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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

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

(61)m=	38	33.07	35.24	32.76	32.47	30.09	31.09	32.47	32.76	35.24	35.44	38	(61)
--------	----	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	------

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

(62)m=	148.58	129.79	135.04	119.77	115.96	102.13	97.85	109.08	110.29	125.58	134.06	145.09	(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=	148.58	129.79	135.04	119.77	115.96	102.13	97.85	109.08	110.29	125.58	134.06	145.09	
Output from water heater (annual) _{1...12}												1473.24	(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=	46.27	40.43	41.99	37.12	35.88	31.48	29.97	33.59	33.97	38.85	41.65	45.11	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.86	84.86	84.86	84.86	84.86	84.86	84.86	84.86	84.86	84.86	84.86	84.86	(66)

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

(67)m=	27.26	24.21	19.69	14.9	11.14	9.41	10.16	13.21	17.73	22.51	26.28	28.01	(67)
--------	-------	-------	-------	------	-------	------	-------	-------	-------	-------	-------	-------	------

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

(68)m=	182.52	184.41	179.64	169.48	156.65	144.6	136.55	134.65	139.43	149.59	162.41	174.47	(68)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-56.57	-56.57	-56.57	-56.57	-56.57	-56.57	-56.57	-56.57	-56.57	-56.57	-56.57	-56.57	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	62.19	60.16	56.44	51.56	48.22	43.72	40.28	45.15	47.18	52.22	57.85	60.63	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	348.15	344.97	331.96	312.13	292.21	273.91	263.18	269.2	280.52	300.5	322.72	339.3	(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	0.55	x	11.28	x	0.76	x	0.7	=	2.29	(75)
Northeast 0.9x	0.77	x	0.55	x	22.97	x	0.76	x	0.7	=	4.66	(75)
Northeast 0.9x	0.77	x	0.55	x	41.38	x	0.76	x	0.7	=	8.39	(75)
Northeast 0.9x	0.77	x	0.55	x	67.96	x	0.76	x	0.7	=	13.78	(75)
Northeast 0.9x	0.77	x	0.55	x	91.35	x	0.76	x	0.7	=	18.52	(75)

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Northeast 0.9x	0.77	x	0.55	x	97.38	x	0.76	x	0.7	=	19.75	(75)
Northeast 0.9x	0.77	x	0.55	x	91.1	x	0.76	x	0.7	=	18.47	(75)
Northeast 0.9x	0.77	x	0.55	x	72.63	x	0.76	x	0.7	=	14.73	(75)
Northeast 0.9x	0.77	x	0.55	x	50.42	x	0.76	x	0.7	=	10.22	(75)
Northeast 0.9x	0.77	x	0.55	x	28.07	x	0.76	x	0.7	=	5.69	(75)
Northeast 0.9x	0.77	x	0.55	x	14.2	x	0.76	x	0.7	=	2.88	(75)
Northeast 0.9x	0.77	x	0.55	x	9.21	x	0.76	x	0.7	=	1.87	(75)
Southwest 0.9x	0.77	x	0.55	x	36.79		0.76	x	0.7	=	7.46	(79)
Southwest 0.9x	0.77	x	0.55	x	62.67		0.76	x	0.7	=	12.71	(79)
Southwest 0.9x	0.77	x	0.55	x	85.75		0.76	x	0.7	=	17.39	(79)
Southwest 0.9x	0.77	x	0.55	x	106.25		0.76	x	0.7	=	21.54	(79)
Southwest 0.9x	0.77	x	0.55	x	119.01		0.76	x	0.7	=	24.13	(79)
Southwest 0.9x	0.77	x	0.55	x	118.15		0.76	x	0.7	=	23.96	(79)
Southwest 0.9x	0.77	x	0.55	x	113.91		0.76	x	0.7	=	23.1	(79)
Southwest 0.9x	0.77	x	0.55	x	104.39		0.76	x	0.7	=	21.17	(79)
Southwest 0.9x	0.77	x	0.55	x	92.85		0.76	x	0.7	=	18.83	(79)
Southwest 0.9x	0.77	x	0.55	x	69.27		0.76	x	0.7	=	14.05	(79)
Southwest 0.9x	0.77	x	0.55	x	44.07		0.76	x	0.7	=	8.94	(79)
Southwest 0.9x	0.77	x	0.55	x	31.49		0.76	x	0.7	=	6.38	(79)
Northwest 0.9x	0.77	x	8.25	x	11.28	x	0.76	x	0.7	=	34.32	(81)
Northwest 0.9x	0.77	x	8.25	x	22.97	x	0.76	x	0.7	=	69.86	(81)
Northwest 0.9x	0.77	x	8.25	x	41.38	x	0.76	x	0.7	=	125.86	(81)
Northwest 0.9x	0.77	x	8.25	x	67.96	x	0.76	x	0.7	=	206.69	(81)
Northwest 0.9x	0.77	x	8.25	x	91.35	x	0.76	x	0.7	=	277.84	(81)
Northwest 0.9x	0.77	x	8.25	x	97.38	x	0.76	x	0.7	=	296.2	(81)
Northwest 0.9x	0.77	x	8.25	x	91.1	x	0.76	x	0.7	=	277.09	(81)
Northwest 0.9x	0.77	x	8.25	x	72.63	x	0.76	x	0.7	=	220.9	(81)
Northwest 0.9x	0.77	x	8.25	x	50.42	x	0.76	x	0.7	=	153.36	(81)
Northwest 0.9x	0.77	x	8.25	x	28.07	x	0.76	x	0.7	=	85.37	(81)
Northwest 0.9x	0.77	x	8.25	x	14.2	x	0.76	x	0.7	=	43.18	(81)
Northwest 0.9x	0.77	x	8.25	x	9.21	x	0.76	x	0.7	=	28.03	(81)

Solar gains in watts, calculated for each month

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

(83)m= 44.07 87.22 151.64 242.02 320.49 339.91 318.66 256.79 182.41 105.11 55 36.28 (83)

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

(84)m= 392.22 432.19 483.59 554.15 612.7 613.82 581.84 525.99 462.93 405.61 377.72 375.58 (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=	0.99	0.98	0.97	0.93	0.85	0.71	0.58	0.64	0.84	0.95	0.98	0.99

(86)

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

(87)m= 18.8 18.99 19.37 19.93 20.43 20.79 20.92 20.89 20.6 19.98 19.33 18.8 (87)

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

(88)m=	19.17	19.17	19.18	19.22	19.23	19.26	19.26	19.27	19.25	19.23	19.21	19.2	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

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

(89)m=	0.98	0.98	0.96	0.9	0.78	0.58	0.38	0.44	0.74	0.93	0.97	0.99	(89)
--------	------	------	------	-----	------	------	------	------	------	------	------	------	------

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

(90)m=	17.29	17.48	17.86	18.43	18.88	19.18	19.25	19.24	19.05	18.49	17.84	17.31	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.41 \quad (91)$$

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

(92)m=	17.91	18.11	18.48	19.05	19.52	19.84	19.94	19.92	19.69	19.1	18.45	17.93	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

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

(93)m=	17.91	18.11	18.48	19.05	19.52	19.84	19.94	19.92	19.69	19.1	18.45	17.93	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.98	0.97	0.95	0.9	0.8	0.63	0.46	0.52	0.77	0.93	0.97	0.98	(94)
--------	------	------	------	-----	-----	------	------	------	------	------	------	------	------

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

(95)m=	384.12	419.74	460.02	498.74	488.51	386.5	268.56	275.34	358.36	375.47	366.22	368.78	(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=	1239	1195.13	1078.51	889.25	681.82	446.23	284.08	298.56	480.37	741.26	1000.11	1221.98	(97)
--------	------	---------	---------	--------	--------	--------	--------	--------	--------	--------	---------	---------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	636.03	521.06	460.15	281.16	143.82	0	0	0	0	272.15	456.4	634.78	(98)
--------	--------	--------	--------	--------	--------	---	---	---	---	--------	-------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 3405.57 \quad (98)$$

Space heating requirement in kWh/m²/year

$$84.51 \quad (99)$$

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

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

$$1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

$$1 \quad (204)$$

Efficiency of main space heating system 1

$$88.8 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

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

kWh/year

Space heating requirement (calculated above)

636.03	521.06	460.15	281.16	143.82	0	0	0	0	272.15	456.4	634.78
--------	--------	--------	--------	--------	---	---	---	---	--------	-------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

716.26	586.78	518.19	316.63	161.96	0	0	0	0	306.48	513.96	714.85
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 3835.1 \quad (211)$$

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

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

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Water heating

Output from water heater (calculated above)

148.58	129.79	135.04	119.77	115.96	102.13	97.85	109.08	110.29	125.58	134.06	145.09
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------

Efficiency of water heater

79.5 (216)

(217)m= 86.88 86.78 86.5 85.8 84.39 79.5 79.5 79.5 79.5 85.64 86.5 86.91 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

171.03	149.57	156.11	139.59	137.41	128.47	123.08	137.21	138.72	146.65	154.97	166.95
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Total = Sum(219a)_{1..12} = 1749.77 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

3835.1

Water heating fuel used

1749.77

Electricity for pumps, fans and electric keep-hot

central heating pump:

30

(230c)

boiler with a fan-assisted flue

45

(230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 75 (231)

Electricity for lighting

192.53

(232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

5852.41 (238)

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 =	133.46 (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 =	60.89 (247)
Pumps, fans and electric keep-hot	(231)	13.19 x 0.01 =	9.89 (249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a)			
Energy for lighting	(232)	13.19 x 0.01 =	25.4 (250)
Additional standing charges (Table 12)			120 (251)

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

Total energy cost (245)...(247) + (250)...(254) = 349.64 (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] =	1.72 (257)
SAP rating (Section 12)	75.98 (258)

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

Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
--------------------	-------------------------------	--------------------------

SAP WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.216	=	828.38	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	377.95	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1206.33	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	99.93	(268)
Total CO ₂ , kg/year		sum of (265)...(271) =		1345.18	(272)
CO₂ emissions per m²		(272) ÷ (4) =		33.38	(273)
El rating (section 14)				79	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	1.22	=	4678.83	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2134.72	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6813.54	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	591.08	(268)
Total Primary Energy		sum of (265)...(271) =		7634.88	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		189.45	(273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.60

Property Address: DE2406 (Actual CO2)

Address : Flat 6, 8 Southey Road, Worthing, BN11 3HT

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	40.3 (1a)	2.95 (2a)	118.88 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	40.3 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	118.88 (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				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				20	0.17 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)					
Number of storeys in the dwelling (ns)					0 (9)
Additional infiltration					0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction					0 (11)
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					
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					15 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)					0.92 (18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used					
Number of sides sheltered					4 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.7 (20)
Infiltration rate incorporating shelter factor				(21) = (18) x (20) =	0.64 (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
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

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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SAP WorkSheet: New dwelling design stage

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

0.82	0.8	0.79	0.71	0.69	0.61	0.61	0.59	0.64	0.69	0.72	0.76
------	-----	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x 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) x [1 - (23c) ÷ 100]

(24a)m= 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 (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 (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= 0.84 0.82 0.81 0.75 0.74 0.69 0.69 0.68 0.71 0.74 0.76 0.79 (24d)

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

(25)m= 0.84 0.82 0.81 0.75 0.74 0.69 0.69 0.68 0.71 0.74 0.76 0.79 (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
Windows Type 1			0.55	$\times 1/[1/(2.7) + 0.04] =$	1.34		
Windows Type 2			8.25	$\times 1/[1/(2.7) + 0.04] =$	20.1		
Windows Type 3			0.55	$\times 1/[1/(2.7) + 0.04] =$	1.34		
Walls	58.1	9.35	48.75	x 0.3	14.63		
Roof	40.3	0	40.3	x 0.15	6.05		
Total area of elements, m²			98.4				

* 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) = 43.45 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7675.2 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 14.76 (36)

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

Total fabric heat loss (33) + (36) = 58.21 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	32.79	32.28	31.78	29.42	28.98	26.93	26.93	26.55	27.72	28.98	29.87	30.8

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

(39)m=	91	90.49	89.99	87.64	87.2	85.14	85.14	84.76	85.93	87.2	88.09	89.02
Average = Sum(39) _{1...12} /12=												87.63 (39)

SAP WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	2.26	2.25	2.23	2.17	2.16	2.11	2.11	2.1	2.13	2.16	2.19	2.21		
	Average = Sum(40) _{1...12} /12=												2.17	(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

1.41

(42)

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

if TFA ≤ 13.9, N = 1

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

67.79

(43)

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

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

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

(44)m=	74.57	71.86	69.15	66.43	63.72	61.01	61.01	63.72	66.43	69.15	71.86	74.57		
	Total = Sum(44) _{1...12} =												813.48	(44)

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

(45)m=	110.58	96.72	99.8	87.01	83.49	72.05	66.76	76.61	77.52	90.35	98.62	107.09		
	Total = Sum(45) _{1...12} =												1066.61	(45)

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

(46)m=	16.59	14.51	14.97	13.05	12.52	10.81	10.01	11.49	11.63	13.55	14.79	16.06		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

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

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m 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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

SAP WorkSheet: New dwelling design stage

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

(61)m=	38	33.07	35.24	32.76	32.47	30.09	31.09	32.47	32.76	35.24	35.44	38	(61)
--------	----	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	------

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

(62)m=	148.58	129.79	135.04	119.77	115.96	102.13	97.85	109.08	110.29	125.58	134.06	145.09	(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=	148.58	129.79	135.04	119.77	115.96	102.13	97.85	109.08	110.29	125.58	134.06	145.09	
Output from water heater (annual) _{1...12}												1473.24	(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=	46.27	40.43	41.99	37.12	35.88	31.48	29.97	33.59	33.97	38.85	41.65	45.11	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.86	84.86	84.86	84.86	84.86	84.86	84.86	84.86	84.86	84.86	84.86	84.86	(66)

