Ritchie + Daffin

Chester Road Hostel

Appendix D – SAP & SBEM Outputs
Energy Statement

13 May 2020

SAP Input

Property Details: Flat Type A Energy Eff only

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	07 November 2019
Date of certificate:	12 May 2020
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Low
Water use <= 125 litres/person/day:	True
PCDF Version:	460

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2020

Floor Location:	Floor area:	Storey height:
Floor 0	55.3 m²	3.09 m

Living area:	28.01 m² (fraction 0.507)
Front of dwelling faces:	North East

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D8_01	Manufacturer	Solid			Metal
Vent_08_03	Manufacturer	Solid			
Vent_08_02	Manufacturer	Solid			
Vent_08_06	Manufacturer	Solid			
V_01	Manufacturer	Solid			Metal
Window_08_07	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_08_01	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_08_04	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_08_05	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Fanlight	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D8_01	mm	0	0	1	2.13	1
Vent_08_03	mm	0	0	1	0.96	1
Vent_08_02	mm	0	0	1	0.96	1
Vent_08_06	mm	0	0	1	0.7	1
V_01	mm	0	0	1	0.2	1
Window_08_07	6mm	0.7	0.4	1.2	0.86	1
Window_08_01	6mm	0.7	0.4	1.2	2.01	1
Window_08_04	6mm	0.7	0.4	1.2	2.01	1
Window_08_05	6mm	0.7	0.4	1.2	1.46	1
Fanlight	6mm	0.7	0.4	1.2	0.32	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D8_01		8_01	North East	0	0
Vent_08_03		8_07	South West	0	0
Vent_08_02		8_07	South West	0	0
Vent_08_06		8_07	South West	0	0
V_01		8_01	North East	1.01	0.2

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Window_08_07	8_05	North East	0.6	1.44
Window_08_01	8_07	South West	1.22	1.65
Window_08_04	8_07	South West	1.22	1.65
Window_08_05	8_07	South West	1.22	1.2
Fanlight	8_01	North East	1.01	0.315

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
8_01	15.172	2.65	12.52	0.13	0	False	N/A
8_02	1.854	0	1.85	0.13	0	False	N/A
8_03	6.727	0	6.73	0.13	0	False	N/A
8_04	1.823	0	1.82	0.13	0	False	N/A
8_05	6.365	0.86	5.5	0.13	0	False	N/A
8_07	28.737	8.1	20.64	0.13	0	False	N/A
8_08	19.467	0	19.47	0.13	0.82	False	N/A
Ground	55.3			0.11			N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test: Yes (As designed)

Ventilation: Balanced with heat recovery
Number of wet rooms: Kitchen + 1
Ductwork: Insulation, rigid
Approved Installation Scheme: False

Number of chimneys: 0
Number of open flues: 0
Number of fans: 0
Number of passive stacks: 0
Number of sides sheltered: 0
Pressure test: 2.5

Main heating system:

Main heating system: Boiler systems with radiators or underfloor heating
Gas boilers and oil boilers
Fuel: mains gas
Info Source: Manufacturer Declaration
Manufacturer's data
Efficiency: 89.5% (SEDBUK2009)
Condensing combi with automatic ignition
Fuel Burning Type: Unknown
Systems with radiators
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Room-sealed
Boiler interlock: Yes

Main heating Control:

Main heating Control: Programmer, room thermostat and TRVs
Control code: 2106

Secondary heating system:

Secondary heating system: None

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Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type A Energy Eff only

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.3	(1a) x	3.09	(2a) =	170.88	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.3	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	170.88	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

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

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

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.96	x	1	=	0.96			(26)
Doors Type 3			0.96	x	1	=	0.96			(26)
Doors Type 4			0.7	x	1	=	0.7			(26)
Doors Type 5			0.2	x	1	=	0.2			(26)
Windows Type 1			0.86		x1/[1/(1.2)+ 0.04]	=	0.98			(27)
Windows Type 2			2.01		x1/[1/(1.2)+ 0.04]	=	2.3			(27)
Windows Type 3			2.01		x1/[1/(1.2)+ 0.04]	=	2.3			(27)
Windows Type 4			1.46		x1/[1/(1.2)+ 0.04]	=	1.67			(27)
Windows Type 5			0.32		x1/[1/(1.2)+ 0.04]	=	0.37			(27)
Floor			55.3	x	0.11	=	6.083			(28)
Walls Type1	15.17	2.65	12.52	x	0.13	=	1.63			(29)
Walls Type2	1.85	0	1.85	x	0.13	=	0.24			(29)
Walls Type3	6.73	0	6.73	x	0.13	=	0.87			(29)
Walls Type4	1.82	0	1.82	x	0.13	=	0.24			(29)
Walls Type5	6.36	0.86	5.5	x	0.13	=	0.72			(29)
Walls Type6	28.74	8.1	20.64	x	0.13	=	2.68			(29)
Walls Type7	19.47	0	19.47	x	0.12	=	2.29			(29)
Total area of elements, m²			135.44							(31)

SAP WorkSheet: New dwelling design stage

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	27.32	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6083	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Low	100	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		20.32	(36)

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

Total fabric heat loss	(33) + (36) =	47.64	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	15.85	15.68	15.5	14.62	14.44	13.56	13.56	13.39	13.91	14.44	14.8	15.15	(38)

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

(39)m=	63.49	63.32	63.14	62.26	62.08	61.2	61.2	61.03	61.56	62.08	62.44	62.79	

Average = Sum(39)$_{1…12}$ /12= 62.22 (39)

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

(40)m=	1.15	1.14	1.14	1.13	1.12	1.11	1.11	1.1	1.11	1.12	1.13	1.14	

Average = Sum(40)$_{1…12}$ /12= 1.13 (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 1.85 (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 78.05 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	85.85	82.73	79.61	76.49	73.36	70.24	70.24	73.36	76.49	79.61	82.73	85.85	

Total = Sum(44)$_{1…12}$ = 936.55 (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=	127.31	111.35	114.9	100.17	96.12	82.94	76.86	88.2	89.25	104.01	113.54	123.3	

Total = Sum(45)$_{1…12}$ = 1227.97 (45)

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

(46)m=	19.1	16.7	17.24	15.03	14.42	12.44	11.53	13.23	13.39	15.6	17.03	18.49	(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)

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Energy lost from water storage, kWh/year	(48) x (49) =	0		(50)
b) If manufacturer's declared cylinder loss factor is not known:				
Hot water storage loss factor from Table 2 (kWh/litre/day)		0		(51)
If community heating see section 4.3				
Volume factor from Table 2a		0		(52)
Temperature factor from Table 2b		0		(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0		(54)
Enter (50) or (54) in (55)		0		(55)

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

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

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

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

(61)m=	43.75	38.08	40.57	37.72	37.39	34.64	35.79	37.39	37.72	40.57	40.8	43.75	(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=	171.06	149.43	155.47	137.89	133.51	117.58	112.65	125.58	126.97	144.58	154.34	167.05	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	171.06	149.43	155.47	137.89	133.51	117.58	112.65	125.58	126.97	144.58	154.34	167.05

Output from water heater (annual)$_{1...12}$ — 1696.11 (64)

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

(65)m=	53.27	46.54	48.35	42.74	41.31	36.24	34.5	38.67	39.11	44.73	47.95	51.93	(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=	110.77	110.77	110.77	110.77	110.77	110.77	110.77	110.77	110.77	110.77	110.77	110.77	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	39.79	35.34	28.74	21.76	16.26	13.73	14.84	19.28	25.88	32.87	38.36	40.89	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	240.24	242.73	236.45	223.07	206.19	190.33	179.73	177.23	183.51	196.89	213.77	229.64	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	47.92	47.92	47.92	47.92	47.92	47.92	47.92	47.92	47.92	47.92	47.92	47.92	(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=	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	(71)

Water heating gains (Table 5)

(72)m=	71.6	69.26	64.98	59.36	55.52	50.33	46.38	51.98	54.31	60.12	66.6	69.8	(72)

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

(73)m=	439.47	435.17	418.01	392.03	365.82	342.23	328.78	336.34	351.56	377.72	406.57	428.18	(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)	
Northeast	0.9x	0.77	x	0.86	x	11.28	x	0.4	x	0.7	=	1.88	(75)
Northeast	0.9x	0.77	x	0.32	x	11.28	x	0.4	x	0.7	=	0.7	(75)
Northeast	0.9x	0.77	x	0.86	x	22.97	x	0.4	x	0.7	=	3.83	(75)
Northeast	0.9x	0.77	x	0.32	x	22.97	x	0.4	x	0.7	=	1.43	(75)
Northeast	0.9x	0.77	x	0.86	x	41.38	x	0.4	x	0.7	=	6.91	(75)
Northeast	0.9x	0.77	x	0.32	x	41.38	x	0.4	x	0.7	=	2.57	(75)
Northeast	0.9x	0.77	x	0.86	x	67.96	x	0.4	x	0.7	=	11.34	(75)
Northeast	0.9x	0.77	x	0.32	x	67.96	x	0.4	x	0.7	=	4.22	(75)
Northeast	0.9x	0.77	x	0.86	x	91.35	x	0.4	x	0.7	=	15.24	(75)
Northeast	0.9x	0.77	x	0.32	x	91.35	x	0.4	x	0.7	=	5.67	(75)
Northeast	0.9x	0.77	x	0.86	x	97.38	x	0.4	x	0.7	=	16.25	(75)
Northeast	0.9x	0.77	x	0.32	x	97.38	x	0.4	x	0.7	=	6.05	(75)
Northeast	0.9x	0.77	x	0.86	x	91.1	x	0.4	x	0.7	=	15.2	(75)
Northeast	0.9x	0.77	x	0.32	x	91.1	x	0.4	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	0.86	x	72.63	x	0.4	x	0.7	=	12.12	(75)
Northeast	0.9x	0.77	x	0.32	x	72.63	x	0.4	x	0.7	=	4.51	(75)
Northeast	0.9x	0.77	x	0.86	x	50.42	x	0.4	x	0.7	=	8.41	(75)
Northeast	0.9x	0.77	x	0.32	x	50.42	x	0.4	x	0.7	=	3.13	(75)
Northeast	0.9x	0.77	x	0.86	x	28.07	x	0.4	x	0.7	=	4.68	(75)
Northeast	0.9x	0.77	x	0.32	x	28.07	x	0.4	x	0.7	=	1.74	(75)
Northeast	0.9x	0.77	x	0.86	x	14.2	x	0.4	x	0.7	=	2.37	(75)
Northeast	0.9x	0.77	x	0.32	x	14.2	x	0.4	x	0.7	=	0.88	(75)
Northeast	0.9x	0.77	x	0.86	x	9.21	x	0.4	x	0.7	=	1.54	(75)
Northeast	0.9x	0.77	x	0.32	x	9.21	x	0.4	x	0.7	=	0.57	(75)
Southwest	0.9x	0.77	x	2.01	x	36.79		0.4	x	0.7	=	14.35	(79)
Southwest	0.9x	0.77	x	2.01	x	36.79		0.4	x	0.7	=	14.35	(79)
Southwest	0.9x	0.77	x	1.46	x	36.79		0.4	x	0.7	=	10.42	(79)
Southwest	0.9x	0.77	x	2.01	x	62.67		0.4	x	0.7	=	24.44	(79)
Southwest	0.9x	0.77	x	2.01	x	62.67		0.4	x	0.7	=	24.44	(79)
Southwest	0.9x	0.77	x	1.46	x	62.67		0.4	x	0.7	=	17.76	(79)
Southwest	0.9x	0.77	x	2.01	x	85.75		0.4	x	0.7	=	33.45	(79)
Southwest	0.9x	0.77	x	2.01	x	85.75		0.4	x	0.7	=	33.45	(79)

Southwest0.9x	0.77	x	1.46	x	85.75		0.4	x	0.7	=	24.29	(79)
Southwest0.9x	0.77	x	2.01	x	106.25		0.4	x	0.7	=	41.44	(79)
Southwest0.9x	0.77	x	2.01	x	106.25		0.4	x	0.7	=	41.44	(79)
Southwest0.9x	0.77	x	1.46	x	106.25		0.4	x	0.7	=	30.1	(79)
Southwest0.9x	0.77	x	2.01	x	119.01		0.4	x	0.7	=	46.42	(79)
Southwest0.9x	0.77	x	2.01	x	119.01		0.4	x	0.7	=	46.42	(79)
Southwest0.9x	0.77	x	1.46	x	119.01		0.4	x	0.7	=	33.72	(79)
Southwest0.9x	0.77	x	2.01	x	118.15		0.4	x	0.7	=	46.08	(79)
Southwest0.9x	0.77	x	2.01	x	118.15		0.4	x	0.7	=	46.08	(79)
Southwest0.9x	0.77	x	1.46	x	118.15		0.4	x	0.7	=	33.47	(79)
Southwest0.9x	0.77	x	2.01	x	113.91		0.4	x	0.7	=	44.43	(79)
Southwest0.9x	0.77	x	2.01	x	113.91		0.4	x	0.7	=	44.43	(79)
Southwest0.9x	0.77	x	1.46	x	113.91		0.4	x	0.7	=	32.27	(79)
Southwest0.9x	0.77	x	2.01	x	104.39		0.4	x	0.7	=	40.71	(79)
Southwest0.9x	0.77	x	2.01	x	104.39		0.4	x	0.7	=	40.71	(79)
Southwest0.9x	0.77	x	1.46	x	104.39		0.4	x	0.7	=	29.57	(79)
Southwest0.9x	0.77	x	2.01	x	92.85		0.4	x	0.7	=	36.21	(79)
Southwest0.9x	0.77	x	2.01	x	92.85		0.4	x	0.7	=	36.21	(79)
Southwest0.9x	0.77	x	1.46	x	92.85		0.4	x	0.7	=	26.3	(79)
Southwest0.9x	0.77	x	2.01	x	69.27		0.4	x	0.7	=	27.02	(79)
Southwest0.9x	0.77	x	2.01	x	69.27		0.4	x	0.7	=	27.02	(79)
Southwest0.9x	0.77	x	1.46	x	69.27		0.4	x	0.7	=	19.62	(79)
Southwest0.9x	0.77	x	2.01	x	44.07		0.4	x	0.7	=	17.19	(79)
Southwest0.9x	0.77	x	2.01	x	44.07		0.4	x	0.7	=	17.19	(79)
Southwest0.9x	0.77	x	1.46	x	44.07		0.4	x	0.7	=	12.49	(79)
Southwest0.9x	0.77	x	2.01	x	31.49		0.4	x	0.7	=	12.28	(79)
Southwest0.9x	0.77	x	2.01	x	31.49		0.4	x	0.7	=	12.28	(79)
Southwest0.9x	0.77	x	1.46	x	31.49		0.4	x	0.7	=	8.92	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	41.71	71.9	100.66	128.54	147.46	147.93	141.98	127.63	110.28	80.08	50.11	35.59	(83)

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

(84)m=	481.18	507.08	518.67	520.58	513.28	490.16	470.77	463.97	461.84	457.8	456.69	463.77	(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=	0.93	0.91	0.89	0.84	0.77	0.64	0.51	0.53	0.7	0.84	0.9	0.93	(86)

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

(87)m=	19.01	19.2	19.53	19.98	20.4	20.75	20.9	20.89	20.66	20.14	19.52	18.98	(87)

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

(88)m=	19.96	19.96	19.97	19.98	19.98	20	20	20	19.99	19.98	19.98	19.97	(88)

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

(89)m=	0.92	0.9	0.87	0.82	0.73	0.57	0.41	0.44	0.63	0.81	0.89	0.92	(89)

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

(90)m=	18.17	18.35	18.68	19.12	19.52	19.83	19.95	19.94	19.76	19.29	18.68	18.15	(90)

fLA = Living area ÷ (4) = 0.51 (91)

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

(92)m=	18.6	18.78	19.11	19.55	19.97	20.3	20.43	20.42	20.22	19.72	19.11	18.57	(92)

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

(93)m=	18.6	18.78	19.11	19.55	19.97	20.3	20.43	20.42	20.22	19.72	19.11	18.57	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.9	0.88	0.86	0.81	0.73	0.6	0.46	0.48	0.65	0.8	0.87	0.91	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	433.29	448.18	444.08	419.95	372.63	291.95	214.76	222.18	299.93	365.3	398.95	420.8	(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=	907.86	878.96	796.03	663.28	513.26	348.68	234.57	245.42	376.6	566.24	749.59	902.13	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	353.08	289.48	261.85	175.2	104.63	0	0	0	0	149.49	252.46	358.11	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1944.31 (98)

Space heating requirement in kWh/m²/year 35.16 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.3	(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)													
	353.08	289.48	261.85	175.2	104.63	0	0	0	0	149.49	252.46	358.11	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	391.01	320.58	289.97	194.02	115.87	0	0	0	0	165.55	279.58	396.58	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2153.17 (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)

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Water heating

Output from water heater (calculated above)

171.06	149.43	155.47	137.89	133.51	117.58	112.65	125.58	126.97	144.58	154.34	167.05

Efficiency of water heater 81 (216)

(217)m=	87.04	86.9	86.6	85.95	84.84	81	81	81	81	85.48	86.53	87.12	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	196.54	171.95	179.53	160.43	157.36	145.17	139.08	155.04	156.75	169.15	178.36	191.75

Total = Sum(219a)$_{1...12}$ = 2001.1 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2153.17	
Water heating fuel used			2001.1	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		218.89		(230a)
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		293.89	(231)
Electricity for lighting			281.06	(232)

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 =	74.93	(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 =	69.64	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	38.76	(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 =	37.07	(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) = 340.41 (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)		80.12	(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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Space heating (main system 1)	(211) x	0.216	=	465.08	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	432.24	(264)
Space and water heating	(261) + (262) + (263) + (264) =			897.32	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	152.53	(267)
Electricity for lighting	(232) x	0.519	=	145.87	(268)
Total CO2, kg/year		sum of (265)…(271) =		1195.72	(272)
CO2 emissions per m²		(272) ÷ (4) =		21.62	(273)
EI 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	=	2626.87	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2441.35	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5068.21	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	902.25	(267)
Electricity for lighting	(232) x	0	=	862.85	(268)
‘Total Primary Energy		sum of (265)…(271) =		6833.32	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		123.57	(273)

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User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type A Energy Eff only

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	55.3	(1a)	x	3.09	(2a)	=	170.88	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.3	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			170.88	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)
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			2.5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.12	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.12	(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

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

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.96	x	1	=	0.96			(26)
Doors Type 3			0.96	x	1	=	0.96			(26)
Doors Type 4			0.7	x	1	=	0.7			(26)
Doors Type 5			0.2	x	1	=	0.2			(26)
Windows Type 1			0.86		x1/[1/(1.2)+ 0.04]	=	0.98			(27)
Windows Type 2			2.01		x1/[1/(1.2)+ 0.04]	=	2.3			(27)
Windows Type 3			2.01		x1/[1/(1.2)+ 0.04]	=	2.3			(27)
Windows Type 4			1.46		x1/[1/(1.2)+ 0.04]	=	1.67			(27)
Windows Type 5			0.32		x1/[1/(1.2)+ 0.04]	=	0.37			(27)
Floor			55.3	x	0.11	=	6.083			(28)
Walls Type1	15.17	2.65	12.52	x	0.13	=	1.63			(29)
Walls Type2	1.85	0	1.85	x	0.13	=	0.24			(29)
Walls Type3	6.73	0	6.73	x	0.13	=	0.87			(29)
Walls Type4	1.82	0	1.82	x	0.13	=	0.24			(29)
Walls Type5	6.36	0.86	5.5	x	0.13	=	0.72			(29)
Walls Type6	28.74	8.1	20.64	x	0.13	=	2.68			(29)
Walls Type7	19.47	0	19.47	x	0.12	=	2.29			(29)
Total area of elements, m²			135.44							(31)

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** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	27.32	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6083	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Low	100	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		20.32	(36)

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

Total fabric heat loss	(33) + (36) =	47.64	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	15.85	15.68	15.5	14.62	14.44	13.56	13.56	13.39	13.91	14.44	14.8	15.15	(38)

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

(39)m=	63.49	63.32	63.14	62.26	62.08	61.2	61.2	61.03	61.56	62.08	62.44	62.79	

Average = $Sum(39)_{1…12}$ /12= 62.22 (39)

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

(40)m=	1.15	1.14	1.14	1.13	1.12	1.11	1.11	1.1	1.11	1.12	1.13	1.14	

Average = $Sum(40)_{1…12}$ /12= 1.13 (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 — 1.85 (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 — 78.05 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	85.85	82.73	79.61	76.49	73.36	70.24	70.24	73.36	76.49	79.61	82.73	85.85	

Total = $Sum(44)_{1…12}$ = 936.55 (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=	127.31	111.35	114.9	100.17	96.12	82.94	76.86	88.2	89.25	104.01	113.54	123.3	

Total = $Sum(45)_{1…12}$ = 1227.97 (45)

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

(46)m=	19.1	16.7	17.24	15.03	14.42	12.44	11.53	13.23	13.39	15.6	17.03	18.49	(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)

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Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

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

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

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

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

(61)m=	43.75	38.08	40.57	37.72	37.39	34.64	35.79	37.39	37.72	40.57	40.8	43.75	(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=	171.06	149.43	155.47	137.89	133.51	117.58	112.65	125.58	126.97	144.58	154.34	167.05	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	171.06	149.43	155.47	137.89	133.51	117.58	112.65	125.58	126.97	144.58	154.34	167.05	

Output from water heater (annual)$_{1...12}$ | 1696.11 | (64)

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

(65)m=	53.27	46.54	48.35	42.74	41.31	36.24	34.5	38.67	39.11	44.73	47.95	51.93	(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=	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	(66)

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

(67)m=	15.91	14.14	11.5	8.7	6.51	5.49	5.93	7.71	10.35	13.15	15.34	16.36	(67)

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

(68)m=	160.96	162.63	158.42	149.46	138.15	127.52	120.42	118.75	122.95	131.92	143.23	153.86	(68)

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

(69)m=	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	(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=	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	(71)

Water heating gains (Table 5)

(72)m=	71.6	69.26	64.98	59.36	55.52	50.33	46.38	51.98	54.31	60.12	66.6	69.8	(72)

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

(73)m=	302.16	299.72	288.59	271.21	253.87	237.03	226.42	232.13	241.31	258.87	278.86	293.71	(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)	
Northeast 0.9x	0.77	x	0.86	x	11.28	x	0.4	x	0.7	=	1.88	(75)
Northeast 0.9x	0.77	x	0.32	x	11.28	x	0.4	x	0.7	=	0.7	(75)
Northeast 0.9x	0.77	x	0.86	x	22.97	x	0.4	x	0.7	=	3.83	(75)
Northeast 0.9x	0.77	x	0.32	x	22.97	x	0.4	x	0.7	=	1.43	(75)
Northeast 0.9x	0.77	x	0.86	x	41.38	x	0.4	x	0.7	=	6.91	(75)
Northeast 0.9x	0.77	x	0.32	x	41.38	x	0.4	x	0.7	=	2.57	(75)
Northeast 0.9x	0.77	x	0.86	x	67.96	x	0.4	x	0.7	=	11.34	(75)
Northeast 0.9x	0.77	x	0.32	x	67.96	x	0.4	x	0.7	=	4.22	(75)
Northeast 0.9x	0.77	x	0.86	x	91.35	x	0.4	x	0.7	=	15.24	(75)
Northeast 0.9x	0.77	x	0.32	x	91.35	x	0.4	x	0.7	=	5.67	(75)
Northeast 0.9x	0.77	x	0.86	x	97.38	x	0.4	x	0.7	=	16.25	(75)
Northeast 0.9x	0.77	x	0.32	x	97.38	x	0.4	x	0.7	=	6.05	(75)
Northeast 0.9x	0.77	x	0.86	x	91.1	x	0.4	x	0.7	=	15.2	(75)
Northeast 0.9x	0.77	x	0.32	x	91.1	x	0.4	x	0.7	=	5.66	(75)
Northeast 0.9x	0.77	x	0.86	x	72.63	x	0.4	x	0.7	=	12.12	(75)
Northeast 0.9x	0.77	x	0.32	x	72.63	x	0.4	x	0.7	=	4.51	(75)
Northeast 0.9x	0.77	x	0.86	x	50.42	x	0.4	x	0.7	=	8.41	(75)
Northeast 0.9x	0.77	x	0.32	x	50.42	x	0.4	x	0.7	=	3.13	(75)
Northeast 0.9x	0.77	x	0.86	x	28.07	x	0.4	x	0.7	=	4.68	(75)
Northeast 0.9x	0.77	x	0.32	x	28.07	x	0.4	x	0.7	=	1.74	(75)
Northeast 0.9x	0.77	x	0.86	x	14.2	x	0.4	x	0.7	=	2.37	(75)
Northeast 0.9x	0.77	x	0.32	x	14.2	x	0.4	x	0.7	=	0.88	(75)
Northeast 0.9x	0.77	x	0.86	x	9.21	x	0.4	x	0.7	=	1.54	(75)
Northeast 0.9x	0.77	x	0.32	x	9.21	x	0.4	x	0.7	=	0.57	(75)
Southwest 0.9x	0.77	x	2.01	x	36.79		0.4	x	0.7	=	14.35	(79)
Southwest 0.9x	0.77	x	2.01	x	36.79		0.4	x	0.7	=	14.35	(79)
Southwest 0.9x	0.77	x	1.46	x	36.79		0.4	x	0.7	=	10.42	(79)
Southwest 0.9x	0.77	x	2.01	x	62.67		0.4	x	0.7	=	24.44	(79)
Southwest 0.9x	0.77	x	2.01	x	62.67		0.4	x	0.7	=	24.44	(79)
Southwest 0.9x	0.77	x	1.46	x	62.67		0.4	x	0.7	=	17.76	(79)
Southwest 0.9x	0.77	x	2.01	x	85.75		0.4	x	0.7	=	33.45	(79)
Southwest 0.9x	0.77	x	2.01	x	85.75		0.4	x	0.7	=	33.45	(79)

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Southwest0.9x	0.77	x	1.46	x	85.75		0.4	x	0.7	=	24.29	(79)
Southwest0.9x	0.77	x	2.01	x	106.25		0.4	x	0.7	=	41.44	(79)
Southwest0.9x	0.77	x	2.01	x	106.25		0.4	x	0.7	=	41.44	(79)
Southwest0.9x	0.77	x	1.46	x	106.25		0.4	x	0.7	=	30.1	(79)
Southwest0.9x	0.77	x	2.01	x	119.01		0.4	x	0.7	=	46.42	(79)
Southwest0.9x	0.77	x	2.01	x	119.01		0.4	x	0.7	=	46.42	(79)
Southwest0.9x	0.77	x	1.46	x	119.01		0.4	x	0.7	=	33.72	(79)
Southwest0.9x	0.77	x	2.01	x	118.15		0.4	x	0.7	=	46.08	(79)
Southwest0.9x	0.77	x	2.01	x	118.15		0.4	x	0.7	=	46.08	(79)
Southwest0.9x	0.77	x	1.46	x	118.15		0.4	x	0.7	=	33.47	(79)
Southwest0.9x	0.77	x	2.01	x	113.91		0.4	x	0.7	=	44.43	(79)
Southwest0.9x	0.77	x	2.01	x	113.91		0.4	x	0.7	=	44.43	(79)
Southwest0.9x	0.77	x	1.46	x	113.91		0.4	x	0.7	=	32.27	(79)
Southwest0.9x	0.77	x	2.01	x	104.39		0.4	x	0.7	=	40.71	(79)
Southwest0.9x	0.77	x	2.01	x	104.39		0.4	x	0.7	=	40.71	(79)
Southwest0.9x	0.77	x	1.46	x	104.39		0.4	x	0.7	=	29.57	(79)
Southwest0.9x	0.77	x	2.01	x	92.85		0.4	x	0.7	=	36.21	(79)
Southwest0.9x	0.77	x	2.01	x	92.85		0.4	x	0.7	=	36.21	(79)
Southwest0.9x	0.77	x	1.46	x	92.85		0.4	x	0.7	=	26.3	(79)
Southwest0.9x	0.77	x	2.01	x	69.27		0.4	x	0.7	=	27.02	(79)
Southwest0.9x	0.77	x	2.01	x	69.27		0.4	x	0.7	=	27.02	(79)
Southwest0.9x	0.77	x	1.46	x	69.27		0.4	x	0.7	=	19.62	(79)
Southwest0.9x	0.77	x	2.01	x	44.07		0.4	x	0.7	=	17.19	(79)
Southwest0.9x	0.77	x	2.01	x	44.07		0.4	x	0.7	=	17.19	(79)
Southwest0.9x	0.77	x	1.46	x	44.07		0.4	x	0.7	=	12.49	(79)
Southwest0.9x	0.77	x	2.01	x	31.49		0.4	x	0.7	=	12.28	(79)
Southwest0.9x	0.77	x	2.01	x	31.49		0.4	x	0.7	=	12.28	(79)
Southwest0.9x	0.77	x	1.46	x	31.49		0.4	x	0.7	=	8.92	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	41.71	71.9	100.66	128.54	147.46	147.93	141.98	127.63	110.28	80.08	50.11	35.59	(83)

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

(84)m=	343.87	371.62	389.25	399.75	401.33	384.97	368.4	359.76	351.59	338.95	328.97	329.3	(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=	0.96	0.95	0.94	0.9	0.84	0.73	0.61	0.63	0.79	0.9	0.95	0.97	(86)

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

(87)m=	18.64	18.85	19.21	19.72	20.22	20.64	20.85	20.83	20.52	19.89	19.19	18.61	(87)

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

(88)m=	19.96	19.96	19.97	19.98	19.98	20	20	20	19.99	19.98	19.98	19.97	(88)

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

(89)m=	0.96	0.95	0.93	0.88	0.81	0.67	0.5	0.53	0.74	0.88	0.94	0.96	(89)

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

(90)m=	17.81	18.02	18.38	18.88	19.36	19.76	19.92	19.91	19.65	19.06	18.37	17.79	(90)

fLA = Living area ÷ (4) = 0.51 (91)

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

(92)m=	18.23	18.44	18.8	19.31	19.8	20.21	20.39	20.37	20.09	19.48	18.79	18.2	(92)

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

(93)m=	18.23	18.44	18.8	19.31	19.8	20.21	20.39	20.37	20.09	19.48	18.79	18.2	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.95	0.93	0.91	0.87	0.8	0.68	0.55	0.57	0.74	0.87	0.93	0.95	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	325.47	346.79	354.69	348.21	321.81	263.56	201.51	206.58	261.67	295.65	305.64	313.3	(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=	884.68	857.13	776.78	648.03	502.68	343.09	232.08	242.47	368.88	551.48	729.67	879.22	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	416.05	342.95	314.04	215.87	134.57	0	0	0	0	190.33	305.3	421.04	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2340.16 (98)

Space heating requirement in kWh/m²/year 42.32 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.3	(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)													
	416.05	342.95	314.04	215.87	134.57	0	0	0	0	190.33	305.3	421.04	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	460.75	379.79	347.77	239.06	149.03	0	0	0	0	210.78	338.1	466.27	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2591.54 (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	0

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

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

171.06	149.43	155.47	137.89	133.51	117.58	112.65	125.58	126.97	144.58	154.34	167.05

Efficiency of water heater: 81 (216)

(217)m=	87.38	87.26	86.99	86.43	85.42	81	81	81	81	86.04	86.95	87.45	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	195.77	171.24	178.72	159.54	156.3	145.17	139.08	155.04	156.75	168.05	177.51	191.02

Total = Sum(219a)$_{1...12}$ = 1994.19 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2591.54	
Water heating fuel used		1994.19	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	218.89		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		293.89	(231)
Electricity for lighting		281.06	(232)

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	=	559.77	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	430.75	(264)
Space and water heating	(261) + (262) + (263) + (264) =			990.52	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	152.53	(267)
Electricity for lighting	(232) x	0.519	=	145.87	(268)
Total CO2, kg/year		sum of (265)…(271) =		1288.92	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		23.31	(273)
EI rating (section 14)				83	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type A Energy Eff only

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.3	(1a) x	3.09	(2a) =	170.88	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.3	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		170.88	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =	0.12	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

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

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

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59	(24d)

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

(25)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.96	x	1	=	0.96			(26)
Doors Type 3			0.96	x	1	=	0.96			(26)
Doors Type 4			0.7	x	1	=	0.7			(26)
Doors Type 5			0.2	x	1	=	0.2			(26)
Windows Type 1			0.86	x1/[1/(1.4)+ 0.04]		=	1.14			(27)
Windows Type 2			2.01	x1/[1/(1.4)+ 0.04]		=	2.66			(27)
Windows Type 3			2.01	x1/[1/(1.4)+ 0.04]		=	2.66			(27)
Windows Type 4			1.46	x1/[1/(1.4)+ 0.04]		=	1.94			(27)
Windows Type 5			0.32	x1/[1/(1.4)+ 0.04]		=	0.42			(27)
Floor			55.3	x	0.13	=	7.189			(28)
Walls Type1	15.17	2.65	12.52	x	0.18	=	2.25			(29)
Walls Type2	1.85	0	1.85	x	0.18	=	0.33			(29)
Walls Type3	6.73	0	6.73	x	0.18	=	1.21			(29)
Walls Type4	1.82	0	1.82	x	0.18	=	0.33			(29)
Walls Type5	6.36	0.86	5.5	x	0.18	=	0.99			(29)
Walls Type6	28.74	8.1	20.64	x	0.18	=	3.71			(29)
Walls Type7	19.47	0	19.47	x	0.18	=	3.5			(29)
Total area of elements, m²			135.44							(31)

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** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	33.3	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6083	(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		6.77	(36)

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

Total fabric heat loss	(33) + (36) =	40.08	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	34.37	34.13	33.89	32.79	32.58	31.62	31.62	31.44	31.99	32.58	33	33.44	(38)

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

(39)m=	74.45	74.21	73.97	72.87	72.66	71.7	71.7	71.52	72.07	72.66	73.08	73.52	

Average = Sum(39)$_{1…12}$ /12= 72.87 (39)

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

(40)m=	1.35	1.34	1.34	1.32	1.31	1.3	1.3	1.29	1.3	1.31	1.32	1.33	

Average = Sum(40)$_{1…12}$ /12= 1.32 (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 — 1.85 (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 — 78.05 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	85.85	82.73	79.61	76.49	73.36	70.24	70.24	73.36	76.49	79.61	82.73	85.85

Total = Sum(44)$_{1…12}$ = 936.55 (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=	127.31	111.35	114.9	100.17	96.12	82.94	76.86	88.2	89.25	104.01	113.54	123.3

Total = Sum(45)$_{1…12}$ = 1227.97 (45)

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

(46)m=	19.1	16.7	17.24	15.03	14.42	12.44	11.53	13.23	13.39	15.6	17.03	18.49	(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)

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Energy lost from water storage, kWh/year	(48) x (49) =		0	(50)
b) If manufacturer's declared cylinder loss factor is not known:				
Hot water storage loss factor from Table 2 (kWh/litre/day)			0	(51)
If community heating see section 4.3				
Volume factor from Table 2a			0	(52)
Temperature factor from Table 2b			0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =		0	(54)
Enter (50) or (54) in (55)			0	(55)

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

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

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

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

(61)m=	43.75	38.08	40.57	37.72	37.39	34.64	35.79	37.39	37.72	40.57	40.8	43.75	(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=	171.06	149.43	155.47	137.89	133.51	117.58	112.65	125.58	126.97	144.58	154.34	167.05	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	171.06	149.43	155.47	137.89	133.51	117.58	112.65	125.58	126.97	144.58	154.34	167.05

Output from water heater (annual)$_{1...12}$ — 1696.11 (64)

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

(65)m=	53.27	46.54	48.35	42.74	41.31	36.24	34.5	38.67	39.11	44.73	47.95	51.93	(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=	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	(66)

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

(67)m=	15.91	14.14	11.5	8.7	6.51	5.49	5.93	7.71	10.35	13.15	15.34	16.36	(67)

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

(68)m=	160.96	162.63	158.42	149.46	138.15	127.52	120.42	118.75	122.95	131.92	143.23	153.86	(68)

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

(69)m=	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	(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=	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	(71)

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Water heating gains (Table 5)

(72)m=	71.6	69.26	64.98	59.36	55.52	50.33	46.38	51.98	54.31	60.12	66.6	69.8	(72)

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

(73)m=	302.16	299.72	288.59	271.21	253.87	237.03	226.42	232.13	241.31	258.87	278.86	293.71	(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)	
Northeast	0.9x	0.77	x	0.86	x	11.28	x	0.63	x	0.7	=	2.97	(75)
Northeast	0.9x	0.77	x	0.32	x	11.28	x	0.63	x	0.7	=	1.1	(75)
Northeast	0.9x	0.77	x	0.86	x	22.97	x	0.63	x	0.7	=	6.04	(75)
Northeast	0.9x	0.77	x	0.32	x	22.97	x	0.63	x	0.7	=	2.25	(75)
Northeast	0.9x	0.77	x	0.86	x	41.38	x	0.63	x	0.7	=	10.88	(75)
Northeast	0.9x	0.77	x	0.32	x	41.38	x	0.63	x	0.7	=	4.05	(75)
Northeast	0.9x	0.77	x	0.86	x	67.96	x	0.63	x	0.7	=	17.86	(75)
Northeast	0.9x	0.77	x	0.32	x	67.96	x	0.63	x	0.7	=	6.65	(75)
Northeast	0.9x	0.77	x	0.86	x	91.35	x	0.63	x	0.7	=	24.01	(75)
Northeast	0.9x	0.77	x	0.32	x	91.35	x	0.63	x	0.7	=	8.93	(75)
Northeast	0.9x	0.77	x	0.86	x	97.38	x	0.63	x	0.7	=	25.6	(75)
Northeast	0.9x	0.77	x	0.32	x	97.38	x	0.63	x	0.7	=	9.52	(75)
Northeast	0.9x	0.77	x	0.86	x	91.1	x	0.63	x	0.7	=	23.94	(75)
Northeast	0.9x	0.77	x	0.32	x	91.1	x	0.63	x	0.7	=	8.91	(75)
Northeast	0.9x	0.77	x	0.86	x	72.63	x	0.63	x	0.7	=	19.09	(75)
Northeast	0.9x	0.77	x	0.32	x	72.63	x	0.63	x	0.7	=	7.1	(75)
Northeast	0.9x	0.77	x	0.86	x	50.42	x	0.63	x	0.7	=	13.25	(75)
Northeast	0.9x	0.77	x	0.32	x	50.42	x	0.63	x	0.7	=	4.93	(75)
Northeast	0.9x	0.77	x	0.86	x	28.07	x	0.63	x	0.7	=	7.38	(75)
Northeast	0.9x	0.77	x	0.32	x	28.07	x	0.63	x	0.7	=	2.74	(75)
Northeast	0.9x	0.77	x	0.86	x	14.2	x	0.63	x	0.7	=	3.73	(75)
Northeast	0.9x	0.77	x	0.32	x	14.2	x	0.63	x	0.7	=	1.39	(75)
Northeast	0.9x	0.77	x	0.86	x	9.21	x	0.63	x	0.7	=	2.42	(75)
Northeast	0.9x	0.77	x	0.32	x	9.21	x	0.63	x	0.7	=	0.9	(75)
Southwest	0.9x	0.77	x	2.01	x	36.79		0.63	x	0.7	=	22.6	(79)
Southwest	0.9x	0.77	x	2.01	x	36.79		0.63	x	0.7	=	22.6	(79)
Southwest	0.9x	0.77	x	1.46	x	36.79		0.63	x	0.7	=	16.42	(79)
Southwest	0.9x	0.77	x	2.01	x	62.67		0.63	x	0.7	=	38.5	(79)
Southwest	0.9x	0.77	x	2.01	x	62.67		0.63	x	0.7	=	38.5	(79)
Southwest	0.9x	0.77	x	1.46	x	62.67		0.63	x	0.7	=	27.96	(79)
Southwest	0.9x	0.77	x	2.01	x	85.75		0.63	x	0.7	=	52.68	(79)
Southwest	0.9x	0.77	x	2.01	x	85.75		0.63	x	0.7	=	52.68	(79)