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

(67)m=	27.26	24.21	19.69	14.9	11.14	9.41	10.16	13.21	17.73	22.51	26.28	28.01	(67)
--------	-------	-------	-------	------	-------	------	-------	-------	-------	-------	-------	-------	------

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

(68)m=	182.52	184.41	179.64	169.48	156.65	144.6	136.55	134.65	139.43	149.59	162.41	174.47	(68)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-56.57	-56.57	-56.57	-56.57	-56.57	-56.57	-56.57	-56.57	-56.57	-56.57	-56.57	-56.57	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	62.19	60.16	56.44	51.56	48.22	43.72	40.28	45.15	47.18	52.22	57.85	60.63	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	348.15	344.97	331.96	312.13	292.21	273.91	263.18	269.2	280.52	300.5	322.72	339.3	(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	0.55	x	11.28	x	0.76	x	0.7	=	2.29	(75)
Northeast 0.9x	0.77	x	0.55	x	22.97	x	0.76	x	0.7	=	4.66	(75)
Northeast 0.9x	0.77	x	0.55	x	41.38	x	0.76	x	0.7	=	8.39	(75)
Northeast 0.9x	0.77	x	0.55	x	67.96	x	0.76	x	0.7	=	13.78	(75)
Northeast 0.9x	0.77	x	0.55	x	91.35	x	0.76	x	0.7	=	18.52	(75)

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Northeast 0.9x	0.77	x	0.55	x	97.38	x	0.76	x	0.7	=	19.75	(75)
Northeast 0.9x	0.77	x	0.55	x	91.1	x	0.76	x	0.7	=	18.47	(75)
Northeast 0.9x	0.77	x	0.55	x	72.63	x	0.76	x	0.7	=	14.73	(75)
Northeast 0.9x	0.77	x	0.55	x	50.42	x	0.76	x	0.7	=	10.22	(75)
Northeast 0.9x	0.77	x	0.55	x	28.07	x	0.76	x	0.7	=	5.69	(75)
Northeast 0.9x	0.77	x	0.55	x	14.2	x	0.76	x	0.7	=	2.88	(75)
Northeast 0.9x	0.77	x	0.55	x	9.21	x	0.76	x	0.7	=	1.87	(75)
Southwest 0.9x	0.77	x	0.55	x	36.79		0.76	x	0.7	=	7.46	(79)
Southwest 0.9x	0.77	x	0.55	x	62.67		0.76	x	0.7	=	12.71	(79)
Southwest 0.9x	0.77	x	0.55	x	85.75		0.76	x	0.7	=	17.39	(79)
Southwest 0.9x	0.77	x	0.55	x	106.25		0.76	x	0.7	=	21.54	(79)
Southwest 0.9x	0.77	x	0.55	x	119.01		0.76	x	0.7	=	24.13	(79)
Southwest 0.9x	0.77	x	0.55	x	118.15		0.76	x	0.7	=	23.96	(79)
Southwest 0.9x	0.77	x	0.55	x	113.91		0.76	x	0.7	=	23.1	(79)
Southwest 0.9x	0.77	x	0.55	x	104.39		0.76	x	0.7	=	21.17	(79)
Southwest 0.9x	0.77	x	0.55	x	92.85		0.76	x	0.7	=	18.83	(79)
Southwest 0.9x	0.77	x	0.55	x	69.27		0.76	x	0.7	=	14.05	(79)
Southwest 0.9x	0.77	x	0.55	x	44.07		0.76	x	0.7	=	8.94	(79)
Southwest 0.9x	0.77	x	0.55	x	31.49		0.76	x	0.7	=	6.38	(79)
Northwest 0.9x	0.77	x	8.25	x	11.28	x	0.76	x	0.7	=	34.32	(81)
Northwest 0.9x	0.77	x	8.25	x	22.97	x	0.76	x	0.7	=	69.86	(81)
Northwest 0.9x	0.77	x	8.25	x	41.38	x	0.76	x	0.7	=	125.86	(81)
Northwest 0.9x	0.77	x	8.25	x	67.96	x	0.76	x	0.7	=	206.69	(81)
Northwest 0.9x	0.77	x	8.25	x	91.35	x	0.76	x	0.7	=	277.84	(81)
Northwest 0.9x	0.77	x	8.25	x	97.38	x	0.76	x	0.7	=	296.2	(81)
Northwest 0.9x	0.77	x	8.25	x	91.1	x	0.76	x	0.7	=	277.09	(81)
Northwest 0.9x	0.77	x	8.25	x	72.63	x	0.76	x	0.7	=	220.9	(81)
Northwest 0.9x	0.77	x	8.25	x	50.42	x	0.76	x	0.7	=	153.36	(81)
Northwest 0.9x	0.77	x	8.25	x	28.07	x	0.76	x	0.7	=	85.37	(81)
Northwest 0.9x	0.77	x	8.25	x	14.2	x	0.76	x	0.7	=	43.18	(81)
Northwest 0.9x	0.77	x	8.25	x	9.21	x	0.76	x	0.7	=	28.03	(81)

Solar gains in watts, calculated for each month

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

(83)m= 44.07 87.22 151.64 242.02 320.49 339.91 318.66 256.79 182.41 105.11 55 36.28 (83)

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

(84)m= 392.22 432.19 483.59 554.15 612.7 613.82 581.84 525.99 462.93 405.61 377.72 375.58 (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=	0.99	0.98	0.97	0.93	0.85	0.71	0.58	0.64	0.84	0.95	0.98	0.99

(86)

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

(87)m= 18.8 18.99 19.37 19.93 20.43 20.79 20.92 20.89 20.6 19.98 19.33 18.8 (87)

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

(88)m=	19.17	19.17	19.18	19.22	19.23	19.26	19.26	19.27	19.25	19.23	19.21	19.2	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.98	0.96	0.9	0.78	0.58	0.38	0.44	0.74	0.93	0.97	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.29	17.48	17.86	18.43	18.88	19.18	19.25	19.24	19.05	18.49	17.84	17.31	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.41 \quad (91)$$

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

(92)m=	17.91	18.11	18.48	19.05	19.52	19.84	19.94	19.92	19.69	19.1	18.45	17.93	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

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

(93)m=	17.91	18.11	18.48	19.05	19.52	19.84	19.94	19.92	19.69	19.1	18.45	17.93	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.98	0.97	0.95	0.9	0.8	0.63	0.46	0.52	0.77	0.93	0.97	0.98	(94)
--------	------	------	------	-----	-----	------	------	------	------	------	------	------	------

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

(95)m=	384.12	419.74	460.02	498.74	488.51	386.5	268.56	275.34	358.36	375.47	366.22	368.78	(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=	1239	1195.13	1078.51	889.25	681.82	446.23	284.08	298.56	480.37	741.26	1000.11	1221.98	(97)
--------	------	---------	---------	--------	--------	--------	--------	--------	--------	--------	---------	---------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	636.03	521.06	460.15	281.16	143.82	0	0	0	0	272.15	456.4	634.78	(98)
--------	--------	--------	--------	--------	--------	---	---	---	---	--------	-------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 3405.57 \quad (98)$$

Space heating requirement in kWh/m²/year

$$84.51 \quad (99)$$

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

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

$$1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

$$1 \quad (204)$$

Efficiency of main space heating system 1

$$88.8 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

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

kWh/year

Space heating requirement (calculated above)

636.03	521.06	460.15	281.16	143.82	0	0	0	0	272.15	456.4	634.78
--------	--------	--------	--------	--------	---	---	---	---	--------	-------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

716.26	586.78	518.19	316.63	161.96	0	0	0	0	306.48	513.96	714.85
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 3835.1 \quad (211)$$

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

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

SAP WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

148.58	129.79	135.04	119.77	115.96	102.13	97.85	109.08	110.29	125.58	134.06	145.09
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------

Efficiency of water heater

79.5 (216)

(217)m= 86.88 86.78 86.5 85.8 84.39 79.5 79.5 79.5 79.5 85.64 86.5 86.91 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

171.03	149.57	156.11	139.59	137.41	128.47	123.08	137.21	138.72	146.65	154.97	166.95
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

1749.77 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

3835.1

Water heating fuel used

1749.77

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75 (231)

Electricity for lighting

192.53 (232)

Electricity generated by PVs

-922.15 (233)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

4930.26 (238)

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 =	133.46 (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 =	60.89 (247)
Pumps, fans and electric keep-hot	(231)	13.19 x 0.01 =	9.89 (249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a			
Energy for lighting	(232)	13.19 x 0.01 =	25.4 (250)
Additional standing charges (Table 12)			120 (251)
	one of (233) to (235) x	13.19 x 0.01 =	-121.63 (252)

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

Total energy cost

(245)...(247) + (250)...(254) =

228.01 (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] =

1.12 (257)

SAP rating (Section 12)

84.34 (258)

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

SAP WorkSheet: New dwelling design stage

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	828.38 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	377.95 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1206.33 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93 (267)
Electricity for lighting	(232) x	0.519	=	99.93 (268)
Energy saving/generation technologies Item 1		0.519	=	-478.6 (269)
Total CO2, kg/year		sum of (265)...(271) =		866.59 (272)
CO2 emissions per m²		(272) ÷ (4) =		21.5 (273)
El rating (section 14)				86 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year
Space heating (main system 1)	(211) x	1.22	=	4678.83 (261)
Space heating (secondary)	(215) x	3.07	=	0 (263)
Energy for water heating	(219) x	1.22	=	2134.72 (264)
Space and water heating	(261) + (262) + (263) + (264) =			6813.54 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25 (267)
Electricity for lighting	(232) x	0	=	591.08 (268)
Energy saving/generation technologies Item 1		3.07	=	-2831 (269)
'Total Primary Energy		sum of (265)...(271) =		4803.87 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =		119.2 (273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.60

Property Address: DE2407 (Base CO2)

Address : Flat 7, 8 Southey Road, Worthing, BN11 3HT

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	54.2 (1a)	2.25 (2a)	121.95 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.2 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	121.95 (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				2	20 (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) =	0.16 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

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)

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

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 15 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.91 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 4 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.7 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.64 (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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SAP WorkSheet: New dwelling design stage

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

0.82	0.8	0.78	0.7	0.69	0.61	0.61	0.59	0.64	0.69	0.72	0.75
------	-----	------	-----	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x 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) x [1 - (23c) ÷ 100]

(24a)m= 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 (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 (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= 0.83 0.82 0.81 0.75 0.74 0.68 0.68 0.68 0.7 0.74 0.76 0.78 (24d)

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

(25)m= 0.83 0.82 0.81 0.75 0.74 0.68 0.68 0.68 0.7 0.74 0.76 0.78 (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
Windows Type 1			0.9	$\times 1/[1/(2.7) + 0.04] =$	2.19		(27)
Windows Type 2			4.05	$\times 1/[1/(2.7) + 0.04] =$	9.87		(27)
Windows Type 3			2.65	$\times 1/[1/(1.4) + 0.04] =$	3.51		(27)
Walls	29.3	7.6	21.7	x 0.55 =	11.93		(29)
Roof	54.2	0	54.2	x 0.16 =	8.67		(30)
Total area of elements, m²			83.5				(31)

* 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) = 36.18 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 3742.8 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 12.53 (36)

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

Total fabric heat loss (33) + (36) = 48.71 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	33.51	32.99	32.48	30.09	29.64	27.56	27.56	27.17	28.36	29.64	30.55	31.49

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

(39)m=	82.22	81.7	81.19	78.8	78.35	76.26	76.26	75.88	77.07	78.35	79.25	80.2
Average = Sum(39) _{1...12} /12=												78.79 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.52	1.51	1.5	1.45	1.45	1.41	1.41	1.4	1.42	1.45	1.46	1.48		
Average = Sum(40) _{1...12} /12=													1.45	(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

1.81

(42)

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

if TFA ≤ 13.9, N = 1

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

77.28

(43)

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

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

(44)m=	85.01	81.92	78.83	75.73	72.64	69.55	69.55	72.64	75.73	78.83	81.92	85.01		
Total = Sum(44) _{1...12} =													927.36	(44)

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

(45)m=	126.06	110.26	113.77	99.19	95.18	82.13	76.11	87.33	88.38	102.99	112.42	122.09		
Total = Sum(45) _{1...12} =													1215.91	(45)

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

(46)m=	18.91	16.54	17.07	14.88	14.28	12.32	11.42	13.1	13.26	15.45	16.86	18.31		(46)
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Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

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

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m 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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

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

(61)m=	43.32	37.7	40.17	37.35	37.02	34.3	35.44	37.02	37.35	40.17	40.4	43.32	(61)
--------	-------	------	-------	-------	-------	------	-------	-------	-------	-------	------	-------	------

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

(62)m=	169.38	147.96	153.94	136.54	132.19	116.43	111.55	124.35	125.72	143.16	152.82	165.41	(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=	169.38	147.96	153.94	136.54	132.19	116.43	111.55	124.35	125.72	143.16	152.82	165.41	
Output from water heater (annual) _{1...12}												1679.46	(64)

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

(65)m=	52.75	46.09	47.87	42.32	40.9	35.88	34.17	38.29	38.72	44.29	47.48	51.42	(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=	108.83	108.83	108.83	108.83	108.83	108.83	108.83	108.83	108.83	108.83	108.83	108.83	(66)

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

(67)m=	37.79	33.57	27.3	20.67	15.45	13.04	14.09	18.32	24.59	31.22	36.44	38.85	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	236	238.45	232.28	219.14	202.56	186.97	176.56	174.11	180.28	193.42	210	225.59	(68)
--------	-----	--------	--------	--------	--------	--------	--------	--------	--------	--------	-----	--------	------

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

(69)m=	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	70.9	68.58	64.34	58.78	54.97	49.84	45.92	51.47	53.78	59.53	65.95	69.12	(72)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	431.67	427.58	410.9	385.56	359.96	336.83	323.55	330.87	345.62	371.14	399.36	420.53	(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)	
South	0.9x	0.77	x	0.9	x	46.75	x	0.76	x	0.7	=	15.51 (78)
South	0.9x	0.77	x	0.9	x	76.57	x	0.76	x	0.7	=	25.41 (78)
South	0.9x	0.77	x	0.9	x	97.53	x	0.76	x	0.7	=	32.36 (78)
South	0.9x	0.77	x	0.9	x	110.23	x	0.76	x	0.7	=	36.58 (78)
South	0.9x	0.77	x	0.9	x	114.87	x	0.76	x	0.7	=	38.12 (78)

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South	0.9x	0.77	x	0.9	x	110.55	x	0.76	x	0.7	=	36.68	(78)
South	0.9x	0.77	x	0.9	x	108.01	x	0.76	x	0.7	=	35.84	(78)
South	0.9x	0.77	x	0.9	x	104.89	x	0.76	x	0.7	=	34.8	(78)
South	0.9x	0.77	x	0.9	x	101.89	x	0.76	x	0.7	=	33.81	(78)
South	0.9x	0.77	x	0.9	x	82.59	x	0.76	x	0.7	=	27.4	(78)
South	0.9x	0.77	x	0.9	x	55.42	x	0.76	x	0.7	=	18.39	(78)
South	0.9x	0.77	x	0.9	x	40.4	x	0.76	x	0.7	=	13.4	(78)
Southwest	0.9x	0.77	x	4.05	x	36.79		0.76	x	0.7	=	54.94	(79)
Southwest	0.9x	0.77	x	2.65	x	36.79		0.63	x	0.7	=	29.8	(79)
Southwest	0.9x	0.77	x	4.05	x	62.67		0.76	x	0.7	=	93.58	(79)
Southwest	0.9x	0.77	x	2.65	x	62.67		0.63	x	0.7	=	50.76	(79)
Southwest	0.9x	0.77	x	4.05	x	85.75		0.76	x	0.7	=	128.04	(79)
Southwest	0.9x	0.77	x	2.65	x	85.75		0.63	x	0.7	=	69.45	(79)
Southwest	0.9x	0.77	x	4.05	x	106.25		0.76	x	0.7	=	158.65	(79)
Southwest	0.9x	0.77	x	2.65	x	106.25		0.63	x	0.7	=	86.05	(79)
Southwest	0.9x	0.77	x	4.05	x	119.01		0.76	x	0.7	=	177.7	(79)
Southwest	0.9x	0.77	x	2.65	x	119.01		0.63	x	0.7	=	96.38	(79)
Southwest	0.9x	0.77	x	4.05	x	118.15		0.76	x	0.7	=	176.41	(79)
Southwest	0.9x	0.77	x	2.65	x	118.15		0.63	x	0.7	=	95.69	(79)
Southwest	0.9x	0.77	x	4.05	x	113.91		0.76	x	0.7	=	170.08	(79)
Southwest	0.9x	0.77	x	2.65	x	113.91		0.63	x	0.7	=	92.25	(79)
Southwest	0.9x	0.77	x	4.05	x	104.39		0.76	x	0.7	=	155.87	(79)
Southwest	0.9x	0.77	x	2.65	x	104.39		0.63	x	0.7	=	84.54	(79)
Southwest	0.9x	0.77	x	4.05	x	92.85		0.76	x	0.7	=	138.64	(79)
Southwest	0.9x	0.77	x	2.65	x	92.85		0.63	x	0.7	=	75.2	(79)
Southwest	0.9x	0.77	x	4.05	x	69.27		0.76	x	0.7	=	103.43	(79)
Southwest	0.9x	0.77	x	2.65	x	69.27		0.63	x	0.7	=	56.1	(79)
Southwest	0.9x	0.77	x	4.05	x	44.07		0.76	x	0.7	=	65.8	(79)
Southwest	0.9x	0.77	x	2.65	x	44.07		0.63	x	0.7	=	35.69	(79)
Southwest	0.9x	0.77	x	4.05	x	31.49		0.76	x	0.7	=	47.02	(79)
Southwest	0.9x	0.77	x	2.65	x	31.49		0.63	x	0.7	=	25.5	(79)

Solar gains in watts, calculated for each month

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

(83)m= 100.25 169.74 229.85 281.28 312.2 308.78 298.17 275.22 247.65 186.93 119.88 85.92 (83)

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

(84)m= 531.92 597.32 640.75 666.84 672.15 645.61 621.72 606.09 593.27 558.07 519.24 506.45 (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=	0.99	0.98	0.96	0.92	0.84	0.68	0.52	0.55	0.76	0.93	0.98	0.99

(86)

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

(87)m= 19.62 19.81 20.08 20.44 20.73 20.92 20.98 20.98 20.87 20.51 20.03 19.62 (87)

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

(88)m=	19.67	19.68	19.69	19.72	19.73	19.76	19.76	19.76	19.75	19.73	19.72	19.7	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

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

(89)m=	0.98	0.97	0.95	0.89	0.78	0.58	0.38	0.42	0.67	0.89	0.97	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	18.47	18.66	18.93	19.3	19.56	19.73	19.75	19.76	19.68	19.37	18.9	18.49	(90)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------	-------	------

$$fLA = \text{Living area} \div (4) = 0.65 \quad (91)$$

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

(92)m=	19.22	19.41	19.68	20.05	20.32	20.51	20.56	20.55	20.46	20.11	19.63	19.22	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	19.22	19.41	19.68	20.05	20.32	20.51	20.56	20.55	20.46	20.11	19.63	19.22	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.98	0.97	0.95	0.9	0.81	0.64	0.47	0.5	0.73	0.9	0.97	0.98	(94)
--------	------	------	------	-----	------	------	------	-----	------	-----	------	------	------

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

(95)m=	521.57	578.55	606.74	600.12	544.32	416.35	294.52	305.8	430.37	504.68	502.03	498.16	(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=	1226.94	1185.56	1070.48	878.21	675.54	450.53	301.65	315.14	489.98	745.47	993.45	1204.96	(97)
--------	---------	---------	---------	--------	--------	--------	--------	--------	--------	--------	--------	---------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	524.79	407.91	345.02	200.23	97.63	0	0	0	0	179.15	353.82	525.86	(98)
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 2634.41 \quad (98)$$

Space heating requirement in kWh/m²/year

$$48.61 \quad (99)$$

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

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$88.8 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

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

kWh/year

Space heating requirement (calculated above)

524.79	407.91	345.02	200.23	97.63	0	0	0	0	179.15	353.82	525.86
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

590.98	459.36	388.54	225.48	109.94	0	0	0	0	201.74	398.44	592.19
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 2966.68 \quad (211)$$

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

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

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Water heating

Output from water heater (calculated above)

169.38	147.96	153.94	136.54	132.19	116.43	111.55	124.35	125.72	143.16	152.82	165.41
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

79.5 (216)

(217)m= 86.34 86.12 85.71 84.78 83.2 79.5 79.5 79.5 79.5 84.41 85.77 86.38 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

196.19	171.81	179.62	161.05	158.88	146.45	140.31	156.42	158.14	169.59	178.17	191.48
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Total = Sum(219a)_{1..12} = 2008.13 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

2966.68

Water heating fuel used

2008.13

Electricity for pumps, fans and electric keep-hot

central heating pump:

30

(230c)

boiler with a fan-assisted flue

45

(230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 75 (231)

Electricity for lighting

266.99

(232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

5316.79 (238)

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 =	103.24 (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 =	69.88 (247)
Pumps, fans and electric keep-hot	(231)	13.19 x 0.01 =	9.89 (249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a)			
Energy for lighting	(232)	13.19 x 0.01 =	35.22 (250)
Additional standing charges (Table 12)			120 (251)

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

Total energy cost (245)...(247) + (250)...(254) = 338.23 (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] =	1.43 (257)
SAP rating (Section 12)	80.02 (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	0.216	=	640.8	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	433.76	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1074.56	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	138.57	(268)
Total CO ₂ , kg/year		sum of (265)...(271) =		1252.05	(272)
CO₂ emissions per m²		(272) ÷ (4) =		23.1	(273)
El rating (section 14)				83	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3619.34	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2449.91	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6069.26	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	819.65	(268)
Total Primary Energy		sum of (265)...(271) =		7119.16	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		131.35	(273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.60

Property Address: DE2407 (Actual CO2)

Address : Flat 7, 8 Southey Road, Worthing, BN11 3HT

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	54.2 (1a)	2.25 (2a)	121.95 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.2 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	121.95 (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				2	20 (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) =	0.16 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

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)

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

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 15 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.91 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 4 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.7 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.64 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

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

0.82	0.8	0.78	0.7	0.69	0.61	0.61	0.59	0.64	0.69	0.72	0.75
------	-----	------	-----	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x 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) x [1 - (23c) ÷ 100]

(24a)m= 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 (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 (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= 0.83 0.82 0.81 0.75 0.74 0.68 0.68 0.68 0.7 0.74 0.76 0.78 (24d)

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

(25)m= 0.83 0.82 0.81 0.75 0.74 0.68 0.68 0.68 0.7 0.74 0.76 0.78 (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
Windows Type 1			0.9	$\times 1/[1/(2.7) + 0.04] =$	2.19		
Windows Type 2			4.05	$\times 1/[1/(2.7) + 0.04] =$	9.87		
Windows Type 3			2.65	$\times 1/[1/(1.4) + 0.04] =$	3.51		
Walls	29.3	7.6	21.7	x 0.55	11.93		
Roof	54.2	0	54.2	x 0.16	8.67		
Total area of elements, m²			83.5				

* 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) = 36.18 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 3742.8 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 12.53 (36)

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

Total fabric heat loss (33) + (36) = 48.71 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	33.51	32.99	32.48	30.09	29.64	27.56	27.56	27.17	28.36	29.64	30.55	31.49

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

(39)m=	82.22	81.7	81.19	78.8	78.35	76.26	76.26	75.88	77.07	78.35	79.25	80.2
Average = Sum(39) _{1...12} /12=												78.79

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.52	1.51	1.5	1.45	1.45	1.41	1.41	1.4	1.42	1.45	1.46	1.48		
Average = Sum(40) _{1...12} /12=													1.45	(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

1.81

(42)

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

if TFA ≤ 13.9, N = 1

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

77.28

(43)

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

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

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

(44)m=	85.01	81.92	78.83	75.73	72.64	69.55	69.55	72.64	75.73	78.83	81.92	85.01		
Total = Sum(44) _{1...12} =													927.36	(44)

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

(45)m=	126.06	110.26	113.77	99.19	95.18	82.13	76.11	87.33	88.38	102.99	112.42	122.09		
Total = Sum(45) _{1...12} =													1215.91	(45)

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

(46)m=	18.91	16.54	17.07	14.88	14.28	12.32	11.42	13.1	13.26	15.45	16.86	18.31		(46)
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Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

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

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m 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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

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

(61)m=	43.32	37.7	40.17	37.35	37.02	34.3	35.44	37.02	37.35	40.17	40.4	43.32	(61)
--------	-------	------	-------	-------	-------	------	-------	-------	-------	-------	------	-------	------

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

(62)m=	169.38	147.96	153.94	136.54	132.19	116.43	111.55	124.35	125.72	143.16	152.82	165.41	(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=	169.38	147.96	153.94	136.54	132.19	116.43	111.55	124.35	125.72	143.16	152.82	165.41	
Output from water heater (annual) _{1...12}												1679.46	(64)

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

(65)m=	52.75	46.09	47.87	42.32	40.9	35.88	34.17	38.29	38.72	44.29	47.48	51.42	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	108.83	108.83	108.83	108.83	108.83	108.83	108.83	108.83	108.83	108.83	108.83	108.83	(66)

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

(67)m=	37.79	33.57	27.3	20.67	15.45	13.04	14.09	18.32	24.59	31.22	36.44	38.85	(67)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(68)m=	236	238.45	232.28	219.14	202.56	186.97	176.56	174.11	180.28	193.42	210	225.59	(68)
--------	-----	--------	--------	--------	--------	--------	--------	--------	--------	--------	-----	--------	------

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

(69)m=	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	70.9	68.58	64.34	58.78	54.97	49.84	45.92	51.47	53.78	59.53	65.95	69.12	(72)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	431.67	427.58	410.9	385.56	359.96	336.83	323.55	330.87	345.62	371.14	399.36	420.53	(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)	
South	0.9x	0.77	x	0.9	x	46.75	x	0.76	x	0.7	=	15.51 (78)
South	0.9x	0.77	x	0.9	x	76.57	x	0.76	x	0.7	=	25.41 (78)
South	0.9x	0.77	x	0.9	x	97.53	x	0.76	x	0.7	=	32.36 (78)
South	0.9x	0.77	x	0.9	x	110.23	x	0.76	x	0.7	=	36.58 (78)
South	0.9x	0.77	x	0.9	x	114.87	x	0.76	x	0.7	=	38.12 (78)