Southwest0.9x	0.77	x	1.46	x	85.75	0.63	x	0.7	=	38.26	(79)
Southwest0.9x	0.77	x	2.01	x	106.25	0.63	x	0.7	=	65.27	(79)
Southwest0.9x	0.77	x	2.01	x	106.25	0.63	x	0.7	=	65.27	(79)
Southwest0.9x	0.77	x	1.46	x	106.25	0.63	x	0.7	=	47.41	(79)
Southwest0.9x	0.77	x	2.01	x	119.01	0.63	x	0.7	=	73.11	(79)
Southwest0.9x	0.77	x	2.01	x	119.01	0.63	x	0.7	=	73.11	(79)
Southwest0.9x	0.77	x	1.46	x	119.01	0.63	x	0.7	=	53.1	(79)
Southwest0.9x	0.77	x	2.01	x	118.15	0.63	x	0.7	=	72.58	(79)
Southwest0.9x	0.77	x	2.01	x	118.15	0.63	x	0.7	=	72.58	(79)
Southwest0.9x	0.77	x	1.46	x	118.15	0.63	x	0.7	=	52.72	(79)
Southwest0.9x	0.77	x	2.01	x	113.91	0.63	x	0.7	=	69.97	(79)
Southwest0.9x	0.77	x	2.01	x	113.91	0.63	x	0.7	=	69.97	(79)
Southwest0.9x	0.77	x	1.46	x	113.91	0.63	x	0.7	=	50.83	(79)
Southwest0.9x	0.77	x	2.01	x	104.39	0.63	x	0.7	=	64.13	(79)
Southwest0.9x	0.77	x	2.01	x	104.39	0.63	x	0.7	=	64.13	(79)
Southwest0.9x	0.77	x	1.46	x	104.39	0.63	x	0.7	=	46.58	(79)
Southwest0.9x	0.77	x	2.01	x	92.85	0.63	x	0.7	=	57.04	(79)
Southwest0.9x	0.77	x	2.01	x	92.85	0.63	x	0.7	=	57.04	(79)
Southwest0.9x	0.77	x	1.46	x	92.85	0.63	x	0.7	=	41.43	(79)
Southwest0.9x	0.77	x	2.01	x	69.27	0.63	x	0.7	=	42.55	(79)
Southwest0.9x	0.77	x	2.01	x	69.27	0.63	x	0.7	=	42.55	(79)
Southwest0.9x	0.77	x	1.46	x	69.27	0.63	x	0.7	=	30.91	(79)
Southwest0.9x	0.77	x	2.01	x	44.07	0.63	x	0.7	=	27.07	(79)
Southwest0.9x	0.77	x	2.01	x	44.07	0.63	x	0.7	=	27.07	(79)
Southwest0.9x	0.77	x	1.46	x	44.07	0.63	x	0.7	=	19.66	(79)
Southwest0.9x	0.77	x	2.01	x	31.49	0.63	x	0.7	=	19.34	(79)
Southwest0.9x	0.77	x	2.01	x	31.49	0.63	x	0.7	=	19.34	(79)
Southwest0.9x	0.77	x	1.46	x	31.49	0.63	x	0.7	=	14.05	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	65.69	113.25	158.54	202.45	232.26	232.99	223.62	201.02	173.69	126.13	78.93	56.06	(83)

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

(84)m=	367.85	412.96	447.13	473.66	486.12	470.03	450.04	433.15	415	385	357.79	349.77	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.97	0.92	0.81	0.65	0.69	0.89	0.98	0.99	1	(86)

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

(87)m=	19.56	19.71	19.96	20.3	20.63	20.87	20.96	20.95	20.79	20.37	19.91	19.54	(87)

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

(88)m=	19.8	19.81	19.81	19.83	19.83	19.84	19.84	19.85	19.84	19.83	19.82	19.82	(88)

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

(89)m=	1	0.99	0.98	0.96	0.89	0.72	0.5	0.55	0.82	0.96	0.99	1	(89)

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

(90)m=	17.91	18.13	18.5	19	19.45	19.75	19.83	19.83	19.66	19.11	18.44	17.89	(90)

fLA = Living area ÷ (4) = 0.51 (91)

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

(92)m=	18.75	18.93	19.24	19.66	20.04	20.32	20.4	20.4	20.23	19.75	19.18	18.73	(92)

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

(93)m=	18.75	18.93	19.24	19.66	20.04	20.32	20.4	20.4	20.23	19.75	19.18	18.73	(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=	0.99	0.99	0.98	0.96	0.9	0.76	0.58	0.62	0.84	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	365.78	408.87	438.54	453.12	435.8	357.38	261.17	269.77	350.49	370.59	354.12	348.18	(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=	1075.62	1041.41	942.56	784.18	606.31	410.01	272.78	285.84	441.78	664.72	883.13	1068.04	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	528.12	425.07	374.99	238.36	126.87	0	0	0	0	218.83	380.88	535.57	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2828.69 (98)

Space heating requirement in kWh/m²/year 51.15 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	528.12	425.07	374.99	238.36	126.87	0	0	0	0	218.83	380.88	535.57	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	565.44	455.1	401.48	255.21	135.83	0	0	0	0	234.29	407.8	573.42	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3028.58 (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)

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

171.06	149.43	155.47	137.89	133.51	117.58	112.65	125.58	126.97	144.58	154.34	167.05

Efficiency of water heater 80.3 (216)

(217)m=	87.7	87.54	87.19	86.42	84.92	80.3	80.3	80.3	80.3	86.09	87.24	87.78

(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	195.05	170.7	178.32	159.57	157.21	146.43	140.29	156.39	158.12	167.94	176.92	190.31

Total = Sum(219a)$_{1...12}$ = 1997.25 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3028.58	
Water heating fuel used		1997.25	
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		281.06	(232)

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	=	654.17	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	431.41	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1085.58	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	145.87	(268)
Total CO2, kg/year		sum of (265)…(271) =		1270.37	(272)

TER = 22.97 (273)

SAP Input

Property Details: Flat Type B Energy Eff Only

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	07 November 2019
Date of certificate:	12 May 2020
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Low
Water use <= 125 litres/person/day:	True
PCDF Version:	460

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2020	
Floor Location:	Floor area:	Storey height:
Floor 0	35 m²	3.09 m
Living area:	22 m² (fraction 0.629)	
Front of dwelling faces:	North East	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D_5_01	Manufacturer	Solid			Metal
Vent_05_03	Manufacturer	Solid			
Vent_05_01	Manufacturer	Solid			
Vent_D5_08	Manufacturer	Solid			
Window_05_02	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_05_01	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Fanlight	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_05_08	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D_5_01	mm	0	0	1	2.13	1
Vent_05_03	mm	0	0	1	0.94	1
Vent_05_01	mm	0	0	1	0.75	1
Vent_D5_08	mm	0	0	1	0.68	1
Window_05_02	6mm	0.7	0.4	1.2	2	1
Window_05_01	6mm	0.7	0.4	1.2	1.04	1
Fanlight	6mm	0.7	0.4	1.2	0.32	1
Window_05_08	6mm	0.7	0.4	1.2	1.45	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D_5_01		5_01	North East	0	0
Vent_05_03		5_05	South West	0.57	1.65
Vent_05_01		5_01	North East	0.623	1.2
Vent_D5_08		5_05	South West	0.57	1.2
Window_05_02		5_05	South West	1.21	1.65
Window_05_01		5_01	North East	1.2	0.863
Fanlight		5_01	North East	1.01	0.315
Window_05_08		5_05	South West	1.21	1.2

SAP Input

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
5_01	15.481	4.24	11.24	0.13	0	False	N/A
5_02	2.039	0	2.04	0.13	0	False	N/A
5_03	2.874	0	2.87	0.13	0	False	N/A
5_05	18.386	5.07	13.32	0.13	0	False	N/A
R_01	35	0	35	0.1	0		N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test: Yes (As designed)

Ventilation: Balanced with heat recovery
Number of wet rooms: Kitchen + 1
Ductwork: Insulation, rigid
Approved Installation Scheme: False

Number of chimneys: 0
Number of open flues: 0
Number of fans: 0
Number of passive stacks: 0
Number of sides sheltered: 0
Pressure test: 2.5

Main heating system:

Main heating system: Boiler systems with radiators or underfloor heating
Gas boilers and oil boilers
Fuel: mains gas
Info Source: Manufacturer Declaration
Manufacturer's data
Efficiency: 89.5% (SEDBUK2009)
Condensing combi with automatic ignition
Fuel Burning Type: Modulation
Systems with radiators
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Room-sealed
Boiler interlock: Yes

Main heating Control:

Main heating Control: Programmer, room thermostat and TRVs
Control code: 2106

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating: From main heating system
Water code: 901
Fuel :mains gas
No hot water cylinder
Solar panel: False

Others:

Electricity tariff: Standard Tariff
In Smoke Control Area: Yes

SAP Input

Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type B Energy Eff Only

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	35	(1a)	x	3.09	(2a)	=	108.15	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	35	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	108.15	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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

SAP WorkSheet: New dwelling design stage

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

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.94	x	1	=	0.94			(26)
Doors Type 3			0.75	x	1	=	0.75			(26)
Doors Type 4			0.68	x	1	=	0.68			(26)
Windows Type 1			2	x1/[1/(1.2)+ 0.04]		=	2.29			(27)
Windows Type 2			1.04	x1/[1/(1.2)+ 0.04]		=	1.19			(27)
Windows Type 3			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Windows Type 4			1.45	x1/[1/(1.2)+ 0.04]		=	1.66			(27)
Walls Type1	15.48	4.24	11.24	x	0.13	=	1.46			(29)
Walls Type2	2.04	0	2.04	x	0.13	=	0.27			(29)
Walls Type3	2.87	0	2.87	x	0.13	=	0.37			(29)
Walls Type4	18.39	5.07	13.32	x	0.13	=	1.73			(29)
Roof	35	0	35	x	0.1	=	3.5			(30)
Total area of elements, m²			73.78							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 17.34 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 315 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 11.07 | (36)

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

Total fabric heat loss (33) + (36) = | 28.41 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	10.03	9.92	9.81	9.25	9.14	8.58	8.58	8.47	8.81	9.14	9.36	9.59	(38)

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

(39)m=	38.44	38.33	38.22	37.66	37.55	36.99	36.99	36.88	37.21	37.55	37.77	37.99	

Average = Sum(39)$_{1…12}$ /12= | 37.63 | (39)

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

(40)m=	1.1	1.1	1.09	1.08	1.07	1.06	1.06	1.05	1.06	1.07	1.08	1.09	

Average = Sum(40)$_{1…12}$ /12= | 1.08 | (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 | 1.28 | (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 | 64.62 | (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	71.08	68.49	65.91	63.32	60.74	58.16	58.16	60.74	63.32	65.91	68.49	71.08	

Total = Sum(44)$_{1…12}$ = | 775.4 | (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=	105.41	92.19	95.13	82.94	79.58	68.67	63.64	73.02	73.89	86.12	94	102.08	

Total = Sum(45)$_{1…12}$ = | 1016.67 | (45)

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

(46)m=	15.81	13.83	14.27	12.44	11.94	10.3	9.55	10.95	11.08	12.92	14.1	15.31	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47)

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

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

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): | 0 | (48)

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 0 | (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0 | (52)

Temperature factor from Table 2b | 0 | (53)

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

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

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

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

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

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

(61)m=	36.22	31.53	33.59	31.23	30.95	28.68	29.64	30.95	31.23	33.59	33.78	36.22	(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=	141.63	123.72	128.72	114.17	110.53	97.35	93.27	103.97	105.12	119.7	127.78	138.3	(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=	141.63	123.72	128.72	114.17	110.53	97.35	93.27	103.97	105.12	119.7	127.78	138.3

Output from water heater (annual)$_{1...12}$ 1404.27 (64)

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

(65)m=	44.1	38.53	40.03	35.38	34.2	30	28.57	32.02	32.38	37.03	39.7	43	(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=	76.84	76.84	76.84	76.84	76.84	76.84	76.84	76.84	76.84	76.84	76.84	76.84	(66)

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

(67)m=	26.21	23.28	18.94	14.34	10.72	9.05	9.78	12.71	17.05	21.65	25.27	26.94	(67)

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

(68)m=	162.98	164.67	160.41	151.33	139.88	129.12	121.93	120.23	124.5	133.57	145.02	155.79	(68)

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

(69)m=	43.96	43.96	43.96	43.96	43.96	43.96	43.96	43.96	43.96	43.96	43.96	43.96	(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=	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	(71)

Water heating gains (Table 5)

(72)m=	59.28	57.34	53.8	49.14	45.97	41.67	38.4	43.03	44.97	49.77	55.14	57.79	(72)

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

(73)m=	321.05	317.87	305.72	287.39	269.14	252.41	242.68	248.56	259.1	277.58	298.02	313.1	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	1.04	x	11.28	x	0.4	x	0.7	=	2.28	(75)
Northeast	0.9x	0.77	x	0.32	x	11.28	x	0.4	x	0.7	=	0.7	(75)
Northeast	0.9x	0.77	x	1.04	x	22.97	x	0.4	x	0.7	=	4.63	(75)
Northeast	0.9x	0.77	x	0.32	x	22.97	x	0.4	x	0.7	=	1.43	(75)
Northeast	0.9x	0.77	x	1.04	x	41.38	x	0.4	x	0.7	=	8.35	(75)
Northeast	0.9x	0.77	x	0.32	x	41.38	x	0.4	x	0.7	=	2.57	(75)
Northeast	0.9x	0.77	x	1.04	x	67.96	x	0.4	x	0.7	=	13.71	(75)
Northeast	0.9x	0.77	x	0.32	x	67.96	x	0.4	x	0.7	=	4.22	(75)
Northeast	0.9x	0.77	x	1.04	x	91.35	x	0.4	x	0.7	=	18.43	(75)
Northeast	0.9x	0.77	x	0.32	x	91.35	x	0.4	x	0.7	=	5.67	(75)
Northeast	0.9x	0.77	x	1.04	x	97.38	x	0.4	x	0.7	=	19.65	(75)
Northeast	0.9x	0.77	x	0.32	x	97.38	x	0.4	x	0.7	=	6.05	(75)
Northeast	0.9x	0.77	x	1.04	x	91.1	x	0.4	x	0.7	=	18.38	(75)
Northeast	0.9x	0.77	x	0.32	x	91.1	x	0.4	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	1.04	x	72.63	x	0.4	x	0.7	=	14.66	(75)
Northeast	0.9x	0.77	x	0.32	x	72.63	x	0.4	x	0.7	=	4.51	(75)
Northeast	0.9x	0.77	x	1.04	x	50.42	x	0.4	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	0.32	x	50.42	x	0.4	x	0.7	=	3.13	(75)
Northeast	0.9x	0.77	x	1.04	x	28.07	x	0.4	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	0.32	x	28.07	x	0.4	x	0.7	=	1.74	(75)
Northeast	0.9x	0.77	x	1.04	x	14.2	x	0.4	x	0.7	=	2.86	(75)
Northeast	0.9x	0.77	x	0.32	x	14.2	x	0.4	x	0.7	=	0.88	(75)
Northeast	0.9x	0.77	x	1.04	x	9.21	x	0.4	x	0.7	=	1.86	(75)
Northeast	0.9x	0.77	x	0.32	x	9.21	x	0.4	x	0.7	=	0.57	(75)
Southwest	0.9x	0.77	x	2	x	36.79		0.4	x	0.7	=	14.28	(79)
Southwest	0.9x	0.77	x	1.45	x	36.79		0.4	x	0.7	=	10.35	(79)
Southwest	0.9x	0.77	x	2	x	62.67		0.4	x	0.7	=	24.32	(79)
Southwest	0.9x	0.77	x	1.45	x	62.67		0.4	x	0.7	=	17.63	(79)
Southwest	0.9x	0.77	x	2	x	85.75		0.4	x	0.7	=	33.28	(79)
Southwest	0.9x	0.77	x	1.45	x	85.75		0.4	x	0.7	=	24.13	(79)
Southwest	0.9x	0.77	x	2	x	106.25		0.4	x	0.7	=	41.23	(79)
Southwest	0.9x	0.77	x	1.45	x	106.25		0.4	x	0.7	=	29.89	(79)
Southwest	0.9x	0.77	x	2	x	119.01		0.4	x	0.7	=	46.19	(79)
Southwest	0.9x	0.77	x	1.45	x	119.01		0.4	x	0.7	=	33.48	(79)
Southwest	0.9x	0.77	x	2	x	118.15		0.4	x	0.7	=	45.85	(79)
Southwest	0.9x	0.77	x	1.45	x	118.15		0.4	x	0.7	=	33.24	(79)
Southwest	0.9x	0.77	x	2	x	113.91		0.4	x	0.7	=	44.21	(79)
Southwest	0.9x	0.77	x	1.45	x	113.91		0.4	x	0.7	=	32.05	(79)
Southwest	0.9x	0.77	x	2	x	104.39		0.4	x	0.7	=	40.51	(79)

Southwest	0.9x	0.77	x	1.45	x	104.39	0.4	x	0.7	=	29.37	(79)
Southwest	0.9x	0.77	x	2	x	92.85	0.4	x	0.7	=	36.03	(79)
Southwest	0.9x	0.77	x	1.45	x	92.85	0.4	x	0.7	=	26.12	(79)
Southwest	0.9x	0.77	x	2	x	69.27	0.4	x	0.7	=	26.88	(79)
Southwest	0.9x	0.77	x	1.45	x	69.27	0.4	x	0.7	=	19.49	(79)
Southwest	0.9x	0.77	x	2	x	44.07	0.4	x	0.7	=	17.1	(79)
Southwest	0.9x	0.77	x	1.45	x	44.07	0.4	x	0.7	=	12.4	(79)
Southwest	0.9x	0.77	x	2	x	31.49	0.4	x	0.7	=	12.22	(79)
Southwest	0.9x	0.77	x	1.45	x	31.49	0.4	x	0.7	=	8.86	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	27.61	48.02	68.33	89.06	103.78	104.79	100.3	89.05	75.46	53.78	33.25	23.51	(83)

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

(84)m=	348.66	365.89	374.05	376.46	372.92	357.21	342.97	337.6	334.56	331.35	331.26	336.61	(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=	0.9	0.88	0.85	0.8	0.71	0.57	0.44	0.46	0.63	0.79	0.87	0.91	(86)

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

(87)m=	19.3	19.47	19.78	20.18	20.55	20.83	20.94	20.93	20.76	20.32	19.76	19.26	(87)

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

(88)m=	20	20	20.01	20.02	20.02	20.04	20.04	20.04	20.03	20.02	20.02	20.01	(88)

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

(89)m=	0.89	0.87	0.83	0.77	0.66	0.51	0.36	0.38	0.57	0.76	0.85	0.9	(89)

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

(90)m=	18.48	18.65	18.94	19.34	19.68	19.93	20.01	20	19.87	19.48	18.94	18.45	(90)

fLA = Living area ÷ (4) = 0.63 (91)

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

(92)m=	18.99	19.16	19.47	19.87	20.23	20.49	20.59	20.58	20.43	20.01	19.46	18.96	(92)

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

(93)m=	18.99	19.16	19.47	19.87	20.23	20.49	20.59	20.58	20.43	20.01	19.46	18.96	(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=	0.87	0.85	0.82	0.76	0.67	0.54	0.41	0.43	0.6	0.75	0.84	0.88	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	304.7	312.76	307.58	287.73	251.27	192.11	139.05	144.11	199.08	250.05	278.67	296.8	(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=	564.71	546.73	495.52	413.18	320.24	217.99	147.69	154.32	235.5	353.29	466.77	560.82	(97)

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

(98)m=	193.45	157.23	139.83	90.32	51.31	0	0	0	0	76.81	135.44	196.43

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1040.82 (98)

Space heating requirement in kWh/m²/year 29.74 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	193.45	157.23	139.83	90.32	51.31	0	0	0	0	76.81	135.44	196.43	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)	213.99	173.92	154.68	99.91	56.76	0	0	0	0	84.97	149.82	217.29	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1151.35 (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)	141.63	123.72	128.72	114.17	110.53	97.35	93.27	103.97	105.12	119.7	127.78	138.3	
Efficiency of water heater													80.3 (216)
(217)m=	85.84	85.66	85.26	84.47	83.25	80.3	80.3	80.3	80.3	83.97	85.2	85.93	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	165	144.43	150.97	135.16	132.77	121.24	116.15	129.48	130.91	142.56	149.98	160.94

Total = Sum(219a)$_{1...12}$ = 1679.6 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1151.35	
Water heating fuel used			1679.6	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		138.54		(230a)
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		213.54	(231)
Electricity for lighting			185.19	(232)

10a. Fuel costs - individual heating systems:

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	Fuel kWh/year		Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211)	x	3.48	x 0.01 =	40.07	(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 =	58.45	(247)
Pumps, fans and electric keep-hot	(231)		13.19	x 0.01 =	28.17	(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 =	24.43	(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) =	271.11	(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] =	1.42	(257)
SAP rating (Section 12)		80.14	(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	=	248.69	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	362.79	(264)
Space and water heating	(261) + (262) + (263) + (264) =				611.48	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	110.83	(267)
Electricity for lighting	(232)	x	0.519	=	96.11	(268)
Total CO2, kg/year			sum of (265)…(271) =		818.42	(272)
CO2 emissions per m²			(272) ÷ (4) =		23.38	(273)
EI 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	=	1404.64	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	2049.11	(264)
Space and water heating	(261) + (262) + (263) + (264) =				3453.76	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	655.57	(267)

Electricity for lighting	(232) x	0	=	568.52	(268)
'Total Primary Energy		sum of (265)…(271) =		4677.85	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		133.65	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type B Energy Eff Only

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	35	(1a) x	3.09	(2a) =	108.15	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	35	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	108.15	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.94	x	1	=	0.94			(26)
Doors Type 3			0.75	x	1	=	0.75			(26)
Doors Type 4			0.68	x	1	=	0.68			(26)
Windows Type 1			2		x1/[1/(1.2)+ 0.04]	=	2.29			(27)
Windows Type 2			1.04		x1/[1/(1.2)+ 0.04]	=	1.19			(27)
Windows Type 3			0.32		x1/[1/(1.2)+ 0.04]	=	0.37			(27)
Windows Type 4			1.45		x1/[1/(1.2)+ 0.04]	=	1.66			(27)
Walls Type1	15.48	4.24	11.24	x	0.13	=	1.46			(29)
Walls Type2	2.04	0	2.04	x	0.13	=	0.27			(29)
Walls Type3	2.87	0	2.87	x	0.13	=	0.37			(29)
Walls Type4	18.39	5.07	13.32	x	0.13	=	1.73			(29)
Roof	35	0	35	x	0.1	=	3.5			(30)
Total area of elements, m²			73.78							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 17.34 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 315 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K	11.07	(36)
if details of thermal bridging are not known (36) = 0.05 x (31)		
Total fabric heat loss (33) + (36) =	28.41	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	10.03	9.92	9.81	9.25	9.14	8.58	8.58	8.47	8.81	9.14	9.36	9.59	(38)

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

(39)m=	38.44	38.33	38.22	37.66	37.55	36.99	36.99	36.88	37.21	37.55	37.77	37.99

Average = $Sum(39)_{1...12}$ /12= 37.63 (39)

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

(40)m=	1.1	1.1	1.09	1.08	1.07	1.06	1.06	1.05	1.06	1.07	1.08	1.09

Average = $Sum(40)_{1...12}$ /12= 1.08 (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 1.28 (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 64.62 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	71.08	68.49	65.91	63.32	60.74	58.16	58.16	60.74	63.32	65.91	68.49	71.08

Total = $Sum(44)_{1...12}$ = 775.4 (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=	105.41	92.19	95.13	82.94	79.58	68.67	63.64	73.02	73.89	86.12	94	102.08

Total = $Sum(45)_{1...12}$ = 1016.67 (45)

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

(46)m=	15.81	13.83	14.27	12.44	11.94	10.3	9.55	10.95	11.08	12.92	14.1	15.31	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	0	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)		
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)		
Water storage loss:		
a) If manufacturer’s declared loss factor is known (kWh/day):	0	(48)
Temperature factor from Table 2b	0	(49)
Energy lost from water storage, kWh/year (48) x (49) =	0	(50)
b) If manufacturer’s declared cylinder loss factor is not known:		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If community heating see section 4.3		
Volume factor from Table 2a	0	(52)
Temperature factor from Table 2b	0	(53)

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

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

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

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

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

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

(61)m=	36.22	31.53	33.59	31.23	30.95	28.68	29.64	30.95	31.23	33.59	33.78	36.22	(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=	141.63	123.72	128.72	114.17	110.53	97.35	93.27	103.97	105.12	119.7	127.78	138.3	(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=	141.63	123.72	128.72	114.17	110.53	97.35	93.27	103.97	105.12	119.7	127.78	138.3

Output from water heater (annual)$_{1...12}$ 1404.27 (64)

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

(65)m=	44.1	38.53	40.03	35.38	34.2	30	28.57	32.02	32.38	37.03	39.7	43	(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=	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	(66)

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

(67)m=	10.49	9.31	7.57	5.73	4.29	3.62	3.91	5.08	6.82	8.66	10.11	10.78	(67)

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

(68)m=	109.19	110.33	107.47	101.39	93.72	86.51	81.69	80.56	83.41	89.49	97.16	104.38	(68)

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

(69)m=	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	(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=	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	(71)

Water heating gains (Table 5)

(72)m=	59.28	57.34	53.8	49.14	45.97	41.67	38.4	43.03	44.97	49.77	55.14	57.79	(72)

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

(73)m=	224.17	222.2	214.06	201.48	189.18	177.01	169.21	173.89	180.41	193.14	207.62	218.16	(73)

6. Solar gains:

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

DER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	1.04	x	11.28	x	0.4	x	0.7	=	2.28	(75)
Northeast	0.9x	0.77	x	0.32	x	11.28	x	0.4	x	0.7	=	0.7	(75)
Northeast	0.9x	0.77	x	1.04	x	22.97	x	0.4	x	0.7	=	4.63	(75)
Northeast	0.9x	0.77	x	0.32	x	22.97	x	0.4	x	0.7	=	1.43	(75)
Northeast	0.9x	0.77	x	1.04	x	41.38	x	0.4	x	0.7	=	8.35	(75)
Northeast	0.9x	0.77	x	0.32	x	41.38	x	0.4	x	0.7	=	2.57	(75)
Northeast	0.9x	0.77	x	1.04	x	67.96	x	0.4	x	0.7	=	13.71	(75)
Northeast	0.9x	0.77	x	0.32	x	67.96	x	0.4	x	0.7	=	4.22	(75)
Northeast	0.9x	0.77	x	1.04	x	91.35	x	0.4	x	0.7	=	18.43	(75)
Northeast	0.9x	0.77	x	0.32	x	91.35	x	0.4	x	0.7	=	5.67	(75)
Northeast	0.9x	0.77	x	1.04	x	97.38	x	0.4	x	0.7	=	19.65	(75)
Northeast	0.9x	0.77	x	0.32	x	97.38	x	0.4	x	0.7	=	6.05	(75)
Northeast	0.9x	0.77	x	1.04	x	91.1	x	0.4	x	0.7	=	18.38	(75)
Northeast	0.9x	0.77	x	0.32	x	91.1	x	0.4	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	1.04	x	72.63	x	0.4	x	0.7	=	14.66	(75)
Northeast	0.9x	0.77	x	0.32	x	72.63	x	0.4	x	0.7	=	4.51	(75)
Northeast	0.9x	0.77	x	1.04	x	50.42	x	0.4	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	0.32	x	50.42	x	0.4	x	0.7	=	3.13	(75)
Northeast	0.9x	0.77	x	1.04	x	28.07	x	0.4	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	0.32	x	28.07	x	0.4	x	0.7	=	1.74	(75)
Northeast	0.9x	0.77	x	1.04	x	14.2	x	0.4	x	0.7	=	2.86	(75)
Northeast	0.9x	0.77	x	0.32	x	14.2	x	0.4	x	0.7	=	0.88	(75)
Northeast	0.9x	0.77	x	1.04	x	9.21	x	0.4	x	0.7	=	1.86	(75)
Northeast	0.9x	0.77	x	0.32	x	9.21	x	0.4	x	0.7	=	0.57	(75)
Southwest	0.9x	0.77	x	2	x	36.79		0.4	x	0.7	=	14.28	(79)
Southwest	0.9x	0.77	x	1.45	x	36.79		0.4	x	0.7	=	10.35	(79)
Southwest	0.9x	0.77	x	2	x	62.67		0.4	x	0.7	=	24.32	(79)
Southwest	0.9x	0.77	x	1.45	x	62.67		0.4	x	0.7	=	17.63	(79)
Southwest	0.9x	0.77	x	2	x	85.75		0.4	x	0.7	=	33.28	(79)
Southwest	0.9x	0.77	x	1.45	x	85.75		0.4	x	0.7	=	24.13	(79)
Southwest	0.9x	0.77	x	2	x	106.25		0.4	x	0.7	=	41.23	(79)
Southwest	0.9x	0.77	x	1.45	x	106.25		0.4	x	0.7	=	29.89	(79)
Southwest	0.9x	0.77	x	2	x	119.01		0.4	x	0.7	=	46.19	(79)
Southwest	0.9x	0.77	x	1.45	x	119.01		0.4	x	0.7	=	33.48	(79)
Southwest	0.9x	0.77	x	2	x	118.15		0.4	x	0.7	=	45.85	(79)
Southwest	0.9x	0.77	x	1.45	x	118.15		0.4	x	0.7	=	33.24	(79)
Southwest	0.9x	0.77	x	2	x	113.91		0.4	x	0.7	=	44.21	(79)
Southwest	0.9x	0.77	x	1.45	x	113.91		0.4	x	0.7	=	32.05	(79)
Southwest	0.9x	0.77	x	2	x	104.39		0.4	x	0.7	=	40.51	(79)

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Southwest	0.9x	0.77	x	1.45	x	104.39	0.4	x	0.7	=	29.37	(79)
Southwest	0.9x	0.77	x	2	x	92.85	0.4	x	0.7	=	36.03	(79)
Southwest	0.9x	0.77	x	1.45	x	92.85	0.4	x	0.7	=	26.12	(79)
Southwest	0.9x	0.77	x	2	x	69.27	0.4	x	0.7	=	26.88	(79)
Southwest	0.9x	0.77	x	1.45	x	69.27	0.4	x	0.7	=	19.49	(79)
Southwest	0.9x	0.77	x	2	x	44.07	0.4	x	0.7	=	17.1	(79)
Southwest	0.9x	0.77	x	1.45	x	44.07	0.4	x	0.7	=	12.4	(79)
Southwest	0.9x	0.77	x	2	x	31.49	0.4	x	0.7	=	12.22	(79)
Southwest	0.9x	0.77	x	1.45	x	31.49	0.4	x	0.7	=	8.86	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	27.61	48.02	68.33	89.06	103.78	104.79	100.3	89.05	75.46	53.78	33.25	23.51	(83)

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

(84)m=	251.78	270.21	282.38	290.55	292.96	281.8	269.5	262.93	255.88	246.91	240.87	241.67	(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=	0.95	0.94	0.91	0.87	0.79	0.67	0.53	0.56	0.73	0.87	0.93	0.95	(86)

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

(87)m=	18.91	19.11	19.46	19.94	20.39	20.74	20.9	20.88	20.64	20.08	19.43	18.87	(87)

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

(88)m=	20	20	20.01	20.02	20.02	20.04	20.04	20.04	20.03	20.02	20.02	20.01	(88)

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

(89)m=	0.94	0.93	0.9	0.85	0.75	0.6	0.44	0.47	0.68	0.85	0.92	0.95	(89)

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

(90)m=	18.1	18.3	18.64	19.12	19.54	19.87	19.99	19.98	19.78	19.26	18.62	18.07	(90)

fLA = Living area ÷ (4) = 0.63 (91)

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

(92)m=	18.61	18.8	19.15	19.63	20.07	20.42	20.56	20.55	20.32	19.78	19.13	18.57	(92)

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

(93)m=	18.61	18.8	19.15	19.63	20.07	20.42	20.56	20.55	20.32	19.78	19.13	18.57	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.93	0.91	0.89	0.84	0.76	0.63	0.49	0.52	0.69	0.84	0.91	0.94	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	234.04	246.89	250.46	243.49	221.74	177.15	132.62	136.42	177.82	207.24	218.57	226.07	(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=	549.89	532.93	483.59	404.13	314.38	215.21	146.53	152.94	231.42	344.57	454.3	546.11	(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=	234.99	192.21	173.45	115.66	68.93	0	0	0	0	102.17	169.73	238.11

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1295.24 (98)

Space heating requirement in kWh/m²/year 37.01 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	234.99	192.21	173.45	115.66	68.93	0	0	0	0	102.17	169.73	238.11	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)	259.95	212.63	191.87	127.94	76.24	0	0	0	0	113.02	187.75	263.39	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1432.79 (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)	141.63	123.72	128.72	114.17	110.53	97.35	93.27	103.97	105.12	119.7	127.78	138.3	
Efficiency of water heater													80.3 (216)
(217)m=	86.32	86.16	85.8	85.08	83.9	80.3	80.3	80.3	80.3	84.66	85.77	86.41	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	164.08	143.59	150.02	134.18	131.74	121.24	116.15	129.48	130.91	141.4	148.99	160.06

Total = Sum(219a)$_{1...12}$ = 1671.85 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1432.79	
Water heating fuel used			1671.85	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		138.54		(230a)
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		213.54	(231)
Electricity for lighting			185.19	(232)

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	=	309.48	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	361.12	(264)
Space and water heating	(261) + (262) + (263) + (264) =				670.6	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	110.83	(267)
Electricity for lighting	(232)	x	0.519	=	96.11	(268)
Total CO2, kg/year			sum of (265)…(271) =		877.54	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		25.07	(273)
EI rating (section 14)					85	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type B Energy Eff Only

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	35	(1a) x	3.09	(2a) =	108.15	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	35	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		108.15	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =	0.18	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.43	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.55	0.54	0.53	0.48	0.47	0.41	0.41	0.4	0.43	0.47	0.49	0.51

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0.65	0.65	0.64	0.61	0.61	0.59	0.59	0.58	0.59	0.61	0.62	0.63	(24d)

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

(25)m=	0.65	0.65	0.64	0.61	0.61	0.59	0.59	0.58	0.59	0.61	0.62	0.63	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.94	x	1	=	0.94			(26)
Doors Type 3			0.75	x	1	=	0.75			(26)
Doors Type 4			0.68	x	1	=	0.68			(26)
Windows Type 1			1.77	x1/[1/(1.4)+ 0.04]		=	2.35			(27)
Windows Type 2			0.92	x1/[1/(1.4)+ 0.04]		=	1.22			(27)
Windows Type 3			0.28	x1/[1/(1.4)+ 0.04]		=	0.37			(27)
Windows Type 4			1.28	x1/[1/(1.4)+ 0.04]		=	1.7			(27)
Walls Type1	15.48	4.08	11.4	x	0.18	=	2.05			(29)
Walls Type2	2.04	0	2.04	x	0.18	=	0.37			(29)
Walls Type3	2.87	0	2.87	x	0.18	=	0.52			(29)
Walls Type4	18.39	4.67	13.72	x	0.18	=	2.47			(29)
Roof	35	0	35	x	0.13	=	4.55			(30)
Total area of elements, m²			73.78							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 20.09 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 315 (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		3.69	(36)
if details of thermal bridging are not known (36) = 0.05 x (31)			
Total fabric heat loss	(33) + (36) =	23.78	(37)
Ventilation heat loss calculated monthly	(38)m = 0.33 × (25)m x (5)		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.33	23.12	22.91	21.93	21.75	20.89	20.89	20.73	21.22	21.75	22.12	22.51	(38)

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

(39)m=	47.11	46.9	46.69	45.71	45.52	44.67	44.67	44.51	45	45.52	45.9	46.28	

Average = Sum(39)$_{1…12}$ /12= 45.71 (39)

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

(40)m=	1.35	1.34	1.33	1.31	1.3	1.28	1.28	1.27	1.29	1.3	1.31	1.32	

Average = Sum(40)$_{1…12}$ /12= 1.31 (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 1.28 (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 64.62 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	71.08	68.49	65.91	63.32	60.74	58.16	58.16	60.74	63.32	65.91	68.49	71.08

Total = Sum(44)$_{1…12}$ = 775.4 (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=	105.41	92.19	95.13	82.94	79.58	68.67	63.64	73.02	73.89	86.12	94	102.08

Total = Sum(45)$_{1…12}$ = 1016.67 (45)

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

(46)m=	15.81	13.83	14.27	12.44	11.94	10.3	9.55	10.95	11.08	12.92	14.1	15.31	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)

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Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

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

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

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

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

(61)m=	36.22	31.53	33.59	31.23	30.95	28.68	29.64	30.95	31.23	33.59	33.78	36.22	(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=	141.63	123.72	128.72	114.17	110.53	97.35	93.27	103.97	105.12	119.7	127.78	138.3	(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=	141.63	123.72	128.72	114.17	110.53	97.35	93.27	103.97	105.12	119.7	127.78	138.3	

Output from water heater (annual)$_{1...12}$ — 1404.27 (64)