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South	0.9x	0.77	x	0.9	x	110.55	x	0.76	x	0.7	=	36.68	(78)
South	0.9x	0.77	x	0.9	x	108.01	x	0.76	x	0.7	=	35.84	(78)
South	0.9x	0.77	x	0.9	x	104.89	x	0.76	x	0.7	=	34.8	(78)
South	0.9x	0.77	x	0.9	x	101.89	x	0.76	x	0.7	=	33.81	(78)
South	0.9x	0.77	x	0.9	x	82.59	x	0.76	x	0.7	=	27.4	(78)
South	0.9x	0.77	x	0.9	x	55.42	x	0.76	x	0.7	=	18.39	(78)
South	0.9x	0.77	x	0.9	x	40.4	x	0.76	x	0.7	=	13.4	(78)
Southwest	0.9x	0.77	x	4.05	x	36.79		0.76	x	0.7	=	54.94	(79)
Southwest	0.9x	0.77	x	2.65	x	36.79		0.63	x	0.7	=	29.8	(79)
Southwest	0.9x	0.77	x	4.05	x	62.67		0.76	x	0.7	=	93.58	(79)
Southwest	0.9x	0.77	x	2.65	x	62.67		0.63	x	0.7	=	50.76	(79)
Southwest	0.9x	0.77	x	4.05	x	85.75		0.76	x	0.7	=	128.04	(79)
Southwest	0.9x	0.77	x	2.65	x	85.75		0.63	x	0.7	=	69.45	(79)
Southwest	0.9x	0.77	x	4.05	x	106.25		0.76	x	0.7	=	158.65	(79)
Southwest	0.9x	0.77	x	2.65	x	106.25		0.63	x	0.7	=	86.05	(79)
Southwest	0.9x	0.77	x	4.05	x	119.01		0.76	x	0.7	=	177.7	(79)
Southwest	0.9x	0.77	x	2.65	x	119.01		0.63	x	0.7	=	96.38	(79)
Southwest	0.9x	0.77	x	4.05	x	118.15		0.76	x	0.7	=	176.41	(79)
Southwest	0.9x	0.77	x	2.65	x	118.15		0.63	x	0.7	=	95.69	(79)
Southwest	0.9x	0.77	x	4.05	x	113.91		0.76	x	0.7	=	170.08	(79)
Southwest	0.9x	0.77	x	2.65	x	113.91		0.63	x	0.7	=	92.25	(79)
Southwest	0.9x	0.77	x	4.05	x	104.39		0.76	x	0.7	=	155.87	(79)
Southwest	0.9x	0.77	x	2.65	x	104.39		0.63	x	0.7	=	84.54	(79)
Southwest	0.9x	0.77	x	4.05	x	92.85		0.76	x	0.7	=	138.64	(79)
Southwest	0.9x	0.77	x	2.65	x	92.85		0.63	x	0.7	=	75.2	(79)
Southwest	0.9x	0.77	x	4.05	x	69.27		0.76	x	0.7	=	103.43	(79)
Southwest	0.9x	0.77	x	2.65	x	69.27		0.63	x	0.7	=	56.1	(79)
Southwest	0.9x	0.77	x	4.05	x	44.07		0.76	x	0.7	=	65.8	(79)
Southwest	0.9x	0.77	x	2.65	x	44.07		0.63	x	0.7	=	35.69	(79)
Southwest	0.9x	0.77	x	4.05	x	31.49		0.76	x	0.7	=	47.02	(79)
Southwest	0.9x	0.77	x	2.65	x	31.49		0.63	x	0.7	=	25.5	(79)

Solar gains in watts, calculated for each month

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

(83)m= 100.25 169.74 229.85 281.28 312.2 308.78 298.17 275.22 247.65 186.93 119.88 85.92 (83)

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

(84)m= 531.92 597.32 640.75 666.84 672.15 645.61 621.72 606.09 593.27 558.07 519.24 506.45 (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=	0.99	0.98	0.96	0.92	0.84	0.68	0.52	0.55	0.76	0.93	0.98	0.99

(86)

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

(87)m= 19.62 19.81 20.08 20.44 20.73 20.92 20.98 20.98 20.87 20.51 20.03 19.62 (87)

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

(88)m=	19.67	19.68	19.69	19.72	19.73	19.76	19.76	19.76	19.75	19.73	19.72	19.7	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

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

(89)m=	0.98	0.97	0.95	0.89	0.78	0.58	0.38	0.42	0.67	0.89	0.97	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	18.47	18.66	18.93	19.3	19.56	19.73	19.75	19.76	19.68	19.37	18.9	18.49	(90)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------	-------	------

$$fLA = \text{Living area} \div (4) = 0.65 \quad (91)$$

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

(92)m=	19.22	19.41	19.68	20.05	20.32	20.51	20.56	20.55	20.46	20.11	19.63	19.22	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	19.22	19.41	19.68	20.05	20.32	20.51	20.56	20.55	20.46	20.11	19.63	19.22	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.98	0.97	0.95	0.9	0.81	0.64	0.47	0.5	0.73	0.9	0.97	0.98	(94)
--------	------	------	------	-----	------	------	------	-----	------	-----	------	------	------

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

(95)m=	521.57	578.55	606.74	600.12	544.32	416.35	294.52	305.8	430.37	504.68	502.03	498.16	(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=	1226.94	1185.56	1070.48	878.21	675.54	450.53	301.65	315.14	489.98	745.47	993.45	1204.96	(97)
--------	---------	---------	---------	--------	--------	--------	--------	--------	--------	--------	--------	---------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	524.79	407.91	345.02	200.23	97.63	0	0	0	0	179.15	353.82	525.86	(98)
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 2634.41 \quad (98)$$

Space heating requirement in kWh/m²/year

$$48.61 \quad (99)$$

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

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$88.8 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

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

Space heating requirement (calculated above)

524.79	407.91	345.02	200.23	97.63	0	0	0	0	179.15	353.82	525.86
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

590.98	459.36	388.54	225.48	109.94	0	0	0	0	201.74	398.44	592.19
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 2966.68 \quad (211)$$

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

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

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Water heating

Output from water heater (calculated above)

169.38	147.96	153.94	136.54	132.19	116.43	111.55	124.35	125.72	143.16	152.82	165.41
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

79.5 (216)

(217)m= 86.34 86.12 85.71 84.78 83.2 79.5 79.5 79.5 79.5 84.41 85.77 86.38 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

196.19	171.81	179.62	161.05	158.88	146.45	140.31	156.42	158.14	169.59	178.17	191.48
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Total = Sum(219a)_{1...12} = 2008.13 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

2966.68

Water heating fuel used

2008.13

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 75 (231)

Electricity for lighting

266.99 (232)

Electricity generated by PVs

-922.15 (233)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

4394.64 (238)

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 =	103.24 (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 =	69.88 (247)
Pumps, fans and electric keep-hot	(231)	13.19 x 0.01 =	9.89 (249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a			
Energy for lighting	(232)	13.19 x 0.01 =	35.22 (250)
Additional standing charges (Table 12)			120 (251)
	one of (233) to (235) x	13.19 x 0.01 =	-121.63 (252)

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

Total energy cost (245)...(247) + (250)...(254) = 216.6 (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] = 0.92 (257)

SAP rating (Section 12) 87.21 (258)

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

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	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	640.8 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	433.76 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1074.56 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93 (267)
Electricity for lighting	(232) x	0.519	=	138.57 (268)
Energy saving/generation technologies Item 1		0.519	=	-478.6 (269)
Total CO2, kg/year		sum of (265)...(271) =		773.45 (272)
CO2 emissions per m²		(272) ÷ (4) =		14.27 (273)
El rating (section 14)				90 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year
Space heating (main system 1)	(211) x	1.22	=	3619.34 (261)
Space heating (secondary)	(215) x	3.07	=	0 (263)
Energy for water heating	(219) x	1.22	=	2449.91 (264)
Space and water heating	(261) + (262) + (263) + (264) =			6069.26 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25 (267)
Electricity for lighting	(232) x	0	=	819.65 (268)
Energy saving/generation technologies Item 1		3.07	=	-2831 (269)
Total Primary Energy		sum of (265)...(271) =		4288.15 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =		79.12 (273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.60

Property Address: DE2408 (Base CO2)

Address : Flat 8, 8 Southey Road, Worthing, BN11 3HT

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	43.3 (1a)	2.25 (2a)	97.42 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	43.3 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	97.42 (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				2	20 (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) =	20 ÷ (5) = 0.21 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

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)

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

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 15 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.96 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 4 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.7 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.67 (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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SAP WorkSheet: New dwelling design stage

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

0.85	0.84	0.82	0.74	0.72	0.64	0.64	0.62	0.67	0.72	0.75	0.79
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x 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) x [1 - (23c) ÷ 100]

(24a)m= 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 (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 (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= 0.86 0.85 0.84 0.77 0.76 0.7 0.7 0.69 0.72 0.76 0.78 0.81 (24d)

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

(25)m= 0.86 0.85 0.84 0.77 0.76 0.7 0.7 0.69 0.72 0.76 0.78 0.81 (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
Windows Type 1			0.9	$\times 1/[1/(2.7) + 0.04] =$	2.19		(27)
Windows Type 2			1.3	$\times 1/[1/(2.7) + 0.04] =$	3.17		(27)
Windows Type 3			5.3	$\times 1/[1/(1.4) + 0.04] =$	7.03		(27)
Windows Type 4			1.3	$\times 1/[1/(1.4) + 0.04] =$	1.72		(27)
Walls	55.6	8.8	46.8	x 0.55 =	25.74		(29)
Roof	43.3	0	43.3	x 0.16 =	6.93		(30)
Total area of elements, m²			98.9				(31)

* 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) = 46.78 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7409.7 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 14.84 (36)

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

Total fabric heat loss (33) + (36) = 61.61 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	27.76	27.31	26.86	24.77	24.38	22.56	22.56	22.23	23.26	24.38	25.17	26

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

(39)m=	89.37	88.92	88.48	86.39	86	84.18	84.18	83.84	84.88	86	86.79	87.61
Average = Sum(39) _{1...12} /12=												86.38 (39)

SAP WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	2.06	2.05	2.04	2	1.99	1.94	1.94	1.94	1.96	1.99	2	2.02		
Average = Sum(40) _{1...12} /12=													2	(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

1.5

(42)

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

if TFA ≤ 13.9, N = 1

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

69.74

(43)

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

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

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

(44)m=	76.72	73.93	71.14	68.35	65.56	62.77	62.77	65.56	68.35	71.14	73.93	76.72		
Total = Sum(44) _{1...12} =													836.92	(44)

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

(45)m=	113.77	99.5	102.68	89.52	85.89	74.12	68.68	78.82	79.76	92.95	101.46	110.18		
Total = Sum(45) _{1...12} =													1097.33	(45)

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

(46)m=	17.07	14.93	15.4	13.43	12.88	11.12	10.3	11.82	11.96	13.94	15.22	16.53		(46)
--------	-------	-------	------	-------	-------	-------	------	-------	-------	-------	-------	-------	--	------

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

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

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m 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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

SAP WorkSheet: New dwelling design stage

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

(61)m=	39.09	34.03	36.25	33.71	33.41	30.95	31.99	33.41	33.71	36.25	36.46	39.09	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(62)m=	152.86	133.53	138.93	123.22	119.3	105.07	100.67	112.22	113.46	129.2	137.92	149.27	(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=	152.86	133.53	138.93	123.22	119.3	105.07	100.67	112.22	113.46	129.2	137.92	149.27	
Output from water heater (annual) _{1...12}												1515.67	(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=	47.6	41.59	43.2	38.19	36.91	32.38	30.83	34.56	34.95	39.97	42.85	46.41	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	89.79	89.79	89.79	89.79	89.79	89.79	89.79	89.79	89.79	89.79	89.79	89.79	(66)

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

(67)m=	29.11	25.86	21.03	15.92	11.9	10.05	10.86	14.11	18.94	24.05	28.07	29.92	(67)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

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

(68)m=	193.9	195.91	190.84	180.05	166.42	153.62	145.06	143.05	148.12	158.91	172.54	185.34	(68)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	45.48	45.48	45.48	45.48	45.48	45.48	45.48	45.48	45.48	45.48	45.48	45.48	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-59.86	-59.86	-59.86	-59.86	-59.86	-59.86	-59.86	-59.86	-59.86	-59.86	-59.86	-59.86	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	63.98	61.89	58.07	53.04	49.61	44.98	41.44	46.45	48.54	53.72	59.51	62.38	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	365.4	362.07	348.35	327.42	306.34	287.05	275.77	282.01	294	315.09	338.53	356.05	(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)	
North	0.9x	0.77	x	0.9	x	10.63	x	0.76	x	0.7	=	3.53	(74)
North	0.9x	0.77	x	0.9	x	20.32	x	0.76	x	0.7	=	6.74	(74)
North	0.9x	0.77	x	0.9	x	34.53	x	0.76	x	0.7	=	11.46	(74)
North	0.9x	0.77	x	0.9	x	55.46	x	0.76	x	0.7	=	18.4	(74)
North	0.9x	0.77	x	0.9	x	74.72	x	0.76	x	0.7	=	24.79	(74)