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

(65)m=	44.1	38.53	40.03	35.38	34.2	30	28.57	32.02	32.38	37.03	39.7	43	(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=	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	10.78	9.57	7.78	5.89	4.41	3.72	4.02	5.22	7.01	8.9	10.39	11.08	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	109.19	110.33	107.47	101.39	93.72	86.51	81.69	80.56	83.41	89.49	97.16	104.38	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	(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=	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	(71)
Water heating gains (Table 5)													
(72)m=	59.28	57.34	53.8	49.14	45.97	41.67	38.4	43.03	44.97	49.77	55.14	57.79	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	224.46	222.45	214.27	201.64	189.3	177.11	169.32	174.03	180.6	193.38	207.91	218.46	(73)

6. Solar gains:

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

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Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	0.92	x	11.28	x	0.63	x	0.7	=	3.17	(75)
Northeast 0.9x	0.77	x	0.28	x	11.28	x	0.63	x	0.7	=	0.97	(75)
Northeast 0.9x	0.77	x	0.92	x	22.97	x	0.63	x	0.7	=	6.46	(75)
Northeast 0.9x	0.77	x	0.28	x	22.97	x	0.63	x	0.7	=	1.97	(75)
Northeast 0.9x	0.77	x	0.92	x	41.38	x	0.63	x	0.7	=	11.63	(75)
Northeast 0.9x	0.77	x	0.28	x	41.38	x	0.63	x	0.7	=	3.54	(75)
Northeast 0.9x	0.77	x	0.92	x	67.96	x	0.63	x	0.7	=	19.11	(75)
Northeast 0.9x	0.77	x	0.28	x	67.96	x	0.63	x	0.7	=	5.82	(75)
Northeast 0.9x	0.77	x	0.92	x	91.35	x	0.63	x	0.7	=	25.68	(75)
Northeast 0.9x	0.77	x	0.28	x	91.35	x	0.63	x	0.7	=	7.82	(75)
Northeast 0.9x	0.77	x	0.92	x	97.38	x	0.63	x	0.7	=	27.38	(75)
Northeast 0.9x	0.77	x	0.28	x	97.38	x	0.63	x	0.7	=	8.33	(75)
Northeast 0.9x	0.77	x	0.92	x	91.1	x	0.63	x	0.7	=	25.61	(75)
Northeast 0.9x	0.77	x	0.28	x	91.1	x	0.63	x	0.7	=	7.8	(75)
Northeast 0.9x	0.77	x	0.92	x	72.63	x	0.63	x	0.7	=	20.42	(75)
Northeast 0.9x	0.77	x	0.28	x	72.63	x	0.63	x	0.7	=	6.21	(75)
Northeast 0.9x	0.77	x	0.92	x	50.42	x	0.63	x	0.7	=	14.18	(75)
Northeast 0.9x	0.77	x	0.28	x	50.42	x	0.63	x	0.7	=	4.31	(75)
Northeast 0.9x	0.77	x	0.92	x	28.07	x	0.63	x	0.7	=	7.89	(75)
Northeast 0.9x	0.77	x	0.28	x	28.07	x	0.63	x	0.7	=	2.4	(75)
Northeast 0.9x	0.77	x	0.92	x	14.2	x	0.63	x	0.7	=	3.99	(75)
Northeast 0.9x	0.77	x	0.28	x	14.2	x	0.63	x	0.7	=	1.21	(75)
Northeast 0.9x	0.77	x	0.92	x	9.21	x	0.63	x	0.7	=	2.59	(75)
Northeast 0.9x	0.77	x	0.28	x	9.21	x	0.63	x	0.7	=	0.79	(75)
Southwest 0.9x	0.77	x	1.77	x	36.79		0.63	x	0.7	=	19.9	(79)
Southwest 0.9x	0.77	x	1.28	x	36.79		0.63	x	0.7	=	14.39	(79)
Southwest 0.9x	0.77	x	1.77	x	62.67		0.63	x	0.7	=	33.9	(79)
Southwest 0.9x	0.77	x	1.28	x	62.67		0.63	x	0.7	=	24.52	(79)
Southwest 0.9x	0.77	x	1.77	x	85.75		0.63	x	0.7	=	46.39	(79)
Southwest 0.9x	0.77	x	1.28	x	85.75		0.63	x	0.7	=	33.55	(79)
Southwest 0.9x	0.77	x	1.77	x	106.25		0.63	x	0.7	=	57.48	(79)
Southwest 0.9x	0.77	x	1.28	x	106.25		0.63	x	0.7	=	41.56	(79)
Southwest 0.9x	0.77	x	1.77	x	119.01		0.63	x	0.7	=	64.38	(79)
Southwest 0.9x	0.77	x	1.28	x	119.01		0.63	x	0.7	=	46.56	(79)
Southwest 0.9x	0.77	x	1.77	x	118.15		0.63	x	0.7	=	63.91	(79)
Southwest 0.9x	0.77	x	1.28	x	118.15		0.63	x	0.7	=	46.22	(79)
Southwest 0.9x	0.77	x	1.77	x	113.91		0.63	x	0.7	=	61.62	(79)
Southwest 0.9x	0.77	x	1.28	x	113.91		0.63	x	0.7	=	44.56	(79)
Southwest 0.9x	0.77	x	1.77	x	104.39		0.63	x	0.7	=	56.47	(79)

Southwest0.9x	0.77	x	1.28	x	104.39		0.63	x	0.7	=	40.84	(79)
Southwest0.9x	0.77	x	1.77	x	92.85		0.63	x	0.7	=	50.23	(79)
Southwest0.9x	0.77	x	1.28	x	92.85		0.63	x	0.7	=	36.32	(79)
Southwest0.9x	0.77	x	1.77	x	69.27		0.63	x	0.7	=	37.47	(79)
Southwest0.9x	0.77	x	1.28	x	69.27		0.63	x	0.7	=	27.1	(79)
Southwest0.9x	0.77	x	1.77	x	44.07		0.63	x	0.7	=	23.84	(79)
Southwest0.9x	0.77	x	1.28	x	44.07		0.63	x	0.7	=	17.24	(79)
Southwest0.9x	0.77	x	1.77	x	31.49		0.63	x	0.7	=	17.03	(79)
Southwest0.9x	0.77	x	1.28	x	31.49		0.63	x	0.7	=	12.32	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	38.43	66.84	95.11	123.96	144.43	145.84	139.59	123.94	105.04	74.86	46.29	32.73	(83)

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

(84)m=	262.89	289.3	309.38	325.6	333.73	322.95	308.9	297.97	285.64	268.24	254.19	251.19	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.96	0.9	0.77	0.61	0.64	0.85	0.97	0.99	1	(86)

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

(87)m=	19.64	19.79	20.03	20.37	20.68	20.9	20.97	20.97	20.83	20.44	19.99	19.63	(87)

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

(88)m=	19.8	19.81	19.81	19.84	19.84	19.86	19.86	19.86	19.85	19.84	19.83	19.82	(88)

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

(89)m=	0.99	0.99	0.98	0.95	0.86	0.67	0.46	0.51	0.78	0.95	0.99	0.99	(89)

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

(90)m=	18.02	18.24	18.6	19.1	19.52	19.79	19.85	19.85	19.71	19.21	18.56	18.02	(90)

fLA = Living area ÷ (4) = 0.63 (91)

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

(92)m=	19.04	19.21	19.5	19.9	20.25	20.49	20.56	20.55	20.41	19.98	19.46	19.03	(92)

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

(93)m=	19.04	19.21	19.5	19.9	20.25	20.49	20.56	20.55	20.41	19.98	19.46	19.03	(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=	0.99	0.99	0.98	0.95	0.88	0.73	0.55	0.59	0.82	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	260.69	285.38	301.73	308.11	292.68	235.49	170.8	176.59	233.98	255.29	250.45	249.45	(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=	694.38	671.17	606.97	502.84	389.24	263.07	176.77	184.79	284.04	427.09	567.3	686.42	(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=	322.66	259.25	227.1	140.2	71.84	0	0	0	0	127.82	228.13	325.1

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1702.1 (98)

Space heating requirement in kWh/m²/year 48.63 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	322.66	259.25	227.1	140.2	71.84	0	0	0	0	127.82	228.13	325.1		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	345.47	277.57	243.15	150.11	76.91	0	0	0	0	136.85	244.25	348.07		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1822.38	(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)	141.63	123.72	128.72	114.17	110.53	97.35	93.27	103.97	105.12	119.7	127.78	138.3		
Efficiency of water heater													80.3	(216)
(217)m=	87.06	86.87	86.47	85.57	84	80.3	80.3	80.3	80.3	85.22	86.49	87.13		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	162.68	142.41	148.87	133.42	131.59	121.24	116.15	129.48	130.91	140.47	147.73	158.73		
Total = Sum(219a)$_{1...12}$ =													1663.69	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1822.38	
Water heating fuel used			1663.69	
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			190.32	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

TER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.216	=	393.63	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	359.36	(264)
Space and water heating	(261) + (262) + (263) + (264) =			752.99	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	98.78	(268)
Total CO2, kg/year		sum of (265)…(271) =		890.7	(272)

TER = 25.45 (273)

SAP Input

Property Details: Flat Type C Energy Eff only

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	07 November 2019
Date of certificate:	12 May 2020
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Low
Water use <= 125 litres/person/day:	True
PCDF Version:	460

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2020	
Floor Location:	Floor area:	Storey height:
Floor 0	35.12 m²	3.09 m
Living area:	23.9 m² (fraction 0.681)	
Front of dwelling faces:	North East	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D6_01	Manufacturer	Solid			Metal
Vent_06_01	Manufacturer	Solid			
Vent_06_05	Manufacturer	Solid			
Vent_06_04	Manufacturer	Solid			
Vent_06_06	Manufacturer	Solid			
V_D6_01	Manufacturer	Solid			Metal
Window_06_01	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_06_04	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_06_04	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_06_05	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Fanlight	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D6_01	mm	0	0	1	2.13	1
Vent_06_01	mm	0	0	1	0.72	1
Vent_06_05	mm	0	0	1	0.99	1
Vent_06_04	mm	0	0	1	0.72	1
Vent_06_06	mm	0	0	1	0.72	1
V_D6_01	mm	0	0	1	0.63	1
Window_06_01	6mm	0.7	0.4	1.2	1.08	1
Window_06_04	6mm	0.7	0.4	1.2	1.97	1
Window_06_04	6mm	0.7	0.4	1.2	1.42	1
Window_06_05	6mm	0.7	0.4	1.2	1.45	1
Fanlight	6mm	0.7	0.4	1.2	0.32	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D6_01		06_01	North East	0	0
Vent_06_01		06_03	North East	0.6	1.2
Vent_06_05		06_03	South East	0.6	1.65
Vent_06_04		06_05	South West	0.6	1.2

SAP Input

Vent_06_06	06_06	South West	0.6	1.2
V_D6_01	06_01	North East	0.3	2.11
Window_06_01	06_03	North East	0.9	1.2
Window_06_04	06_04	South East	1.195	1.65
Window_06_04	06_05	South West	1.185	1.2
Window_06_05	06_06	South West	1.21	1.2
Fanlight	06_01	North East	1.01	0.315

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
06_01	10.506	3.08	7.43	0.13	0	False	N/A
06_03	8.065	2.79	5.27	0.13	0	False	N/A
06_04	19.498	1.97	17.53	0.13	0	False	N/A
06_05	9.425	2.14	7.29	0.13	0	False	N/A
06_06	9.023	2.17	6.85	0.13	0	False	N/A
R6_01	35.12	0	35.12	0.1	0		N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test: Yes (As designed)

Ventilation: Balanced with heat recovery
Number of wet rooms: Kitchen + 1
Ductwork: Insulation, rigid
Approved Installation Scheme: False

Number of chimneys: 0
Number of open flues: 0
Number of fans: 0
Number of passive stacks: 0
Number of sides sheltered: 0
Pressure test: 2.5

Main heating system:

Main heating system: Boiler systems with radiators or underfloor heating
Gas boilers and oil boilers
Fuel: mains gas
Info Source: Manufacturer Declaration
Manufacturer's data
Efficiency: 89.5% (SEDBUK2009)
Condensing combi with automatic ignition
Fuel Burning Type: Modulation
Systems with radiators
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Room-sealed
Boiler interlock: Yes

Main heating Control:

Main heating Control: Programmer, room thermostat and TRVs
Control code: 2106

Secondary heating system:

Secondary heating system: None

SAP Input

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type C Energy Eff only

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	35.12	(1a) x	3.09	(2a) =	108.52	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	35.12	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	108.52	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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

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

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.72	x	1	=	0.72			(26)
Doors Type 3			0.99	x	1	=	0.99			(26)
Doors Type 4			0.72	x	1	=	0.72			(26)
Doors Type 5			0.72	x	1	=	0.72			(26)
Doors Type 6			0.63	x	1	=	0.63			(26)
Windows Type 1			1.08	x1/[1/(1.2)+ 0.04]		=	1.24			(27)
Windows Type 2			1.97	x1/[1/(1.2)+ 0.04]		=	2.26			(27)
Windows Type 3			1.42	x1/[1/(1.2)+ 0.04]		=	1.63			(27)
Windows Type 4			1.45	x1/[1/(1.2)+ 0.04]		=	1.66			(27)
Windows Type 5			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Walls Type1	10.51	3.08	7.43	x	0.13	=	0.97			(29)
Walls Type2	8.06	2.79	5.27	x	0.13	=	0.69			(29)
Walls Type3	19.5	1.97	17.53	x	0.13	=	2.28			(29)
Walls Type4	9.43	2.14	7.29	x	0.13	=	0.95			(29)
Walls Type5	9.02	2.17	6.85	x	0.13	=	0.89			(29)
Roof	35.12	0	35.12	x	0.1	=	3.51			(30)
Total area of elements, m²			91.64							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 22.33 (33)

SAP WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 316.08 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 13.75 (36)

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

Total fabric heat loss (33) + (36) = 36.08 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	10.07	9.96	9.84	9.28	9.17	8.61	8.61	8.5	8.84	9.17	9.4	9.62	(38)

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

(39)m=	46.15	46.04	45.92	45.36	45.25	44.69	44.69	44.58	44.92	45.25	45.48	45.7	

Average = $Sum(39)_{1…12}$ /12= 45.34 (39)

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

(40)m=	1.31	1.31	1.31	1.29	1.29	1.27	1.27	1.27	1.28	1.29	1.29	1.3	

Average = $Sum(40)_{1…12}$ /12= 1.29 (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 1.28 (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 64.68 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	71.15	68.56	65.98	63.39	60.8	58.22	58.22	60.8	63.39	65.98	68.56	71.15	

Total = $Sum(44)_{1…12}$ = 776.21 (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=	105.52	92.29	95.23	83.02	79.66	68.74	63.7	73.1	73.97	86.21	94.1	102.19	

Total = $Sum(45)_{1…12}$ = 1017.73 (45)

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

(46)m=	15.83	13.84	14.28	12.45	11.95	10.31	9.56	10.96	11.1	12.93	14.12	15.33	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

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Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

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

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

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

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

(61)m=	36.26	31.56	33.62	31.26	30.98	28.71	29.67	30.98	31.26	33.62	33.81	36.26	(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=	141.78	123.84	128.85	114.29	110.65	97.45	93.37	104.08	105.23	119.83	127.91	138.45	(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=	141.78	123.84	128.85	114.29	110.65	97.45	93.37	104.08	105.23	119.83	127.91	138.45	

Output from water heater (annual)$_{1…12}$ | 1405.73 | (64)

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

(65)m=	44.15	38.57	40.07	35.42	34.23	30.03	28.6	32.05	32.41	37.07	39.74	43.04	(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=	77.01	77.01	77.01	77.01	77.01	77.01	77.01	77.01	77.01	77.01	77.01	77.01	(66)

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

(67)m=	24.98	22.18	18.04	13.66	10.21	8.62	9.31	12.11	16.25	20.63	24.08	25.67	(67)

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

(68)m=	163.41	165.11	160.83	151.74	140.25	129.46	122.25	120.55	124.83	133.92	145.41	156.2	(68)

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

(69)m=	43.98	43.98	43.98	43.98	43.98	43.98	43.98	43.98	43.98	43.98	43.98	43.98	(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=	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	(71)

Water heating gains (Table 5)

(72)m=	59.34	57.4	53.86	49.2	46.01	41.71	38.44	43.08	45.01	49.82	55.2	57.85	(72)

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

(73)m=	320.38	317.35	305.39	287.24	269.13	252.45	242.66	248.39	258.75	277.03	297.34	312.38	(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)	
Northeast	0.9x	0.77	x	1.08	x	11.28	x	0.4	x	0.7	=	2.36	(75)
Northeast	0.9x	0.77	x	0.32	x	11.28	x	0.4	x	0.7	=	0.7	(75)
Northeast	0.9x	0.77	x	1.08	x	22.97	x	0.4	x	0.7	=	4.81	(75)
Northeast	0.9x	0.77	x	0.32	x	22.97	x	0.4	x	0.7	=	1.43	(75)
Northeast	0.9x	0.77	x	1.08	x	41.38	x	0.4	x	0.7	=	8.67	(75)
Northeast	0.9x	0.77	x	0.32	x	41.38	x	0.4	x	0.7	=	2.57	(75)
Northeast	0.9x	0.77	x	1.08	x	67.96	x	0.4	x	0.7	=	14.24	(75)
Northeast	0.9x	0.77	x	0.32	x	67.96	x	0.4	x	0.7	=	4.22	(75)
Northeast	0.9x	0.77	x	1.08	x	91.35	x	0.4	x	0.7	=	19.14	(75)
Northeast	0.9x	0.77	x	0.32	x	91.35	x	0.4	x	0.7	=	5.67	(75)
Northeast	0.9x	0.77	x	1.08	x	97.38	x	0.4	x	0.7	=	20.41	(75)
Northeast	0.9x	0.77	x	0.32	x	97.38	x	0.4	x	0.7	=	6.05	(75)
Northeast	0.9x	0.77	x	1.08	x	91.1	x	0.4	x	0.7	=	19.09	(75)
Northeast	0.9x	0.77	x	0.32	x	91.1	x	0.4	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	1.08	x	72.63	x	0.4	x	0.7	=	15.22	(75)
Northeast	0.9x	0.77	x	0.32	x	72.63	x	0.4	x	0.7	=	4.51	(75)
Northeast	0.9x	0.77	x	1.08	x	50.42	x	0.4	x	0.7	=	10.57	(75)
Northeast	0.9x	0.77	x	0.32	x	50.42	x	0.4	x	0.7	=	3.13	(75)
Northeast	0.9x	0.77	x	1.08	x	28.07	x	0.4	x	0.7	=	5.88	(75)
Northeast	0.9x	0.77	x	0.32	x	28.07	x	0.4	x	0.7	=	1.74	(75)
Northeast	0.9x	0.77	x	1.08	x	14.2	x	0.4	x	0.7	=	2.98	(75)
Northeast	0.9x	0.77	x	0.32	x	14.2	x	0.4	x	0.7	=	0.88	(75)
Northeast	0.9x	0.77	x	1.08	x	9.21	x	0.4	x	0.7	=	1.93	(75)
Northeast	0.9x	0.77	x	0.32	x	9.21	x	0.4	x	0.7	=	0.57	(75)
Southeast	0.9x	0.77	x	1.97	x	36.79	x	0.4	x	0.7	=	14.06	(77)
Southeast	0.9x	0.77	x	1.97	x	62.67	x	0.4	x	0.7	=	23.96	(77)
Southeast	0.9x	0.77	x	1.97	x	85.75	x	0.4	x	0.7	=	32.78	(77)
Southeast	0.9x	0.77	x	1.97	x	106.25	x	0.4	x	0.7	=	40.62	(77)
Southeast	0.9x	0.77	x	1.97	x	119.01	x	0.4	x	0.7	=	45.49	(77)
Southeast	0.9x	0.77	x	1.97	x	118.15	x	0.4	x	0.7	=	45.16	(77)
Southeast	0.9x	0.77	x	1.97	x	113.91	x	0.4	x	0.7	=	43.54	(77)
Southeast	0.9x	0.77	x	1.97	x	104.39	x	0.4	x	0.7	=	39.9	(77)
Southeast	0.9x	0.77	x	1.97	x	92.85	x	0.4	x	0.7	=	35.49	(77)
Southeast	0.9x	0.77	x	1.97	x	69.27	x	0.4	x	0.7	=	26.48	(77)

Southeast 0.9x	0.77	x	1.97	x	44.07	x	0.4	x	0.7	=	16.85	(77)
Southeast 0.9x	0.77	x	1.97	x	31.49	x	0.4	x	0.7	=	12.04	(77)
Southwest 0.9x	0.77	x	1.42	x	36.79		0.4	x	0.7	=	10.14	(79)
Southwest 0.9x	0.77	x	1.45	x	36.79		0.4	x	0.7	=	10.35	(79)
Southwest 0.9x	0.77	x	1.42	x	62.67		0.4	x	0.7	=	17.27	(79)
Southwest 0.9x	0.77	x	1.45	x	62.67		0.4	x	0.7	=	17.63	(79)
Southwest 0.9x	0.77	x	1.42	x	85.75		0.4	x	0.7	=	23.63	(79)
Southwest 0.9x	0.77	x	1.45	x	85.75		0.4	x	0.7	=	24.13	(79)
Southwest 0.9x	0.77	x	1.42	x	106.25		0.4	x	0.7	=	29.28	(79)
Southwest 0.9x	0.77	x	1.45	x	106.25		0.4	x	0.7	=	29.89	(79)
Southwest 0.9x	0.77	x	1.42	x	119.01		0.4	x	0.7	=	32.79	(79)
Southwest 0.9x	0.77	x	1.45	x	119.01		0.4	x	0.7	=	33.48	(79)
Southwest 0.9x	0.77	x	1.42	x	118.15		0.4	x	0.7	=	32.55	(79)
Southwest 0.9x	0.77	x	1.45	x	118.15		0.4	x	0.7	=	33.24	(79)
Southwest 0.9x	0.77	x	1.42	x	113.91		0.4	x	0.7	=	31.39	(79)
Southwest 0.9x	0.77	x	1.45	x	113.91		0.4	x	0.7	=	32.05	(79)
Southwest 0.9x	0.77	x	1.42	x	104.39		0.4	x	0.7	=	28.76	(79)
Southwest 0.9x	0.77	x	1.45	x	104.39		0.4	x	0.7	=	29.37	(79)
Southwest 0.9x	0.77	x	1.42	x	92.85		0.4	x	0.7	=	25.58	(79)
Southwest 0.9x	0.77	x	1.45	x	92.85		0.4	x	0.7	=	26.12	(79)
Southwest 0.9x	0.77	x	1.42	x	69.27		0.4	x	0.7	=	19.09	(79)
Southwest 0.9x	0.77	x	1.45	x	69.27		0.4	x	0.7	=	19.49	(79)
Southwest 0.9x	0.77	x	1.42	x	44.07		0.4	x	0.7	=	12.14	(79)
Southwest 0.9x	0.77	x	1.45	x	44.07		0.4	x	0.7	=	12.4	(79)
Southwest 0.9x	0.77	x	1.42	x	31.49		0.4	x	0.7	=	8.68	(79)
Southwest 0.9x	0.77	x	1.45	x	31.49		0.4	x	0.7	=	8.86	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	37.62	65.1	91.78	118.25	136.58	137.42	131.73	117.77	100.9	72.68	45.25	32.08	(83)

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

(84)m=	358	382.45	397.16	405.49	405.71	389.87	374.38	366.16	359.64	349.71	342.58	344.45	(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=	0.91	0.89	0.86	0.81	0.72	0.59	0.47	0.49	0.66	0.81	0.88	0.92	(86)

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

(87)m=	18.86	19.07	19.44	19.92	20.38	20.74	20.89	20.88	20.64	20.08	19.4	18.81	(87)

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

(88)m=	19.83	19.83	19.83	19.85	19.85	19.86	19.86	19.86	19.86	19.85	19.84	19.84	(88)

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

(89)m=	0.9	0.88	0.84	0.78	0.67	0.52	0.37	0.39	0.59	0.77	0.86	0.9	(89)

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

(90)m=	17.92	18.13	18.49	18.97	19.39	19.7	19.82	19.81	19.63	19.12	18.47	17.89	(90)

fLA = Living area ÷ (4) = 0.68 (91)

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

(92)m=	18.56	18.77	19.13	19.62	20.06	20.41	20.55	20.54	20.31	19.78	19.1	18.52	(92)

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

(93)m=	18.56	18.77	19.13	19.62	20.06	20.41	20.55	20.54	20.31	19.78	19.1	18.52	(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=	0.88	0.86	0.83	0.77	0.68	0.56	0.43	0.45	0.62	0.77	0.85	0.89	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	314.93	328.54	328.1	312.2	277.5	217.17	160.64	165.72	221.47	268.27	291.04	305.69	(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=	658.02	638.54	580.2	486.23	378.42	259.47	176.57	184.41	279.16	415.26	545.92	654.34	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	255.25	208.32	187.56	125.3	75.08	0	0	0	0	109.36	183.52	259.4	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1403.79 (98)

Space heating requirement in kWh/m²/year 39.97 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	255.25	208.32	187.56	125.3	75.08	0	0	0	0	109.36	183.52	259.4	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	282.36	230.44	207.48	138.61	83.05	0	0	0	0	120.97	203	286.95	

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 1552.87 (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)

141.78	123.84	128.85	114.29	110.65	97.45	93.37	104.08	105.23	119.83	127.91	138.45

Efficiency of water heater 80.3 (216)

(217)m=	86.51	86.35	86	85.28	84.1	80.3	80.3	80.3	80.3	84.82	85.96	86.61	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	163.87	143.42	149.84	134.01	131.57	121.36	116.27	129.62	131.05	141.27	148.81	159.85

Total = Sum(219a)$_{1...12}$ = 1670.94 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1552.87	
Water heating fuel used			1670.94	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		139.02		(230a)
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		214.02	(231)
Electricity for lighting			176.43	(232)

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 =	54.04	(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 =	58.15	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	28.23	(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 =	23.27	(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) =			283.69	(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] =	1.49	(257)
SAP rating (Section 12)		79.25	(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	=	335.42	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	360.92	(264)

Space and water heating	(261) + (262) + (263) + (264) =			696.34	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	111.07	(267)
Electricity for lighting	(232) x	0.519	=	91.57	(268)
Total CO2, kg/year		sum of (265)…(271) =		898.98	(272)
CO2 emissions per m²		(272) ÷ (4) =		25.6	(273)
EI rating (section 14)				85	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	1894.5	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2038.54	(264)
Space and water heating	(261) + (262) + (263) + (264) =			3933.04	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	657.03	(267)
Electricity for lighting	(232) x	0	=	541.64	(268)
'Total Primary Energy		sum of (265)…(271) =		5131.7	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		146.12	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type C Energy Eff only

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	35.12	(1a)	x	3.09	(2a)	=	108.52	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	35.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	108.52	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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

DER WorkSheet: New dwelling design stage

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

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.72	x	1	=	0.72			(26)
Doors Type 3			0.99	x	1	=	0.99			(26)
Doors Type 4			0.72	x	1	=	0.72			(26)
Doors Type 5			0.72	x	1	=	0.72			(26)
Doors Type 6			0.63	x	1	=	0.63			(26)
Windows Type 1			1.08	x1/[1/(1.2)+ 0.04]		=	1.24			(27)
Windows Type 2			1.97	x1/[1/(1.2)+ 0.04]		=	2.26			(27)
Windows Type 3			1.42	x1/[1/(1.2)+ 0.04]		=	1.63			(27)
Windows Type 4			1.45	x1/[1/(1.2)+ 0.04]		=	1.66			(27)
Windows Type 5			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Walls Type1	10.51	3.08	7.43	x	0.13	=	0.97			(29)
Walls Type2	8.06	2.79	5.27	x	0.13	=	0.69			(29)
Walls Type3	19.5	1.97	17.53	x	0.13	=	2.28			(29)
Walls Type4	9.43	2.14	7.29	x	0.13	=	0.95			(29)
Walls Type5	9.02	2.17	6.85	x	0.13	=	0.89			(29)
Roof	35.12	0	35.12	x	0.1	=	3.51			(30)
Total area of elements, m²			91.64							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 22.33 (33)

DER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	316.08	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Low	100	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		13.75	(36)

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

Total fabric heat loss	(33) + (36) =	36.08	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	10.07	9.96	9.84	9.28	9.17	8.61	8.61	8.5	8.84	9.17	9.4	9.62	(38)

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

(39)m=	46.15	46.04	45.92	45.36	45.25	44.69	44.69	44.58	44.92	45.25	45.48	45.7	

Average = Sum(39)$_{1…12}$ /12= 45.34 (39)

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

(40)m=	1.31	1.31	1.31	1.29	1.29	1.27	1.27	1.27	1.28	1.29	1.29	1.3	

Average = Sum(40)$_{1…12}$ /12= 1.29 (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 — 1.28 (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 — 64.68 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	71.15	68.56	65.98	63.39	60.8	58.22	58.22	60.8	63.39	65.98	68.56	71.15	

Total = Sum(44)$_{1…12}$ = 776.21 (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=	105.52	92.29	95.23	83.02	79.66	68.74	63.7	73.1	73.97	86.21	94.1	102.19	

Total = Sum(45)$_{1…12}$ = 1017.73 (45)

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

(46)m=	15.83	13.84	14.28	12.45	11.95	10.31	9.56	10.96	11.1	12.93	14.12	15.33	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

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

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

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

DER WorkSheet: New dwelling design stage

Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If community heating see section 4.3		
Volume factor from Table 2a	0	(52)
Temperature factor from Table 2b	0	(53)
Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)	0	(55)

Water storage loss calculated for each month ((56)m = (55) × (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 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

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

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

(61)m=	36.26	31.56	33.62	31.26	30.98	28.71	29.67	30.98	31.26	33.62	33.81	36.26	(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=	141.78	123.84	128.85	114.29	110.65	97.45	93.37	104.08	105.23	119.83	127.91	138.45	(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=	141.78	123.84	128.85	114.29	110.65	97.45	93.37	104.08	105.23	119.83	127.91	138.45

Output from water heater (annual)$_{1...12}$ | 1405.73 | (64)

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

(65)m=	44.15	38.57	40.07	35.42	34.23	30.03	28.6	32.05	32.41	37.07	39.74	43.04	(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=	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	(66)

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

(67)m=	9.99	8.87	7.22	5.46	4.08	3.45	3.73	4.84	6.5	8.25	9.63	10.27	(67)

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

(68)m=	109.48	110.62	107.76	101.66	93.97	86.74	81.91	80.77	83.63	89.73	97.42	104.65	(68)

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

(69)m=	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	(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=	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	(71)

Water heating gains (Table 5)

(72)m=	59.34	57.4	53.86	49.2	46.01	41.71	38.44	43.08	45.01	49.82	55.2	57.85	(72)

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

(73)m=	224.07	222.15	214.08	201.57	189.32	177.15	169.32	173.95	180.4	193.06	207.5	218.03	(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)	
Northeast 0.9x	0.77	x	1.08	x	11.28	x	0.4	x	0.7	=	2.36	(75)
Northeast 0.9x	0.77	x	0.32	x	11.28	x	0.4	x	0.7	=	0.7	(75)
Northeast 0.9x	0.77	x	1.08	x	22.97	x	0.4	x	0.7	=	4.81	(75)
Northeast 0.9x	0.77	x	0.32	x	22.97	x	0.4	x	0.7	=	1.43	(75)
Northeast 0.9x	0.77	x	1.08	x	41.38	x	0.4	x	0.7	=	8.67	(75)
Northeast 0.9x	0.77	x	0.32	x	41.38	x	0.4	x	0.7	=	2.57	(75)
Northeast 0.9x	0.77	x	1.08	x	67.96	x	0.4	x	0.7	=	14.24	(75)
Northeast 0.9x	0.77	x	0.32	x	67.96	x	0.4	x	0.7	=	4.22	(75)
Northeast 0.9x	0.77	x	1.08	x	91.35	x	0.4	x	0.7	=	19.14	(75)
Northeast 0.9x	0.77	x	0.32	x	91.35	x	0.4	x	0.7	=	5.67	(75)
Northeast 0.9x	0.77	x	1.08	x	97.38	x	0.4	x	0.7	=	20.41	(75)
Northeast 0.9x	0.77	x	0.32	x	97.38	x	0.4	x	0.7	=	6.05	(75)
Northeast 0.9x	0.77	x	1.08	x	91.1	x	0.4	x	0.7	=	19.09	(75)
Northeast 0.9x	0.77	x	0.32	x	91.1	x	0.4	x	0.7	=	5.66	(75)
Northeast 0.9x	0.77	x	1.08	x	72.63	x	0.4	x	0.7	=	15.22	(75)
Northeast 0.9x	0.77	x	0.32	x	72.63	x	0.4	x	0.7	=	4.51	(75)
Northeast 0.9x	0.77	x	1.08	x	50.42	x	0.4	x	0.7	=	10.57	(75)
Northeast 0.9x	0.77	x	0.32	x	50.42	x	0.4	x	0.7	=	3.13	(75)
Northeast 0.9x	0.77	x	1.08	x	28.07	x	0.4	x	0.7	=	5.88	(75)
Northeast 0.9x	0.77	x	0.32	x	28.07	x	0.4	x	0.7	=	1.74	(75)
Northeast 0.9x	0.77	x	1.08	x	14.2	x	0.4	x	0.7	=	2.98	(75)
Northeast 0.9x	0.77	x	0.32	x	14.2	x	0.4	x	0.7	=	0.88	(75)
Northeast 0.9x	0.77	x	1.08	x	9.21	x	0.4	x	0.7	=	1.93	(75)
Northeast 0.9x	0.77	x	0.32	x	9.21	x	0.4	x	0.7	=	0.57	(75)
Southeast 0.9x	0.77	x	1.97	x	36.79	x	0.4	x	0.7	=	14.06	(77)
Southeast 0.9x	0.77	x	1.97	x	62.67	x	0.4	x	0.7	=	23.96	(77)
Southeast 0.9x	0.77	x	1.97	x	85.75	x	0.4	x	0.7	=	32.78	(77)
Southeast 0.9x	0.77	x	1.97	x	106.25	x	0.4	x	0.7	=	40.62	(77)
Southeast 0.9x	0.77	x	1.97	x	119.01	x	0.4	x	0.7	=	45.49	(77)
Southeast 0.9x	0.77	x	1.97	x	118.15	x	0.4	x	0.7	=	45.16	(77)
Southeast 0.9x	0.77	x	1.97	x	113.91	x	0.4	x	0.7	=	43.54	(77)
Southeast 0.9x	0.77	x	1.97	x	104.39	x	0.4	x	0.7	=	39.9	(77)
Southeast 0.9x	0.77	x	1.97	x	92.85	x	0.4	x	0.7	=	35.49	(77)
Southeast 0.9x	0.77	x	1.97	x	69.27	x	0.4	x	0.7	=	26.48	(77)

Southeast 0.9x	0.77	x	1.97	x	44.07	x	0.4	x	0.7	=	16.85	(77)
Southeast 0.9x	0.77	x	1.97	x	31.49	x	0.4	x	0.7	=	12.04	(77)
Southwest 0.9x	0.77	x	1.42	x	36.79		0.4	x	0.7	=	10.14	(79)
Southwest 0.9x	0.77	x	1.45	x	36.79		0.4	x	0.7	=	10.35	(79)
Southwest 0.9x	0.77	x	1.42	x	62.67		0.4	x	0.7	=	17.27	(79)
Southwest 0.9x	0.77	x	1.45	x	62.67		0.4	x	0.7	=	17.63	(79)
Southwest 0.9x	0.77	x	1.42	x	85.75		0.4	x	0.7	=	23.63	(79)
Southwest 0.9x	0.77	x	1.45	x	85.75		0.4	x	0.7	=	24.13	(79)
Southwest 0.9x	0.77	x	1.42	x	106.25		0.4	x	0.7	=	29.28	(79)
Southwest 0.9x	0.77	x	1.45	x	106.25		0.4	x	0.7	=	29.89	(79)
Southwest 0.9x	0.77	x	1.42	x	119.01		0.4	x	0.7	=	32.79	(79)
Southwest 0.9x	0.77	x	1.45	x	119.01		0.4	x	0.7	=	33.48	(79)
Southwest 0.9x	0.77	x	1.42	x	118.15		0.4	x	0.7	=	32.55	(79)
Southwest 0.9x	0.77	x	1.45	x	118.15		0.4	x	0.7	=	33.24	(79)
Southwest 0.9x	0.77	x	1.42	x	113.91		0.4	x	0.7	=	31.39	(79)
Southwest 0.9x	0.77	x	1.45	x	113.91		0.4	x	0.7	=	32.05	(79)
Southwest 0.9x	0.77	x	1.42	x	104.39		0.4	x	0.7	=	28.76	(79)
Southwest 0.9x	0.77	x	1.45	x	104.39		0.4	x	0.7	=	29.37	(79)
Southwest 0.9x	0.77	x	1.42	x	92.85		0.4	x	0.7	=	25.58	(79)
Southwest 0.9x	0.77	x	1.45	x	92.85		0.4	x	0.7	=	26.12	(79)
Southwest 0.9x	0.77	x	1.42	x	69.27		0.4	x	0.7	=	19.09	(79)
Southwest 0.9x	0.77	x	1.45	x	69.27		0.4	x	0.7	=	19.49	(79)
Southwest 0.9x	0.77	x	1.42	x	44.07		0.4	x	0.7	=	12.14	(79)
Southwest 0.9x	0.77	x	1.45	x	44.07		0.4	x	0.7	=	12.4	(79)
Southwest 0.9x	0.77	x	1.42	x	31.49		0.4	x	0.7	=	8.68	(79)
Southwest 0.9x	0.77	x	1.45	x	31.49		0.4	x	0.7	=	8.86	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	37.62	65.1	91.78	118.25	136.58	137.42	131.73	117.77	100.9	72.68	45.25	32.08	(83)

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

(84)m=	261.69	287.25	305.86	319.82	325.9	314.57	301.05	291.71	281.3	265.74	252.75	250.1	(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=	0.95	0.94	0.91	0.87	0.79	0.68	0.55	0.58	0.74	0.87	0.93	0.95	(86)

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

(87)m=	18.49	18.72	19.13	19.68	20.21	20.64	20.85	20.82	20.51	19.84	19.08	18.44	(87)

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

(88)m=	19.83	19.83	19.83	19.85	19.85	19.86	19.86	19.86	19.86	19.85	19.84	19.84	(88)

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

(89)m=	0.94	0.93	0.9	0.84	0.75	0.6	0.44	0.47	0.68	0.85	0.92	0.95	(89)

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

(90)m=	17.57	17.8	18.2	18.75	19.25	19.64	19.79	19.78	19.53	18.91	18.16	17.53	(90)

fLA = Living area ÷ (4) = 0.68 (91)

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

(92)m=	18.19	18.43	18.84	19.38	19.9	20.32	20.51	20.49	20.2	19.55	18.79	18.15	(92)

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

(93)m=	18.19	18.43	18.84	19.38	19.9	20.32	20.51	20.49	20.2	19.55	18.79	18.15	(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=	0.93	0.91	0.88	0.83	0.75	0.63	0.51	0.53	0.7	0.84	0.91	0.93	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	242.92	261.49	269.72	266.22	245.62	199.43	152.04	155.53	197.01	222.93	229.13	233.69	(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=	641.13	622.79	566.51	475.61	371.25	255.71	174.83	182.33	273.82	404.8	531.49	637.58	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	296.26	242.79	220.81	150.76	93.47	0	0	0	0	135.31	217.7	300.49	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1657.6 (98)

Space heating requirement in kWh/m²/year 47.2 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	296.26	242.79	220.81	150.76	93.47	0	0	0	0	135.31	217.7	300.49	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	327.73	268.58	244.26	166.77	103.4	0	0	0	0	149.68	240.82	332.4	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1833.63 (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)

141.78	123.84	128.85	114.29	110.65	97.45	93.37	104.08	105.23	119.83	127.91	138.45

Efficiency of water heater 80.3 (216)

(217)m=	86.86	86.72	86.4	85.75	84.63	80.3	80.3	80.3	80.3	85.36	86.38	86.95	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	163.22	142.82	149.14	133.28	130.74	121.36	116.27	129.62	131.05	140.38	148.08	159.22

Total = Sum(219a)$_{1...12}$ = 1665.19 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1833.63	
Water heating fuel used			1665.19	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		139.02		(230a)
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		214.02	(231)
Electricity for lighting			176.43	(232)

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	=	396.06	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	359.68	(264)
Space and water heating	(261) + (262) + (263) + (264) =			755.74	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	111.07	(267)
Electricity for lighting	(232) x	0.519	=	91.57	(268)
Total CO2, kg/year		sum of (265)…(271) =		958.38	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		27.29	(273)
EI rating (section 14)				84	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type C Energy Eff only

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	35.12	(1a)	x	3.09	(2a)	=	108.52	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	35.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			108.52	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =	0.18	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.43	(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

TER WorkSheet: New dwelling design stage

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

0.55	0.54	0.53	0.48	0.47	0.41	0.41	0.4	0.43	0.47	0.49	0.51

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0.65	0.65	0.64	0.61	0.61	0.59	0.59	0.58	0.59	0.61	0.62	0.63	(24d)

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

(25)m=	0.65	0.65	0.64	0.61	0.61	0.59	0.59	0.58	0.59	0.61	0.62	0.63	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.72	x	1	=	0.72			(26)
Doors Type 3			0.99	x	1	=	0.99			(26)
Doors Type 4			0.72	x	1	=	0.72			(26)
Doors Type 5			0.72	x	1	=	0.72			(26)
Doors Type 6			0.63	x	1	=	0.63			(26)
Windows Type 1			0.5	x1/[1/(1.4)+ 0.04]		=	0.66			(27)
Windows Type 2			0.91	x1/[1/(1.4)+ 0.04]		=	1.21			(27)
Windows Type 3			0.65	x1/[1/(1.4)+ 0.04]		=	0.86			(27)
Windows Type 4			0.67	x1/[1/(1.4)+ 0.04]		=	0.89			(27)
Windows Type 5			0.15	x1/[1/(1.4)+ 0.04]		=	0.2			(27)
Walls Type1	10.51	2.91	7.6	x	0.18	=	1.37			(29)
Walls Type2	8.06	2.21	5.85	x	0.18	=	1.05			(29)
Walls Type3	19.5	0.91	18.59	x	0.18	=	3.35			(29)
Walls Type4	9.43	1.37	8.06	x	0.18	=	1.45			(29)
Walls Type5	9.02	1.39	7.63	x	0.18	=	1.37			(29)
Roof	35.12	0	35.12	x	0.13	=	4.57			(30)
Total area of elements, m²			91.64							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 22.88 (33)

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Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	316.08	(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		4.58	(36)

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

Total fabric heat loss	(33) + (36) =	27.47	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.4	23.18	22.97	21.99	21.81	20.95	20.95	20.8	21.28	21.81	22.18	22.57	(38)

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

(39)m=	50.86	50.65	50.44	49.46	49.28	48.42	48.42	48.26	48.75	49.28	49.65	50.04	

Average = $Sum(39)_{1…12}$ /12= 49.46 (39)

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

(40)m=	1.45	1.44	1.44	1.41	1.4	1.38	1.38	1.37	1.39	1.4	1.41	1.42	

Average = $Sum(40)_{1…12}$ /12= 1.41 (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 1.28 (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 64.68 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	71.15	68.56	65.98	63.39	60.8	58.22	58.22	60.8	63.39	65.98	68.56	71.15	

Total = $Sum(44)_{1…12}$ = 776.21 (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=	105.52	92.29	95.23	83.02	79.66	68.74	63.7	73.1	73.97	86.21	94.1	102.19	

Total = $Sum(45)_{1…12}$ = 1017.73 (45)

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

(46)m=	15.83	13.84	14.28	12.45	11.95	10.31	9.56	10.96	11.1	12.93	14.12	15.33	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

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

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

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

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

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

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

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

(61)m=	36.26	31.56	33.62	31.26	30.98	28.71	29.67	30.98	31.26	33.62	33.81	36.26	(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=	141.78	123.84	128.85	114.29	110.65	97.45	93.37	104.08	105.23	119.83	127.91	138.45	(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=	141.78	123.84	128.85	114.29	110.65	97.45	93.37	104.08	105.23	119.83	127.91	138.45	

Output from water heater (annual)1…12 — 1405.73 (64)

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

(65)m=	44.15	38.57	40.07	35.42	34.23	30.03	28.6	32.05	32.41	37.07	39.74	43.04	(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=	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	11.73	10.42	8.47	6.41	4.79	4.05	4.37	5.68	7.63	9.69	11.31	12.05	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	109.48	110.62	107.76	101.66	93.97	86.74	81.91	80.77	83.63	89.73	97.42	104.65	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	(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=	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	(71)
Water heating gains (Table 5)													
(72)m=	59.34	57.4	53.86	49.2	46.01	41.71	38.44	43.08	45.01	49.82	55.2	57.85	(72)

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

(73)m=	225.81	223.69	215.34	202.52	190.03	177.75	169.97	174.79	181.53	194.49	209.18	219.81	(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)	
Northeast 0.9x	0.77	x	0.5	x	11.28	x	0.63	x	0.7	=	1.72	(75)
Northeast 0.9x	0.77	x	0.15	x	11.28	x	0.63	x	0.7	=	0.52	(75)
Northeast 0.9x	0.77	x	0.5	x	22.97	x	0.63	x	0.7	=	3.51	(75)
Northeast 0.9x	0.77	x	0.15	x	22.97	x	0.63	x	0.7	=	1.05	(75)
Northeast 0.9x	0.77	x	0.5	x	41.38	x	0.63	x	0.7	=	6.32	(75)
Northeast 0.9x	0.77	x	0.15	x	41.38	x	0.63	x	0.7	=	1.9	(75)
Northeast 0.9x	0.77	x	0.5	x	67.96	x	0.63	x	0.7	=	10.38	(75)
Northeast 0.9x	0.77	x	0.15	x	67.96	x	0.63	x	0.7	=	3.12	(75)
Northeast 0.9x	0.77	x	0.5	x	91.35	x	0.63	x	0.7	=	13.96	(75)
Northeast 0.9x	0.77	x	0.15	x	91.35	x	0.63	x	0.7	=	4.19	(75)
Northeast 0.9x	0.77	x	0.5	x	97.38	x	0.63	x	0.7	=	14.88	(75)
Northeast 0.9x	0.77	x	0.15	x	97.38	x	0.63	x	0.7	=	4.46	(75)
Northeast 0.9x	0.77	x	0.5	x	91.1	x	0.63	x	0.7	=	13.92	(75)
Northeast 0.9x	0.77	x	0.15	x	91.1	x	0.63	x	0.7	=	4.18	(75)
Northeast 0.9x	0.77	x	0.5	x	72.63	x	0.63	x	0.7	=	11.1	(75)
Northeast 0.9x	0.77	x	0.15	x	72.63	x	0.63	x	0.7	=	3.33	(75)
Northeast 0.9x	0.77	x	0.5	x	50.42	x	0.63	x	0.7	=	7.7	(75)
Northeast 0.9x	0.77	x	0.15	x	50.42	x	0.63	x	0.7	=	2.31	(75)
Northeast 0.9x	0.77	x	0.5	x	28.07	x	0.63	x	0.7	=	4.29	(75)
Northeast 0.9x	0.77	x	0.15	x	28.07	x	0.63	x	0.7	=	1.29	(75)
Northeast 0.9x	0.77	x	0.5	x	14.2	x	0.63	x	0.7	=	2.17	(75)
Northeast 0.9x	0.77	x	0.15	x	14.2	x	0.63	x	0.7	=	0.65	(75)
Northeast 0.9x	0.77	x	0.5	x	9.21	x	0.63	x	0.7	=	1.41	(75)
Northeast 0.9x	0.77	x	0.15	x	9.21	x	0.63	x	0.7	=	0.42	(75)
Southeast 0.9x	0.77	x	0.91	x	36.79	x	0.63	x	0.7	=	10.23	(77)
Southeast 0.9x	0.77	x	0.91	x	62.67	x	0.63	x	0.7	=	17.43	(77)
Southeast 0.9x	0.77	x	0.91	x	85.75	x	0.63	x	0.7	=	23.85	(77)
Southeast 0.9x	0.77	x	0.91	x	106.25	x	0.63	x	0.7	=	29.55	(77)
Southeast 0.9x	0.77	x	0.91	x	119.01	x	0.63	x	0.7	=	33.1	(77)
Southeast 0.9x	0.77	x	0.91	x	118.15	x	0.63	x	0.7	=	32.86	(77)
Southeast 0.9x	0.77	x	0.91	x	113.91	x	0.63	x	0.7	=	31.68	(77)
Southeast 0.9x	0.77	x	0.91	x	104.39	x	0.63	x	0.7	=	29.03	(77)
Southeast 0.9x	0.77	x	0.91	x	92.85	x	0.63	x	0.7	=	25.82	(77)
Southeast 0.9x	0.77	x	0.91	x	69.27	x	0.63	x	0.7	=	19.26	(77)

Southeast 0.9x	0.77	x	0.91	x	44.07	x	0.63	x	0.7	=	12.26	(77)
Southeast 0.9x	0.77	x	0.91	x	31.49	x	0.63	x	0.7	=	8.76	(77)
Southwest 0.9x	0.77	x	0.65	x	36.79		0.63	x	0.7	=	7.31	(79)
Southwest 0.9x	0.77	x	0.67	x	36.79		0.63	x	0.7	=	7.53	(79)
Southwest 0.9x	0.77	x	0.65	x	62.67		0.63	x	0.7	=	12.45	(79)
Southwest 0.9x	0.77	x	0.67	x	62.67		0.63	x	0.7	=	12.83	(79)
Southwest 0.9x	0.77	x	0.65	x	85.75		0.63	x	0.7	=	17.03	(79)
Southwest 0.9x	0.77	x	0.67	x	85.75		0.63	x	0.7	=	17.56	(79)
Southwest 0.9x	0.77	x	0.65	x	106.25		0.63	x	0.7	=	21.11	(79)
Southwest 0.9x	0.77	x	0.67	x	106.25		0.63	x	0.7	=	21.76	(79)
Southwest 0.9x	0.77	x	0.65	x	119.01		0.63	x	0.7	=	23.64	(79)
Southwest 0.9x	0.77	x	0.67	x	119.01		0.63	x	0.7	=	24.37	(79)
Southwest 0.9x	0.77	x	0.65	x	118.15		0.63	x	0.7	=	23.47	(79)
Southwest 0.9x	0.77	x	0.67	x	118.15		0.63	x	0.7	=	24.19	(79)
Southwest 0.9x	0.77	x	0.65	x	113.91		0.63	x	0.7	=	22.63	(79)
Southwest 0.9x	0.77	x	0.67	x	113.91		0.63	x	0.7	=	23.32	(79)
Southwest 0.9x	0.77	x	0.65	x	104.39		0.63	x	0.7	=	20.74	(79)
Southwest 0.9x	0.77	x	0.67	x	104.39		0.63	x	0.7	=	21.38	(79)
Southwest 0.9x	0.77	x	0.65	x	92.85		0.63	x	0.7	=	18.44	(79)
Southwest 0.9x	0.77	x	0.67	x	92.85		0.63	x	0.7	=	19.01	(79)
Southwest 0.9x	0.77	x	0.65	x	69.27		0.63	x	0.7	=	13.76	(79)
Southwest 0.9x	0.77	x	0.67	x	69.27		0.63	x	0.7	=	14.18	(79)
Southwest 0.9x	0.77	x	0.65	x	44.07		0.63	x	0.7	=	8.75	(79)
Southwest 0.9x	0.77	x	0.67	x	44.07		0.63	x	0.7	=	9.02	(79)
Southwest 0.9x	0.77	x	0.65	x	31.49		0.63	x	0.7	=	6.26	(79)
Southwest 0.9x	0.77	x	0.67	x	31.49		0.63	x	0.7	=	6.45	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	27.32	47.28	66.66	85.91	99.25	99.87	95.73	85.57	73.3	52.78	32.85	23.29	(83)

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

(84)m=	253.12	270.97	282	288.44	289.28	277.62	265.7	260.36	254.83	247.28	242.03	243.1	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.98	0.94	0.86	0.71	0.74	0.91	0.98	0.99	1	(86)

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

(87)m=	19.48	19.61	19.85	20.19	20.53	20.81	20.94	20.93	20.73	20.31	19.85	19.48	(87)

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

(88)m=	19.73	19.73	19.74	19.76	19.76	19.78	19.78	19.78	19.77	19.76	19.75	19.74	(88)

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

(89)m=	0.99	0.99	0.98	0.97	0.91	0.77	0.56	0.59	0.84	0.96	0.99	1	(89)

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

(90)m=	17.75	17.94	18.28	18.79	19.26	19.64	19.76	19.75	19.54	18.96	18.3	17.75		(90)

fLA = Living area ÷ (4) = 0.68 (91)

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

(92)m=	18.93	19.08	19.35	19.74	20.12	20.44	20.56	20.55	20.35	19.88	19.36	18.92	(92)

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

(93)m=	18.93	19.08	19.35	19.74	20.12	20.44	20.56	20.55	20.35	19.88	19.36	18.92	(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=	0.99	0.99	0.98	0.97	0.92	0.82	0.66	0.69	0.88	0.97	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	251.31	268.16	277.2	278.74	267.51	227.84	176.21	180.88	223.56	238.87	239.18	241.63	(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=	744.09	718.08	648.14	536.33	415.07	282.73	191.84	200.35	304.69	457.19	608.49	736.68	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	366.63	302.34	275.98	185.46	109.79	0	0	0	0	162.43	265.9	368.32	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2036.86 (98)

Space heating requirement in kWh/m²/year 58 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	366.63	302.34	275.98	185.46	109.79	0	0	0	0	162.43	265.9	368.32	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	392.54	323.71	295.48	198.57	117.54	0	0	0	0	173.91	284.69	394.34	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2180.79 (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)

141.78	123.84	128.85	114.29	110.65	97.45	93.37	104.08	105.23	119.83	127.91	138.45

Efficiency of water heater 80.3 (216)

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(217)m=	87.34	87.21	86.92	86.26	85.03	80.3	80.3	80.3	80.3	85.82	86.85	87.4	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	162.33	142	148.24	132.48	130.13	121.36	116.27	129.62	131.05	139.63	147.28	158.41

Total = $Sum(219a)_{1...12}$ = 1658.81 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2180.79	
Water heating fuel used			1658.81	
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			207.11	(232)

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	=	471.05	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	358.3	(264)
Space and water heating	(261) + (262) + (263) + (264) =			829.35	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	107.49	(268)
Total CO2, kg/year		sum of (265)…(271) =		975.77	(272)

TER = 27.78 (273)

SAP Input

Property Details: Flat Type D Energy Eff only

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	07 November 2019
Date of certificate:	12 May 2020
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Low
Water use <= 125 litres/person/day:	True
PCDF Version:	460

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2020	
Floor Location:	Floor area:	Storey height:
Floor 0	25 m²	3.09 m
Living area:	21.1 m² (fraction 0.844)	
Front of dwelling faces:	West	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D4_01	Manufacturer	Solid			Metal
Vent_04_02	Manufacturer	Solid			
Vent_04_04	Manufacturer	Solid			
Window_04_01	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_04_05	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Fanlight	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D4_01	mm	0	0	1	2.13	1
Vent_04_02	mm	0	0	1	0.35	1
Vent_04_04	mm	0	0	1	0.99	1
Window_04_01	6mm	0.7	0.4	1.2	0.7	1
Window_04_05	6mm	0.7	0.4	1.2	1.96	1
Fanlight	6mm	0.7	0.4	1.2	0.32	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D4_01		4_01	West	0	0
Vent_04_02		4_01	West	0.295	1.2
Vent_04_04		4_05	East	0.6	1.65
Window_04_01		4_01	West	0.585	1.2
Window_04_05		4_05	East	1.185	1.65
Fanlight		4_01	West	1.01	0.315

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
4_01	10.073	3.5	6.57	0.13	0	False	N/A
4_05	12.978	2.95	10.03	0.13	0	False	N/A
4_03	1.869	0	1.87	0.13	0	False	N/A
4_04	2.905	0	2.9	0.13	0	False	N/A

SAP Input

R4_01	25	0	25	0.1	0	N/A

Internal Elements
Party Elements

Thermal bridges:

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: False
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	0
Pressure test:	2.5

Main heating system:

Main heating system:	Boiler systems with radiators or underfloor heating Gas boilers and oil boilers Fuel: mains gas Info Source: Manufacturer Declaration Manufacturer's data Efficiency: 89.5% (SEDBUK2009) Condensing combi with automatic ignition Fuel Burning Type: Modulation Systems with radiators Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Room-sealed Boiler interlock: Yes

Main heating Control:

Main heating Control:	Programmer, room thermostat and TRVs Control code: 2106

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type D Energy Eff only

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	25	(1a)	x	3.09	(2a)	=	77.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	25	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			77.25	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)
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			2.5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.12	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.12	(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

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

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.35	x	1	=	0.35			(26)
Doors Type 3			0.99	x	1	=	0.99			(26)
Windows Type 1			0.7	x1/[1/(1.2)+ 0.04]		=	0.8			(27)
Windows Type 2			1.96	x1/[1/(1.2)+ 0.04]		=	2.24			(27)
Windows Type 3			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Walls Type1	10.07	3.5	6.57	x	0.13	=	0.85			(29)
Walls Type2	12.98	2.95	10.03	x	0.13	=	1.3			(29)
Walls Type3	1.87	0	1.87	x	0.13	=	0.24			(29)
Walls Type4	2.9	0	2.9	x	0.13	=	0.38			(29)
Roof	25	0	25	x	0.1	=	2.5			(30)
Total area of elements, m²			52.82							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 12.16 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 225 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 7.92 (36)

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

SAP WorkSheet: New dwelling design stage

Total fabric heat loss (33) + (36) = 20.08 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	7.17	7.09	7.01	6.61	6.53	6.13	6.13	6.05	6.29	6.53	6.69	6.85	(38)

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

(39)m=	27.25	27.17	27.09	26.69	26.61	26.22	26.22	26.14	26.37	26.61	26.77	26.93	

Average = $Sum(39)_{1...12}$ /12= 26.67 (39)

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

(40)m=	1.09	1.09	1.08	1.07	1.06	1.05	1.05	1.05	1.05	1.06	1.07	1.08	

Average = $Sum(40)_{1...12}$ /12= 1.07 (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 1.09 (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 60.05 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	66.06	63.66	61.25	58.85	56.45	54.05	54.05	56.45	58.85	61.25	63.66	66.06	

Total = $Sum(44)_{1...12}$ = 720.62 (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=	97.96	85.68	88.41	77.08	73.96	63.82	59.14	67.86	68.67	80.03	87.36	94.87	

Total = $Sum(45)_{1...12}$ = 944.85 (45)

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

(46)m=	14.69	12.85	13.26	11.56	11.09	9.57	8.87	10.18	10.3	12	13.1	14.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

(61)m=	33.66	29.3	31.21	29.02	28.77	26.65	27.54	28.77	29.02	31.21	31.39	33.66	(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=	131.62	114.98	119.63	106.1	102.72	90.47	86.68	96.63	97.7	111.25	118.75	128.53	(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=	131.62	114.98	119.63	106.1	102.72	90.47	86.68	96.63	97.7	111.25	118.75	128.53

Output from water heater (annual)$_{1...12}$ | 1305.07 | (64)

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

(65)m=	40.99	35.81	37.2	32.88	31.78	27.88	26.55	29.76	30.09	34.41	36.9	39.96	(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=	65.31	65.31	65.31	65.31	65.31	65.31	65.31	65.31	65.31	65.31	65.31	65.31	(66)

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

(67)m=	21.45	19.05	15.49	11.73	8.77	7.4	8	10.39	13.95	17.72	20.68	22.04	(67)

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

(68)m=	128.81	130.15	126.78	119.61	110.56	102.05	96.37	95.03	98.4	105.57	114.62	123.13	(68)

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

(69)m=	42.62	42.62	42.62	42.62	42.62	42.62	42.62	42.62	42.62	42.62	42.62	42.62	(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=	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	(71)

Water heating gains (Table 5)

(72)m=	55.09	53.29	50	45.67	42.72	38.73	35.68	39.99	41.79	46.26	51.24	53.71	(72)

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

(73)m=	272.74	269.88	259.66	244.4	229.43	215.57	207.44	212.81	221.53	236.93	253.93	266.27	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	1.96	x	19.64	x	0.4	x	0.7	=	7.47	(76)
East	0.9x	0.77	x	1.96	x	38.42	x	0.4	x	0.7	=	14.61	(76)
East	0.9x	0.77	x	1.96	x	63.27	x	0.4	x	0.7	=	24.06	(76)
East	0.9x	0.77	x	1.96	x	92.28	x	0.4	x	0.7	=	35.1	(76)
East	0.9x	0.77	x	1.96	x	113.09	x	0.4	x	0.7	=	43.01	(76)
East	0.9x	0.77	x	1.96	x	115.77	x	0.4	x	0.7	=	44.03	(76)
East	0.9x	0.77	x	1.96	x	110.22	x	0.4	x	0.7	=	41.92	(76)
East	0.9x	0.77	x	1.96	x	94.68	x	0.4	x	0.7	=	36.01	(76)
East	0.9x	0.77	x	1.96	x	73.59	x	0.4	x	0.7	=	27.99	(76)
East	0.9x	0.77	x	1.96	x	45.59	x	0.4	x	0.7	=	17.34	(76)
East	0.9x	0.77	x	1.96	x	24.49	x	0.4	x	0.7	=	9.31	(76)
East	0.9x	0.77	x	1.96	x	16.15	x	0.4	x	0.7	=	6.14	(76)
West	0.9x	0.77	x	0.7	x	19.64	x	0.4	x	0.7	=	2.67	(80)
West	0.9x	0.77	x	0.32	x	19.64	x	0.4	x	0.7	=	1.22	(80)
West	0.9x	0.77	x	0.7	x	38.42	x	0.4	x	0.7	=	5.22	(80)
West	0.9x	0.77	x	0.32	x	38.42	x	0.4	x	0.7	=	2.39	(80)
West	0.9x	0.77	x	0.7	x	63.27	x	0.4	x	0.7	=	8.59	(80)
West	0.9x	0.77	x	0.32	x	63.27	x	0.4	x	0.7	=	3.93	(80)
West	0.9x	0.77	x	0.7	x	92.28	x	0.4	x	0.7	=	12.53	(80)
West	0.9x	0.77	x	0.32	x	92.28	x	0.4	x	0.7	=	5.73	(80)
West	0.9x	0.77	x	0.7	x	113.09	x	0.4	x	0.7	=	15.36	(80)
West	0.9x	0.77	x	0.32	x	113.09	x	0.4	x	0.7	=	7.02	(80)
West	0.9x	0.77	x	0.7	x	115.77	x	0.4	x	0.7	=	15.72	(80)
West	0.9x	0.77	x	0.32	x	115.77	x	0.4	x	0.7	=	7.19	(80)
West	0.9x	0.77	x	0.7	x	110.22	x	0.4	x	0.7	=	14.97	(80)
West	0.9x	0.77	x	0.32	x	110.22	x	0.4	x	0.7	=	6.84	(80)
West	0.9x	0.77	x	0.7	x	94.68	x	0.4	x	0.7	=	12.86	(80)
West	0.9x	0.77	x	0.32	x	94.68	x	0.4	x	0.7	=	5.88	(80)
West	0.9x	0.77	x	0.7	x	73.59	x	0.4	x	0.7	=	10	(80)
West	0.9x	0.77	x	0.32	x	73.59	x	0.4	x	0.7	=	4.57	(80)
West	0.9x	0.77	x	0.7	x	45.59	x	0.4	x	0.7	=	6.19	(80)
West	0.9x	0.77	x	0.32	x	45.59	x	0.4	x	0.7	=	2.83	(80)
West	0.9x	0.77	x	0.7	x	24.49	x	0.4	x	0.7	=	3.33	(80)
West	0.9x	0.77	x	0.32	x	24.49	x	0.4	x	0.7	=	1.52	(80)
West	0.9x	0.77	x	0.7	x	16.15	x	0.4	x	0.7	=	2.19	(80)
West	0.9x	0.77	x	0.32	x	16.15	x	0.4	x	0.7	=	1	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	11.36	22.22	36.59	53.36	65.39	66.94	63.73	54.75	42.55	26.36	14.16	9.34	(83)

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

(84)m=	284.09	292.09	296.25	297.76	294.83	282.51	271.17	267.55	264.08	263.29	268.09	275.61	(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=	0.87	0.86	0.82	0.76	0.67	0.53	0.4	0.42	0.59	0.75	0.84	0.88	(86)

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

(87)m=	19.49	19.63	19.91	20.29	20.62	20.86	20.95	20.94	20.8	20.42	19.92	19.46	(87)

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

(88)m=	20.01	20.01	20.01	20.03	20.03	20.04	20.04	20.05	20.04	20.03	20.02	20.02	(88)

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

(89)m=	0.86	0.84	0.8	0.73	0.62	0.46	0.32	0.34	0.53	0.71	0.82	0.87	(89)

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

(90)m=	18.66	18.8	19.07	19.44	19.75	19.96	20.02	20.02	19.91	19.57	19.09	18.64	(90)

fLA = Living area ÷ (4) = | 0.84 | (91)

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

(92)m=	19.36	19.5	19.78	20.16	20.49	20.72	20.81	20.8	20.66	20.28	19.79	19.33	(92)

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

(93)m=	19.36	19.5	19.78	20.16	20.49	20.72	20.81	20.8	20.66	20.28	19.79	19.33	(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=	0.85	0.83	0.8	0.74	0.64	0.51	0.39	0.41	0.57	0.72	0.81	0.85	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	240.51	242.47	236.07	219.04	189.61	143.99	104.66	108.4	149.66	190.82	217.58	235.43	(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, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	410.37	396.76	359.8	300.55	233.83	160.44	110.28	114.99	173.06	257.75	339.7	407.56	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	126.38	103.69	92.05	58.69	32.9	0	0	0	0	49.79	87.92	128.07	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 679.49 | (98)

Space heating requirement in kWh/m²/year | 27.18 | (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	126.38	103.69	92.05	58.69	32.9	0	0	0	0	49.79	87.92	128.07		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	139.8	114.7	101.83	64.92	36.4	0	0	0	0	55.08	97.26	141.67		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													751.65	(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)														
	131.62	114.98	119.63	106.1	102.72	90.47	86.68	96.63	97.7	111.25	118.75	128.53		
Efficiency of water heater													80.3	(216)
(217)m=	84.95	84.79	84.4	83.63	82.54	80.3	80.3	80.3	80.3	83.17	84.31	85.04		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	154.94	135.6	141.73	126.87	124.46	112.67	107.95	120.34	121.66	133.75	140.86	151.14		
Total = Sum(219a)$_{1...12}$ =													1571.98	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		751.65	
Water heating fuel used		1571.98	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	98.96		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		173.96	(231)
Electricity for lighting		151.5	(232)

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 =	26.16	(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 =	54.7	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	22.94	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	19.98	(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) =			243.79	(255)

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11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.46	(257)
SAP rating (Section 12)		79.59	(258)

12a. CO_2 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	=	162.36	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	339.55	(264)
Space and water heating	(261) + (262) + (263) + (264) =				501.9	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	90.28	(267)
Electricity for lighting	(232)	x	0.519	=	78.63	(268)
Total CO2, kg/year			sum of (265)…(271) =		670.81	(272)
CO2 emissions per m²			(272) ÷ (4) =		26.83	(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	=	917.01	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	1917.81	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2834.83	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	534.05	(267)
Electricity for lighting	(232)	x	0	=	465.09	(268)
‘Total Primary Energy			sum of (265)…(271) =		3833.96	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		153.36	(273)

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User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type D Energy Eff only

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	25	(1a)	x	3.09	(2a)	=	77.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	25	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	77.25	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

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

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

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.35	x	1	=	0.35			(26)
Doors Type 3			0.99	x	1	=	0.99			(26)
Windows Type 1			0.7	x1/[1/(1.2)+ 0.04]		=	0.8			(27)
Windows Type 2			1.96	x1/[1/(1.2)+ 0.04]		=	2.24			(27)
Windows Type 3			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Walls Type1	10.07	3.5	6.57	x	0.13	=	0.85			(29)
Walls Type2	12.98	2.95	10.03	x	0.13	=	1.3			(29)
Walls Type3	1.87	0	1.87	x	0.13	=	0.24			(29)
Walls Type4	2.9	0	2.9	x	0.13	=	0.38			(29)
Roof	25	0	25	x	0.1	=	2.5			(30)
Total area of elements, m²			52.82							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 12.16 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 225 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 7.92 (36)

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

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Total fabric heat loss (33) + (36) = 20.08 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	7.17	7.09	7.01	6.61	6.53	6.13	6.13	6.05	6.29	6.53	6.69	6.85	(38)

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

(39)m=	27.25	27.17	27.09	26.69	26.61	26.22	26.22	26.14	26.37	26.61	26.77	26.93	

Average = $Sum(39)_{1...12}$ /12= 26.67 (39)

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

(40)m=	1.09	1.09	1.08	1.07	1.06	1.05	1.05	1.05	1.05	1.06	1.07	1.08	

Average = $Sum(40)_{1...12}$ /12= 1.07 (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 1.09 (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 60.05 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	66.06	63.66	61.25	58.85	56.45	54.05	54.05	56.45	58.85	61.25	63.66	66.06	

Total = $Sum(44)_{1...12}$ = 720.62 (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=	97.96	85.68	88.41	77.08	73.96	63.82	59.14	67.86	68.67	80.03	87.36	94.87	

Total = $Sum(45)_{1...12}$ = 944.85 (45)

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

(46)m=	14.69	12.85	13.26	11.56	11.09	9.57	8.87	10.18	10.3	12	13.1	14.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

(61)m=	33.66	29.3	31.21	29.02	28.77	26.65	27.54	28.77	29.02	31.21	31.39	33.66	(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=	131.62	114.98	119.63	106.1	102.72	90.47	86.68	96.63	97.7	111.25	118.75	128.53	(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=	131.62	114.98	119.63	106.1	102.72	90.47	86.68	96.63	97.7	111.25	118.75	128.53

Output from water heater (annual)1…12 1305.07 (64)

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

(65)m=	40.99	35.81	37.2	32.88	31.78	27.88	26.55	29.76	30.09	34.41	36.9	39.96	(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=	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	(66)

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

(67)m=	8.58	7.62	6.2	4.69	3.51	2.96	3.2	4.16	5.58	7.09	8.27	8.82	(67)

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

(68)m=	86.3	87.2	84.94	80.14	74.07	68.37	64.56	63.67	65.93	70.73	76.8	82.5	(68)

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

(69)m=	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	(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=	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	(71)

Water heating gains (Table 5)

(72)m=	55.09	53.29	50	45.67	42.72	38.73	35.68	39.99	41.79	46.26	51.24	53.71	(72)

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

(73)m=	192.3	190.44	183.47	172.83	162.63	152.39	145.78	150.15	155.63	166.4	178.64	187.35	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	1.96	x	19.64	x	0.4	x	0.7	=	7.47	(76)
East	0.9x	0.77	x	1.96	x	38.42	x	0.4	x	0.7	=	14.61	(76)
East	0.9x	0.77	x	1.96	x	63.27	x	0.4	x	0.7	=	24.06	(76)
East	0.9x	0.77	x	1.96	x	92.28	x	0.4	x	0.7	=	35.1	(76)
East	0.9x	0.77	x	1.96	x	113.09	x	0.4	x	0.7	=	43.01	(76)
East	0.9x	0.77	x	1.96	x	115.77	x	0.4	x	0.7	=	44.03	(76)
East	0.9x	0.77	x	1.96	x	110.22	x	0.4	x	0.7	=	41.92	(76)
East	0.9x	0.77	x	1.96	x	94.68	x	0.4	x	0.7	=	36.01	(76)
East	0.9x	0.77	x	1.96	x	73.59	x	0.4	x	0.7	=	27.99	(76)
East	0.9x	0.77	x	1.96	x	45.59	x	0.4	x	0.7	=	17.34	(76)
East	0.9x	0.77	x	1.96	x	24.49	x	0.4	x	0.7	=	9.31	(76)
East	0.9x	0.77	x	1.96	x	16.15	x	0.4	x	0.7	=	6.14	(76)
West	0.9x	0.77	x	0.7	x	19.64	x	0.4	x	0.7	=	2.67	(80)
West	0.9x	0.77	x	0.32	x	19.64	x	0.4	x	0.7	=	1.22	(80)
West	0.9x	0.77	x	0.7	x	38.42	x	0.4	x	0.7	=	5.22	(80)
West	0.9x	0.77	x	0.32	x	38.42	x	0.4	x	0.7	=	2.39	(80)
West	0.9x	0.77	x	0.7	x	63.27	x	0.4	x	0.7	=	8.59	(80)
West	0.9x	0.77	x	0.32	x	63.27	x	0.4	x	0.7	=	3.93	(80)
West	0.9x	0.77	x	0.7	x	92.28	x	0.4	x	0.7	=	12.53	(80)
West	0.9x	0.77	x	0.32	x	92.28	x	0.4	x	0.7	=	5.73	(80)
West	0.9x	0.77	x	0.7	x	113.09	x	0.4	x	0.7	=	15.36	(80)
West	0.9x	0.77	x	0.32	x	113.09	x	0.4	x	0.7	=	7.02	(80)
West	0.9x	0.77	x	0.7	x	115.77	x	0.4	x	0.7	=	15.72	(80)
West	0.9x	0.77	x	0.32	x	115.77	x	0.4	x	0.7	=	7.19	(80)
West	0.9x	0.77	x	0.7	x	110.22	x	0.4	x	0.7	=	14.97	(80)
West	0.9x	0.77	x	0.32	x	110.22	x	0.4	x	0.7	=	6.84	(80)
West	0.9x	0.77	x	0.7	x	94.68	x	0.4	x	0.7	=	12.86	(80)
West	0.9x	0.77	x	0.32	x	94.68	x	0.4	x	0.7	=	5.88	(80)
West	0.9x	0.77	x	0.7	x	73.59	x	0.4	x	0.7	=	10	(80)
West	0.9x	0.77	x	0.32	x	73.59	x	0.4	x	0.7	=	4.57	(80)
West	0.9x	0.77	x	0.7	x	45.59	x	0.4	x	0.7	=	6.19	(80)
West	0.9x	0.77	x	0.32	x	45.59	x	0.4	x	0.7	=	2.83	(80)
West	0.9x	0.77	x	0.7	x	24.49	x	0.4	x	0.7	=	3.33	(80)
West	0.9x	0.77	x	0.32	x	24.49	x	0.4	x	0.7	=	1.52	(80)
West	0.9x	0.77	x	0.7	x	16.15	x	0.4	x	0.7	=	2.19	(80)
West	0.9x	0.77	x	0.32	x	16.15	x	0.4	x	0.7	=	1	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	11.36	22.22	36.59	53.36	65.39	66.94	63.73	54.75	42.55	26.36	14.16	9.34	(83)

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

(84)m=	203.66	212.65	220.05	226.19	228.02	219.33	209.51	204.89	198.18	192.76	192.8	196.69	(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=	0.93	0.92	0.9	0.85	0.76	0.63	0.5	0.52	0.7	0.85	0.91	0.94	(86)

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

(87)m=	19.07	19.24	19.57	20.03	20.46	20.78	20.92	20.9	20.68	20.17	19.56	19.04	(87)

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

(88)m=	20.01	20.01	20.01	20.03	20.03	20.04	20.04	20.05	20.04	20.03	20.02	20.02	(88)

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

(89)m=	0.92	0.91	0.88	0.82	0.72	0.56	0.41	0.43	0.64	0.82	0.9	0.93	(89)

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

(90)m=	18.26	18.43	18.76	19.21	19.61	19.9	20	20	19.82	19.35	18.76	18.24	(90)

fLA = Living area ÷ (4) = | 0.84 | (91)

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

(92)m=	18.94	19.11	19.44	19.9	20.32	20.64	20.78	20.76	20.55	20.04	19.43	18.91	(92)

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

(93)m=	18.94	19.11	19.44	19.9	20.32	20.64	20.78	20.76	20.55	20.04	19.43	18.91	(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=	0.91	0.9	0.87	0.82	0.74	0.61	0.48	0.5	0.68	0.82	0.89	0.92	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	185.95	191.26	191.84	185.33	167.6	133.11	99.95	102.81	133.85	158.21	171.45	180.76	(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=	398.97	386.09	350.64	293.74	229.53	158.45	109.45	114	170.08	251.18	330.19	396.22	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	158.49	130.93	118.14	78.05	46.08	0	0	0	0	69.16	114.29	160.31	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 875.45 | (98)

Space heating requirement in kWh/m²/year | 35.02 | (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	158.49	130.93	118.14	78.05	46.08	0	0	0	0	69.16	114.29	160.31		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	175.32	144.83	130.69	86.34	50.97	0	0	0	0	76.51	126.43	177.33		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													968.42	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	131.62	114.98	119.63	106.1	102.72	90.47	86.68	96.63	97.7	111.25	118.75	128.53		
Efficiency of water heater													80.3	(216)
(217)m=	85.52	85.38	85.02	84.29	83.18	80.3	80.3	80.3	80.3	83.89	84.95	85.61		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	153.91	134.67	140.7	125.87	123.5	112.67	107.95	120.34	121.66	132.61	139.78	150.14		
Total = Sum(219a)$_{1...12}$ =													1563.8	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		968.42	
Water heating fuel used		1563.8	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	98.96		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		173.96	(231)
Electricity for lighting		151.5	(232)