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North	0.9x	0.77	x	0.9	x	79.99	x	0.76	x	0.7	=	26.54	(74)
North	0.9x	0.77	x	0.9	x	74.68	x	0.76	x	0.7	=	24.78	(74)
North	0.9x	0.77	x	0.9	x	59.25	x	0.76	x	0.7	=	19.66	(74)
North	0.9x	0.77	x	0.9	x	41.52	x	0.76	x	0.7	=	13.78	(74)
North	0.9x	0.77	x	0.9	x	24.19	x	0.76	x	0.7	=	8.03	(74)
North	0.9x	0.77	x	0.9	x	13.12	x	0.76	x	0.7	=	4.35	(74)
North	0.9x	0.77	x	0.9	x	8.86	x	0.76	x	0.7	=	2.94	(74)
East	0.9x	0.77	x	5.3	x	19.64	x	0.63	x	0.7	=	31.81	(76)
East	0.9x	0.77	x	1.3	x	19.64	x	0.63	x	0.7	=	7.8	(76)
East	0.9x	0.77	x	5.3	x	38.42	x	0.63	x	0.7	=	62.23	(76)
East	0.9x	0.77	x	1.3	x	38.42	x	0.63	x	0.7	=	15.26	(76)
East	0.9x	0.77	x	5.3	x	63.27	x	0.63	x	0.7	=	102.49	(76)
East	0.9x	0.77	x	1.3	x	63.27	x	0.63	x	0.7	=	25.14	(76)
East	0.9x	0.77	x	5.3	x	92.28	x	0.63	x	0.7	=	149.47	(76)
East	0.9x	0.77	x	1.3	x	92.28	x	0.63	x	0.7	=	36.66	(76)
East	0.9x	0.77	x	5.3	x	113.09	x	0.63	x	0.7	=	183.18	(76)
East	0.9x	0.77	x	1.3	x	113.09	x	0.63	x	0.7	=	44.93	(76)
East	0.9x	0.77	x	5.3	x	115.77	x	0.63	x	0.7	=	187.52	(76)
East	0.9x	0.77	x	1.3	x	115.77	x	0.63	x	0.7	=	46	(76)
East	0.9x	0.77	x	5.3	x	110.22	x	0.63	x	0.7	=	178.53	(76)
East	0.9x	0.77	x	1.3	x	110.22	x	0.63	x	0.7	=	43.79	(76)
East	0.9x	0.77	x	5.3	x	94.68	x	0.63	x	0.7	=	153.35	(76)
East	0.9x	0.77	x	1.3	x	94.68	x	0.63	x	0.7	=	37.61	(76)
East	0.9x	0.77	x	5.3	x	73.59	x	0.63	x	0.7	=	119.2	(76)
East	0.9x	0.77	x	1.3	x	73.59	x	0.63	x	0.7	=	29.24	(76)
East	0.9x	0.77	x	5.3	x	45.59	x	0.63	x	0.7	=	73.84	(76)
East	0.9x	0.77	x	1.3	x	45.59	x	0.63	x	0.7	=	18.11	(76)
East	0.9x	0.77	x	5.3	x	24.49	x	0.63	x	0.7	=	39.67	(76)
East	0.9x	0.77	x	1.3	x	24.49	x	0.63	x	0.7	=	9.73	(76)
East	0.9x	0.77	x	5.3	x	16.15	x	0.63	x	0.7	=	26.16	(76)
East	0.9x	0.77	x	1.3	x	16.15	x	0.63	x	0.7	=	6.42	(76)
South	0.9x	0.77	x	1.3	x	46.75	x	0.76	x	0.7	=	22.41	(78)
South	0.9x	0.77	x	1.3	x	76.57	x	0.76	x	0.7	=	36.7	(78)
South	0.9x	0.77	x	1.3	x	97.53	x	0.76	x	0.7	=	46.75	(78)
South	0.9x	0.77	x	1.3	x	110.23	x	0.76	x	0.7	=	52.83	(78)
South	0.9x	0.77	x	1.3	x	114.87	x	0.76	x	0.7	=	55.06	(78)
South	0.9x	0.77	x	1.3	x	110.55	x	0.76	x	0.7	=	52.98	(78)
South	0.9x	0.77	x	1.3	x	108.01	x	0.76	x	0.7	=	51.77	(78)
South	0.9x	0.77	x	1.3	x	104.89	x	0.76	x	0.7	=	50.27	(78)
South	0.9x	0.77	x	1.3	x	101.89	x	0.76	x	0.7	=	48.83	(78)
South	0.9x	0.77	x	1.3	x	82.59	x	0.76	x	0.7	=	39.58	(78)

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South	0.9x	0.77	x	1.3	x	55.42	x	0.76	x	0.7	=	26.56	(78)
South	0.9x	0.77	x	1.3	x	40.4	x	0.76	x	0.7	=	19.36	(78)

Solar gains in watts, calculated for each month

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

(83)m=	65.55	120.94	185.83	257.37	307.96	313.04	298.86	260.9	211.04	139.56	80.31	54.88	(83)
--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	-------	-------	------

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

(84)m=	430.95	483	534.17	584.79	614.3	600.08	574.63	542.91	505.04	454.65	418.84	410.93	(84)
--------	--------	-----	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)	21	(85)
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Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.93	0.86	0.73	0.58	0.63	0.82	0.95	0.98	0.99	(86)

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

(87)m=	19.02	19.22	19.57	20.06	20.49	20.81	20.93	20.91	20.68	20.13	19.51	19.01	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	19.29	19.3	19.3	19.34	19.34	19.37	19.37	19.38	19.36	19.34	19.33	19.32	(88)
--------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.98	0.97	0.95	0.9	0.79	0.6	0.39	0.44	0.72	0.92	0.97	0.99	(89)
--------	------	------	------	-----	------	-----	------	------	------	------	------	------	------

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

(90)m=	17.59	17.79	18.14	18.63	19.02	19.29	19.36	19.36	19.2	18.71	18.1	17.6	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------	------	------

fLA = Living area ÷ (4) =	0.53	(91)
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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.35	18.55	18.9	19.39	19.8	20.1	20.2	20.18	19.99	19.46	18.85	18.35	(92)
--------	-------	-------	------	-------	------	------	------	-------	-------	-------	-------	-------	------

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

(93)m=	18.35	18.55	18.9	19.39	19.8	20.1	20.2	20.18	19.99	19.46	18.85	18.35	(93)
--------	-------	-------	------	-------	------	------	------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.98	0.97	0.95	0.9	0.81	0.66	0.5	0.54	0.77	0.92	0.97	0.98	(94)
--------	------	------	------	-----	------	------	-----	------	------	------	------	------	------

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

(95)m=	422.03	468.21	506.77	527.75	500.62	398.05	285.19	293.72	387.2	417.91	405.56	403.58	(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=	1255.36	1213.49	1097.05	906.17	696.68	462.75	302.63	317.28	499.77	762.17	1019.56	1239.33	(97)
--------	---------	---------	---------	--------	--------	--------	--------	--------	--------	--------	---------	---------	------

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

(98)m=	620	500.83	439.17	272.46	145.87	0	0	0	0	256.12	442.08	621.8	(98)
--------	-----	--------	--------	--------	--------	---	---	---	---	--------	--------	-------	------

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

3298.34	(98)
---------	------

Space heating requirement in kWh/m²/year

76.17	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

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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		88.8	(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)

620	500.83	439.17	272.46	145.87	0	0	0	0	256.12	442.08	621.8
-----	--------	--------	--------	--------	---	---	---	---	--------	--------	-------

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

698.2	564	494.56	306.83	164.27	0	0	0	0	288.43	497.84	700.22
-------	-----	--------	--------	--------	---	---	---	---	--------	--------	--------

Total (kWh/year) = Sum(211)_{1...5,10...12} = 3714.35 (211)

Space heating fuel (secondary), kWh/month

= {[[(98)m × (201)] } × 100 ÷ (208)

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)

152.86	133.53	138.93	123.22	119.3	105.07	100.67	112.22	113.46	129.2	137.92	149.27
--------	--------	--------	--------	-------	--------	--------	--------	--------	-------	--------	--------

Efficiency of water heater 79.5 (216)

(217)m = 86.79 86.67 86.37 85.68 84.36 79.5 79.5 79.5 79.5 85.45 86.4 86.83 (217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

176.13	154.07	160.85	143.82	141.42	132.17	126.63	141.16	142.72	151.2	159.63	171.91
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------

Total = Sum(219a)_{1...12} = 1801.72 (219)

Annual totals

Space heating fuel used, main system 1

kWh/year

3714.35

Water heating fuel used

1801.72

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 75 (231)

Electricity for lighting

205.65 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

5796.72 (338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) ×	3.48 × 0.01 =	129.26 (240)
Space heating - main system 2	(213) ×	0 × 0.01 =	0 (241)
Space heating - secondary	(215) ×	13.19 × 0.01 =	0 (242)
Water heating cost (other fuel)	(219)	3.48 × 0.01 =	62.7 (247)
Pumps, fans and electric keep-hot	(231)	13.19 × 0.01 =	9.89 (249)

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(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 = 27.13 (250)

Additional standing charges (Table 12) 120 (251)

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

Total energy cost (245)...(247) + (250)...(254) = 348.98 (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] = 1.66 (257)

SAP rating (Section 12) 76.84 (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 =	802.3 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	389.17 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1191.47 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	106.73 (268)
Total CO2, kg/year		sum of (265)...(271) =	1337.13 (272)
CO2 emissions per m²		(272) ÷ (4) =	30.88 (273)
El rating (section 14)			80 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) x	1.22 =	4531.5 (261)
Space heating (secondary)	(215) x	3.07 =	0 (263)
Energy for water heating	(219) x	1.22 =	2198.09 (264)
Space and water heating	(261) + (262) + (263) + (264) =		6729.6 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07 =	230.25 (267)
Electricity for lighting	(232) x	0 =	631.35 (268)
'Total Primary Energy		sum of (265)...(271) =	7591.2 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =	175.32 (273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.60

Property Address: DE2408 (Actual CO2)

Address : Flat 8, 8 Southey Road, Worthing, BN11 3HT

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	43.3 (1a)	2.25 (2a)	97.42 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	43.3 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	97.42 (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				2	20 (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) =	20 ÷ (5) = 0.21 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

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)

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

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 15 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.96 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 4 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.7 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.67 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

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

0.85	0.84	0.82	0.74	0.72	0.64	0.64	0.62	0.67	0.72	0.75	0.79
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x 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) x [1 - (23c) ÷ 100]

(24a)m= 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 (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 (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= 0.86 0.85 0.84 0.77 0.76 0.7 0.7 0.69 0.72 0.76 0.78 0.81 (24d)

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

(25)m= 0.86 0.85 0.84 0.77 0.76 0.7 0.7 0.69 0.72 0.76 0.78 0.81 (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
Windows Type 1			0.9	$\times 1/[1/(2.7) + 0.04] =$	2.19		(27)
Windows Type 2			1.3	$\times 1/[1/(2.7) + 0.04] =$	3.17		(27)
Windows Type 3			5.3	$\times 1/[1/(1.4) + 0.04] =$	7.03		(27)
Windows Type 4			1.3	$\times 1/[1/(1.4) + 0.04] =$	1.72		(27)
Walls	55.6	8.8	46.8	x 0.55 =	25.74		(29)
Roof	43.3	0	43.3	x 0.16 =	6.93		(30)
Total area of elements, m²			98.9				(31)

* 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) = 46.78 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7409.7 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 14.84 (36)

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

Total fabric heat loss (33) + (36) = 61.61 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	27.76	27.31	26.86	24.77	24.38	22.56	22.56	22.23	23.26	24.38	25.17	26

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

(39)m=	89.37	88.92	88.48	86.39	86	84.18	84.18	83.84	84.88	86	86.79	87.61
Average = Sum(39) _{1...12} /12=												86.38 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	2.06	2.05	2.04	2	1.99	1.94	1.94	1.94	1.96	1.99	2	2.02		
Average = Sum(40) _{1...12} /12=													2	(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

1.5

(42)

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

if TFA ≤ 13.9, N = 1

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

69.74

(43)

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

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

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

(44)m=	76.72	73.93	71.14	68.35	65.56	62.77	62.77	65.56	68.35	71.14	73.93	76.72		
Total = Sum(44) _{1...12} =													836.92	(44)

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

(45)m=	113.77	99.5	102.68	89.52	85.89	74.12	68.68	78.82	79.76	92.95	101.46	110.18		
Total = Sum(45) _{1...12} =													1097.33	(45)

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

(46)m=	17.07	14.93	15.4	13.43	12.88	11.12	10.3	11.82	11.96	13.94	15.22	16.53		(46)
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Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

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

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m 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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

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

(61)m=	39.09	34.03	36.25	33.71	33.41	30.95	31.99	33.41	33.71	36.25	36.46	39.09	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(62)m=	152.86	133.53	138.93	123.22	119.3	105.07	100.67	112.22	113.46	129.2	137.92	149.27	(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=	152.86	133.53	138.93	123.22	119.3	105.07	100.67	112.22	113.46	129.2	137.92	149.27	
Output from water heater (annual) _{1...12}												1515.67	(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=	47.6	41.59	43.2	38.19	36.91	32.38	30.83	34.56	34.95	39.97	42.85	46.41	(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=	89.79	89.79	89.79	89.79	89.79	89.79	89.79	89.79	89.79	89.79	89.79	89.79	(66)

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

(67)m=	29.11	25.86	21.03	15.92	11.9	10.05	10.86	14.11	18.94	24.05	28.07	29.92	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	193.9	195.91	190.84	180.05	166.42	153.62	145.06	143.05	148.12	158.91	172.54	185.34	(68)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	45.48	45.48	45.48	45.48	45.48	45.48	45.48	45.48	45.48	45.48	45.48	45.48	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-59.86	-59.86	-59.86	-59.86	-59.86	-59.86	-59.86	-59.86	-59.86	-59.86	-59.86	-59.86	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	63.98	61.89	58.07	53.04	49.61	44.98	41.44	46.45	48.54	53.72	59.51	62.38	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	365.4	362.07	348.35	327.42	306.34	287.05	275.77	282.01	294	315.09	338.53	356.05	(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)	
North	0.9x	0.77	x	0.9	x	10.63	x	0.76	x	0.7	=	3.53	(74)
North	0.9x	0.77	x	0.9	x	20.32	x	0.76	x	0.7	=	6.74	(74)
North	0.9x	0.77	x	0.9	x	34.53	x	0.76	x	0.7	=	11.46	(74)
North	0.9x	0.77	x	0.9	x	55.46	x	0.76	x	0.7	=	18.4	(74)
North	0.9x	0.77	x	0.9	x	74.72	x	0.76	x	0.7	=	24.79	(74)