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	=	209.18	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	337.78	(264)
Space and water heating	(261) + (262) + (263) + (264) =				546.96	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	90.28	(267)
Electricity for lighting	(232)	x	0.519	=	78.63	(268)
Total CO2, kg/year			sum of (265)…(271) =		715.87	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		28.63	(273)
EI rating (section 14)					86	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type D Energy Eff only

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	25	(1a)	x	3.09	(2a)	=	77.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	25	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	77.25	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =	0.26	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.51	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.51	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.65	0.64	0.62	0.56	0.55	0.48	0.48	0.47	0.51	0.55	0.57	0.6

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0.71	0.7	0.69	0.66	0.65	0.62	0.62	0.61	0.63	0.65	0.66	0.68	(24d)

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

(25)m=	0.71	0.7	0.69	0.66	0.65	0.62	0.62	0.61	0.63	0.65	0.66	0.68	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.35	x	1	=	0.35			(26)
Doors Type 3			0.99	x	1	=	0.99			(26)
Windows Type 1			0.65	x1/[1/(1.4)+ 0.04]		=	0.86			(27)
Windows Type 2			1.83	x1/[1/(1.4)+ 0.04]		=	2.43			(27)
Windows Type 3			0.3	x1/[1/(1.4)+ 0.04]		=	0.4			(27)
Walls Type1	10.07	3.43	6.64	x	0.18	=	1.2			(29)
Walls Type2	12.98	2.82	10.16	x	0.18	=	1.83			(29)
Walls Type3	1.87	0	1.87	x	0.18	=	0.34			(29)
Walls Type4	2.9	0	2.9	x	0.18	=	0.52			(29)
Roof	25	0	25	x	0.13	=	3.25			(30)
Total area of elements, m²			52.82							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 14.29 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 225 (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 2.64 (36)

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

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Total fabric heat loss	(33) + (36) =	16.93 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	18.11	17.9	17.7	16.74	16.56	15.73	15.73	15.57	16.05	16.56	16.92	17.3	(38)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	35.04	34.83	34.63	33.67	33.49	32.66	32.66	32.5	32.98	33.49	33.85	34.23	

Average = Sum(39)$_{1…12}$ /12= 33.67 (39)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.4	1.39	1.39	1.35	1.34	1.31	1.31	1.3	1.32	1.34	1.35	1.37	

Average = Sum(40)$_{1…12}$ /12= 1.35 (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 — 1.09 (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 — 60.05 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	66.06	63.66	61.25	58.85	56.45	54.05	54.05	56.45	58.85	61.25	63.66	66.06	

Total = Sum(44)$_{1…12}$ = 720.62 (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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	97.96	85.68	88.41	77.08	73.96	63.82	59.14	67.86	68.67	80.03	87.36	94.87	

Total = Sum(45)$_{1…12}$ = 944.85 (45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	14.69	12.85	13.26	11.56	11.09	9.57	8.87	10.18	10.3	12	13.1	14.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 0 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

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

Enter (50) or (54) in (55) — 0 (55)

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

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

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

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

(61)m=	33.66	29.3	31.21	29.02	28.77	26.65	27.54	28.77	29.02	31.21	31.39	33.66	(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=	131.62	114.98	119.63	106.1	102.72	90.47	86.68	96.63	97.7	111.25	118.75	128.53	(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=	131.62	114.98	119.63	106.1	102.72	90.47	86.68	96.63	97.7	111.25	118.75	128.53

Output from water heater (annual)$_{1...12}$ — 1305.07 (64)

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

(65)m=	40.99	35.81	37.2	32.88	31.78	27.88	26.55	29.76	30.09	34.41	36.9	39.96	(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=	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	(66)

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

(67)m=	8.68	7.71	6.27	4.75	3.55	3	3.24	4.21	5.65	7.17	8.37	8.93	(67)

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

(68)m=	86.3	87.2	84.94	80.14	74.07	68.37	64.56	63.67	65.93	70.73	76.8	82.5	(68)

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

(69)m=	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	(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=	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	(71)

Water heating gains (Table 5)

(72)m=	55.09	53.29	50	45.67	42.72	38.73	35.68	39.99	41.79	46.26	51.24	53.71	(72)

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

(73)m=	192.41	190.53	183.54	172.89	162.67	152.43	145.82	150.2	155.69	166.49	178.74	187.46	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	1.83	x	19.64	x	0.63	x	0.7	=	10.98	(76)
East	0.9x	0.77	x	1.83	x	38.42	x	0.63	x	0.7	=	21.49	(76)
East	0.9x	0.77	x	1.83	x	63.27	x	0.63	x	0.7	=	35.39	(76)
East	0.9x	0.77	x	1.83	x	92.28	x	0.63	x	0.7	=	51.61	(76)
East	0.9x	0.77	x	1.83	x	113.09	x	0.63	x	0.7	=	63.25	(76)
East	0.9x	0.77	x	1.83	x	115.77	x	0.63	x	0.7	=	64.75	(76)
East	0.9x	0.77	x	1.83	x	110.22	x	0.63	x	0.7	=	61.64	(76)
East	0.9x	0.77	x	1.83	x	94.68	x	0.63	x	0.7	=	52.95	(76)
East	0.9x	0.77	x	1.83	x	73.59	x	0.63	x	0.7	=	41.16	(76)
East	0.9x	0.77	x	1.83	x	45.59	x	0.63	x	0.7	=	25.5	(76)
East	0.9x	0.77	x	1.83	x	24.49	x	0.63	x	0.7	=	13.7	(76)
East	0.9x	0.77	x	1.83	x	16.15	x	0.63	x	0.7	=	9.03	(76)
West	0.9x	0.77	x	0.65	x	19.64	x	0.63	x	0.7	=	3.9	(80)
West	0.9x	0.77	x	0.3	x	19.64	x	0.63	x	0.7	=	1.8	(80)
West	0.9x	0.77	x	0.65	x	38.42	x	0.63	x	0.7	=	7.63	(80)
West	0.9x	0.77	x	0.3	x	38.42	x	0.63	x	0.7	=	3.52	(80)
West	0.9x	0.77	x	0.65	x	63.27	x	0.63	x	0.7	=	12.57	(80)
West	0.9x	0.77	x	0.3	x	63.27	x	0.63	x	0.7	=	5.8	(80)
West	0.9x	0.77	x	0.65	x	92.28	x	0.63	x	0.7	=	18.33	(80)
West	0.9x	0.77	x	0.3	x	92.28	x	0.63	x	0.7	=	8.46	(80)
West	0.9x	0.77	x	0.65	x	113.09	x	0.63	x	0.7	=	22.47	(80)
West	0.9x	0.77	x	0.3	x	113.09	x	0.63	x	0.7	=	10.37	(80)
West	0.9x	0.77	x	0.65	x	115.77	x	0.63	x	0.7	=	23	(80)
West	0.9x	0.77	x	0.3	x	115.77	x	0.63	x	0.7	=	10.61	(80)
West	0.9x	0.77	x	0.65	x	110.22	x	0.63	x	0.7	=	21.89	(80)
West	0.9x	0.77	x	0.3	x	110.22	x	0.63	x	0.7	=	10.11	(80)
West	0.9x	0.77	x	0.65	x	94.68	x	0.63	x	0.7	=	18.81	(80)
West	0.9x	0.77	x	0.3	x	94.68	x	0.63	x	0.7	=	8.68	(80)
West	0.9x	0.77	x	0.65	x	73.59	x	0.63	x	0.7	=	14.62	(80)
West	0.9x	0.77	x	0.3	x	73.59	x	0.63	x	0.7	=	6.75	(80)
West	0.9x	0.77	x	0.65	x	45.59	x	0.63	x	0.7	=	9.06	(80)
West	0.9x	0.77	x	0.3	x	45.59	x	0.63	x	0.7	=	4.18	(80)
West	0.9x	0.77	x	0.65	x	24.49	x	0.63	x	0.7	=	4.86	(80)
West	0.9x	0.77	x	0.3	x	24.49	x	0.63	x	0.7	=	2.25	(80)
West	0.9x	0.77	x	0.65	x	16.15	x	0.63	x	0.7	=	3.21	(80)
West	0.9x	0.77	x	0.3	x	16.15	x	0.63	x	0.7	=	1.48	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	16.69	32.64	53.76	78.4	96.08	98.36	93.64	80.44	62.52	38.73	20.81	13.72	(83)

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

(84)m=	209.09	223.17	237.3	251.29	258.75	250.78	239.46	230.64	218.22	205.22	199.55	201.18	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) — 21 (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	0.99	0.98	0.95	0.88	0.74	0.58	0.61	0.84	0.96	0.99	0.99	(86)

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

(87)m=	19.64	19.78	20.03	20.39	20.7	20.91	20.98	20.97	20.83	20.45	20.01	19.64	(87)

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

(88)m=	20.3	20.3	20.31	20.33	20.33	20.35	20.35	20.35	20.34	20.33	20.32	20.32	(88)

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

(89)m=	0.99	0.99	0.98	0.94	0.86	0.69	0.5	0.54	0.79	0.95	0.98	0.99	(89)

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

(90)m=	19.03	19.17	19.42	19.79	20.09	20.29	20.34	20.34	20.22	19.85	19.41	19.04	(90)

fLA = Living area ÷ (4) = 0.84 (91)

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

(92)m=	19.55	19.68	19.93	20.3	20.6	20.82	20.88	20.87	20.74	20.36	19.92	19.55	(92)

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

(93)m=	19.55	19.68	19.93	20.3	20.6	20.82	20.88	20.87	20.74	20.36	19.92	19.55	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.97	0.94	0.87	0.72	0.56	0.6	0.82	0.95	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	206.83	219.73	230.87	236.56	225	181.54	134.41	138.25	178.91	194.79	196.01	199.32	(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=	534.31	514.89	465.19	383.72	298.2	202.97	139.7	145.33	218.95	326.77	433.87	525.52	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	243.65	198.35	174.34	105.95	54.46	0	0	0	0	98.19	171.26	242.69	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1288.89 (98)

Space heating requirement in kWh/m²/year — 51.56 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	243.65	198.35	174.34	105.95	54.46	0	0	0	0	98.19	171.26	242.69		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	260.87	212.36	186.65	113.44	58.31	0	0	0	0	105.13	183.36	259.84		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1379.97	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	131.62	114.98	119.63	106.1	102.72	90.47	86.68	96.63	97.7	111.25	118.75	128.53		
Efficiency of water heater													80.3	(216)
(217)m=	86.58	86.41	86	85.05	83.53	80.3	80.3	80.3	80.3	84.74	85.97	86.63		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	152.02	133.06	139.1	124.76	122.97	112.67	107.95	120.34	121.66	131.28	138.13	148.37		
Total = Sum(219a)$_{1...12}$ =													1552.32	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1379.97	
Water heating fuel used			1552.32	
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			153.37	(232)

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	=	298.07	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	335.3	(264)
Space and water heating	(261) + (262) + (263) + (264) =			633.37	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	79.6	(268)
Total CO2, kg/year		sum of (265)…(271) =		751.9	(272)

TER = 30.08 (273)

SAP Input

Property Details: Flat Type E Energy Eff only

Address:	
Located in:	Wales
Region:	Thames valley
UPRN:	
Date of assessment:	07 November 2019
Date of certificate:	12 May 2020
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Low
Water use <= 125 litres/person/day:	True
PCDF Version:	460

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2020	
Floor Location:	Floor area:	Storey height:
Floor 0	49.68 m²	3.09 m
Living area:	24.05 m² (fraction 0.484)	
Front of dwelling faces:	South	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D9_01	Manufacturer	Solid			
Vent_09_01	Manufacturer	Solid			
Vent_09_09	Manufacturer	Solid			
Vent_09_04	Manufacturer	Solid			
Vent_09_10	Manufacturer	Solid			
Window_09_02	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_09_03	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_09_05	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_09_11	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_09_07	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_09_08	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Fanlight	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D9_01	mm	0	0	1	2.13	1
Vent_09_01	mm	0	0	1	0.7	1
Vent_09_09	mm	0	0	1	0.96	1
Vent_09_04	mm	0	0	1	0.7	1
Vent_09_10	mm	0	0	1	0.7	1
Window_09_02	6mm	0.7	0.4	1.2	1.1	1
Window_09_03	6mm	0.7	0.4	1.2	0.19	1
Window_09_05	6mm	0.7	0.4	1.2	2.01	1
Window_09_11	6mm	0.7	0.4	1.2	1.46	1
Window_09_07	6mm	0.7	0.4	1.2	1.46	1
Window_09_08	6mm	0.7	0.4	1.2	0.99	1
Fanlight	6mm	0.7	0.4	1.2	0.32	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D9_01		9_01	South	0	0
Vent_09_01		9_01	South	0.58	1.2

SAP Input

Vent_09_09	9_09	East	0.58	1.65
Vent_09_04	9_06	North	1.2	0.58
Vent_09_10	9_07	North	0.58	1.2
Window_09_02	9_01	South	0.92	1.2
Window_09_03	9_01	South	0	0
Window_09_05	9_06	North	1.22	1.65
Window_09_11	9_07	North	1.22	1.2
Window_09_07	9_08	North	1.22	1.2
Window_09_08	9_09	East	0.6	1.65
Fanlight	9_01	South	1.01	0.315

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
9_01	12.36	4.44	7.92	0.13	0	False	N/A
9_02	5.871	0	5.87	0.13	0	False	N/A
9_03	5.84	0	5.84	0.13	0	False	N/A
9_04	2.812	0	2.81	0.13	0	False	N/A
9_06	8.498	2.71	5.79	0.13	0	False	N/A
9_07	8.019	2.16	5.86	0.13	0	False	N/A
9_08	10.521	1.46	9.06	0.13	0	False	N/A
9_09	19.467	1.95	17.52	0.13	0	False	N/A
R9_01	49.68	0	49.68	0.1	0		N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 2 Ductwork: Insulation, rigid Approved Installation Scheme: False
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	0
Pressure test:	2.5

Main heating system:

Main heating system:
Boiler systems with radiators or underfloor heating
Gas boilers and oil boilers
Fuel: mains gas
Info Source: Manufacturer Declaration
Manufacturer's data
Efficiency: 89.5% (SEDBUK2009)
Condensing combi with automatic ignition
Fuel Burning Type: Modulation
Systems with radiators
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Room-sealed

SAP Input

	Boiler interlock: Yes
Main heating Control:	
Main heating Control:	Programmer, room thermostat and TRVs Control code: 2106
Secondary heating system:	
Secondary heating system:	None
Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Solar panel: False
Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type E Energy Eff only

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	49.68	(1a) x	3.09	(2a) =	153.51	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.68	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	153.51	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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

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

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.95 (23c)

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

(24a)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.25	0.26	0.26	0.27	0.28	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.25	0.26	0.26	0.27	0.28	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.7	x	1	=	0.7			(26)
Doors Type 3			0.96	x	1	=	0.96			(26)
Doors Type 4			0.7	x	1	=	0.7			(26)
Doors Type 5			0.7	x	1	=	0.7			(26)
Windows Type 1			1.1		x1/[1/(1.2)+ 0.04]	=	1.26			(27)
Windows Type 2			0.19		x1/[1/(1.2)+ 0.04]	=	0.22			(27)
Windows Type 3			2.01		x1/[1/(1.2)+ 0.04]	=	2.3			(27)
Windows Type 4			1.46		x1/[1/(1.2)+ 0.04]	=	1.67			(27)
Windows Type 5			1.46		x1/[1/(1.2)+ 0.04]	=	1.67			(27)
Windows Type 6			0.99		x1/[1/(1.2)+ 0.04]	=	1.13			(27)
Windows Type 7			0.32		x1/[1/(1.2)+ 0.04]	=	0.37			(27)
Walls Type1	12.36	4.44	7.92	x	0.13	=	1.03			(29)
Walls Type2	5.87	0	5.87	x	0.13	=	0.76			(29)
Walls Type3	5.84	0	5.84	x	0.13	=	0.76			(29)
Walls Type4	2.81	0	2.81	x	0.13	=	0.37			(29)
Walls Type5	8.5	2.71	5.79	x	0.13	=	0.75			(29)
Walls Type6	8.02	2.16	5.86	x	0.13	=	0.76			(29)
Walls Type7	10.52	1.46	9.06	x	0.13	=	1.18			(29)

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Walls Type8	19.47	1.95	17.52	x	0.13	=	2.28			(29)
Roof	49.68	0	49.68	x	0.1	=	4.97			(30)
Total area of elements, m²			123.07							(31)

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

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	26.67	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	447.12	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Low	100	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		18.46	(36)

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

Total fabric heat loss	(33) + (36) =	45.13	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	14.67	14.51	14.36	13.56	13.41	12.61	12.61	12.46	12.93	13.41	13.72	14.04	(38)

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

(39)m=	59.8	59.64	59.48	58.69	58.53	57.74	57.74	57.58	58.06	58.53	58.85	59.17	

Average = Sum(39)$_{1…12}$ /12= 58.65 (39)

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

(40)m=	1.2	1.2	1.2	1.18	1.18	1.16	1.16	1.16	1.17	1.18	1.18	1.19	

Average = Sum(40)$_{1…12}$ /12= 1.18 (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 1.68 (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 74.12 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	81.53	78.56	75.6	72.63	69.67	66.7	66.7	69.67	72.63	75.6	78.56	81.53

Total = Sum(44)$_{1…12}$ = 889.39 (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=	120.9	105.74	109.12	95.13	91.28	78.77	72.99	83.76	84.76	98.78	107.82	117.09

Total = Sum(45)$_{1…12}$ = 1166.14 (45)

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

(46)m=	18.14	15.86	16.37	14.27	13.69	11.82	10.95	12.56	12.71	14.82	16.17	17.56	(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)

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Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

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

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

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

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

(61)m=	41.55	36.16	38.52	35.82	35.5	32.9	33.99	35.5	35.82	38.52	38.74	41.55	(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=	162.45	141.9	147.64	130.95	126.78	111.66	106.98	119.26	120.58	137.3	146.57	158.63	(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=	162.45	141.9	147.64	130.95	126.78	111.66	106.98	119.26	120.58	137.3	146.57	158.63

Output from water heater (annual)$_{1…12}$ — 1610.71 (64)

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

(65)m=	50.59	44.2	45.91	40.59	39.23	34.41	32.77	36.73	37.14	42.47	45.54	49.32	(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=	100.84	100.84	100.84	100.84	100.84	100.84	100.84	100.84	100.84	100.84	100.84	100.84	(66)

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

(67)m=	34.46	30.6	24.89	18.84	14.08	11.89	12.85	16.7	22.42	28.46	33.22	35.41	(67)

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

(68)m=	218.51	220.78	215.07	202.9	187.55	173.11	163.47	161.21	166.92	179.08	194.44	208.87	(68)

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

(69)m=	46.76	46.76	46.76	46.76	46.76	46.76	46.76	46.76	46.76	46.76	46.76	46.76	(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=	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	(71)

Water heating gains (Table 5)

(72)m=	67.99	65.77	61.71	56.37	52.72	47.8	44.04	49.36	51.58	57.09	63.25	66.29	(72)

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

(73)m=	404.34	400.53	385.04	361.49	337.73	316.18	303.74	310.65	324.29	348.01	374.28	393.95	(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)	
North	0.9x	0.77	x	2.01	x	10.63	x	0.4	x	0.7	=	4.15	(74)
North	0.9x	0.77	x	1.46	x	10.63	x	0.4	x	0.7	=	3.01	(74)
North	0.9x	0.77	x	1.46	x	10.63	x	0.4	x	0.7	=	3.01	(74)
North	0.9x	0.77	x	2.01	x	20.32	x	0.4	x	0.7	=	7.93	(74)
North	0.9x	0.77	x	1.46	x	20.32	x	0.4	x	0.7	=	5.76	(74)
North	0.9x	0.77	x	1.46	x	20.32	x	0.4	x	0.7	=	5.76	(74)
North	0.9x	0.77	x	2.01	x	34.53	x	0.4	x	0.7	=	13.47	(74)
North	0.9x	0.77	x	1.46	x	34.53	x	0.4	x	0.7	=	9.78	(74)
North	0.9x	0.77	x	1.46	x	34.53	x	0.4	x	0.7	=	9.78	(74)
North	0.9x	0.77	x	2.01	x	55.46	x	0.4	x	0.7	=	21.63	(74)
North	0.9x	0.77	x	1.46	x	55.46	x	0.4	x	0.7	=	15.71	(74)
North	0.9x	0.77	x	1.46	x	55.46	x	0.4	x	0.7	=	15.71	(74)
North	0.9x	0.77	x	2.01	x	74.72	x	0.4	x	0.7	=	29.14	(74)
North	0.9x	0.77	x	1.46	x	74.72	x	0.4	x	0.7	=	21.17	(74)
North	0.9x	0.77	x	1.46	x	74.72	x	0.4	x	0.7	=	21.17	(74)
North	0.9x	0.77	x	2.01	x	79.99	x	0.4	x	0.7	=	31.2	(74)
North	0.9x	0.77	x	1.46	x	79.99	x	0.4	x	0.7	=	22.66	(74)
North	0.9x	0.77	x	1.46	x	79.99	x	0.4	x	0.7	=	22.66	(74)
North	0.9x	0.77	x	2.01	x	74.68	x	0.4	x	0.7	=	29.13	(74)
North	0.9x	0.77	x	1.46	x	74.68	x	0.4	x	0.7	=	21.16	(74)
North	0.9x	0.77	x	1.46	x	74.68	x	0.4	x	0.7	=	21.16	(74)
North	0.9x	0.77	x	2.01	x	59.25	x	0.4	x	0.7	=	23.11	(74)
North	0.9x	0.77	x	1.46	x	59.25	x	0.4	x	0.7	=	16.78	(74)
North	0.9x	0.77	x	1.46	x	59.25	x	0.4	x	0.7	=	16.78	(74)
North	0.9x	0.77	x	2.01	x	41.52	x	0.4	x	0.7	=	16.19	(74)
North	0.9x	0.77	x	1.46	x	41.52	x	0.4	x	0.7	=	11.76	(74)
North	0.9x	0.77	x	1.46	x	41.52	x	0.4	x	0.7	=	11.76	(74)
North	0.9x	0.77	x	2.01	x	24.19	x	0.4	x	0.7	=	9.43	(74)
North	0.9x	0.77	x	1.46	x	24.19	x	0.4	x	0.7	=	6.85	(74)
North	0.9x	0.77	x	1.46	x	24.19	x	0.4	x	0.7	=	6.85	(74)

SAP WorkSheet: New dwelling design stage

North	0.9x	0.77	x	2.01	x	13.12	x	0.4	x	0.7	=	5.12	(74)
North	0.9x	0.77	x	1.46	x	13.12	x	0.4	x	0.7	=	3.72	(74)
North	0.9x	0.77	x	1.46	x	13.12	x	0.4	x	0.7	=	3.72	(74)
North	0.9x	0.77	x	2.01	x	8.86	x	0.4	x	0.7	=	3.46	(74)
North	0.9x	0.77	x	1.46	x	8.86	x	0.4	x	0.7	=	2.51	(74)
North	0.9x	0.77	x	1.46	x	8.86	x	0.4	x	0.7	=	2.51	(74)
East	0.9x	0.77	x	0.99	x	19.64	x	0.4	x	0.7	=	3.77	(76)
East	0.9x	0.77	x	0.99	x	38.42	x	0.4	x	0.7	=	7.38	(76)
East	0.9x	0.77	x	0.99	x	63.27	x	0.4	x	0.7	=	12.15	(76)
East	0.9x	0.77	x	0.99	x	92.28	x	0.4	x	0.7	=	17.73	(76)
East	0.9x	0.77	x	0.99	x	113.09	x	0.4	x	0.7	=	21.73	(76)
East	0.9x	0.77	x	0.99	x	115.77	x	0.4	x	0.7	=	22.24	(76)
East	0.9x	0.77	x	0.99	x	110.22	x	0.4	x	0.7	=	21.17	(76)
East	0.9x	0.77	x	0.99	x	94.68	x	0.4	x	0.7	=	18.19	(76)
East	0.9x	0.77	x	0.99	x	73.59	x	0.4	x	0.7	=	14.14	(76)
East	0.9x	0.77	x	0.99	x	45.59	x	0.4	x	0.7	=	8.76	(76)
East	0.9x	0.77	x	0.99	x	24.49	x	0.4	x	0.7	=	4.7	(76)
East	0.9x	0.77	x	0.99	x	16.15	x	0.4	x	0.7	=	3.1	(76)
South	0.9x	0.77	x	1.1	x	46.75	x	0.4	x	0.7	=	9.98	(78)
South	0.9x	0.77	x	0.19	x	46.75	x	0.4	x	0.7	=	1.72	(78)
South	0.9x	0.77	x	0.32	x	46.75	x	0.4	x	0.7	=	2.9	(78)
South	0.9x	0.77	x	1.1	x	76.57	x	0.4	x	0.7	=	16.34	(78)
South	0.9x	0.77	x	0.19	x	76.57	x	0.4	x	0.7	=	2.82	(78)
South	0.9x	0.77	x	0.32	x	76.57	x	0.4	x	0.7	=	4.75	(78)
South	0.9x	0.77	x	1.1	x	97.53	x	0.4	x	0.7	=	20.82	(78)
South	0.9x	0.77	x	0.19	x	97.53	x	0.4	x	0.7	=	3.6	(78)
South	0.9x	0.77	x	0.32	x	97.53	x	0.4	x	0.7	=	6.06	(78)
South	0.9x	0.77	x	1.1	x	110.23	x	0.4	x	0.7	=	23.53	(78)
South	0.9x	0.77	x	0.19	x	110.23	x	0.4	x	0.7	=	4.06	(78)
South	0.9x	0.77	x	0.32	x	110.23	x	0.4	x	0.7	=	6.84	(78)
South	0.9x	0.77	x	1.1	x	114.87	x	0.4	x	0.7	=	24.52	(78)
South	0.9x	0.77	x	0.19	x	114.87	x	0.4	x	0.7	=	4.24	(78)
South	0.9x	0.77	x	0.32	x	114.87	x	0.4	x	0.7	=	7.13	(78)
South	0.9x	0.77	x	1.1	x	110.55	x	0.4	x	0.7	=	23.6	(78)
South	0.9x	0.77	x	0.19	x	110.55	x	0.4	x	0.7	=	4.08	(78)
South	0.9x	0.77	x	0.32	x	110.55	x	0.4	x	0.7	=	6.86	(78)
South	0.9x	0.77	x	1.1	x	108.01	x	0.4	x	0.7	=	23.05	(78)
South	0.9x	0.77	x	0.19	x	108.01	x	0.4	x	0.7	=	3.98	(78)
South	0.9x	0.77	x	0.32	x	108.01	x	0.4	x	0.7	=	6.71	(78)
South	0.9x	0.77	x	1.1	x	104.89	x	0.4	x	0.7	=	22.39	(78)
South	0.9x	0.77	x	0.19	x	104.89	x	0.4	x	0.7	=	3.87	(78)

South	0.9x	0.77	x	0.32	x	104.89	x	0.4	x	0.7	=	6.51	(78)
South	0.9x	0.77	x	1.1	x	101.89	x	0.4	x	0.7	=	21.75	(78)
South	0.9x	0.77	x	0.19	x	101.89	x	0.4	x	0.7	=	3.76	(78)
South	0.9x	0.77	x	0.32	x	101.89	x	0.4	x	0.7	=	6.33	(78)
South	0.9x	0.77	x	1.1	x	82.59	x	0.4	x	0.7	=	17.63	(78)
South	0.9x	0.77	x	0.19	x	82.59	x	0.4	x	0.7	=	3.04	(78)
South	0.9x	0.77	x	0.32	x	82.59	x	0.4	x	0.7	=	5.13	(78)
South	0.9x	0.77	x	1.1	x	55.42	x	0.4	x	0.7	=	11.83	(78)
South	0.9x	0.77	x	0.19	x	55.42	x	0.4	x	0.7	=	2.04	(78)
South	0.9x	0.77	x	0.32	x	55.42	x	0.4	x	0.7	=	3.44	(78)
South	0.9x	0.77	x	1.1	x	40.4	x	0.4	x	0.7	=	8.62	(78)
South	0.9x	0.77	x	0.19	x	40.4	x	0.4	x	0.7	=	1.49	(78)
South	0.9x	0.77	x	0.32	x	40.4	x	0.4	x	0.7	=	2.51	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	28.55	50.74	75.66	105.22	129.09	133.29	126.35	107.63	85.68	57.7	34.57	24.2	(83)

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

(84)m=	432.89	451.27	460.7	466.71	466.82	449.47	430.09	418.28	409.97	405.71	408.85	418.15	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.93	0.92	0.89	0.85	0.77	0.65	0.52	0.55	0.71	0.85	0.91	0.93	(86)

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

(87)m=	18.89	19.07	19.41	19.88	20.35	20.72	20.89	20.87	20.61	20.06	19.41	18.86	(87)

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

(88)m=	19.92	19.92	19.92	19.93	19.94	19.95	19.95	19.95	19.95	19.94	19.93	19.93	(88)

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

(89)m=	0.92	0.9	0.88	0.83	0.73	0.58	0.42	0.45	0.65	0.82	0.89	0.92	(89)

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

(90)m=	18.02	18.2	18.53	19	19.44	19.77	19.9	19.89	19.68	19.17	18.55	18	(90)

fLA = Living area ÷ (4) = 0.48 (91)

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

(92)m=	18.44	18.62	18.95	19.43	19.88	20.23	20.38	20.36	20.13	19.6	18.97	18.42	(92)

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

(93)m=	18.44	18.62	18.95	19.43	19.88	20.23	20.38	20.36	20.13	19.6	18.97	18.42	(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=	0.9	0.89	0.86	0.81	0.73	0.6	0.46	0.49	0.66	0.81	0.88	0.91	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	390.32	400.53	396.9	378.89	340.29	268.68	197.89	203.99	271.53	327.16	358.38	379.68	(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=	845.84	818.19	740.77	617.94	478.62	325.17	218.15	228.22	350.32	526.76	698.26	841.06	(97)

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

(98)m=	338.91	280.66	255.84	172.12	102.92	0	0	0	0	148.5	244.71	343.26

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1886.92 (98)

Space heating requirement in kWh/m²/year 37.98 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.4 (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	338.91	280.66	255.84	172.12	102.92	0	0	0	0	148.5	244.71	343.26	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)	374.9	310.47	283.01	190.4	113.85	0	0	0	0	164.27	270.7	379.72	

Total (kWh/year) =$Sum(211)_{1...5,10...12}$= 2087.3 (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)

	162.45	141.9	147.64	130.95	126.78	111.66	106.98	119.26	120.58	137.3	146.57	158.63	

Efficiency of water heater 80.3 (216)

(217)m=	86.86	86.74	86.42	85.74	84.53	80.3	80.3	80.3	80.3	85.25	86.33	86.94	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	187.02	163.6	170.84	152.73	149.98	139.06	133.23	148.52	150.16	161.06	169.77	182.46

Total = $Sum(219a)_{1...12}$ = 1908.42 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2087.3	
Water heating fuel used		1908.42	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	215		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)

Total electricity for the above, kWh/year	sum of (230a)…(230g) =	290	(231)
Electricity for lighting		243.4	(232)

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 =	72.64	(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 =	66.41	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	38.25	(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 =	32.1	(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) =	329.41	(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] =	1.46	(257)
SAP rating (Section 12)		79.62	(258)

12a. CO_2 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	=	450.86	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	412.22	(264)
Space and water heating	(261) + (262) + (263) + (264) =			863.08	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	150.51	(267)
Electricity for lighting	(232) x	0.519	=	126.33	(268)
Total CO2, kg/year		sum of (265)…(271) =		1139.91	(272)
CO2 emissions per m²		(272) ÷ (4) =		22.95	(273)
EI 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	=	2546.51	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)

Energy for water heating	(219) x	1.22	=	2328.28	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4874.79	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	890.31	(267)
Electricity for lighting	(232) x	0	=	747.25	(268)
'Total Primary Energy	sum of (265)…(271) =			6512.34	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			131.09	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type E Energy Eff only

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.68	(1a)	x	3.09	(2a)	=	153.51	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.68	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			153.51	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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

DER WorkSheet: New dwelling design stage

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

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.95 (23c)

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

(24a)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.25	0.26	0.26	0.27	0.28	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.25	0.26	0.26	0.27	0.28	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.7	x	1	=	0.7			(26)
Doors Type 3			0.96	x	1	=	0.96			(26)
Doors Type 4			0.7	x	1	=	0.7			(26)
Doors Type 5			0.7	x	1	=	0.7			(26)
Windows Type 1			1.1		x1/[1/(1.2)+ 0.04]	=	1.26			(27)
Windows Type 2			0.19		x1/[1/(1.2)+ 0.04]	=	0.22			(27)
Windows Type 3			2.01		x1/[1/(1.2)+ 0.04]	=	2.3			(27)
Windows Type 4			1.46		x1/[1/(1.2)+ 0.04]	=	1.67			(27)
Windows Type 5			1.46		x1/[1/(1.2)+ 0.04]	=	1.67			(27)
Windows Type 6			0.99		x1/[1/(1.2)+ 0.04]	=	1.13			(27)
Windows Type 7			0.32		x1/[1/(1.2)+ 0.04]	=	0.37			(27)
Walls Type1	12.36	4.44	7.92	x	0.13	=	1.03			(29)
Walls Type2	5.87	0	5.87	x	0.13	=	0.76			(29)
Walls Type3	5.84	0	5.84	x	0.13	=	0.76			(29)
Walls Type4	2.81	0	2.81	x	0.13	=	0.37			(29)
Walls Type5	8.5	2.71	5.79	x	0.13	=	0.75			(29)
Walls Type6	8.02	2.16	5.86	x	0.13	=	0.76			(29)
Walls Type7	10.52	1.46	9.06	x	0.13	=	1.18			(29)

DER WorkSheet: New dwelling design stage

Walls Type8	19.47	1.95	17.52	x	0.13	=	2.28			(29)
Roof	49.68	0	49.68	x	0.1	=	4.97			(30)
Total area of elements, m²			123.07							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	26.67	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	447.12	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Low	100	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		18.46	(36)

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

Total fabric heat loss	(33) + (36) =	45.13	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	14.67	14.51	14.36	13.56	13.41	12.61	12.61	12.46	12.93	13.41	13.72	14.04	(38)

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

(39)m=	59.8	59.64	59.48	58.69	58.53	57.74	57.74	57.58	58.06	58.53	58.85	59.17	

Average = Sum(39)$_{1…12}$ /12= 58.65 (39)

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

(40)m=	1.2	1.2	1.2	1.18	1.18	1.16	1.16	1.16	1.17	1.18	1.18	1.19	

Average = Sum(40)$_{1…12}$ /12= 1.18 (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 1.68 (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 74.12 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	81.53	78.56	75.6	72.63	69.67	66.7	66.7	69.67	72.63	75.6	78.56	81.53	

Total = Sum(44)$_{1…12}$ = 889.39 (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=	120.9	105.74	109.12	95.13	91.28	78.77	72.99	83.76	84.76	98.78	107.82	117.09	

Total = Sum(45)$_{1…12}$ = 1166.14 (45)

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

(46)m=	18.14	15.86	16.37	14.27	13.69	11.82	10.95	12.56	12.71	14.82	16.17	17.56	(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)

DER WorkSheet: New dwelling design stage

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

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

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

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

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

(61)m=	41.55	36.16	38.52	35.82	35.5	32.9	33.99	35.5	35.82	38.52	38.74	41.55	(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=	162.45	141.9	147.64	130.95	126.78	111.66	106.98	119.26	120.58	137.3	146.57	158.63	(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=	162.45	141.9	147.64	130.95	126.78	111.66	106.98	119.26	120.58	137.3	146.57	158.63

Output from water heater (annual)$_{1...12}$ — 1610.71 (64)

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

(65)m=	50.59	44.2	45.91	40.59	39.23	34.41	32.77	36.73	37.14	42.47	45.54	49.32	(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=	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	(66)

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

(67)m=	13.78	12.24	9.96	7.54	5.63	4.76	5.14	6.68	8.97	11.39	13.29	14.17	(67)

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

(68)m=	146.4	147.92	144.09	135.94	125.66	115.99	109.53	108.01	111.84	119.99	130.27	139.94	(68)

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

(69)m=	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	(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=	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	(71)

Water heating gains (Table 5)

(72)m=	67.99	65.77	61.71	56.37	52.72	47.8	44.04	49.36	51.58	57.09	63.25	66.29	(72)

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

(73)m=	279.39	277.15	266.97	251.06	235.22	219.75	209.92	215.26	223.59	239.67	258.02	271.61	(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)	
North	0.9x	0.77	x	2.01	x	10.63	x	0.4	x	0.7	=	4.15	(74)
North	0.9x	0.77	x	1.46	x	10.63	x	0.4	x	0.7	=	3.01	(74)
North	0.9x	0.77	x	1.46	x	10.63	x	0.4	x	0.7	=	3.01	(74)
North	0.9x	0.77	x	2.01	x	20.32	x	0.4	x	0.7	=	7.93	(74)
North	0.9x	0.77	x	1.46	x	20.32	x	0.4	x	0.7	=	5.76	(74)
North	0.9x	0.77	x	1.46	x	20.32	x	0.4	x	0.7	=	5.76	(74)
North	0.9x	0.77	x	2.01	x	34.53	x	0.4	x	0.7	=	13.47	(74)
North	0.9x	0.77	x	1.46	x	34.53	x	0.4	x	0.7	=	9.78	(74)
North	0.9x	0.77	x	1.46	x	34.53	x	0.4	x	0.7	=	9.78	(74)
North	0.9x	0.77	x	2.01	x	55.46	x	0.4	x	0.7	=	21.63	(74)
North	0.9x	0.77	x	1.46	x	55.46	x	0.4	x	0.7	=	15.71	(74)
North	0.9x	0.77	x	1.46	x	55.46	x	0.4	x	0.7	=	15.71	(74)
North	0.9x	0.77	x	2.01	x	74.72	x	0.4	x	0.7	=	29.14	(74)
North	0.9x	0.77	x	1.46	x	74.72	x	0.4	x	0.7	=	21.17	(74)
North	0.9x	0.77	x	1.46	x	74.72	x	0.4	x	0.7	=	21.17	(74)
North	0.9x	0.77	x	2.01	x	79.99	x	0.4	x	0.7	=	31.2	(74)
North	0.9x	0.77	x	1.46	x	79.99	x	0.4	x	0.7	=	22.66	(74)
North	0.9x	0.77	x	1.46	x	79.99	x	0.4	x	0.7	=	22.66	(74)
North	0.9x	0.77	x	2.01	x	74.68	x	0.4	x	0.7	=	29.13	(74)
North	0.9x	0.77	x	1.46	x	74.68	x	0.4	x	0.7	=	21.16	(74)
North	0.9x	0.77	x	1.46	x	74.68	x	0.4	x	0.7	=	21.16	(74)
North	0.9x	0.77	x	2.01	x	59.25	x	0.4	x	0.7	=	23.11	(74)
North	0.9x	0.77	x	1.46	x	59.25	x	0.4	x	0.7	=	16.78	(74)
North	0.9x	0.77	x	1.46	x	59.25	x	0.4	x	0.7	=	16.78	(74)
North	0.9x	0.77	x	2.01	x	41.52	x	0.4	x	0.7	=	16.19	(74)
North	0.9x	0.77	x	1.46	x	41.52	x	0.4	x	0.7	=	11.76	(74)
North	0.9x	0.77	x	1.46	x	41.52	x	0.4	x	0.7	=	11.76	(74)
North	0.9x	0.77	x	2.01	x	24.19	x	0.4	x	0.7	=	9.43	(74)
North	0.9x	0.77	x	1.46	x	24.19	x	0.4	x	0.7	=	6.85	(74)
North	0.9x	0.77	x	1.46	x	24.19	x	0.4	x	0.7	=	6.85	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	2.01	x	13.12	x	0.4	x	0.7	=	5.12	(74)
North	0.9x	0.77	x	1.46	x	13.12	x	0.4	x	0.7	=	3.72	(74)
North	0.9x	0.77	x	1.46	x	13.12	x	0.4	x	0.7	=	3.72	(74)
North	0.9x	0.77	x	2.01	x	8.86	x	0.4	x	0.7	=	3.46	(74)
North	0.9x	0.77	x	1.46	x	8.86	x	0.4	x	0.7	=	2.51	(74)
North	0.9x	0.77	x	1.46	x	8.86	x	0.4	x	0.7	=	2.51	(74)
East	0.9x	0.77	x	0.99	x	19.64	x	0.4	x	0.7	=	3.77	(76)
East	0.9x	0.77	x	0.99	x	38.42	x	0.4	x	0.7	=	7.38	(76)
East	0.9x	0.77	x	0.99	x	63.27	x	0.4	x	0.7	=	12.15	(76)
East	0.9x	0.77	x	0.99	x	92.28	x	0.4	x	0.7	=	17.73	(76)
East	0.9x	0.77	x	0.99	x	113.09	x	0.4	x	0.7	=	21.73	(76)
East	0.9x	0.77	x	0.99	x	115.77	x	0.4	x	0.7	=	22.24	(76)
East	0.9x	0.77	x	0.99	x	110.22	x	0.4	x	0.7	=	21.17	(76)
East	0.9x	0.77	x	0.99	x	94.68	x	0.4	x	0.7	=	18.19	(76)
East	0.9x	0.77	x	0.99	x	73.59	x	0.4	x	0.7	=	14.14	(76)
East	0.9x	0.77	x	0.99	x	45.59	x	0.4	x	0.7	=	8.76	(76)
East	0.9x	0.77	x	0.99	x	24.49	x	0.4	x	0.7	=	4.7	(76)
East	0.9x	0.77	x	0.99	x	16.15	x	0.4	x	0.7	=	3.1	(76)
South	0.9x	0.77	x	1.1	x	46.75	x	0.4	x	0.7	=	9.98	(78)
South	0.9x	0.77	x	0.19	x	46.75	x	0.4	x	0.7	=	1.72	(78)
South	0.9x	0.77	x	0.32	x	46.75	x	0.4	x	0.7	=	2.9	(78)
South	0.9x	0.77	x	1.1	x	76.57	x	0.4	x	0.7	=	16.34	(78)
South	0.9x	0.77	x	0.19	x	76.57	x	0.4	x	0.7	=	2.82	(78)
South	0.9x	0.77	x	0.32	x	76.57	x	0.4	x	0.7	=	4.75	(78)
South	0.9x	0.77	x	1.1	x	97.53	x	0.4	x	0.7	=	20.82	(78)
South	0.9x	0.77	x	0.19	x	97.53	x	0.4	x	0.7	=	3.6	(78)
South	0.9x	0.77	x	0.32	x	97.53	x	0.4	x	0.7	=	6.06	(78)
South	0.9x	0.77	x	1.1	x	110.23	x	0.4	x	0.7	=	23.53	(78)
South	0.9x	0.77	x	0.19	x	110.23	x	0.4	x	0.7	=	4.06	(78)
South	0.9x	0.77	x	0.32	x	110.23	x	0.4	x	0.7	=	6.84	(78)
South	0.9x	0.77	x	1.1	x	114.87	x	0.4	x	0.7	=	24.52	(78)
South	0.9x	0.77	x	0.19	x	114.87	x	0.4	x	0.7	=	4.24	(78)
South	0.9x	0.77	x	0.32	x	114.87	x	0.4	x	0.7	=	7.13	(78)
South	0.9x	0.77	x	1.1	x	110.55	x	0.4	x	0.7	=	23.6	(78)
South	0.9x	0.77	x	0.19	x	110.55	x	0.4	x	0.7	=	4.08	(78)
South	0.9x	0.77	x	0.32	x	110.55	x	0.4	x	0.7	=	6.86	(78)
South	0.9x	0.77	x	1.1	x	108.01	x	0.4	x	0.7	=	23.05	(78)
South	0.9x	0.77	x	0.19	x	108.01	x	0.4	x	0.7	=	3.98	(78)
South	0.9x	0.77	x	0.32	x	108.01	x	0.4	x	0.7	=	6.71	(78)
South	0.9x	0.77	x	1.1	x	104.89	x	0.4	x	0.7	=	22.39	(78)
South	0.9x	0.77	x	0.19	x	104.89	x	0.4	x	0.7	=	3.87	(78)

South	0.9x	0.77	x	0.32	x	104.89	x	0.4	x	0.7	=	6.51	(78)
South	0.9x	0.77	x	1.1	x	101.89	x	0.4	x	0.7	=	21.75	(78)
South	0.9x	0.77	x	0.19	x	101.89	x	0.4	x	0.7	=	3.76	(78)
South	0.9x	0.77	x	0.32	x	101.89	x	0.4	x	0.7	=	6.33	(78)
South	0.9x	0.77	x	1.1	x	82.59	x	0.4	x	0.7	=	17.63	(78)
South	0.9x	0.77	x	0.19	x	82.59	x	0.4	x	0.7	=	3.04	(78)
South	0.9x	0.77	x	0.32	x	82.59	x	0.4	x	0.7	=	5.13	(78)
South	0.9x	0.77	x	1.1	x	55.42	x	0.4	x	0.7	=	11.83	(78)
South	0.9x	0.77	x	0.19	x	55.42	x	0.4	x	0.7	=	2.04	(78)
South	0.9x	0.77	x	0.32	x	55.42	x	0.4	x	0.7	=	3.44	(78)
South	0.9x	0.77	x	1.1	x	40.4	x	0.4	x	0.7	=	8.62	(78)
South	0.9x	0.77	x	0.19	x	40.4	x	0.4	x	0.7	=	1.49	(78)
South	0.9x	0.77	x	0.32	x	40.4	x	0.4	x	0.7	=	2.51	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	28.55	50.74	75.66	105.22	129.09	133.29	126.35	107.63	85.68	57.7	34.57	24.2	(83)

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

(84)m=	307.94	327.89	342.63	356.28	364.31	353.04	336.27	322.89	309.27	297.37	292.58	295.81	(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=	0.96	0.96	0.94	0.91	0.85	0.74	0.61	0.65	0.81	0.91	0.95	0.97	(86)

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

(87)m=	18.52	18.71	19.09	19.62	20.16	20.61	20.83	20.8	20.46	19.8	19.08	18.49	(87)

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

(88)m=	19.92	19.92	19.92	19.93	19.94	19.95	19.95	19.95	19.95	19.94	19.93	19.93	(88)

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

(89)m=	0.96	0.95	0.93	0.89	0.81	0.67	0.51	0.55	0.75	0.89	0.94	0.96	(89)

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

(90)m=	17.66	17.85	18.23	18.76	19.27	19.69	19.87	19.85	19.57	18.94	18.23	17.64	(90)

fLA = Living area ÷ (4) = 0.48 (91)

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

(92)m=	18.08	18.27	18.64	19.18	19.7	20.14	20.33	20.31	20	19.35	18.64	18.05	(92)

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

(93)m=	18.08	18.27	18.64	19.18	19.7	20.14	20.33	20.31	20	19.35	18.64	18.05	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.95	0.94	0.92	0.87	0.8	0.69	0.55	0.58	0.76	0.88	0.93	0.95	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	291.58	306.83	313.61	311.74	292.71	241.86	184.99	188.4	234.03	261.42	272.35	281.43	(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, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	823.98	797.42	722.3	603.2	468.38	319.72	215.64	225.17	342.46	512.36	679.33	819.48	(97)

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

(98)m=	396.1	329.68	304.06	209.85	130.7	0	0	0	0	186.7	293.02	400.31	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2250.43 (98)

Space heating requirement in kWh/m²/year 45.3 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	396.1	329.68	304.06	209.85	130.7	0	0	0	0	186.7	293.02	400.31		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	438.17	364.69	336.35	232.14	144.58	0	0	0	0	206.52	324.14	442.82		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2489.41	(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)	162.45	141.9	147.64	130.95	126.78	111.66	106.98	119.26	120.58	137.3	146.57	158.63		
Efficiency of water heater													80.3	(216)
(217)m=	87.21	87.1	86.83	86.23	85.13	80.3	80.3	80.3	80.3	85.83	86.76	87.28		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	186.27	162.91	170.03	151.86	148.93	139.06	133.23	148.52	150.16	159.98	168.93	181.74		
Total = Sum(219a)$_{1...12}$ =													1901.63	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2489.41	
Water heating fuel used		1901.63	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	215		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)

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Total electricity for the above, kWh/year	sum of (230a)…(230g) =	290	(231)
Electricity for lighting		243.4	(232)

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	=	537.71	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	410.75	(264)
Space and water heating	(261) + (262) + (263) + (264) =				948.46	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	150.51	(267)
Electricity for lighting	(232)	x	0.519	=	126.33	(268)
Total CO2, kg/year			sum of (265)…(271) =		1225.3	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		24.66	(273)
EI rating (section 14)					83	(274)

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User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type E Energy Eff only

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	49.68	(1a) x	3.09	(2a) =	153.51	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.68	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	153.51	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =	0.13	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.38	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.48	0.48	0.47	0.42	0.41	0.36	0.36	0.35	0.38	0.41	0.43	0.45

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6	(24d)

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

(25)m=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.7	x	1	=	0.7			(26)
Doors Type 3			0.96	x	1	=	0.96			(26)
Doors Type 4			0.7	x	1	=	0.7			(26)
Doors Type 5			0.7	x	1	=	0.7			(26)
Windows Type 1			1.06	x1/[1/(1.4)+ 0.04]		=	1.41			(27)
Windows Type 2			0.18	x1/[1/(1.4)+ 0.04]		=	0.24			(27)
Windows Type 3			1.93	x1/[1/(1.4)+ 0.04]		=	2.56			(27)
Windows Type 4			1.4	x1/[1/(1.4)+ 0.04]		=	1.86			(27)
Windows Type 5			1.4	x1/[1/(1.4)+ 0.04]		=	1.86			(27)
Windows Type 6			0.95	x1/[1/(1.4)+ 0.04]		=	1.26			(27)
Windows Type 7			0.31	x1/[1/(1.4)+ 0.04]		=	0.41			(27)
Walls Type1	12.36	4.38	7.98	x	0.18	=	1.44			(29)
Walls Type2	5.87	0	5.87	x	0.18	=	1.06			(29)
Walls Type3	5.84	0	5.84	x	0.18	=	1.05			(29)
Walls Type4	2.81	0	2.81	x	0.18	=	0.51			(29)
Walls Type5	8.5	2.63	5.87	x	0.18	=	1.06			(29)
Walls Type6	8.02	2.1	5.92	x	0.18	=	1.07			(29)
Walls Type7	10.52	1.4	9.12	x	0.18	=	1.64			(29)

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Walls Type8	19.47	1.91	17.56	x	0.18	=	3.16			(29)
Roof	49.68	0	49.68	x	0.13	=	6.46			(30)
Total area of elements, m²			123.07							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 32.21 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 447.12 (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 6.15 (36)

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

Total fabric heat loss (33) + (36) = 38.36 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	31.28	31.05	30.83	29.76	29.56	28.64	28.64	28.46	28.99	29.56	29.97	30.39	(38)

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

(39)m=	69.65	69.41	69.19	68.12	67.92	67	67	66.82	67.35	67.92	68.33	68.75	

Average = Sum(39)$_{1…12}$ /12= 68.12 (39)

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

(40)m=	1.4	1.4	1.39	1.37	1.37	1.35	1.35	1.35	1.36	1.37	1.38	1.38

Average = Sum(40)$_{1…12}$ /12= 1.37 (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 1.68 (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 74.12 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	81.53	78.56	75.6	72.63	69.67	66.7	66.7	69.67	72.63	75.6	78.56	81.53

Total = Sum(44)$_{1…12}$ = 889.39 (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=	120.9	105.74	109.12	95.13	91.28	78.77	72.99	83.76	84.76	98.78	107.82	117.09

Total = Sum(45)$_{1…12}$ = 1166.14 (45)

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

(46)m=	18.14	15.86	16.37	14.27	13.69	11.82	10.95	12.56	12.71	14.82	16.17	17.56	(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)

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Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

(61)m=	41.55	36.16	38.52	35.82	35.5	32.9	33.99	35.5	35.82	38.52	38.74	41.55	(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=	162.45	141.9	147.64	130.95	126.78	111.66	106.98	119.26	120.58	137.3	146.57	158.63	(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=	162.45	141.9	147.64	130.95	126.78	111.66	106.98	119.26	120.58	137.3	146.57	158.63

Output from water heater (annual)$_{1...12}$ 1610.71 (64)

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

(65)m=	50.59	44.2	45.91	40.59	39.23	34.41	32.77	36.73	37.14	42.47	45.54	49.32	(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=	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	(66)

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

(67)m=	13.89	12.33	10.03	7.59	5.68	4.79	5.18	6.73	9.03	11.47	13.39	14.27	(67)

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

(68)m=	146.4	147.92	144.09	135.94	125.66	115.99	109.53	108.01	111.84	119.99	130.27	139.94	(68)

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

(69)m=	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	(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=	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	(71)

Water heating gains (Table 5)

(72)m=	67.99	65.77	61.71	56.37	52.72	47.8	44.04	49.36	51.58	57.09	63.25	66.29	(72)

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

(73)m=	279.49	277.24	267.04	251.12	235.27	219.79	209.96	215.31	223.66	239.76	258.12	271.71	(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)	
North	0.9x	0.77	x	1.93	x	10.63	x	0.63	x	0.7	=	6.27	(74)
North	0.9x	0.77	x	1.4	x	10.63	x	0.63	x	0.7	=	4.55	(74)
North	0.9x	0.77	x	1.4	x	10.63	x	0.63	x	0.7	=	4.55	(74)
North	0.9x	0.77	x	1.93	x	20.32	x	0.63	x	0.7	=	11.99	(74)
North	0.9x	0.77	x	1.4	x	20.32	x	0.63	x	0.7	=	8.69	(74)
North	0.9x	0.77	x	1.4	x	20.32	x	0.63	x	0.7	=	8.69	(74)
North	0.9x	0.77	x	1.93	x	34.53	x	0.63	x	0.7	=	20.37	(74)
North	0.9x	0.77	x	1.4	x	34.53	x	0.63	x	0.7	=	14.77	(74)
North	0.9x	0.77	x	1.4	x	34.53	x	0.63	x	0.7	=	14.77	(74)
North	0.9x	0.77	x	1.93	x	55.46	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	1.4	x	55.46	x	0.63	x	0.7	=	23.73	(74)
North	0.9x	0.77	x	1.4	x	55.46	x	0.63	x	0.7	=	23.73	(74)
North	0.9x	0.77	x	1.93	x	74.72	x	0.63	x	0.7	=	44.07	(74)
North	0.9x	0.77	x	1.4	x	74.72	x	0.63	x	0.7	=	31.97	(74)
North	0.9x	0.77	x	1.4	x	74.72	x	0.63	x	0.7	=	31.97	(74)
North	0.9x	0.77	x	1.93	x	79.99	x	0.63	x	0.7	=	47.18	(74)
North	0.9x	0.77	x	1.4	x	79.99	x	0.63	x	0.7	=	34.22	(74)
North	0.9x	0.77	x	1.4	x	79.99	x	0.63	x	0.7	=	34.22	(74)
North	0.9x	0.77	x	1.93	x	74.68	x	0.63	x	0.7	=	44.05	(74)
North	0.9x	0.77	x	1.4	x	74.68	x	0.63	x	0.7	=	31.95	(74)
North	0.9x	0.77	x	1.4	x	74.68	x	0.63	x	0.7	=	31.95	(74)
North	0.9x	0.77	x	1.93	x	59.25	x	0.63	x	0.7	=	34.95	(74)
North	0.9x	0.77	x	1.4	x	59.25	x	0.63	x	0.7	=	25.35	(74)
North	0.9x	0.77	x	1.4	x	59.25	x	0.63	x	0.7	=	25.35	(74)
North	0.9x	0.77	x	1.93	x	41.52	x	0.63	x	0.7	=	24.49	(74)
North	0.9x	0.77	x	1.4	x	41.52	x	0.63	x	0.7	=	17.76	(74)
North	0.9x	0.77	x	1.4	x	41.52	x	0.63	x	0.7	=	17.76	(74)
North	0.9x	0.77	x	1.93	x	24.19	x	0.63	x	0.7	=	14.27	(74)
North	0.9x	0.77	x	1.4	x	24.19	x	0.63	x	0.7	=	10.35	(74)
North	0.9x	0.77	x	1.4	x	24.19	x	0.63	x	0.7	=	10.35	(74)

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North	0.9x	0.77	x	1.93	x	13.12	x	0.63	x	0.7	=	7.74	(74)
North	0.9x	0.77	x	1.4	x	13.12	x	0.63	x	0.7	=	5.61	(74)
North	0.9x	0.77	x	1.4	x	13.12	x	0.63	x	0.7	=	5.61	(74)
North	0.9x	0.77	x	1.93	x	8.86	x	0.63	x	0.7	=	5.23	(74)
North	0.9x	0.77	x	1.4	x	8.86	x	0.63	x	0.7	=	3.79	(74)
North	0.9x	0.77	x	1.4	x	8.86	x	0.63	x	0.7	=	3.79	(74)
East	0.9x	0.77	x	0.95	x	19.64	x	0.63	x	0.7	=	5.7	(76)
East	0.9x	0.77	x	0.95	x	38.42	x	0.63	x	0.7	=	11.15	(76)
East	0.9x	0.77	x	0.95	x	63.27	x	0.63	x	0.7	=	18.37	(76)
East	0.9x	0.77	x	0.95	x	92.28	x	0.63	x	0.7	=	26.79	(76)
East	0.9x	0.77	x	0.95	x	113.09	x	0.63	x	0.7	=	32.83	(76)
East	0.9x	0.77	x	0.95	x	115.77	x	0.63	x	0.7	=	33.61	(76)
East	0.9x	0.77	x	0.95	x	110.22	x	0.63	x	0.7	=	32	(76)
East	0.9x	0.77	x	0.95	x	94.68	x	0.63	x	0.7	=	27.49	(76)
East	0.9x	0.77	x	0.95	x	73.59	x	0.63	x	0.7	=	21.37	(76)
East	0.9x	0.77	x	0.95	x	45.59	x	0.63	x	0.7	=	13.24	(76)
East	0.9x	0.77	x	0.95	x	24.49	x	0.63	x	0.7	=	7.11	(76)
East	0.9x	0.77	x	0.95	x	16.15	x	0.63	x	0.7	=	4.69	(76)
South	0.9x	0.77	x	1.06	x	46.75	x	0.63	x	0.7	=	15.15	(78)
South	0.9x	0.77	x	0.18	x	46.75	x	0.63	x	0.7	=	2.57	(78)
South	0.9x	0.77	x	0.31	x	46.75	x	0.63	x	0.7	=	4.43	(78)
South	0.9x	0.77	x	1.06	x	76.57	x	0.63	x	0.7	=	24.8	(78)
South	0.9x	0.77	x	0.18	x	76.57	x	0.63	x	0.7	=	4.21	(78)
South	0.9x	0.77	x	0.31	x	76.57	x	0.63	x	0.7	=	7.25	(78)
South	0.9x	0.77	x	1.06	x	97.53	x	0.63	x	0.7	=	31.6	(78)
South	0.9x	0.77	x	0.18	x	97.53	x	0.63	x	0.7	=	5.37	(78)
South	0.9x	0.77	x	0.31	x	97.53	x	0.63	x	0.7	=	9.24	(78)
South	0.9x	0.77	x	1.06	x	110.23	x	0.63	x	0.7	=	35.71	(78)
South	0.9x	0.77	x	0.18	x	110.23	x	0.63	x	0.7	=	6.06	(78)
South	0.9x	0.77	x	0.31	x	110.23	x	0.63	x	0.7	=	10.44	(78)
South	0.9x	0.77	x	1.06	x	114.87	x	0.63	x	0.7	=	37.21	(78)
South	0.9x	0.77	x	0.18	x	114.87	x	0.63	x	0.7	=	6.32	(78)
South	0.9x	0.77	x	0.31	x	114.87	x	0.63	x	0.7	=	10.88	(78)
South	0.9x	0.77	x	1.06	x	110.55	x	0.63	x	0.7	=	35.81	(78)
South	0.9x	0.77	x	0.18	x	110.55	x	0.63	x	0.7	=	6.08	(78)
South	0.9x	0.77	x	0.31	x	110.55	x	0.63	x	0.7	=	10.47	(78)
South	0.9x	0.77	x	1.06	x	108.01	x	0.63	x	0.7	=	34.99	(78)
South	0.9x	0.77	x	0.18	x	108.01	x	0.63	x	0.7	=	5.94	(78)
South	0.9x	0.77	x	0.31	x	108.01	x	0.63	x	0.7	=	10.23	(78)
South	0.9x	0.77	x	1.06	x	104.89	x	0.63	x	0.7	=	33.98	(78)
South	0.9x	0.77	x	0.18	x	104.89	x	0.63	x	0.7	=	5.77	(78)

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South	0.9x	0.77	x	0.31	x	104.89	x	0.63	x	0.7	=	9.94	(78)
South	0.9x	0.77	x	1.06	x	101.89	x	0.63	x	0.7	=	33.01	(78)
South	0.9x	0.77	x	0.18	x	101.89	x	0.63	x	0.7	=	5.6	(78)
South	0.9x	0.77	x	0.31	x	101.89	x	0.63	x	0.7	=	9.65	(78)
South	0.9x	0.77	x	1.06	x	82.59	x	0.63	x	0.7	=	26.75	(78)
South	0.9x	0.77	x	0.18	x	82.59	x	0.63	x	0.7	=	4.54	(78)
South	0.9x	0.77	x	0.31	x	82.59	x	0.63	x	0.7	=	7.82	(78)
South	0.9x	0.77	x	1.06	x	55.42	x	0.63	x	0.7	=	17.95	(78)
South	0.9x	0.77	x	0.18	x	55.42	x	0.63	x	0.7	=	3.05	(78)
South	0.9x	0.77	x	0.31	x	55.42	x	0.63	x	0.7	=	5.25	(78)
South	0.9x	0.77	x	1.06	x	40.4	x	0.63	x	0.7	=	13.09	(78)
South	0.9x	0.77	x	0.18	x	40.4	x	0.63	x	0.7	=	2.22	(78)
South	0.9x	0.77	x	0.31	x	40.4	x	0.63	x	0.7	=	3.83	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	43.22	76.8	114.49	159.19	195.25	201.6	191.11	162.82	129.64	87.32	52.32	36.64	(83)

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

(84)m=	322.71	354.04	381.53	410.3	430.52	421.39	401.07	378.13	353.3	327.08	310.44	308.35	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.82	0.67	0.72	0.91	0.98	0.99	1	(86)

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

(87)m=	19.48	19.62	19.87	20.23	20.58	20.85	20.96	20.94	20.74	20.3	19.84	19.46	(87)

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

(88)m=	19.76	19.77	19.77	19.79	19.79	19.8	19.8	19.81	19.8	19.79	19.78	19.78	(88)

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

(89)m=	1	0.99	0.99	0.97	0.9	0.73	0.52	0.58	0.85	0.97	0.99	1	(89)

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

(90)m=	17.76	17.96	18.33	18.87	19.36	19.7	19.79	19.78	19.57	18.97	18.3	17.75	(90)

fLA = Living area ÷ (4) = 0.48 (91)

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

(92)m=	18.59	18.76	19.08	19.53	19.95	20.25	20.35	20.34	20.14	19.61	19.04	18.58	(92)

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

(93)m=	18.59	18.76	19.08	19.53	19.95	20.25	20.35	20.34	20.14	19.61	19.04	18.58	(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=	0.99	0.99	0.98	0.96	0.9	0.77	0.59	0.65	0.87	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	320.99	351.03	375.39	394.75	389.1	324.49	238.52	244.67	306.54	317	307.6	307.01	(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=	995.47	962.31	870.1	723.87	560.29	378.82	251.36	263.28	406.57	612.3	815.97	988.5	(97)

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

(98)m=	501.81	410.78	368.06	236.97	127.36	0	0	0	0	219.71	366.03	507.03

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2737.76 (98)

Space heating requirement in kWh/m²/year 55.11 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	501.81	410.78	368.06	236.97	127.36	0	0	0	0	219.71	366.03	507.03		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	537.27	439.81	394.07	253.71	136.36	0	0	0	0	235.23	391.9	542.86		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													2931.22	(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)	162.45	141.9	147.64	130.95	126.78	111.66	106.98	119.26	120.58	137.3	146.57	158.63		
Efficiency of water heater													80.3	(216)
(217)m=	87.7	87.57	87.26	86.53	85.06	80.3	80.3	80.3	80.3	86.23	87.26	87.77		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	185.23	162.04	169.2	151.34	149.05	139.06	133.23	148.52	150.16	159.23	167.96	180.74		
Total = Sum(219a)$_{1...12}$ =													1895.75	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2931.22	
Water heating fuel used			1895.75	
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)

TER WorkSheet: New dwelling design stage

Electricity for lighting			245.23	(232)

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 =	633.14	(261)
Space heating (secondary)	(215) x	0.519 =	0	(263)
Water heating	(219) x	0.216 =	409.48	(264)
Space and water heating	(261) + (262) + (263) + (264) =		1042.63	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93	(267)
Electricity for lighting	(232) x	0.519 =	127.27	(268)
Total CO2, kg/year		sum of (265)…(271) =	1208.82	(272)

TER =	24.33	(273)

SAP Input

Property Details: Flat Type A - ASHP

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	07 November 2019
Date of certificate:	12 May 2020
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Low
Water use <= 125 litres/person/day:	True
PCDF Version:	460

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2020	
Floor Location:	Floor area:	Storey height:
Floor 0	55.3 m²	3.09 m
Living area:	28.01 m² (fraction 0.507)	
Front of dwelling faces:	North East	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D8_01	Manufacturer	Solid			Metal
Vent_08_03	Manufacturer	Solid			
Vent_08_02	Manufacturer	Solid			
Vent_08_06	Manufacturer	Solid			
V_01	Manufacturer	Solid			Metal
Window_08_07	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_08_01	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_08_04	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_08_05	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Fanlight	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D8_01	mm	0	0	1	2.13	1
Vent_08_03	mm	0	0	1	0.96	1
Vent_08_02	mm	0	0	1	0.96	1
Vent_08_06	mm	0	0	1	0.7	1
V_01	mm	0	0	1	0.2	1
Window_08_07	6mm	0.7	0.4	1.2	0.86	1
Window_08_01	6mm	0.7	0.4	1.2	2.01	1
Window_08_04	6mm	0.7	0.4	1.2	2.01	1
Window_08_05	6mm	0.7	0.4	1.2	1.46	1
Fanlight	6mm	0.7	0.4	1.2	0.32	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D8_01		8_01	North East	0	0
Vent_08_03		8_07	South West	0	0
Vent_08_02		8_07	South West	0	0
Vent_08_06		8_07	South West	0	0
V_01		8_01	North East	1.01	0.2

SAP Input

Window_08_07	8_05	North East	0.6	1.44
Window_08_01	8_07	South West	1.22	1.65
Window_08_04	8_07	South West	1.22	1.65
Window_08_05	8_07	South West	1.22	1.2
Fanlight	8_01	North East	1.01	0.315

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
8_01	15.172	2.65	12.52	0.13	0	False	N/A
8_02	1.854	0	1.85	0.13	0	False	N/A
8_03	6.727	0	6.73	0.13	0	False	N/A
8_04	1.823	0	1.82	0.13	0	False	N/A
8_05	6.365	0.86	5.5	0.13	0	False	N/A
8_07	28.737	8.1	20.64	0.13	0	False	N/A
8_08	19.467	0	19.47	0.13	0.82	False	N/A
Ground	55.3			0.11			N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test: Yes (As designed)

Ventilation: Balanced with heat recovery
Number of wet rooms: Kitchen + 1
Ductwork: Insulation, rigid
Approved Installation Scheme: False

Number of chimneys: 0
Number of open flues: 0
Number of fans: 0
Number of passive stacks: 0
Number of sides sheltered: 0
Pressure test: 2.5

Main heating system:

Main heating system: Electric underfloor heating
Standard tariff
Fuel: Electricity
Info Source: SAP Tables
SAP Table: 425
In timber floor, or immediately below floor covering
Underfloor heating, pipes in insulated timber floor
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Room-sealed
Boiler interlock: Yes

Main heating Control:

Main heating Control: Programmer and room thermostat
Control code: 2704

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating: 952 From DHW-only community scheme

SAP Input

	Heat source: From hot-water only community scheme - heat pump heat from electric heat pump, heat fraction 1, efficiency 329 Piping>=1991, pre-insulated, medium temp, variable flow No hot water cylinder Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type A - ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.3	(1a) x	3.09	(2a) =	170.88	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.3	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	170.88	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	75.65	(23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.96	x	1	=	0.96			(26)
Doors Type 3			0.96	x	1	=	0.96			(26)
Doors Type 4			0.7	x	1	=	0.7			(26)
Doors Type 5			0.2	x	1	=	0.2			(26)
Windows Type 1			0.86	x1/[1/(1.2)+ 0.04]		=	0.98			(27)
Windows Type 2			2.01	x1/[1/(1.2)+ 0.04]		=	2.3			(27)
Windows Type 3			2.01	x1/[1/(1.2)+ 0.04]		=	2.3			(27)
Windows Type 4			1.46	x1/[1/(1.2)+ 0.04]		=	1.67			(27)
Windows Type 5			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Floor			55.3	x	0.11	=	6.083			(28)
Walls Type1	15.17	2.65	12.52	x	0.13	=	1.63			(29)
Walls Type2	1.85	0	1.85	x	0.13	=	0.24			(29)
Walls Type3	6.73	0	6.73	x	0.13	=	0.87			(29)
Walls Type4	1.82	0	1.82	x	0.13	=	0.24			(29)
Walls Type5	6.36	0.86	5.5	x	0.13	=	0.72			(29)
Walls Type6	28.74	8.1	20.64	x	0.13	=	2.68			(29)
Walls Type7	19.47	0	19.47	x	0.12	=	2.29			(29)
Total area of elements, m²			135.44							(31)

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** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	27.32	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6083	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Low	100	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		20.32	(36)

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

Total fabric heat loss	(33) + (36) =	47.64	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	15.85	15.68	15.5	14.62	14.44	13.56	13.56	13.39	13.91	14.44	14.8	15.15	(38)

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

(39)m=	63.49	63.32	63.14	62.26	62.08	61.2	61.2	61.03	61.56	62.08	62.44	62.79

Average = Sum(39)$_{1…12}$ /12= 62.22 (39)

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

(40)m=	1.15	1.14	1.14	1.13	1.12	1.11	1.11	1.1	1.11	1.12	1.13	1.14

Average = Sum(40)$_{1…12}$ /12= 1.13 (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 1.85 (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 78.05 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	85.85	82.73	79.61	76.49	73.36	70.24	70.24	73.36	76.49	79.61	82.73	85.85

Total = Sum(44)$_{1…12}$ = 936.55 (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=	127.31	111.35	114.9	100.17	96.12	82.94	76.86	88.2	89.25	104.01	113.54	123.3

Total = Sum(45)$_{1…12}$ = 1227.97 (45)

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

(46)m=	19.1	16.7	17.24	15.03	14.42	12.44	11.53	13.23	13.39	15.6	17.03	18.49	(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)

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Energy lost from water storage, kWh/year	(48) x (49) =	110	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02	(51)
If community heating see section 4.3			
Volume factor from Table 2a		1.03	(52)
Temperature factor from Table 2b		0.6	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)		1.03	(55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	182.59	161.28	170.18	153.67	151.4	136.44	132.14	143.48	142.75	159.29	167.03	178.57	(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=	182.59	161.28	170.18	153.67	151.4	136.44	132.14	143.48	142.75	159.29	167.03	178.57	

Output from water heater (annual)$_{1...12}$ — 1878.81 (64)

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

(65)m=	86.55	76.97	82.43	76.1	76.18	70.37	69.78	73.55	72.47	78.81	80.55	85.22	(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=	110.77	110.77	110.77	110.77	110.77	110.77	110.77	110.77	110.77	110.77	110.77	110.77	(66)

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

(67)m=	39.79	35.34	28.74	21.76	16.26	13.73	14.84	19.28	25.88	32.87	38.36	40.89	(67)

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

(68)m=	240.24	242.73	236.45	223.07	206.19	190.33	179.73	177.23	183.51	196.89	213.77	229.64	(68)

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

(69)m=	47.92	47.92	47.92	47.92	47.92	47.92	47.92	47.92	47.92	47.92	47.92	47.92	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	(71)

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Water heating gains (Table 5)

(72)m=	116.34	114.53	110.79	105.7	102.39	97.74	93.79	98.85	100.65	105.92	111.87	114.54	(72)

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

(73)m=	481.2	477.45	460.82	435.38	409.7	386.64	373.19	380.22	394.9	420.52	448.85	469.91	(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)	
Northeast	0.9x	0.77	x	0.86	x	11.28	x	0.4	x	0.7	=	1.88	(75)
Northeast	0.9x	0.77	x	0.32	x	11.28	x	0.4	x	0.7	=	0.7	(75)
Northeast	0.9x	0.77	x	0.86	x	22.97	x	0.4	x	0.7	=	3.83	(75)
Northeast	0.9x	0.77	x	0.32	x	22.97	x	0.4	x	0.7	=	1.43	(75)
Northeast	0.9x	0.77	x	0.86	x	41.38	x	0.4	x	0.7	=	6.91	(75)
Northeast	0.9x	0.77	x	0.32	x	41.38	x	0.4	x	0.7	=	2.57	(75)
Northeast	0.9x	0.77	x	0.86	x	67.96	x	0.4	x	0.7	=	11.34	(75)
Northeast	0.9x	0.77	x	0.32	x	67.96	x	0.4	x	0.7	=	4.22	(75)
Northeast	0.9x	0.77	x	0.86	x	91.35	x	0.4	x	0.7	=	15.24	(75)
Northeast	0.9x	0.77	x	0.32	x	91.35	x	0.4	x	0.7	=	5.67	(75)
Northeast	0.9x	0.77	x	0.86	x	97.38	x	0.4	x	0.7	=	16.25	(75)
Northeast	0.9x	0.77	x	0.32	x	97.38	x	0.4	x	0.7	=	6.05	(75)
Northeast	0.9x	0.77	x	0.86	x	91.1	x	0.4	x	0.7	=	15.2	(75)
Northeast	0.9x	0.77	x	0.32	x	91.1	x	0.4	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	0.86	x	72.63	x	0.4	x	0.7	=	12.12	(75)
Northeast	0.9x	0.77	x	0.32	x	72.63	x	0.4	x	0.7	=	4.51	(75)
Northeast	0.9x	0.77	x	0.86	x	50.42	x	0.4	x	0.7	=	8.41	(75)
Northeast	0.9x	0.77	x	0.32	x	50.42	x	0.4	x	0.7	=	3.13	(75)
Northeast	0.9x	0.77	x	0.86	x	28.07	x	0.4	x	0.7	=	4.68	(75)
Northeast	0.9x	0.77	x	0.32	x	28.07	x	0.4	x	0.7	=	1.74	(75)
Northeast	0.9x	0.77	x	0.86	x	14.2	x	0.4	x	0.7	=	2.37	(75)
Northeast	0.9x	0.77	x	0.32	x	14.2	x	0.4	x	0.7	=	0.88	(75)
Northeast	0.9x	0.77	x	0.86	x	9.21	x	0.4	x	0.7	=	1.54	(75)
Northeast	0.9x	0.77	x	0.32	x	9.21	x	0.4	x	0.7	=	0.57	(75)
Southwest	0.9x	0.77	x	2.01	x	36.79		0.4	x	0.7	=	14.35	(79)
Southwest	0.9x	0.77	x	2.01	x	36.79		0.4	x	0.7	=	14.35	(79)
Southwest	0.9x	0.77	x	1.46	x	36.79		0.4	x	0.7	=	10.42	(79)
Southwest	0.9x	0.77	x	2.01	x	62.67		0.4	x	0.7	=	24.44	(79)
Southwest	0.9x	0.77	x	2.01	x	62.67		0.4	x	0.7	=	24.44	(79)
Southwest	0.9x	0.77	x	1.46	x	62.67		0.4	x	0.7	=	17.76	(79)
Southwest	0.9x	0.77	x	2.01	x	85.75		0.4	x	0.7	=	33.45	(79)
Southwest	0.9x	0.77	x	2.01	x	85.75		0.4	x	0.7	=	33.45	(79)