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North	0.9x	0.77	x	0.9	x	79.99	x	0.76	x	0.7	=	26.54	(74)
North	0.9x	0.77	x	0.9	x	74.68	x	0.76	x	0.7	=	24.78	(74)
North	0.9x	0.77	x	0.9	x	59.25	x	0.76	x	0.7	=	19.66	(74)
North	0.9x	0.77	x	0.9	x	41.52	x	0.76	x	0.7	=	13.78	(74)
North	0.9x	0.77	x	0.9	x	24.19	x	0.76	x	0.7	=	8.03	(74)
North	0.9x	0.77	x	0.9	x	13.12	x	0.76	x	0.7	=	4.35	(74)
North	0.9x	0.77	x	0.9	x	8.86	x	0.76	x	0.7	=	2.94	(74)
East	0.9x	0.77	x	5.3	x	19.64	x	0.63	x	0.7	=	31.81	(76)
East	0.9x	0.77	x	1.3	x	19.64	x	0.63	x	0.7	=	7.8	(76)
East	0.9x	0.77	x	5.3	x	38.42	x	0.63	x	0.7	=	62.23	(76)
East	0.9x	0.77	x	1.3	x	38.42	x	0.63	x	0.7	=	15.26	(76)
East	0.9x	0.77	x	5.3	x	63.27	x	0.63	x	0.7	=	102.49	(76)
East	0.9x	0.77	x	1.3	x	63.27	x	0.63	x	0.7	=	25.14	(76)
East	0.9x	0.77	x	5.3	x	92.28	x	0.63	x	0.7	=	149.47	(76)
East	0.9x	0.77	x	1.3	x	92.28	x	0.63	x	0.7	=	36.66	(76)
East	0.9x	0.77	x	5.3	x	113.09	x	0.63	x	0.7	=	183.18	(76)
East	0.9x	0.77	x	1.3	x	113.09	x	0.63	x	0.7	=	44.93	(76)
East	0.9x	0.77	x	5.3	x	115.77	x	0.63	x	0.7	=	187.52	(76)
East	0.9x	0.77	x	1.3	x	115.77	x	0.63	x	0.7	=	46	(76)
East	0.9x	0.77	x	5.3	x	110.22	x	0.63	x	0.7	=	178.53	(76)
East	0.9x	0.77	x	1.3	x	110.22	x	0.63	x	0.7	=	43.79	(76)
East	0.9x	0.77	x	5.3	x	94.68	x	0.63	x	0.7	=	153.35	(76)
East	0.9x	0.77	x	1.3	x	94.68	x	0.63	x	0.7	=	37.61	(76)
East	0.9x	0.77	x	5.3	x	73.59	x	0.63	x	0.7	=	119.2	(76)
East	0.9x	0.77	x	1.3	x	73.59	x	0.63	x	0.7	=	29.24	(76)
East	0.9x	0.77	x	5.3	x	45.59	x	0.63	x	0.7	=	73.84	(76)
East	0.9x	0.77	x	1.3	x	45.59	x	0.63	x	0.7	=	18.11	(76)
East	0.9x	0.77	x	5.3	x	24.49	x	0.63	x	0.7	=	39.67	(76)
East	0.9x	0.77	x	1.3	x	24.49	x	0.63	x	0.7	=	9.73	(76)
East	0.9x	0.77	x	5.3	x	16.15	x	0.63	x	0.7	=	26.16	(76)
East	0.9x	0.77	x	1.3	x	16.15	x	0.63	x	0.7	=	6.42	(76)
South	0.9x	0.77	x	1.3	x	46.75	x	0.76	x	0.7	=	22.41	(78)
South	0.9x	0.77	x	1.3	x	76.57	x	0.76	x	0.7	=	36.7	(78)
South	0.9x	0.77	x	1.3	x	97.53	x	0.76	x	0.7	=	46.75	(78)
South	0.9x	0.77	x	1.3	x	110.23	x	0.76	x	0.7	=	52.83	(78)
South	0.9x	0.77	x	1.3	x	114.87	x	0.76	x	0.7	=	55.06	(78)
South	0.9x	0.77	x	1.3	x	110.55	x	0.76	x	0.7	=	52.98	(78)
South	0.9x	0.77	x	1.3	x	108.01	x	0.76	x	0.7	=	51.77	(78)
South	0.9x	0.77	x	1.3	x	104.89	x	0.76	x	0.7	=	50.27	(78)
South	0.9x	0.77	x	1.3	x	101.89	x	0.76	x	0.7	=	48.83	(78)
South	0.9x	0.77	x	1.3	x	82.59	x	0.76	x	0.7	=	39.58	(78)

SAP WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.3	x	55.42	x	0.76	x	0.7	=	26.56	(78)
South	0.9x	0.77	x	1.3	x	40.4	x	0.76	x	0.7	=	19.36	(78)

Solar gains in watts, calculated for each month

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

(83)m=	65.55	120.94	185.83	257.37	307.96	313.04	298.86	260.9	211.04	139.56	80.31	54.88	(83)
--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	-------	-------	------

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

(84)m=	430.95	483	534.17	584.79	614.3	600.08	574.63	542.91	505.04	454.65	418.84	410.93	(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=	0.99	0.98	0.97	0.93	0.86	0.73	0.58	0.63	0.82	0.95	0.98	0.99	(86)

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

(87)m=	19.02	19.22	19.57	20.06	20.49	20.81	20.93	20.91	20.68	20.13	19.51	19.01	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	19.29	19.3	19.3	19.34	19.34	19.37	19.37	19.38	19.36	19.34	19.33	19.32	(88)
--------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.98	0.97	0.95	0.9	0.79	0.6	0.39	0.44	0.72	0.92	0.97	0.99	(89)
--------	------	------	------	-----	------	-----	------	------	------	------	------	------	------

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

(90)m=	17.59	17.79	18.14	18.63	19.02	19.29	19.36	19.36	19.2	18.71	18.1	17.6	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------	------	------

fLA = Living area ÷ (4) =	0.53	(91)
---------------------------	------	------

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

(92)m=	18.35	18.55	18.9	19.39	19.8	20.1	20.2	20.18	19.99	19.46	18.85	18.35	(92)
--------	-------	-------	------	-------	------	------	------	-------	-------	-------	-------	-------	------

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

(93)m=	18.35	18.55	18.9	19.39	19.8	20.1	20.2	20.18	19.99	19.46	18.85	18.35	(93)
--------	-------	-------	------	-------	------	------	------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.98	0.97	0.95	0.9	0.81	0.66	0.5	0.54	0.77	0.92	0.97	0.98	(94)
--------	------	------	------	-----	------	------	-----	------	------	------	------	------	------

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

(95)m=	422.03	468.21	506.77	527.75	500.62	398.05	285.19	293.72	387.2	417.91	405.56	403.58	(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=	1255.36	1213.49	1097.05	906.17	696.68	462.75	302.63	317.28	499.77	762.17	1019.56	1239.33	(97)
--------	---------	---------	---------	--------	--------	--------	--------	--------	--------	--------	---------	---------	------

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

(98)m=	620	500.83	439.17	272.46	145.87	0	0	0	0	256.12	442.08	621.8	(98)
--------	-----	--------	--------	--------	--------	---	---	---	---	--------	--------	-------	------

Total per year (kWh/year) = Sum(98) _{1...5,9...12} =	3298.34	(98)
---	---------	------

Space heating requirement in kWh/m²/year

76.17	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
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SAP WorkSheet: New dwelling design stage

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		88.8	(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)

620	500.83	439.17	272.46	145.87	0	0	0	0	256.12	442.08	621.8
-----	--------	--------	--------	--------	---	---	---	---	--------	--------	-------

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

698.2	564	494.56	306.83	164.27	0	0	0	0	288.43	497.84	700.22
-------	-----	--------	--------	--------	---	---	---	---	--------	--------	--------

Total (kWh/year) = Sum(211)_{1..5,10...12} = 3714.35 (211)

Space heating fuel (secondary), kWh/month

= {[[(98)m × (201)] } × 100 ÷ (208)

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)

152.86	133.53	138.93	123.22	119.3	105.07	100.67	112.22	113.46	129.2	137.92	149.27
--------	--------	--------	--------	-------	--------	--------	--------	--------	-------	--------	--------

Efficiency of water heater 79.5 (216)

(217)m = 86.79 86.67 86.37 85.68 84.36 79.5 79.5 79.5 79.5 85.45 86.4 86.83 (217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

176.13	154.07	160.85	143.82	141.42	132.17	126.63	141.16	142.72	151.2	159.63	171.91
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------

Total = Sum(219a)_{1..12} = 1801.72 (219)

Annual totals

Space heating fuel used, main system 1

kWh/year

3714.35

Water heating fuel used

1801.72

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 75 (231)

Electricity for lighting

205.65 (232)

Electricity generated by PVs

-922.15 (233)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

4874.56 (338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) ×	3.48 × 0.01 =	129.26 (240)
Space heating - main system 2	(213) ×	0 × 0.01 =	0 (241)
Space heating - secondary	(215) ×	13.19 × 0.01 =	0 (242)
Water heating cost (other fuel)	(219)	3.48 × 0.01 =	62.7 (247)

SAP WorkSheet: New dwelling design stage

Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a)					
Energy for lighting	(232)	13.19	x 0.01 =	27.13	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x	13.19	x 0.01 =	-121.63	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)...(254) =			227.35	(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] =	1.08	(257)
SAP rating (Section 12)		84.91	(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	802.3 (261)
Space heating (secondary)	(215) x	0.519	0 (263)
Water heating	(219) x	0.216	389.17 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1191.47 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	38.93 (267)
Electricity for lighting	(232) x	0.519	106.73 (268)
Energy saving/generation technologies Item 1		0.519	-478.6 (269)
Total CO2, kg/year		sum of (265)...(271) =	858.53 (272)
CO2 emissions per m²		(272) ÷ (4) =	19.83 (273)
El rating (section 14)			87 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) x	1.22	4531.5 (261)
Space heating (secondary)	(215) x	3.07	0 (263)
Energy for water heating	(219) x	1.22	2198.09 (264)
Space and water heating	(261) + (262) + (263) + (264) =		6729.6 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	230.25 (267)
Electricity for lighting	(232) x	0	631.35 (268)
Energy saving/generation technologies Item 1		3.07	-2831 (269)
'Total Primary Energy		sum of (265)...(271) =	4760.2 (272)

SAP WorkSheet: New dwelling design stage

Primary energy kWh/m²/year

(272) ÷ (4) =

109.94

(273)

DRAFT

Predicted Energy Assessment



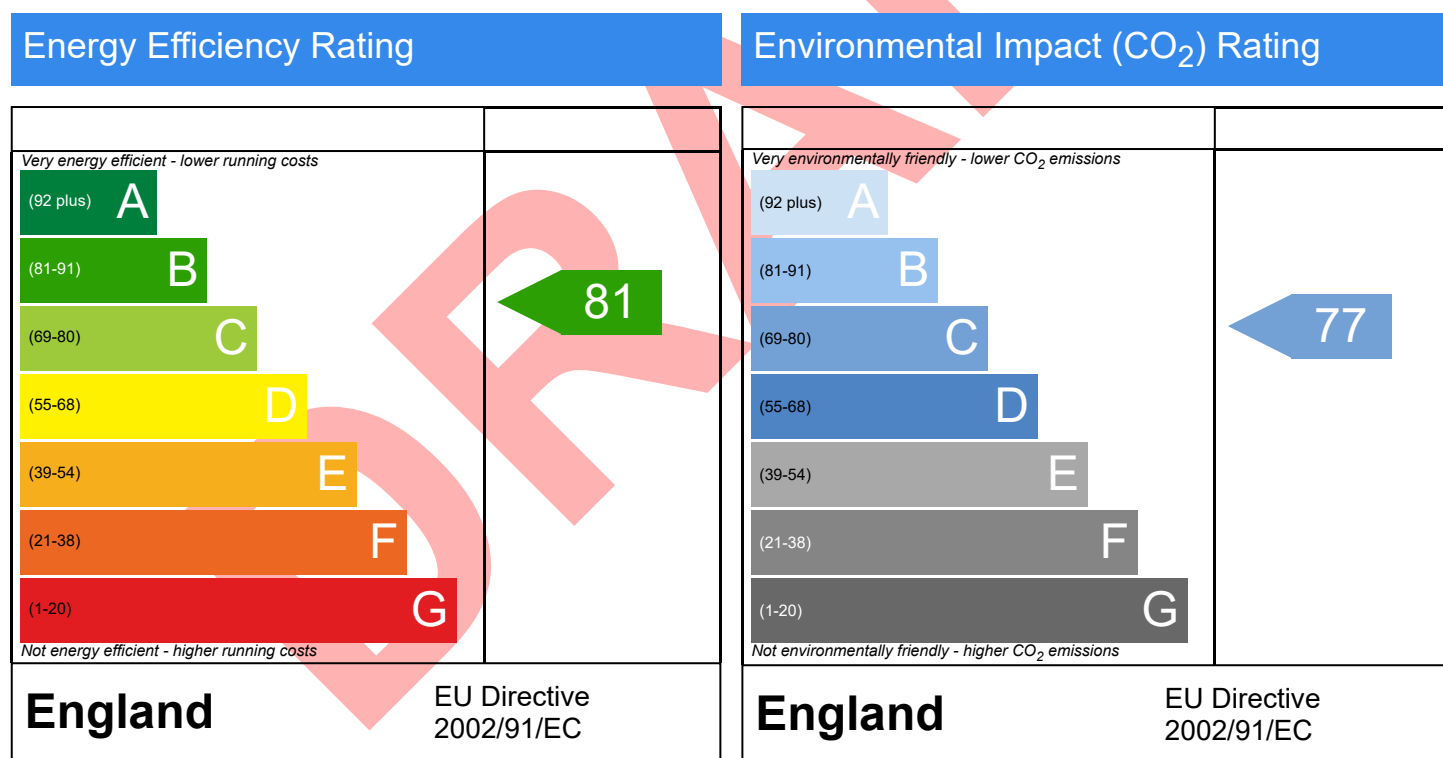
Flat 1, 8, Southey Road, Worthing, West Sussex, BN11 3HT

Dwelling type:
Date of assessment:
SAP Version:
Produced by:
Total floor area:
DRRN:

Flat, End-Terrace
18/06/2026
10.2
Joe Solti
46.2 m²

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The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO₂) emissions.