Southwest0.9x	0.77	x	1.46	x	85.75		0.4	x	0.7	=	24.29	(79)
Southwest0.9x	0.77	x	2.01	x	106.25		0.4	x	0.7	=	41.44	(79)
Southwest0.9x	0.77	x	2.01	x	106.25		0.4	x	0.7	=	41.44	(79)
Southwest0.9x	0.77	x	1.46	x	106.25		0.4	x	0.7	=	30.1	(79)
Southwest0.9x	0.77	x	2.01	x	119.01		0.4	x	0.7	=	46.42	(79)
Southwest0.9x	0.77	x	2.01	x	119.01		0.4	x	0.7	=	46.42	(79)
Southwest0.9x	0.77	x	1.46	x	119.01		0.4	x	0.7	=	33.72	(79)
Southwest0.9x	0.77	x	2.01	x	118.15		0.4	x	0.7	=	46.08	(79)
Southwest0.9x	0.77	x	2.01	x	118.15		0.4	x	0.7	=	46.08	(79)
Southwest0.9x	0.77	x	1.46	x	118.15		0.4	x	0.7	=	33.47	(79)
Southwest0.9x	0.77	x	2.01	x	113.91		0.4	x	0.7	=	44.43	(79)
Southwest0.9x	0.77	x	2.01	x	113.91		0.4	x	0.7	=	44.43	(79)
Southwest0.9x	0.77	x	1.46	x	113.91		0.4	x	0.7	=	32.27	(79)
Southwest0.9x	0.77	x	2.01	x	104.39		0.4	x	0.7	=	40.71	(79)
Southwest0.9x	0.77	x	2.01	x	104.39		0.4	x	0.7	=	40.71	(79)
Southwest0.9x	0.77	x	1.46	x	104.39		0.4	x	0.7	=	29.57	(79)
Southwest0.9x	0.77	x	2.01	x	92.85		0.4	x	0.7	=	36.21	(79)
Southwest0.9x	0.77	x	2.01	x	92.85		0.4	x	0.7	=	36.21	(79)
Southwest0.9x	0.77	x	1.46	x	92.85		0.4	x	0.7	=	26.3	(79)
Southwest0.9x	0.77	x	2.01	x	69.27		0.4	x	0.7	=	27.02	(79)
Southwest0.9x	0.77	x	2.01	x	69.27		0.4	x	0.7	=	27.02	(79)
Southwest0.9x	0.77	x	1.46	x	69.27		0.4	x	0.7	=	19.62	(79)
Southwest0.9x	0.77	x	2.01	x	44.07		0.4	x	0.7	=	17.19	(79)
Southwest0.9x	0.77	x	2.01	x	44.07		0.4	x	0.7	=	17.19	(79)
Southwest0.9x	0.77	x	1.46	x	44.07		0.4	x	0.7	=	12.49	(79)
Southwest0.9x	0.77	x	2.01	x	31.49		0.4	x	0.7	=	12.28	(79)
Southwest0.9x	0.77	x	2.01	x	31.49		0.4	x	0.7	=	12.28	(79)
Southwest0.9x	0.77	x	1.46	x	31.49		0.4	x	0.7	=	8.92	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	41.71	71.9	100.66	128.54	147.46	147.93	141.98	127.63	110.28	80.08	50.11	35.59	(83)

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

(84)m=	522.91	549.35	561.48	563.92	557.16	534.57	515.18	507.85	505.18	500.6	498.96	505.51	(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=	0.91	0.9	0.87	0.82	0.74	0.61	0.47	0.5	0.66	0.81	0.89	0.92	(86)

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

(87)m=	19.12	19.3	19.62	20.05	20.46	20.78	20.92	20.9	20.7	20.22	19.61	19.08	(87)

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

(88)m=	20.43	20.43	20.43	20.44	20.44	20.45	20.45	20.45	20.44	20.44	20.44	20.43	(88)

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

(89)m=	0.91	0.89	0.86	0.81	0.72	0.57	0.42	0.45	0.63	0.79	0.88	0.91	(89)

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

(90)m=	18.65	18.83	19.15	19.58	19.97	20.27	20.39	20.38	20.2	19.74	19.15	18.62	(90)

fLA = Living area ÷ (4) = 0.51 (91)

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

(92)m=	18.89	19.07	19.38	19.82	20.22	20.53	20.66	20.65	20.46	19.98	19.39	18.86	(92)

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

(93)m=	18.89	19.07	19.38	19.82	20.22	20.53	20.66	20.65	20.46	19.98	19.39	18.86	(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=	0.89	0.87	0.84	0.79	0.71	0.58	0.44	0.47	0.63	0.78	0.86	0.89	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	464.36	478.28	472.44	445.22	393.8	308.43	228.74	236.33	317.81	389.7	428.12	452.36	(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=	926.12	896.95	813.58	679.84	528.85	362.98	248.38	259.21	391.32	582.55	767.07	920.24	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	343.55	281.34	253.8	168.92	100.48	0	0	0	0	143.48	244.04	348.1	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1883.71 (98)

Space heating requirement in kWh/m²/year 34.06 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 100 (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)													
	343.55	281.34	253.8	168.92	100.48	0	0	0	0	143.48	244.04	348.1	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	343.55	281.34	253.8	168.92	100.48	0	0	0	0	143.48	244.04	348.1	

Total (kWh/year) =$Sum(211)_{1...5,10...12}$= 1883.71 (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

Water heating from separate community system:

Annual water heating requirement		1878.81	(64)
Fraction of heat from community CHP		1	(303a)
Factor for charging method for community water heating		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.1	(306)
Water heat from CHP	(64) x (303a) x (305) x (306) =	2066.69	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	20.67	(313)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1883.71	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		218.89		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		218.89	(231)
Electricity for lighting			281.06	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	248.46	(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 from CHP	(310a) x	4.24	x 0.01 =	87.63	(342a)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	28.87	(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 =	37.07	(250)
Additional standing charges (Table 12)				60	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			462.03	(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] =	1.93	(257)
SAP rating (Section 12)		73.01	(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	0.519	=	977.65	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating from community system					

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		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	326.02	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	10.73	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	336.75	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	113.61	(267)
Electricity for lighting	(232) x		0.519	=	145.87	(268)
Total CO2, kg/year			sum of (265)…(271) =		1573.87	(272)
CO2 emissions per m²			(272) ÷ (4) =		28.46	(273)
EI rating (section 14)					79	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	3.07	=	5783	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Water heating from community system					

		Energy kWh/year	Primary factor		Emissions kWh/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
Energy associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		3.07	=	1928.49	(367)
Electrical energy for heat distribution	[(313) x		2.92	=	60.35	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)			=	336.75	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		3.07	=	672	(267)
Electricity for lighting	(232) x		0	=	862.85	(268)
'Total Primary Energy			sum of (265)…(271) =		9306.69	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		168.29	(273)

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User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type A - ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.3	(1a) x	3.09	(2a) =	170.88	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.3	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		170.88	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.96	x	1	=	0.96			(26)
Doors Type 3			0.96	x	1	=	0.96			(26)
Doors Type 4			0.7	x	1	=	0.7			(26)
Doors Type 5			0.2	x	1	=	0.2			(26)
Windows Type 1			0.86	x1/[1/(1.2)+ 0.04]		=	0.98			(27)
Windows Type 2			2.01	x1/[1/(1.2)+ 0.04]		=	2.3			(27)
Windows Type 3			2.01	x1/[1/(1.2)+ 0.04]		=	2.3			(27)
Windows Type 4			1.46	x1/[1/(1.2)+ 0.04]		=	1.67			(27)
Windows Type 5			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Floor			55.3	x	0.11	=	6.083			(28)
Walls Type1	15.17	2.65	12.52	x	0.13	=	1.63			(29)
Walls Type2	1.85	0	1.85	x	0.13	=	0.24			(29)
Walls Type3	6.73	0	6.73	x	0.13	=	0.87			(29)
Walls Type4	1.82	0	1.82	x	0.13	=	0.24			(29)
Walls Type5	6.36	0.86	5.5	x	0.13	=	0.72			(29)
Walls Type6	28.74	8.1	20.64	x	0.13	=	2.68			(29)
Walls Type7	19.47	0	19.47	x	0.12	=	2.29			(29)
Total area of elements, m²			135.44							(31)

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** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	27.32	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6083	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Low	100	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		20.32	(36)

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

Total fabric heat loss	(33) + (36) =	47.64	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	15.85	15.68	15.5	14.62	14.44	13.56	13.56	13.39	13.91	14.44	14.8	15.15	(38)

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

(39)m=	63.49	63.32	63.14	62.26	62.08	61.2	61.2	61.03	61.56	62.08	62.44	62.79	

Average = Sum(39)$_{1…12}$ /12= 62.22 (39)

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

(40)m=	1.15	1.14	1.14	1.13	1.12	1.11	1.11	1.1	1.11	1.12	1.13	1.14	

Average = Sum(40)$_{1…12}$ /12= 1.13 (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	1.85	(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	78.05	(43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	85.85	82.73	79.61	76.49	73.36	70.24	70.24	73.36	76.49	79.61	82.73	85.85

Total = Sum(44)$_{1…12}$ = 936.55 (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=	127.31	111.35	114.9	100.17	96.12	82.94	76.86	88.2	89.25	104.01	113.54	123.3

Total = Sum(45)$_{1…12}$ = 1227.97 (45)

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

(46)m=	19.1	16.7	17.24	15.03	14.42	12.44	11.53	13.23	13.39	15.6	17.03	18.49	(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)

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Energy lost from water storage, kWh/year	(48) x (49) =	110	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02	(51)
If community heating see section 4.3			
Volume factor from Table 2a		1.03	(52)
Temperature factor from Table 2b		0.6	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)		1.03	(55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	182.59	161.28	170.18	153.67	151.4	136.44	132.14	143.48	142.75	159.29	167.03	178.57	(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=	182.59	161.28	170.18	153.67	151.4	136.44	132.14	143.48	142.75	159.29	167.03	178.57

Output from water heater (annual)$_{1...12}$ — 1878.81 (64)

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

(65)m=	86.55	76.97	82.43	76.1	76.18	70.37	69.78	73.55	72.47	78.81	80.55	85.22	(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=	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.91	14.14	11.5	8.7	6.51	5.49	5.93	7.71	10.35	13.15	15.34	16.36	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	160.96	162.63	158.42	149.46	138.15	127.52	120.42	118.75	122.95	131.92	143.23	153.86	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	(71)

Water heating gains (Table 5)

(72)m=	116.34	114.53	110.79	105.7	102.39	97.74	93.79	98.85	100.65	105.92	111.87	114.54	(72)

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

(73)m=	343.9	341.99	331.4	314.55	297.74	281.44	270.83	276.01	284.65	301.68	321.13	335.45	(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)	
Northeast	0.9x	0.77	x	0.86	x	11.28	x	0.4	x	0.7	=	1.88	(75)
Northeast	0.9x	0.77	x	0.32	x	11.28	x	0.4	x	0.7	=	0.7	(75)
Northeast	0.9x	0.77	x	0.86	x	22.97	x	0.4	x	0.7	=	3.83	(75)
Northeast	0.9x	0.77	x	0.32	x	22.97	x	0.4	x	0.7	=	1.43	(75)
Northeast	0.9x	0.77	x	0.86	x	41.38	x	0.4	x	0.7	=	6.91	(75)
Northeast	0.9x	0.77	x	0.32	x	41.38	x	0.4	x	0.7	=	2.57	(75)
Northeast	0.9x	0.77	x	0.86	x	67.96	x	0.4	x	0.7	=	11.34	(75)
Northeast	0.9x	0.77	x	0.32	x	67.96	x	0.4	x	0.7	=	4.22	(75)
Northeast	0.9x	0.77	x	0.86	x	91.35	x	0.4	x	0.7	=	15.24	(75)
Northeast	0.9x	0.77	x	0.32	x	91.35	x	0.4	x	0.7	=	5.67	(75)
Northeast	0.9x	0.77	x	0.86	x	97.38	x	0.4	x	0.7	=	16.25	(75)
Northeast	0.9x	0.77	x	0.32	x	97.38	x	0.4	x	0.7	=	6.05	(75)
Northeast	0.9x	0.77	x	0.86	x	91.1	x	0.4	x	0.7	=	15.2	(75)
Northeast	0.9x	0.77	x	0.32	x	91.1	x	0.4	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	0.86	x	72.63	x	0.4	x	0.7	=	12.12	(75)
Northeast	0.9x	0.77	x	0.32	x	72.63	x	0.4	x	0.7	=	4.51	(75)
Northeast	0.9x	0.77	x	0.86	x	50.42	x	0.4	x	0.7	=	8.41	(75)
Northeast	0.9x	0.77	x	0.32	x	50.42	x	0.4	x	0.7	=	3.13	(75)
Northeast	0.9x	0.77	x	0.86	x	28.07	x	0.4	x	0.7	=	4.68	(75)
Northeast	0.9x	0.77	x	0.32	x	28.07	x	0.4	x	0.7	=	1.74	(75)
Northeast	0.9x	0.77	x	0.86	x	14.2	x	0.4	x	0.7	=	2.37	(75)
Northeast	0.9x	0.77	x	0.32	x	14.2	x	0.4	x	0.7	=	0.88	(75)
Northeast	0.9x	0.77	x	0.86	x	9.21	x	0.4	x	0.7	=	1.54	(75)
Northeast	0.9x	0.77	x	0.32	x	9.21	x	0.4	x	0.7	=	0.57	(75)
Southwest	0.9x	0.77	x	2.01	x	36.79		0.4	x	0.7	=	14.35	(79)
Southwest	0.9x	0.77	x	2.01	x	36.79		0.4	x	0.7	=	14.35	(79)
Southwest	0.9x	0.77	x	1.46	x	36.79		0.4	x	0.7	=	10.42	(79)
Southwest	0.9x	0.77	x	2.01	x	62.67		0.4	x	0.7	=	24.44	(79)
Southwest	0.9x	0.77	x	2.01	x	62.67		0.4	x	0.7	=	24.44	(79)
Southwest	0.9x	0.77	x	1.46	x	62.67		0.4	x	0.7	=	17.76	(79)
Southwest	0.9x	0.77	x	2.01	x	85.75		0.4	x	0.7	=	33.45	(79)
Southwest	0.9x	0.77	x	2.01	x	85.75		0.4	x	0.7	=	33.45	(79)

Southwest 0.9x	0.77	x	1.46	x	85.75		0.4	x	0.7	=	24.29	(79)
Southwest 0.9x	0.77	x	2.01	x	106.25		0.4	x	0.7	=	41.44	(79)
Southwest 0.9x	0.77	x	2.01	x	106.25		0.4	x	0.7	=	41.44	(79)
Southwest 0.9x	0.77	x	1.46	x	106.25		0.4	x	0.7	=	30.1	(79)
Southwest 0.9x	0.77	x	2.01	x	119.01		0.4	x	0.7	=	46.42	(79)
Southwest 0.9x	0.77	x	2.01	x	119.01		0.4	x	0.7	=	46.42	(79)
Southwest 0.9x	0.77	x	1.46	x	119.01		0.4	x	0.7	=	33.72	(79)
Southwest 0.9x	0.77	x	2.01	x	118.15		0.4	x	0.7	=	46.08	(79)
Southwest 0.9x	0.77	x	2.01	x	118.15		0.4	x	0.7	=	46.08	(79)
Southwest 0.9x	0.77	x	1.46	x	118.15		0.4	x	0.7	=	33.47	(79)
Southwest 0.9x	0.77	x	2.01	x	113.91		0.4	x	0.7	=	44.43	(79)
Southwest 0.9x	0.77	x	2.01	x	113.91		0.4	x	0.7	=	44.43	(79)
Southwest 0.9x	0.77	x	1.46	x	113.91		0.4	x	0.7	=	32.27	(79)
Southwest 0.9x	0.77	x	2.01	x	104.39		0.4	x	0.7	=	40.71	(79)
Southwest 0.9x	0.77	x	2.01	x	104.39		0.4	x	0.7	=	40.71	(79)
Southwest 0.9x	0.77	x	1.46	x	104.39		0.4	x	0.7	=	29.57	(79)
Southwest 0.9x	0.77	x	2.01	x	92.85		0.4	x	0.7	=	36.21	(79)
Southwest 0.9x	0.77	x	2.01	x	92.85		0.4	x	0.7	=	36.21	(79)
Southwest 0.9x	0.77	x	1.46	x	92.85		0.4	x	0.7	=	26.3	(79)
Southwest 0.9x	0.77	x	2.01	x	69.27		0.4	x	0.7	=	27.02	(79)
Southwest 0.9x	0.77	x	2.01	x	69.27		0.4	x	0.7	=	27.02	(79)
Southwest 0.9x	0.77	x	1.46	x	69.27		0.4	x	0.7	=	19.62	(79)
Southwest 0.9x	0.77	x	2.01	x	44.07		0.4	x	0.7	=	17.19	(79)
Southwest 0.9x	0.77	x	2.01	x	44.07		0.4	x	0.7	=	17.19	(79)
Southwest 0.9x	0.77	x	1.46	x	44.07		0.4	x	0.7	=	12.49	(79)
Southwest 0.9x	0.77	x	2.01	x	31.49		0.4	x	0.7	=	12.28	(79)
Southwest 0.9x	0.77	x	2.01	x	31.49		0.4	x	0.7	=	12.28	(79)
Southwest 0.9x	0.77	x	1.46	x	31.49		0.4	x	0.7	=	8.92	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	41.71	71.9	100.66	128.54	147.46	147.93	141.98	127.63	110.28	80.08	50.11	35.59	(83)

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

(84)m=	385.61	413.89	432.05	443.09	445.2	429.38	412.81	403.64	394.93	381.76	371.25	371.04	(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=	0.95	0.94	0.92	0.88	0.81	0.69	0.56	0.59	0.75	0.88	0.94	0.96	(86)

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

(87)m=	18.76	18.96	19.32	19.82	20.3	20.69	20.88	20.86	20.58	19.99	19.31	18.73	(87)

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

(88)m=	20.43	20.43	20.43	20.44	20.44	20.45	20.45	20.45	20.44	20.44	20.44	20.43	(88)

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

(89)m=	0.95	0.94	0.91	0.87	0.79	0.66	0.51	0.54	0.72	0.87	0.93	0.95	(89)

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

(90)m=	18.3	18.5	18.86	19.35	19.82	20.2	20.36	20.35	20.1	19.53	18.85	18.27	(90)

fLA = Living area ÷ (4) = 0.51 (91)

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

(92)m=	18.53	18.73	19.09	19.59	20.06	20.45	20.62	20.6	20.34	19.76	19.08	18.5	(92)

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

(93)m=	18.53	18.73	19.09	19.59	20.06	20.45	20.62	20.6	20.34	19.76	19.08	18.5	(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=	0.94	0.92	0.9	0.85	0.78	0.66	0.53	0.55	0.72	0.85	0.91	0.94	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	360.57	381.03	387.29	377.77	346.87	282.86	216.84	222.35	283.22	324.83	339.35	348.87	(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=	903.74	875.97	795.23	665.53	519.14	358	246.18	256.61	384.39	568.84	748.09	898.1	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	404.11	332.6	303.51	207.19	128.17	0	0	0	0	181.54	294.29	408.63	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2260.05 (98)

Space heating requirement in kWh/m²/year 40.87 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 100 (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)													
	404.11	332.6	303.51	207.19	128.17	0	0	0	0	181.54	294.29	408.63	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	404.11	332.6	303.51	207.19	128.17	0	0	0	0	181.54	294.29	408.63	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2260.05 (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)

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Water heating

Water heating from separate community system:

Annual water heating requirement		1878.81	(64)
Fraction of heat from community CHP		1	(303a)
Factor for charging method for community water heating		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.1	(306)
Water heat from CHP	(64) x (303a) x (305) x (306) =	2066.69	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	20.67	(313)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2260.05	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		218.89		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		218.89	(231)
Electricity for lighting			281.06	(232)

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	0.519	=	1172.96	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating from community system					

		Energy kWh/year	**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	326.02	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	10.73	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	336.75	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	113.61	(267)
Electricity for lighting	(232) x		0.519	=	145.87	(268)
Total CO2, kg/year	sum of (265)…(271) =				1769.19	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =				31.99	(273)
EI rating (section 14)					76	(274)

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User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type A - ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.3	(1a) x	3.09	(2a) =	170.88	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.3	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		170.88	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =	0.12	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59	(24d)

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

(25)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.96	x	1	=	0.96			(26)
Doors Type 3			0.96	x	1	=	0.96			(26)
Doors Type 4			0.7	x	1	=	0.7			(26)
Doors Type 5			0.2	x	1	=	0.2			(26)
Windows Type 1			0.86	x1/[1/(1.4)+ 0.04]		=	1.14			(27)
Windows Type 2			2.01	x1/[1/(1.4)+ 0.04]		=	2.66			(27)
Windows Type 3			2.01	x1/[1/(1.4)+ 0.04]		=	2.66			(27)
Windows Type 4			1.46	x1/[1/(1.4)+ 0.04]		=	1.94			(27)
Windows Type 5			0.32	x1/[1/(1.4)+ 0.04]		=	0.42			(27)
Floor			55.3	x	0.13	=	7.189			(28)
Walls Type1	15.17	2.65	12.52	x	0.18	=	2.25			(29)
Walls Type2	1.85	0	1.85	x	0.18	=	0.33			(29)
Walls Type3	6.73	0	6.73	x	0.18	=	1.21			(29)
Walls Type4	1.82	0	1.82	x	0.18	=	0.33			(29)
Walls Type5	6.36	0.86	5.5	x	0.18	=	0.99			(29)
Walls Type6	28.74	8.1	20.64	x	0.18	=	3.71			(29)
Walls Type7	19.47	0	19.47	x	0.18	=	3.5			(29)
Total area of elements, m²			135.44							(31)

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** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	33.3	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6083	(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		6.77	(36)

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

Total fabric heat loss	(33) + (36) =	40.08	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	34.37	34.13	33.89	32.79	32.58	31.62	31.62	31.44	31.99	32.58	33	33.44	(38)

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

(39)m=	74.45	74.21	73.97	72.87	72.66	71.7	71.7	71.52	72.07	72.66	73.08	73.52	

Average = $Sum(39)_{1…12}$ /12= 72.87 (39)

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

(40)m=	1.35	1.34	1.34	1.32	1.31	1.3	1.3	1.29	1.3	1.31	1.32	1.33	

Average = $Sum(40)_{1…12}$ /12= 1.32 (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 — 1.85 (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 — 78.05 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	85.85	82.73	79.61	76.49	73.36	70.24	70.24	73.36	76.49	79.61	82.73	85.85	

Total = $Sum(44)_{1…12}$ = 936.55 (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=	127.31	111.35	114.9	100.17	96.12	82.94	76.86	88.2	89.25	104.01	113.54	123.3	

Total = $Sum(45)_{1…12}$ = 1227.97 (45)

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

(46)m=	19.1	16.7	17.24	15.03	14.42	12.44	11.53	13.23	13.39	15.6	17.03	18.49	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (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): — 1.39 (48)

Temperature factor from Table 2b — 0.54 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =		0.75	(50)
b) If manufacturer's declared cylinder loss factor is not known:				
Hot water storage loss factor from Table 2 (kWh/litre/day)			0	(51)
If community heating see section 4.3				
Volume factor from Table 2a			0	(52)
Temperature factor from Table 2b			0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =		0	(54)
Enter (50) or (54) in (55)			0.75	(55)

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

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	173.91	153.44	161.5	145.27	142.72	128.04	123.46	134.79	134.34	150.61	158.63	169.89	(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=	173.91	153.44	161.5	145.27	142.72	128.04	123.46	134.79	134.34	150.61	158.63	169.89

Output from water heater (annual)$_{1...12}$ — 1776.58 (64)

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

(65)m=	79.61	70.69	75.48	69.38	69.24	63.65	62.83	66.6	65.75	71.86	73.83	78.27	(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=	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.91	14.14	11.5	8.7	6.51	5.49	5.93	7.71	10.35	13.15	15.34	16.36	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	160.96	162.63	158.42	149.46	138.15	127.52	120.42	118.75	122.95	131.92	143.23	153.86	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	(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=	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	(71)

Water heating gains (Table 5)

(72)m=	107	105.2	101.45	96.36	93.06	88.41	84.45	89.52	91.32	96.59	102.54	105.2	(72)

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

(73)m=	337.57	335.65	325.06	308.22	291.41	275.11	264.49	269.67	278.32	295.34	314.8	329.11	(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)	
Northeast 0.9x	0.77	x	0.86	x	11.28	x	0.63	x	0.7	=	2.97	(75)
Northeast 0.9x	0.77	x	0.32	x	11.28	x	0.63	x	0.7	=	1.1	(75)
Northeast 0.9x	0.77	x	0.86	x	22.97	x	0.63	x	0.7	=	6.04	(75)
Northeast 0.9x	0.77	x	0.32	x	22.97	x	0.63	x	0.7	=	2.25	(75)
Northeast 0.9x	0.77	x	0.86	x	41.38	x	0.63	x	0.7	=	10.88	(75)
Northeast 0.9x	0.77	x	0.32	x	41.38	x	0.63	x	0.7	=	4.05	(75)
Northeast 0.9x	0.77	x	0.86	x	67.96	x	0.63	x	0.7	=	17.86	(75)
Northeast 0.9x	0.77	x	0.32	x	67.96	x	0.63	x	0.7	=	6.65	(75)
Northeast 0.9x	0.77	x	0.86	x	91.35	x	0.63	x	0.7	=	24.01	(75)
Northeast 0.9x	0.77	x	0.32	x	91.35	x	0.63	x	0.7	=	8.93	(75)
Northeast 0.9x	0.77	x	0.86	x	97.38	x	0.63	x	0.7	=	25.6	(75)
Northeast 0.9x	0.77	x	0.32	x	97.38	x	0.63	x	0.7	=	9.52	(75)
Northeast 0.9x	0.77	x	0.86	x	91.1	x	0.63	x	0.7	=	23.94	(75)
Northeast 0.9x	0.77	x	0.32	x	91.1	x	0.63	x	0.7	=	8.91	(75)
Northeast 0.9x	0.77	x	0.86	x	72.63	x	0.63	x	0.7	=	19.09	(75)
Northeast 0.9x	0.77	x	0.32	x	72.63	x	0.63	x	0.7	=	7.1	(75)
Northeast 0.9x	0.77	x	0.86	x	50.42	x	0.63	x	0.7	=	13.25	(75)
Northeast 0.9x	0.77	x	0.32	x	50.42	x	0.63	x	0.7	=	4.93	(75)
Northeast 0.9x	0.77	x	0.86	x	28.07	x	0.63	x	0.7	=	7.38	(75)
Northeast 0.9x	0.77	x	0.32	x	28.07	x	0.63	x	0.7	=	2.74	(75)
Northeast 0.9x	0.77	x	0.86	x	14.2	x	0.63	x	0.7	=	3.73	(75)
Northeast 0.9x	0.77	x	0.32	x	14.2	x	0.63	x	0.7	=	1.39	(75)
Northeast 0.9x	0.77	x	0.86	x	9.21	x	0.63	x	0.7	=	2.42	(75)
Northeast 0.9x	0.77	x	0.32	x	9.21	x	0.63	x	0.7	=	0.9	(75)
Southwest 0.9x	0.77	x	2.01	x	36.79		0.63	x	0.7	=	22.6	(79)
Southwest 0.9x	0.77	x	2.01	x	36.79		0.63	x	0.7	=	22.6	(79)
Southwest 0.9x	0.77	x	1.46	x	36.79		0.63	x	0.7	=	16.42	(79)
Southwest 0.9x	0.77	x	2.01	x	62.67		0.63	x	0.7	=	38.5	(79)
Southwest 0.9x	0.77	x	2.01	x	62.67		0.63	x	0.7	=	38.5	(79)
Southwest 0.9x	0.77	x	1.46	x	62.67		0.63	x	0.7	=	27.96	(79)
Southwest 0.9x	0.77	x	2.01	x	85.75		0.63	x	0.7	=	52.68	(79)
Southwest 0.9x	0.77	x	2.01	x	85.75		0.63	x	0.7	=	52.68	(79)

Southwest0.9x	0.77	x	1.46	x	85.75		0.63	x	0.7	=	38.26	(79)
Southwest0.9x	0.77	x	2.01	x	106.25		0.63	x	0.7	=	65.27	(79)
Southwest0.9x	0.77	x	2.01	x	106.25		0.63	x	0.7	=	65.27	(79)
Southwest0.9x	0.77	x	1.46	x	106.25		0.63	x	0.7	=	47.41	(79)
Southwest0.9x	0.77	x	2.01	x	119.01		0.63	x	0.7	=	73.11	(79)
Southwest0.9x	0.77	x	2.01	x	119.01		0.63	x	0.7	=	73.11	(79)
Southwest0.9x	0.77	x	1.46	x	119.01		0.63	x	0.7	=	53.1	(79)
Southwest0.9x	0.77	x	2.01	x	118.15		0.63	x	0.7	=	72.58	(79)
Southwest0.9x	0.77	x	2.01	x	118.15		0.63	x	0.7	=	72.58	(79)
Southwest0.9x	0.77	x	1.46	x	118.15		0.63	x	0.7	=	52.72	(79)
Southwest0.9x	0.77	x	2.01	x	113.91		0.63	x	0.7	=	69.97	(79)
Southwest0.9x	0.77	x	2.01	x	113.91		0.63	x	0.7	=	69.97	(79)
Southwest0.9x	0.77	x	1.46	x	113.91		0.63	x	0.7	=	50.83	(79)
Southwest0.9x	0.77	x	2.01	x	104.39		0.63	x	0.7	=	64.13	(79)
Southwest0.9x	0.77	x	2.01	x	104.39		0.63	x	0.7	=	64.13	(79)
Southwest0.9x	0.77	x	1.46	x	104.39		0.63	x	0.7	=	46.58	(79)
Southwest0.9x	0.77	x	2.01	x	92.85		0.63	x	0.7	=	57.04	(79)
Southwest0.9x	0.77	x	2.01	x	92.85		0.63	x	0.7	=	57.04	(79)
Southwest0.9x	0.77	x	1.46	x	92.85		0.63	x	0.7	=	41.43	(79)
Southwest0.9x	0.77	x	2.01	x	69.27		0.63	x	0.7	=	42.55	(79)
Southwest0.9x	0.77	x	2.01	x	69.27		0.63	x	0.7	=	42.55	(79)
Southwest0.9x	0.77	x	1.46	x	69.27		0.63	x	0.7	=	30.91	(79)
Southwest0.9x	0.77	x	2.01	x	44.07		0.63	x	0.7	=	27.07	(79)
Southwest0.9x	0.77	x	2.01	x	44.07		0.63	x	0.7	=	27.07	(79)
Southwest0.9x	0.77	x	1.46	x	44.07		0.63	x	0.7	=	19.66	(79)
Southwest0.9x	0.77	x	2.01	x	31.49		0.63	x	0.7	=	19.34	(79)
Southwest0.9x	0.77	x	2.01	x	31.49		0.63	x	0.7	=	19.34	(79)
Southwest0.9x	0.77	x	1.46	x	31.49		0.63	x	0.7	=	14.05	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	65.69	113.25	158.54	202.45	232.26	232.99	223.62	201.02	173.69	126.13	78.93	56.06	(83)

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

(84)m=	403.25	448.9	483.6	510.67	523.66	508.1	488.12	470.69	452.01	421.47	393.72	385.17	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.96	0.91	0.78	0.61	0.65	0.86	0.97	0.99	1	(86)

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

(87)m=	19.62	19.77	20.02	20.36	20.67	20.89	20.97	20.96	20.82	20.43	19.97	19.6	(87)

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

(88)m=	19.8	19.81	19.81	19.83	19.83	19.84	19.84	19.85	19.84	19.83	19.82	19.82	(88)

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

(89)m=	0.99	0.99	0.98	0.95	0.86	0.68	0.47	0.51	0.78	0.95	0.99	1	(89)

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

(90)m=	18	18.22	18.58	19.07	19.5	19.77	19.83	19.83	19.69	19.18	18.52	17.98	(90)

fLA = Living area ÷ (4) = 0.51 (91)

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

(92)m=	18.82	19	19.31	19.72	20.09	20.34	20.41	20.4	20.26	19.81	19.25	18.8	(92)

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

(93)m=	18.82	19	19.31	19.72	20.09	20.34	20.41	20.4	20.26	19.81	19.25	18.8	(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=	0.99	0.99	0.98	0.95	0.88	0.72	0.54	0.58	0.81	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	400.06	442.91	471.51	482.82	458.31	368.31	264.38	274.11	367.31	400.57	388.04	382.66	(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=	1080.82	1046.57	947.57	788.66	609.63	411.49	273.2	286.41	444.14	669.22	888.21	1073.2	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	506.48	405.66	354.19	220.2	112.58	0	0	0	0	199.87	360.12	513.77	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2672.88 (98)

Space heating requirement in kWh/m²/year 48.33 (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) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)													
	506.48	405.66	354.19	220.2	112.58	0	0	0	0	199.87	360.12	513.77	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	541.69	433.86	378.81	235.51	120.41	0	0	0	0	213.77	385.16	549.48	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2858.69 (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)

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Water heating

Water heating from separate community system:

Annual water heating requirement		1776.58	(64)
Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2858.69	
Water heating fuel used		2103.94	
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		281.06	(232)

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	=	617.48	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	454.45	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1071.93	(265)

Water heating from community system

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Electrical energy for heat distribution	[(313) x	0	=	0	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	0	(373)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	145.87	(268)
Total CO2, kg/year	sum of (265)…(271) =			1256.72	(272)

TER =	33.39	(273)

SAP Input

Property Details: Flat Type B - ASHP

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	07 November 2019
Date of certificate:	12 May 2020
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Low
Water use <= 125 litres/person/day:	True
PCDF Version:	460

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2020	
Floor Location:	Floor area:	Storey height:
Floor 0	35 m²	3.09 m
Living area:	22 m² (fraction 0.594)	
Front of dwelling faces:	North East	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D_5_01	Manufacturer	Solid			Metal
Vent_05_03	Manufacturer	Solid			
Vent_05_01	Manufacturer	Solid			
Vent_D5_08	Manufacturer	Solid			
Window_05_02	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_05_01	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Fanlight	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_05_08	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D_5_01	mm	0	0	1	2.13	1
Vent_05_03	mm	0	0	1	0.94	1
Vent_05_01	mm	0	0	1	0.75	1
Vent_D5_08	mm	0	0	1	0.68	1
Window_05_02	6mm	0.7	0.4	1.2	2	1
Window_05_01	6mm	0.7	0.4	1.2	1.04	1
Fanlight	6mm	0.7	0.4	1.2	0.32	1
Window_05_08	6mm	0.7	0.4	1.2	1.45	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D_5_01		5_01	North East	0	0
Vent_05_03		5_05	South West	0.57	1.65
Vent_05_01		5_01	North East	0.623	1.2
Vent_D5_08		5_05	South West	0.57	1.2
Window_05_02		5_05	South West	1.21	1.65
Window_05_01		5_01	North East	1.2	0.863
Fanlight		5_01	North East	1.01	0.315
Window_05_08		5_05	South West	1.21	1.2

SAP Input

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
5_01	15.481	4.24	11.24	0.13	0	False	N/A
5_02	2.039	0	2.04	0.13	0	False	N/A
5_03	2.874	0	2.87	0.13	0	False	N/A
5_05	18.386	5.07	13.32	0.13	0	False	N/A
R_01	35	0	35	0.1	0		N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test: Yes (As designed)

Ventilation: Balanced with heat recovery
Number of wet rooms: Kitchen + 1
Ductwork: Insulation, rigid
Approved Installation Scheme: False

Number of chimneys: 0
Number of open flues: 0
Number of fans: 0
Number of passive stacks: 0
Number of sides sheltered: 0
Pressure test: 2.5

Main heating system:

Main heating system: Electric underfloor heating
Standard tariff
Fuel: Electricity
Info Source: SAP Tables
SAP Table: 425
In timber floor, or immediately below floor covering
Underfloor heating, pipes in insulated timber floor
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Room-sealed
Boiler interlock: Yes

Main heating Control:

Main heating Control: Programmer and room thermostat
Control code: 2704

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating: 952 From DHW-only community scheme
Heat source: From hot-water only community scheme - heat pump
heat from electric heat pump, heat fraction 1, efficiency 329
Piping>=1991, pre-insulated, medium temp, variable flow
No hot water cylinder
Solar panel: False

Others:

Electricity tariff: Standard Tariff
In Smoke Control Area: Yes

SAP Input

Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type B - ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	35	(1a) x	3.09	(2a) =	108.15	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	35	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	108.15	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 0	÷ (5) =	0	(8)
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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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

SAP WorkSheet: New dwelling design stage

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

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.94	x	1	=	0.94			(26)
Doors Type 3			0.75	x	1	=	0.75			(26)
Doors Type 4			0.68	x	1	=	0.68			(26)
Windows Type 1			2	x1/[1/(1.2)+ 0.04]		=	2.29			(27)
Windows Type 2			1.04	x1/[1/(1.2)+ 0.04]		=	1.19			(27)
Windows Type 3			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Windows Type 4			1.45	x1/[1/(1.2)+ 0.04]		=	1.66			(27)
Walls Type1	15.48	4.24	11.24	x	0.13	=	1.46			(29)
Walls Type2	2.04	0	2.04	x	0.13	=	0.27			(29)
Walls Type3	2.87	0	2.87	x	0.13	=	0.37			(29)
Walls Type4	18.39	5.07	13.32	x	0.13	=	1.73			(29)
Roof	35	0	35	x	0.1	=	3.5			(30)
Total area of elements, m²			73.78							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 17.34 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 315 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 11.07 | (36)

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

Total fabric heat loss (33) + (36) = | 28.41 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	10.03	9.92	9.81	9.25	9.14	8.58	8.58	8.47	8.81	9.14	9.36	9.59	(38)

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

(39)m=	38.44	38.33	38.22	37.66	37.55	36.99	36.99	36.88	37.21	37.55	37.77	37.99	

Average = Sum(39)$_{1…12}$ /12= | 37.63 | (39)

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

(40)m=	1.1	1.1	1.09	1.08	1.07	1.06	1.06	1.05	1.06	1.07	1.08	1.09	

Average = Sum(40)$_{1…12}$ /12= | 1.08 | (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 | 1.28 | (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 | 64.62 | (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	71.08	68.49	65.91	63.32	60.74	58.16	58.16	60.74	63.32	65.91	68.49	71.08	

Total = Sum(44)$_{1…12}$ = | 775.4 | (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=	105.41	92.19	95.13	82.94	79.58	68.67	63.64	73.02	73.89	86.12	94	102.08	

Total = Sum(45)$_{1…12}$ = | 1016.67 | (45)

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

(46)m=	15.81	13.83	14.27	12.44	11.94	10.3	9.55	10.95	11.08	12.92	14.1	15.31	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): | 0 | (48)

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 110 | (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.02 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 1.03 | (52)

Temperature factor from Table 2b | 0.6 | (53)

SAP WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)		1.03	(55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	160.68	142.12	150.41	136.43	134.86	122.17	118.91	128.3	127.39	141.39	147.5	157.36	(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=	160.68	142.12	150.41	136.43	134.86	122.17	118.91	128.3	127.39	141.39	147.5	157.36

Output from water heater (annual)$_{1\ldots12}$ — 1667.51 (64)