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO₂) emissions. The higher the rating the less impact it has on the environment.

Predicted Energy Assessment



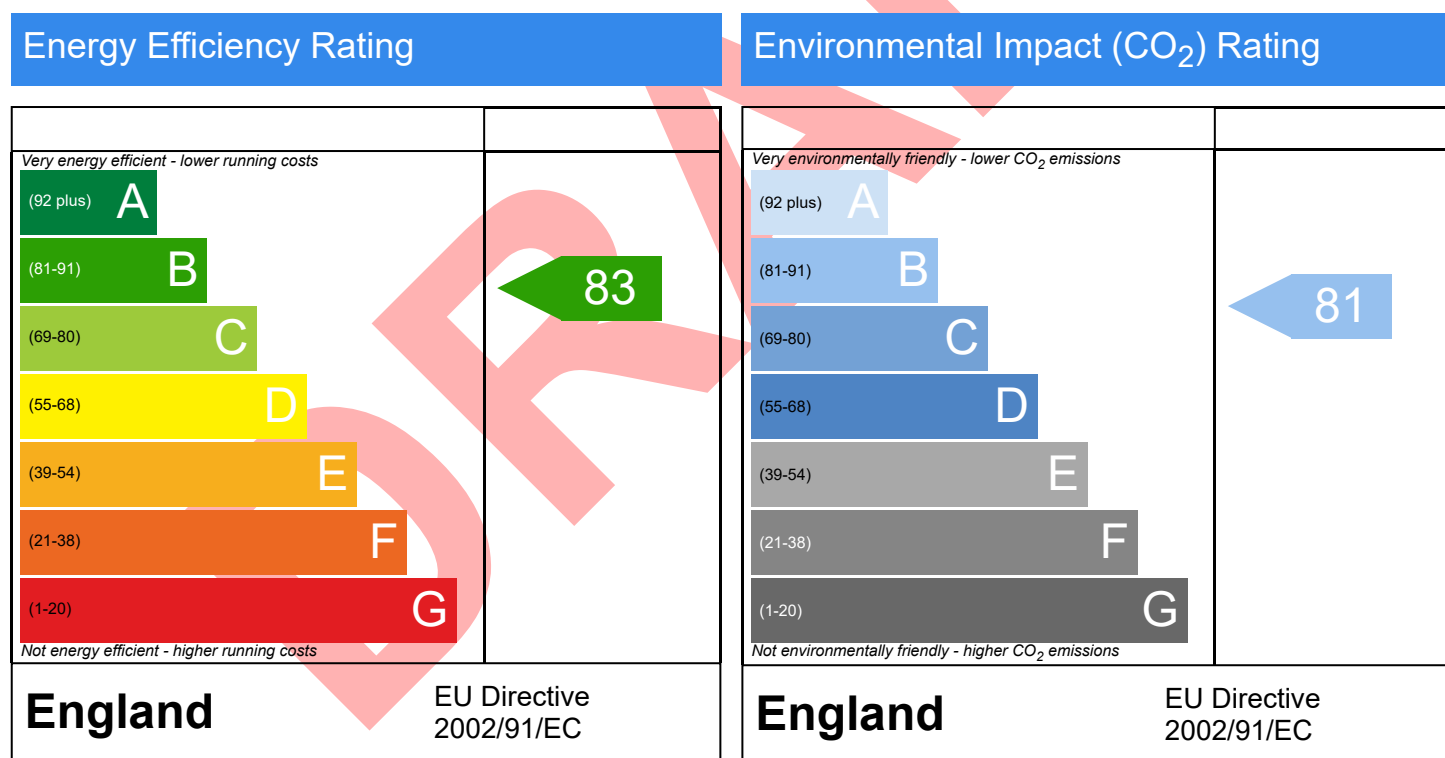
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Dwelling type:
Date of assessment:
SAP Version:
Produced by:
Total floor area:
DRRN:

Flat, Mid-Terrace
18/06/2026
10.2
Joe Solti
51.6 m²

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Predicted Energy Assessment



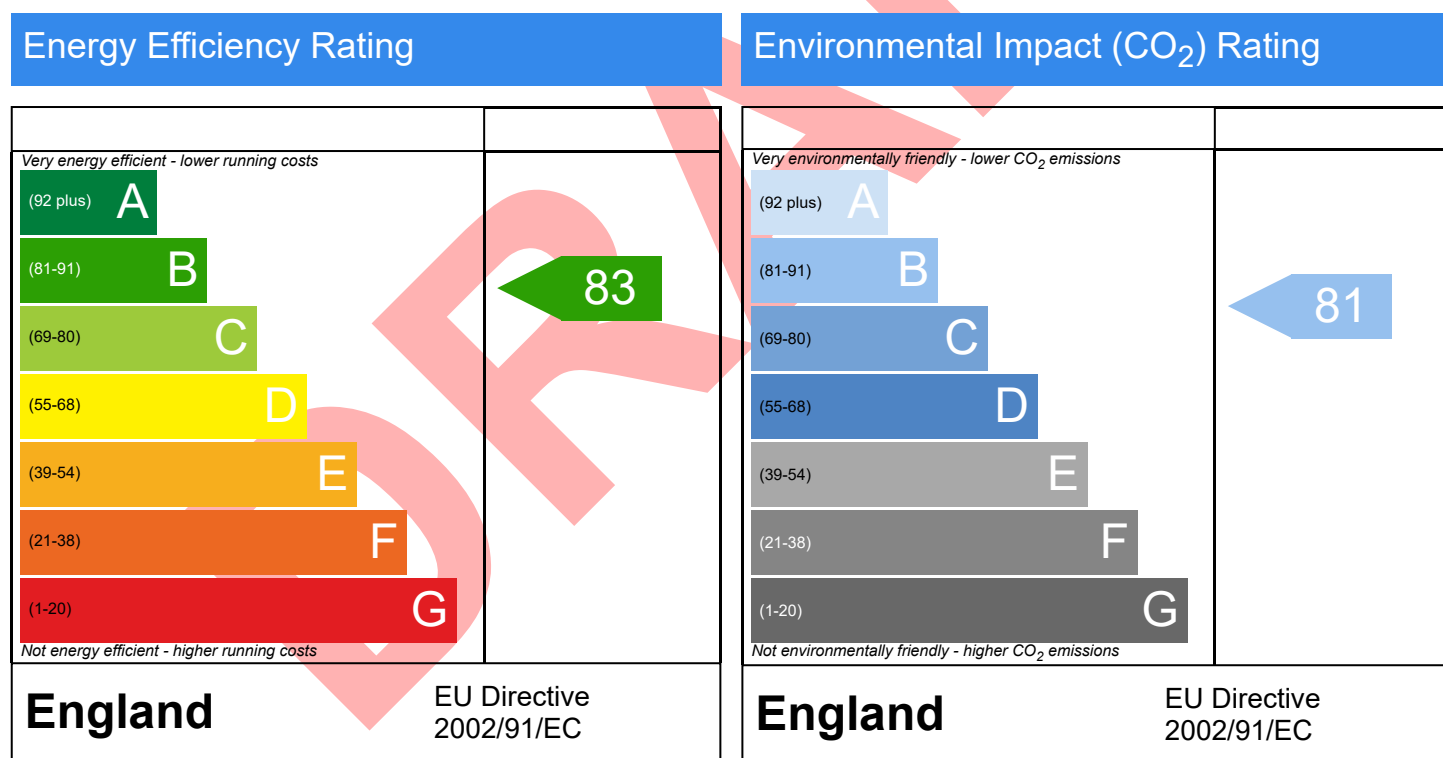
Flat 3, 8, Southey Road, Worthing, West Sussex, BN11 3HT

Dwelling type:
Date of assessment:
SAP Version:
Produced by:
Total floor area:
DRRN:

Flat, Mid-Terrace
18/06/2026
10.2
Joe Solti
48.4 m²

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Predicted Energy Assessment



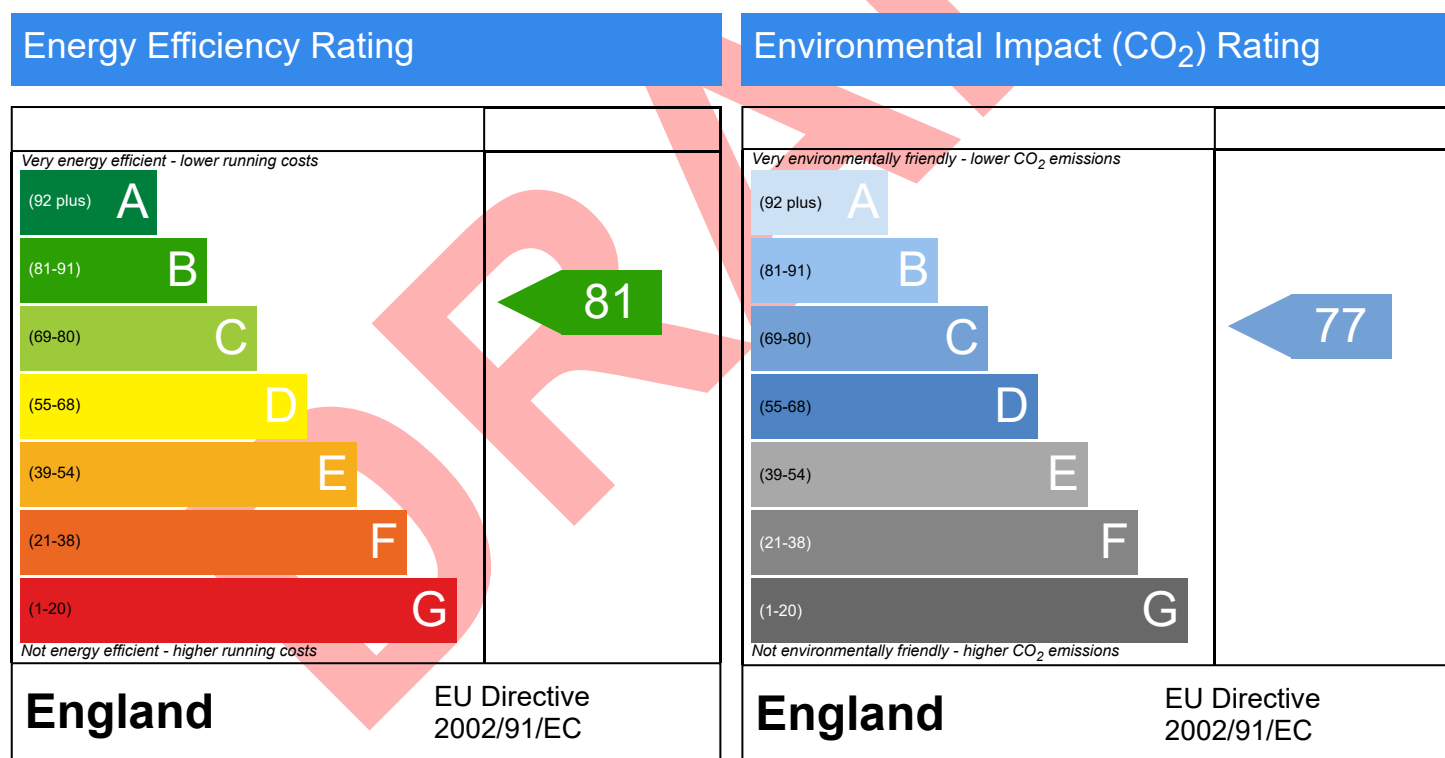
Flat 4, 8, Southey Road, Worthing, West Sussex, BN11 3HT

Dwelling type:
Date of assessment:
SAP Version:
Produced by:
Total floor area:
DRRN:

Flat, Mid-Terrace
18/06/2026
10.2
Joe Solti
50.9 m²

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Predicted Energy Assessment



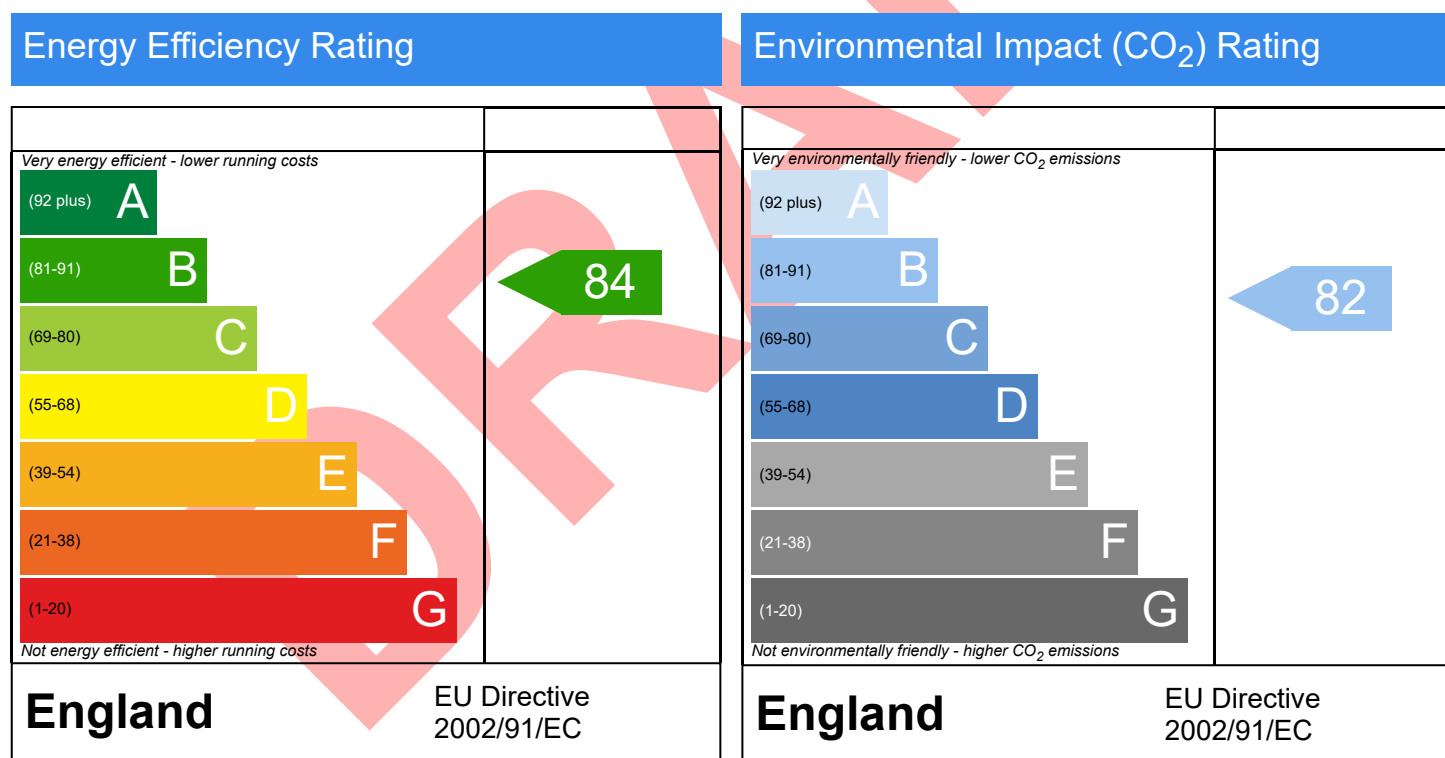
Flat 5, 8, Southey Road, Worthing, West Sussex, BN11 3HT

Dwelling type:
Date of assessment:
SAP Version:
Produced by:
Total floor area:
DRRN:

Flat, Mid-Terrace
18/06/2026
10.2
Joe Solti
40.6 m²

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Predicted Energy Assessment



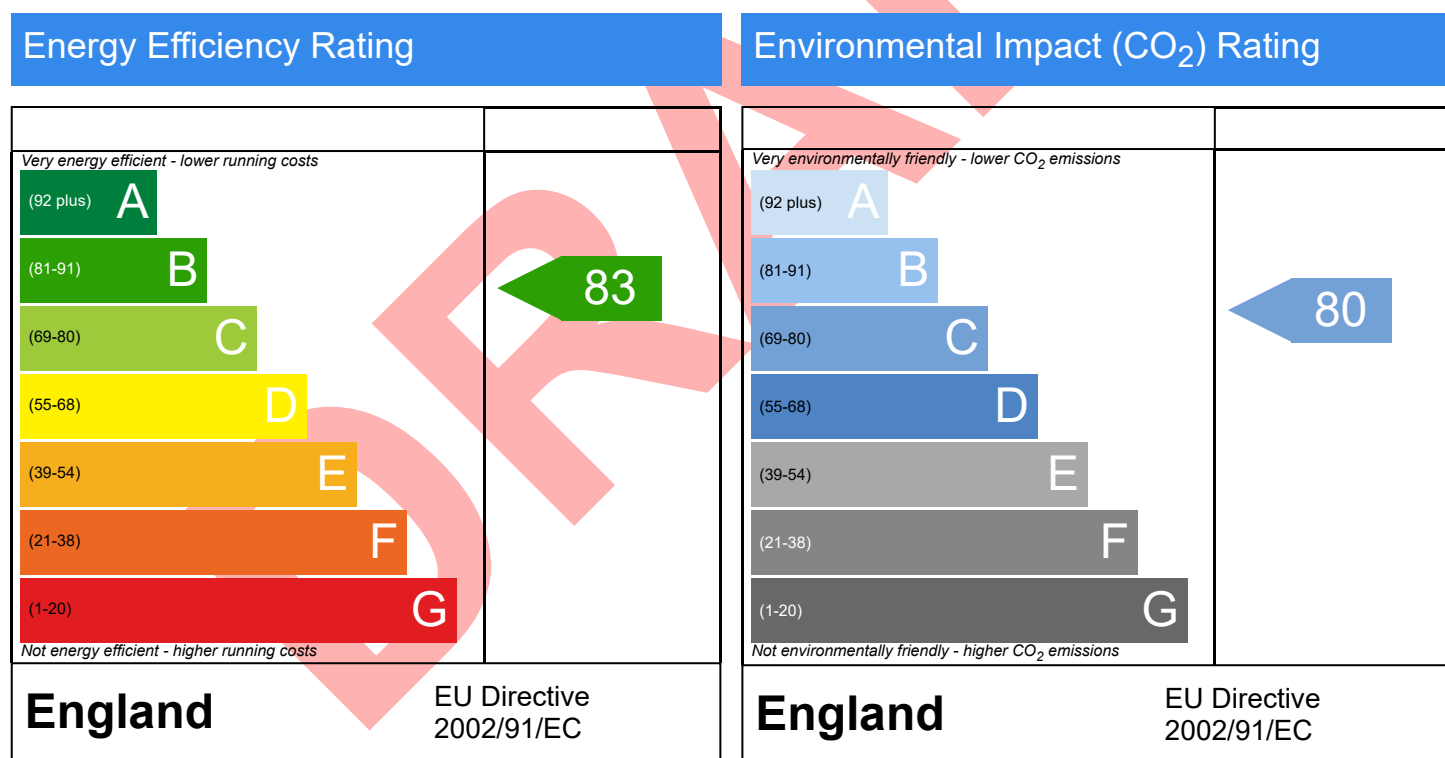
Flat 6, 8, Southey Road, Worthing, West Sussex, BN11 3HT

Dwelling type:
Date of assessment:
SAP Version:
Produced by:
Total floor area:
DRRN:

Flat, End-Terrace
18/06/2026
10.2
Joe Solti
40.3 m²

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Predicted Energy Assessment



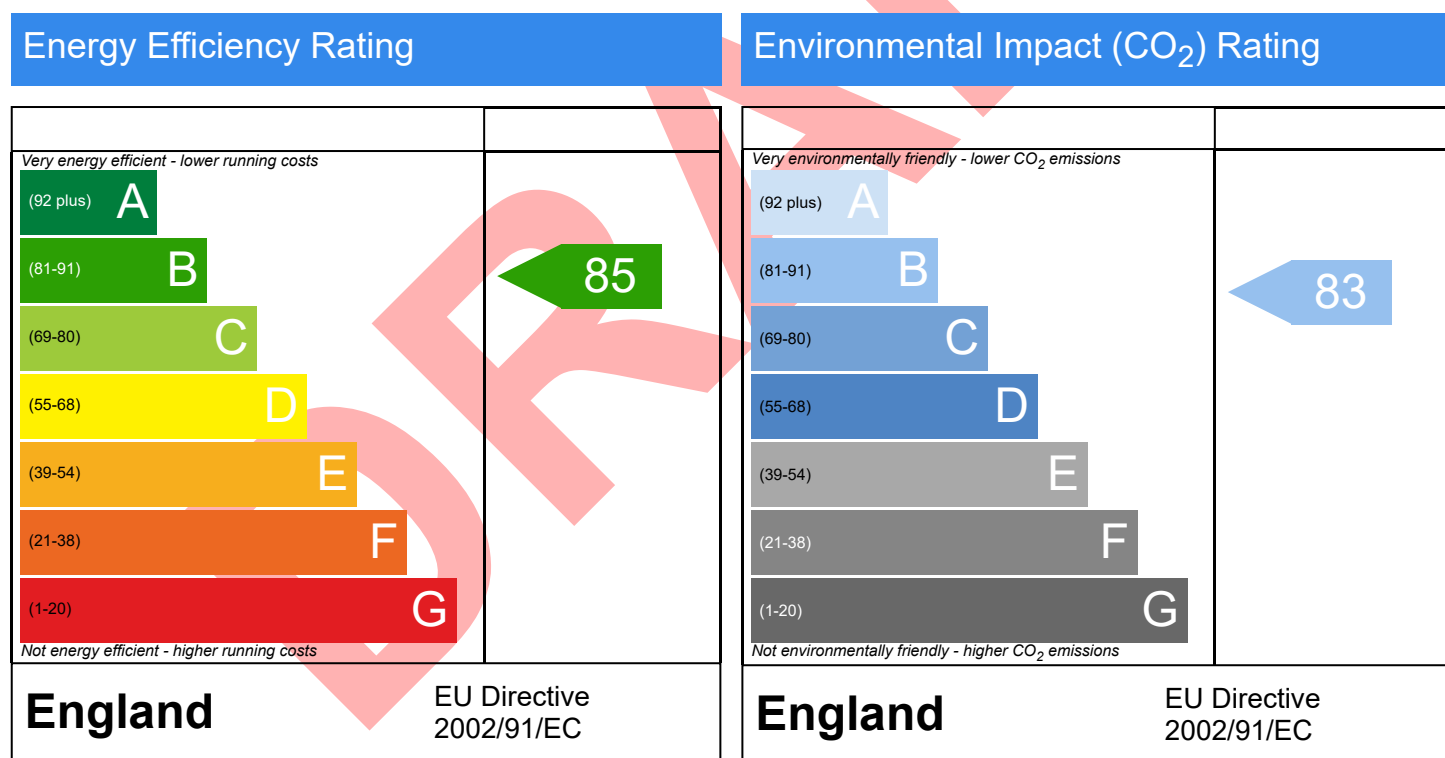
Flat 7, 8, Southey Road, Worthing, West Sussex, BN11 3HT

Dwelling type:
Date of assessment:
SAP Version:
Produced by:
Total floor area:
DRRN:

Flat, Mid-Terrace
18/06/2026
10.2
Joe Solti
54.2 m²

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO₂) emissions.



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO₂) emissions. The higher the rating the less impact it has on the environment.

Predicted Energy Assessment



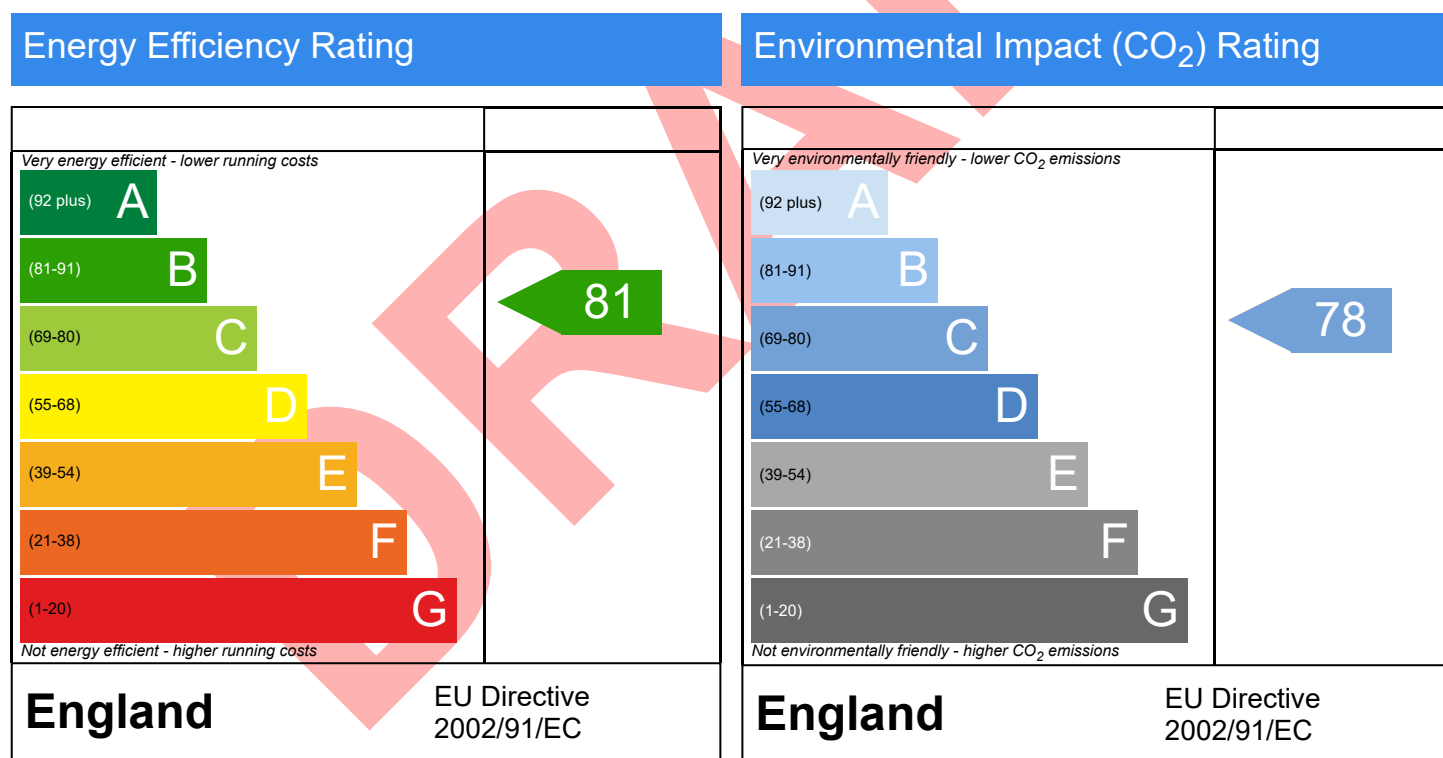
Flat 8, 8, Southey Road, Worthing, West Sussex, BN11 3HT

Dwelling type:
Date of assessment:
SAP Version:
Produced by:
Total floor area:
DRRN:

Flat, End-Terrace
18/06/2026
10.2
Joe Solti
43.3 m²

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