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

(65)m=	79.27	70.6	75.85	70.37	70.68	65.63	65.38	68.5	67.36	72.86	74.05	78.16	(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=	76.84	76.84	76.84	76.84	76.84	76.84	76.84	76.84	76.84	76.84	76.84	76.84	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	26.21	23.28	18.94	14.34	10.72	9.05	9.78	12.71	17.05	21.65	25.27	26.94	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	162.98	164.67	160.41	151.33	139.88	129.12	121.93	120.23	124.5	133.57	145.02	155.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	43.96	43.96	43.96	43.96	43.96	43.96	43.96	43.96	43.96	43.96	43.96	43.96	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	(71)
Water heating gains (Table 5)													
(72)m=	106.54	105.05	101.95	97.74	95	91.15	87.88	92.07	93.56	97.92	102.85	105.06	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	365.32	362.58	350.87	332.99	315.18	298.89	289.16	294.59	304.69	322.73	342.72	357.37	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	1.04	x	11.28	x	0.4	x	0.7	=	2.28	(75)
Northeast	0.9x	0.77	x	0.32	x	11.28	x	0.4	x	0.7	=	0.7	(75)
Northeast	0.9x	0.77	x	1.04	x	22.97	x	0.4	x	0.7	=	4.63	(75)
Northeast	0.9x	0.77	x	0.32	x	22.97	x	0.4	x	0.7	=	1.43	(75)
Northeast	0.9x	0.77	x	1.04	x	41.38	x	0.4	x	0.7	=	8.35	(75)
Northeast	0.9x	0.77	x	0.32	x	41.38	x	0.4	x	0.7	=	2.57	(75)
Northeast	0.9x	0.77	x	1.04	x	67.96	x	0.4	x	0.7	=	13.71	(75)
Northeast	0.9x	0.77	x	0.32	x	67.96	x	0.4	x	0.7	=	4.22	(75)
Northeast	0.9x	0.77	x	1.04	x	91.35	x	0.4	x	0.7	=	18.43	(75)
Northeast	0.9x	0.77	x	0.32	x	91.35	x	0.4	x	0.7	=	5.67	(75)
Northeast	0.9x	0.77	x	1.04	x	97.38	x	0.4	x	0.7	=	19.65	(75)
Northeast	0.9x	0.77	x	0.32	x	97.38	x	0.4	x	0.7	=	6.05	(75)
Northeast	0.9x	0.77	x	1.04	x	91.1	x	0.4	x	0.7	=	18.38	(75)
Northeast	0.9x	0.77	x	0.32	x	91.1	x	0.4	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	1.04	x	72.63	x	0.4	x	0.7	=	14.66	(75)
Northeast	0.9x	0.77	x	0.32	x	72.63	x	0.4	x	0.7	=	4.51	(75)
Northeast	0.9x	0.77	x	1.04	x	50.42	x	0.4	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	0.32	x	50.42	x	0.4	x	0.7	=	3.13	(75)
Northeast	0.9x	0.77	x	1.04	x	28.07	x	0.4	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	0.32	x	28.07	x	0.4	x	0.7	=	1.74	(75)
Northeast	0.9x	0.77	x	1.04	x	14.2	x	0.4	x	0.7	=	2.86	(75)
Northeast	0.9x	0.77	x	0.32	x	14.2	x	0.4	x	0.7	=	0.88	(75)
Northeast	0.9x	0.77	x	1.04	x	9.21	x	0.4	x	0.7	=	1.86	(75)
Northeast	0.9x	0.77	x	0.32	x	9.21	x	0.4	x	0.7	=	0.57	(75)
Southwest	0.9x	0.77	x	2	x	36.79		0.4	x	0.7	=	14.28	(79)
Southwest	0.9x	0.77	x	1.45	x	36.79		0.4	x	0.7	=	10.35	(79)
Southwest	0.9x	0.77	x	2	x	62.67		0.4	x	0.7	=	24.32	(79)
Southwest	0.9x	0.77	x	1.45	x	62.67		0.4	x	0.7	=	17.63	(79)
Southwest	0.9x	0.77	x	2	x	85.75		0.4	x	0.7	=	33.28	(79)
Southwest	0.9x	0.77	x	1.45	x	85.75		0.4	x	0.7	=	24.13	(79)
Southwest	0.9x	0.77	x	2	x	106.25		0.4	x	0.7	=	41.23	(79)
Southwest	0.9x	0.77	x	1.45	x	106.25		0.4	x	0.7	=	29.89	(79)
Southwest	0.9x	0.77	x	2	x	119.01		0.4	x	0.7	=	46.19	(79)
Southwest	0.9x	0.77	x	1.45	x	119.01		0.4	x	0.7	=	33.48	(79)
Southwest	0.9x	0.77	x	2	x	118.15		0.4	x	0.7	=	45.85	(79)
Southwest	0.9x	0.77	x	1.45	x	118.15		0.4	x	0.7	=	33.24	(79)
Southwest	0.9x	0.77	x	2	x	113.91		0.4	x	0.7	=	44.21	(79)
Southwest	0.9x	0.77	x	1.45	x	113.91		0.4	x	0.7	=	32.05	(79)
Southwest	0.9x	0.77	x	2	x	104.39		0.4	x	0.7	=	40.51	(79)

Southwest	0.9x	0.77	x	1.45	x	104.39	0.4	x	0.7	=	29.37	(79)
Southwest	0.9x	0.77	x	2	x	92.85	0.4	x	0.7	=	36.03	(79)
Southwest	0.9x	0.77	x	1.45	x	92.85	0.4	x	0.7	=	26.12	(79)
Southwest	0.9x	0.77	x	2	x	69.27	0.4	x	0.7	=	26.88	(79)
Southwest	0.9x	0.77	x	1.45	x	69.27	0.4	x	0.7	=	19.49	(79)
Southwest	0.9x	0.77	x	2	x	44.07	0.4	x	0.7	=	17.1	(79)
Southwest	0.9x	0.77	x	1.45	x	44.07	0.4	x	0.7	=	12.4	(79)
Southwest	0.9x	0.77	x	2	x	31.49	0.4	x	0.7	=	12.22	(79)
Southwest	0.9x	0.77	x	1.45	x	31.49	0.4	x	0.7	=	8.86	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	27.61	48.02	68.33	89.06	103.78	104.79	100.3	89.05	75.46	53.78	33.25	23.51	(83)

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

(84)m=	392.92	410.6	419.2	422.05	418.96	403.69	389.45	383.64	380.16	376.5	375.97	380.88	(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=	0.88	0.86	0.82	0.76	0.66	0.52	0.39	0.41	0.58	0.74	0.84	0.88	(86)

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

(87)m=	19.45	19.62	19.91	20.29	20.62	20.86	20.95	20.94	20.81	20.42	19.9	19.42	(87)

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

(88)m=	20.45	20.45	20.45	20.46	20.46	20.47	20.47	20.47	20.47	20.46	20.46	20.46	(88)

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

(89)m=	0.87	0.85	0.81	0.74	0.64	0.49	0.35	0.37	0.55	0.73	0.83	0.88	(89)

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

(90)m=	19	19.16	19.45	19.82	20.14	20.37	20.44	20.44	20.31	19.95	19.45	18.97	(90)

fLA = Living area ÷ (4) = 0.63 (91)

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

(92)m=	19.28	19.45	19.74	20.12	20.44	20.68	20.76	20.76	20.62	20.25	19.73	19.26	(92)

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

(93)m=	19.28	19.45	19.74	20.12	20.44	20.68	20.76	20.76	20.62	20.25	19.73	19.26	(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=	0.85	0.83	0.79	0.73	0.64	0.5	0.38	0.4	0.56	0.72	0.81	0.86	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	333.77	340.41	332.77	308.76	267.09	202.43	146.5	151.83	211.2	270.1	304.95	326.49	(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=	575.94	557.61	505.82	422.4	328.31	224.81	153.97	160.63	242.73	362.28	477.18	572.03	(97)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(98)m=	180.17	145.96	128.75	81.82	45.55	0	0	0	0	68.58	124.01	182.69

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 957.53 (98)

Space heating requirement in kWh/m²/year 27.36 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(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)	180.17	145.96	128.75	81.82	45.55	0	0	0	0	68.58	124.01	182.69	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	180.17	145.96	128.75	81.82	45.55	0	0	0	0	68.58	124.01	182.69	(211)

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 957.53 (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

Water heating from separate community system:

Annual water heating requirement		1667.51	(64)
Fraction of heat from community CHP		1	(303a)
Factor for charging method for community water heating		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.1	(306)
Water heat from CHP	(64) x (303a) x (305) x (306) =	1834.27	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	18.34	(313)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			957.53	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		138.54		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		138.54	(231)
Electricity for lighting			185.19	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	126.3	(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 from CHP	(310a) x	4.24	x 0.01 =	77.77	(342a)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	18.27	(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 =	24.43	(250)
Additional standing charges (Table 12)				60	(251)

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

Total energy cost	(245)...(247) + (250)…(254) =	306.77	(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] =	1.61	(257)
SAP rating (Section 12)		77.53	(258)

12a. CO_2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO_2/kWh		**Emissions** kg CO_2/year	
Space heating (main system 1)	(211) x	0.519	=	496.96	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)

Water heating from community system

		Energy kWh/year	**Emission factor** kg CO_2/kWh		**Emissions** kg CO_2/year	
CO_2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
CO_2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	289.36	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	9.52	(372)
Total CO_2 associated with community systems	(363)…(366) + (368)...(372)			=	298.88	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	71.9	(267)
Electricity for lighting	(232) x		0.519	=	96.11	(268)
Total CO_2, kg/year		sum of (265)…(271) =			963.85	(272)
CO_2 emissions per m²		(272) ÷ (4) =			27.54	(273)
EI rating (section 14)					84	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	3.07	=	2939.6	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)

Water heating from community system

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		Energy kWh/year	Primary factor	Emissions kWh/year	
CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel			329	(367a)
Energy associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		3.07 =	1711.61	(367)
Electrical energy for heat distribution	[(313) x		2.92 =	53.56	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)		=	298.88	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		3.07 =	425.32	(267)
Electricity for lighting	(232) x		0 =	568.52	(268)
'Total Primary Energy	sum of (265)…(271) =			5698.61	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			162.82	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type B - ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	35	(1a) x	3.09	(2a) =	108.15	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	35	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	108.15	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.94	x	1	=	0.94			(26)
Doors Type 3			0.75	x	1	=	0.75			(26)
Doors Type 4			0.68	x	1	=	0.68			(26)
Windows Type 1			2	x1/[1/(1.2)+ 0.04]		=	2.29			(27)
Windows Type 2			1.04	x1/[1/(1.2)+ 0.04]		=	1.19			(27)
Windows Type 3			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Windows Type 4			1.45	x1/[1/(1.2)+ 0.04]		=	1.66			(27)
Walls Type1	15.48	4.24	11.24	x	0.13	=	1.46			(29)
Walls Type2	2.04	0	2.04	x	0.13	=	0.27			(29)
Walls Type3	2.87	0	2.87	x	0.13	=	0.37			(29)
Walls Type4	18.39	5.07	13.32	x	0.13	=	1.73			(29)
Roof	35	0	35	x	0.1	=	3.5			(30)
Total area of elements, m²			73.78							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 17.34 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 315 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 11.07 (36)

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

Total fabric heat loss — (33) + (36) = 28.41 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	10.03	9.92	9.81	9.25	9.14	8.58	8.58	8.47	8.81	9.14	9.36	9.59	(38)

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

(39)m=	38.44	38.33	38.22	37.66	37.55	36.99	36.99	36.88	37.21	37.55	37.77	37.99	

Average = Sum(39)$_{1…12}$ /12= 37.63 (39)

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

(40)m=	1.1	1.1	1.09	1.08	1.07	1.06	1.06	1.05	1.06	1.07	1.08	1.09	

Average = Sum(40)$_{1…12}$ /12= 1.08 (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 — 1.28 (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 — 64.62 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	71.08	68.49	65.91	63.32	60.74	58.16	58.16	60.74	63.32	65.91	68.49	71.08	

Total = Sum(44)$_{1…12}$ = 775.4 (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=	105.41	92.19	95.13	82.94	79.58	68.67	63.64	73.02	73.89	86.12	94	102.08	

Total = Sum(45)$_{1…12}$ = 1016.67 (45)

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

(46)m=	15.81	13.83	14.27	12.44	11.94	10.3	9.55	10.95	11.08	12.92	14.1	15.31	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

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

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

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 110 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a — 1.03 (52)

Temperature factor from Table 2b — 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	160.68	142.12	150.41	136.43	134.86	122.17	118.91	128.3	127.39	141.39	147.5	157.36	(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=	160.68	142.12	150.41	136.43	134.86	122.17	118.91	128.3	127.39	141.39	147.5	157.36

Output from water heater (annual)$_{1...12}$ 1667.51 (64)

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

(65)m=	79.27	70.6	75.85	70.37	70.68	65.63	65.38	68.5	67.36	72.86	74.05	78.16	(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=	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	(66)

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

(67)m=	10.49	9.31	7.57	5.73	4.29	3.62	3.91	5.08	6.82	8.66	10.11	10.78	(67)

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

(68)m=	109.19	110.33	107.47	101.39	93.72	86.51	81.69	80.56	83.41	89.49	97.16	104.38	(68)

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

(69)m=	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	(71)

Water heating gains (Table 5)

(72)m=	106.54	105.05	101.95	97.74	95	91.15	87.88	92.07	93.56	97.92	102.85	105.06	(72)

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

(73)m=	268.44	266.9	259.21	247.08	235.22	223.49	215.69	219.92	226.01	238.29	252.33	262.42	(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)	
Northeast	0.9x	0.77	x	1.04	x	11.28	x	0.4	x	0.7	=	2.28	(75)
Northeast	0.9x	0.77	x	0.32	x	11.28	x	0.4	x	0.7	=	0.7	(75)
Northeast	0.9x	0.77	x	1.04	x	22.97	x	0.4	x	0.7	=	4.63	(75)
Northeast	0.9x	0.77	x	0.32	x	22.97	x	0.4	x	0.7	=	1.43	(75)
Northeast	0.9x	0.77	x	1.04	x	41.38	x	0.4	x	0.7	=	8.35	(75)
Northeast	0.9x	0.77	x	0.32	x	41.38	x	0.4	x	0.7	=	2.57	(75)
Northeast	0.9x	0.77	x	1.04	x	67.96	x	0.4	x	0.7	=	13.71	(75)
Northeast	0.9x	0.77	x	0.32	x	67.96	x	0.4	x	0.7	=	4.22	(75)
Northeast	0.9x	0.77	x	1.04	x	91.35	x	0.4	x	0.7	=	18.43	(75)
Northeast	0.9x	0.77	x	0.32	x	91.35	x	0.4	x	0.7	=	5.67	(75)
Northeast	0.9x	0.77	x	1.04	x	97.38	x	0.4	x	0.7	=	19.65	(75)
Northeast	0.9x	0.77	x	0.32	x	97.38	x	0.4	x	0.7	=	6.05	(75)
Northeast	0.9x	0.77	x	1.04	x	91.1	x	0.4	x	0.7	=	18.38	(75)
Northeast	0.9x	0.77	x	0.32	x	91.1	x	0.4	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	1.04	x	72.63	x	0.4	x	0.7	=	14.66	(75)
Northeast	0.9x	0.77	x	0.32	x	72.63	x	0.4	x	0.7	=	4.51	(75)
Northeast	0.9x	0.77	x	1.04	x	50.42	x	0.4	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	0.32	x	50.42	x	0.4	x	0.7	=	3.13	(75)
Northeast	0.9x	0.77	x	1.04	x	28.07	x	0.4	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	0.32	x	28.07	x	0.4	x	0.7	=	1.74	(75)
Northeast	0.9x	0.77	x	1.04	x	14.2	x	0.4	x	0.7	=	2.86	(75)
Northeast	0.9x	0.77	x	0.32	x	14.2	x	0.4	x	0.7	=	0.88	(75)
Northeast	0.9x	0.77	x	1.04	x	9.21	x	0.4	x	0.7	=	1.86	(75)
Northeast	0.9x	0.77	x	0.32	x	9.21	x	0.4	x	0.7	=	0.57	(75)
Southwest	0.9x	0.77	x	2	x	36.79		0.4	x	0.7	=	14.28	(79)
Southwest	0.9x	0.77	x	1.45	x	36.79		0.4	x	0.7	=	10.35	(79)
Southwest	0.9x	0.77	x	2	x	62.67		0.4	x	0.7	=	24.32	(79)
Southwest	0.9x	0.77	x	1.45	x	62.67		0.4	x	0.7	=	17.63	(79)
Southwest	0.9x	0.77	x	2	x	85.75		0.4	x	0.7	=	33.28	(79)
Southwest	0.9x	0.77	x	1.45	x	85.75		0.4	x	0.7	=	24.13	(79)
Southwest	0.9x	0.77	x	2	x	106.25		0.4	x	0.7	=	41.23	(79)
Southwest	0.9x	0.77	x	1.45	x	106.25		0.4	x	0.7	=	29.89	(79)
Southwest	0.9x	0.77	x	2	x	119.01		0.4	x	0.7	=	46.19	(79)
Southwest	0.9x	0.77	x	1.45	x	119.01		0.4	x	0.7	=	33.48	(79)
Southwest	0.9x	0.77	x	2	x	118.15		0.4	x	0.7	=	45.85	(79)
Southwest	0.9x	0.77	x	1.45	x	118.15		0.4	x	0.7	=	33.24	(79)
Southwest	0.9x	0.77	x	2	x	113.91		0.4	x	0.7	=	44.21	(79)
Southwest	0.9x	0.77	x	1.45	x	113.91		0.4	x	0.7	=	32.05	(79)
Southwest	0.9x	0.77	x	2	x	104.39		0.4	x	0.7	=	40.51	(79)

Southwest	0.9x	0.77	x	1.45	x	104.39	0.4	x	0.7	=	29.37	(79)
Southwest	0.9x	0.77	x	2	x	92.85	0.4	x	0.7	=	36.03	(79)
Southwest	0.9x	0.77	x	1.45	x	92.85	0.4	x	0.7	=	26.12	(79)
Southwest	0.9x	0.77	x	2	x	69.27	0.4	x	0.7	=	26.88	(79)
Southwest	0.9x	0.77	x	1.45	x	69.27	0.4	x	0.7	=	19.49	(79)
Southwest	0.9x	0.77	x	2	x	44.07	0.4	x	0.7	=	17.1	(79)
Southwest	0.9x	0.77	x	1.45	x	44.07	0.4	x	0.7	=	12.4	(79)
Southwest	0.9x	0.77	x	2	x	31.49	0.4	x	0.7	=	12.22	(79)
Southwest	0.9x	0.77	x	1.45	x	31.49	0.4	x	0.7	=	8.86	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	27.61	48.02	68.33	89.06	103.78	104.79	100.3	89.05	75.46	53.78	33.25	23.51	(83)

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

(84)m=	296.04	314.92	327.54	336.14	339	328.28	315.98	308.97	301.47	292.06	285.58	285.93	(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=	0.93	0.91	0.88	0.83	0.74	0.61	0.47	0.5	0.67	0.83	0.9	0.93	(86)

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

(87)m=	19.09	19.28	19.62	20.08	20.49	20.8	20.93	20.91	20.71	20.22	19.6	19.06	(87)

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

(88)m=	20.45	20.45	20.45	20.46	20.46	20.47	20.47	20.47	20.47	20.46	20.46	20.46	(88)

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

(89)m=	0.92	0.91	0.88	0.82	0.72	0.57	0.42	0.45	0.64	0.81	0.89	0.93	(89)

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

(90)m=	18.64	18.84	19.17	19.62	20.02	20.31	20.42	20.41	20.24	19.76	19.16	18.62	(90)

fLA = Living area ÷ (4) = 0.63 (91)

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

(92)m=	18.93	19.12	19.45	19.91	20.31	20.62	20.74	20.73	20.54	20.05	19.44	18.9	(92)

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

(93)m=	18.93	19.12	19.45	19.91	20.31	20.62	20.74	20.73	20.54	20.05	19.44	18.9	(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=	0.91	0.89	0.86	0.8	0.71	0.58	0.45	0.47	0.64	0.8	0.88	0.91	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	268.42	279.9	281.04	269.78	242.12	190.56	141.61	145.98	194.13	233.16	250.67	261.04	(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=	562.21	544.94	495.07	414.5	323.43	222.64	153.11	159.6	239.52	354.83	465.95	558.39	(97)

DER WorkSheet: New dwelling design stage

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

(98)m=	218.58	178.1	159.23	104.2	60.5	0	0	0	0	90.52	155	221.23

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1187.36 (98)

Space heating requirement in kWh/m²/year 33.92 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 100 (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)	218.58	178.1	159.23	104.2	60.5	0	0	0	0	90.52	155	221.23	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	218.58	178.1	159.23	104.2	60.5	0	0	0	0	90.52	155	221.23	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1187.36 (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

Water heating from separate community system:

Annual water heating requirement 1667.51 (64)

Fraction of heat from community CHP 1 (303a)

Factor for charging method for community water heating 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.1 (306)

Water heat from CHP (64) x (303a) x (305) x (306) = 1834.27 (310a)

Electricity used for heat distribution 0.01 × [(307a)…(307e) + (310a)…(310e)] = 18.34 (313)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1187.36	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	138.54		(230a)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		138.54	(231)
Electricity for lighting		185.19	(232)

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	0.519	=	616.24	(261)

DER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating from community system					

		Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel			329	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52 =	289.36	(367)
Electrical energy for heat distribution	[(313) x		0.52 =	9.52	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	298.88	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519 =	71.9	(267)
Electricity for lighting	(232) x		0.519 =	96.11	(268)
Total CO2, kg/year		sum of (265)…(271) =		1083.13	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		30.95	(273)
EI rating (section 14)				82	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type B - ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	35	(1a) x	3.09	(2a) =	108.15	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	35	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	108.15	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =	0.18	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.43	(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

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

0.55	0.54	0.53	0.48	0.47	0.41	0.41	0.4	0.43	0.47	0.49	0.51

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0.65	0.65	0.64	0.61	0.61	0.59	0.59	0.58	0.59	0.61	0.62	0.63	(24d)

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

(25)m=	0.65	0.65	0.64	0.61	0.61	0.59	0.59	0.58	0.59	0.61	0.62	0.63	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.94	x	1	=	0.94			(26)
Doors Type 3			0.75	x	1	=	0.75			(26)
Doors Type 4			0.68	x	1	=	0.68			(26)
Windows Type 1			1.77	x1/[1/(1.4)+ 0.04]		=	2.35			(27)
Windows Type 2			0.92	x1/[1/(1.4)+ 0.04]		=	1.22			(27)
Windows Type 3			0.28	x1/[1/(1.4)+ 0.04]		=	0.37			(27)
Windows Type 4			1.28	x1/[1/(1.4)+ 0.04]		=	1.7			(27)
Walls Type1	15.48	4.08	11.4	x	0.18	=	2.05			(29)
Walls Type2	2.04	0	2.04	x	0.18	=	0.37			(29)
Walls Type3	2.87	0	2.87	x	0.18	=	0.52			(29)
Walls Type4	18.39	4.67	13.72	x	0.18	=	2.47			(29)
Roof	35	0	35	x	0.13	=	4.55			(30)
Total area of elements, m²			73.78							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 20.09 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 315 (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 — 3.69 (36)

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

Total fabric heat loss (33) + (36) = 23.78 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.33	23.12	22.91	21.93	21.75	20.89	20.89	20.73	21.22	21.75	22.12	22.51	(38)

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

(39)m=	47.11	46.9	46.69	45.71	45.52	44.67	44.67	44.51	45	45.52	45.9	46.28

Average = Sum(39)$_{1…12}$ /12= 45.71 (39)

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

(40)m=	1.35	1.34	1.33	1.31	1.3	1.28	1.28	1.27	1.29	1.3	1.31	1.32

Average = Sum(40)$_{1…12}$ /12= 1.31 (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 — 1.28 (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 — 64.62 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	71.08	68.49	65.91	63.32	60.74	58.16	58.16	60.74	63.32	65.91	68.49	71.08

Total = Sum(44)$_{1…12}$ = 775.4 (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=	105.41	92.19	95.13	82.94	79.58	68.67	63.64	73.02	73.89	86.12	94	102.08

Total = Sum(45)$_{1…12}$ = 1016.67 (45)

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

(46)m=	15.81	13.83	14.27	12.44	11.94	10.3	9.55	10.95	11.08	12.92	14.1	15.31	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (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): — 1.39 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

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

Enter (50) or (54) in (55) 0.75 (55)

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

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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	134.28	141.73	128.03	126.18	113.76	110.23	119.62	118.99	132.71	139.1	148.68	(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	134.28	141.73	128.03	126.18	113.76	110.23	119.62	118.99	132.71	139.1	148.68

Output from water heater (annual)$_{1...12}$ 1565.29 (64)

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

(65)m=	72.32	64.32	68.91	63.65	63.74	58.91	58.43	61.56	60.64	65.91	67.33	71.22	(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=	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	(66)

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

(67)m=	10.78	9.57	7.78	5.89	4.41	3.72	4.02	5.22	7.01	8.9	10.39	11.08	(67)

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

(68)m=	109.19	110.33	107.47	101.39	93.72	86.51	81.69	80.56	83.41	89.49	97.16	104.38	(68)

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

(69)m=	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	(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=	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	(71)

Water heating gains (Table 5)

(72)m=	97.21	95.72	92.62	88.4	85.67	81.82	78.54	82.74	84.23	88.59	93.51	95.72	(72)

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

(73)m=	262.39	260.83	253.08	240.9	229	217.25	209.46	213.73	219.86	232.19	246.28	256.39	(73)

6. Solar gains:

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

TER WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	0.92	x	11.28	x	0.63	x	0.7	=	3.17	(75)
Northeast 0.9x	0.77	x	0.28	x	11.28	x	0.63	x	0.7	=	0.97	(75)
Northeast 0.9x	0.77	x	0.92	x	22.97	x	0.63	x	0.7	=	6.46	(75)
Northeast 0.9x	0.77	x	0.28	x	22.97	x	0.63	x	0.7	=	1.97	(75)
Northeast 0.9x	0.77	x	0.92	x	41.38	x	0.63	x	0.7	=	11.63	(75)
Northeast 0.9x	0.77	x	0.28	x	41.38	x	0.63	x	0.7	=	3.54	(75)
Northeast 0.9x	0.77	x	0.92	x	67.96	x	0.63	x	0.7	=	19.11	(75)
Northeast 0.9x	0.77	x	0.28	x	67.96	x	0.63	x	0.7	=	5.82	(75)
Northeast 0.9x	0.77	x	0.92	x	91.35	x	0.63	x	0.7	=	25.68	(75)
Northeast 0.9x	0.77	x	0.28	x	91.35	x	0.63	x	0.7	=	7.82	(75)
Northeast 0.9x	0.77	x	0.92	x	97.38	x	0.63	x	0.7	=	27.38	(75)
Northeast 0.9x	0.77	x	0.28	x	97.38	x	0.63	x	0.7	=	8.33	(75)
Northeast 0.9x	0.77	x	0.92	x	91.1	x	0.63	x	0.7	=	25.61	(75)
Northeast 0.9x	0.77	x	0.28	x	91.1	x	0.63	x	0.7	=	7.8	(75)
Northeast 0.9x	0.77	x	0.92	x	72.63	x	0.63	x	0.7	=	20.42	(75)
Northeast 0.9x	0.77	x	0.28	x	72.63	x	0.63	x	0.7	=	6.21	(75)
Northeast 0.9x	0.77	x	0.92	x	50.42	x	0.63	x	0.7	=	14.18	(75)
Northeast 0.9x	0.77	x	0.28	x	50.42	x	0.63	x	0.7	=	4.31	(75)
Northeast 0.9x	0.77	x	0.92	x	28.07	x	0.63	x	0.7	=	7.89	(75)
Northeast 0.9x	0.77	x	0.28	x	28.07	x	0.63	x	0.7	=	2.4	(75)
Northeast 0.9x	0.77	x	0.92	x	14.2	x	0.63	x	0.7	=	3.99	(75)
Northeast 0.9x	0.77	x	0.28	x	14.2	x	0.63	x	0.7	=	1.21	(75)
Northeast 0.9x	0.77	x	0.92	x	9.21	x	0.63	x	0.7	=	2.59	(75)
Northeast 0.9x	0.77	x	0.28	x	9.21	x	0.63	x	0.7	=	0.79	(75)
Southwest 0.9x	0.77	x	1.77	x	36.79		0.63	x	0.7	=	19.9	(79)
Southwest 0.9x	0.77	x	1.28	x	36.79		0.63	x	0.7	=	14.39	(79)
Southwest 0.9x	0.77	x	1.77	x	62.67		0.63	x	0.7	=	33.9	(79)
Southwest 0.9x	0.77	x	1.28	x	62.67		0.63	x	0.7	=	24.52	(79)
Southwest 0.9x	0.77	x	1.77	x	85.75		0.63	x	0.7	=	46.39	(79)
Southwest 0.9x	0.77	x	1.28	x	85.75		0.63	x	0.7	=	33.55	(79)
Southwest 0.9x	0.77	x	1.77	x	106.25		0.63	x	0.7	=	57.48	(79)
Southwest 0.9x	0.77	x	1.28	x	106.25		0.63	x	0.7	=	41.56	(79)
Southwest 0.9x	0.77	x	1.77	x	119.01		0.63	x	0.7	=	64.38	(79)
Southwest 0.9x	0.77	x	1.28	x	119.01		0.63	x	0.7	=	46.56	(79)
Southwest 0.9x	0.77	x	1.77	x	118.15		0.63	x	0.7	=	63.91	(79)
Southwest 0.9x	0.77	x	1.28	x	118.15		0.63	x	0.7	=	46.22	(79)
Southwest 0.9x	0.77	x	1.77	x	113.91		0.63	x	0.7	=	61.62	(79)
Southwest 0.9x	0.77	x	1.28	x	113.91		0.63	x	0.7	=	44.56	(79)
Southwest 0.9x	0.77	x	1.77	x	104.39		0.63	x	0.7	=	56.47	(79)

Southwest	0.9x	0.77	x	1.28	x	104.39	0.63	x	0.7	=	40.84	(79)
Southwest	0.9x	0.77	x	1.77	x	92.85	0.63	x	0.7	=	50.23	(79)
Southwest	0.9x	0.77	x	1.28	x	92.85	0.63	x	0.7	=	36.32	(79)
Southwest	0.9x	0.77	x	1.77	x	69.27	0.63	x	0.7	=	37.47	(79)
Southwest	0.9x	0.77	x	1.28	x	69.27	0.63	x	0.7	=	27.1	(79)
Southwest	0.9x	0.77	x	1.77	x	44.07	0.63	x	0.7	=	23.84	(79)
Southwest	0.9x	0.77	x	1.28	x	44.07	0.63	x	0.7	=	17.24	(79)
Southwest	0.9x	0.77	x	1.77	x	31.49	0.63	x	0.7	=	17.03	(79)
Southwest	0.9x	0.77	x	1.28	x	31.49	0.63	x	0.7	=	12.32	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	38.43	66.84	95.11	123.96	144.43	145.84	139.59	123.94	105.04	74.86	46.29	32.73	(83)

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

(84)m=	300.83	327.67	348.19	364.86	373.44	363.1	349.05	337.67	324.9	307.05	292.56	289.12	(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	0.99	0.97	0.94	0.87	0.71	0.55	0.58	0.8	0.95	0.98	0.99	(86)

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

(87)m=	19.73	19.88	20.12	20.45	20.74	20.93	20.98	20.98	20.87	20.52	20.09	19.72	(87)

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

(88)m=	19.8	19.81	19.81	19.84	19.84	19.86	19.86	19.86	19.85	19.84	19.83	19.82	(88)

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

(89)m=	0.99	0.98	0.97	0.92	0.82	0.61	0.41	0.45	0.72	0.92	0.98	0.99	(89)

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

(90)m=	18.16	18.38	18.73	19.21	19.59	19.81	19.85	19.85	19.75	19.31	18.69	18.16	(90)

fLA = Living area ÷ (4) = | 0.63 | (91)

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

(92)m=	19.15	19.32	19.61	19.99	20.31	20.51	20.56	20.56	20.46	20.07	19.57	19.14	(92)

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

(93)m=	19.15	19.32	19.61	19.99	20.31	20.51	20.56	20.56	20.46	20.07	19.57	19.14	(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=	0.99	0.98	0.96	0.93	0.84	0.67	0.5	0.53	0.77	0.93	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	296.74	320.85	335.54	337.52	313.51	244.36	173.21	179.87	248.68	284.91	285.55	285.77	(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=	699.6	676.31	611.88	507.03	392.1	264.19	177.07	185.2	285.97	431.29	572.3	691.6	(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=	299.73	238.87	205.59	122.04	58.47	0	0	0	0	108.9	206.46	301.94

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1542.01 (98)

Space heating requirement in kWh/m²/year 44.06 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)	299.73	238.87	205.59	122.04	58.47	0	0	0	0	108.9	206.46	301.94		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	320.57	255.48	219.88	130.53	62.54	0	0	0	0	116.47	220.81	322.93		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													1649.21	(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

Water heating from separate community system:

Annual water heating requirement 1565.29 (64)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1649.21	
Water heating fuel used			1870.3	
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			190.32	(232)

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	=	356.23	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	403.98	(264)
Space and water heating	(261) + (262) + (263) + (264) =			760.21	(265)

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Water heating from community system

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Electrical energy for heat distribution		[(313) x	0	=	0	(372)
Total CO2 associated with community systems		(363)…(366) + (368)...(372)		=	0	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	98.78	(268)
Total CO2, kg/year			sum of (265)…(271) =		897.92	(272)

TER =	37.6	(273)

SAP Input

Property Details: Flat type C - ASHP

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	07 November 2019
Date of certificate:	12 May 2020
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Low
Water use <= 125 litres/person/day:	True
PCDF Version:	460

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2020	
Floor Location:	Floor area:	Storey height:
Floor 0	35.12 m²	3.09 m
Living area:	23.9 m² (fraction 0.681)	
Front of dwelling faces:	North East	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D6_01	Manufacturer	Solid			Metal
Vent_06_01	Manufacturer	Solid			
Vent_06_05	Manufacturer	Solid			
Vent_06_04	Manufacturer	Solid			
Vent_06_06	Manufacturer	Solid			
V_D6_01	Manufacturer	Solid			Metal
Window_06_01	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_06_04	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_06_04	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_06_05	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Fanlight	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D6_01	mm	0	0	1	2.13	1
Vent_06_01	mm	0	0	1	0.72	1
Vent_06_05	mm	0	0	1	0.99	1
Vent_06_04	mm	0	0	1	0.72	1
Vent_06_06	mm	0	0	1	0.72	1
V_D6_01	mm	0	0	1	0.63	1
Window_06_01	6mm	0.7	0.4	1.2	1.08	1
Window_06_04	6mm	0.7	0.4	1.2	1.97	1
Window_06_04	6mm	0.7	0.4	1.2	1.42	1
Window_06_05	6mm	0.7	0.4	1.2	1.45	1
Fanlight	6mm	0.7	0.4	1.2	0.32	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D6_01		06_01	North East	0	0
Vent_06_01		06_03	North East	0.6	1.2
Vent_06_05		06_03	South East	0.6	1.65
Vent_06_04		06_05	South West	0.6	1.2

SAP Input

Vent_06_06	06_06	South West	0.6	1.2
V_D6_01	06_01	North East	0.3	2.11
Window_06_01	06_03	North East	0.9	1.2
Window_06_04	06_04	South East	1.195	1.65
Window_06_04	06_05	South West	1.185	1.2
Window_06_05	06_06	South West	1.21	1.2
Fanlight	06_01	North East	1.01	0.315

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
06_01	10.506	3.08	7.43	0.13	0	False	N/A
06_03	8.065	2.79	5.27	0.13	0	False	N/A
06_04	19.498	1.97	17.53	0.13	0	False	N/A
06_05	9.425	2.14	7.29	0.13	0	False	N/A
06_06	9.023	2.17	6.85	0.13	0	False	N/A
R6_01	35.12	0	35.12	0.1	0		N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test: Yes (As designed)

Ventilation: Balanced with heat recovery
Number of wet rooms: Kitchen + 1
Ductwork: Insulation, rigid
Approved Installation Scheme: False

Number of chimneys: 0
Number of open flues: 0
Number of fans: 0
Number of passive stacks: 0
Number of sides sheltered: 0
Pressure test: 2.5

Main heating system:

Main heating system: Electric underfloor heating
Standard tariff
Fuel: Electricity
Info Source: SAP Tables
SAP Table: 425
In timber floor, or immediately below floor covering
Underfloor heating, pipes in insulated timber floor
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Room-sealed
Boiler interlock: Yes

Main heating Control:

Main heating Control: Programmer and room thermostat
Control code: 2704

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating: 952 From DHW-only community scheme

SAP Input

	Heat source: From hot-water only community scheme - heat pump heat from electric heat pump, heat fraction 1, efficiency 329 Piping>=1991, pre-insulated, low temp, variable flow No hot water cylinder Solar panel: False
Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat type C - ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	35.12	(1a)	x	3.09	(2a)	=	108.52	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	35.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	108.52	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	75.65	(23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.72	x	1	=	0.72			(26)
Doors Type 3			0.99	x	1	=	0.99			(26)
Doors Type 4			0.72	x	1	=	0.72			(26)
Doors Type 5			0.72	x	1	=	0.72			(26)
Doors Type 6			0.63	x	1	=	0.63			(26)
Windows Type 1			1.08	x1/[1/(1.2)+ 0.04]		=	1.24			(27)
Windows Type 2			1.97	x1/[1/(1.2)+ 0.04]		=	2.26			(27)
Windows Type 3			1.42	x1/[1/(1.2)+ 0.04]		=	1.63			(27)
Windows Type 4			1.45	x1/[1/(1.2)+ 0.04]		=	1.66			(27)
Windows Type 5			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Walls Type1	10.51	3.08	7.43	x	0.13	=	0.97			(29)
Walls Type2	8.06	2.79	5.27	x	0.13	=	0.69			(29)
Walls Type3	19.5	1.97	17.53	x	0.13	=	2.28			(29)
Walls Type4	9.43	2.14	7.29	x	0.13	=	0.95			(29)
Walls Type5	9.02	2.17	6.85	x	0.13	=	0.89			(29)
Roof	35.12	0	35.12	x	0.1	=	3.51			(30)
Total area of elements, m²			91.64							(31)

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

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	22.33	(33)

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Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 316.08 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 13.75 (36)

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

Total fabric heat loss (33) + (36) = 36.08 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	10.07	9.96	9.84	9.28	9.17	8.61	8.61	8.5	8.84	9.17	9.4	9.62	(38)

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

(39)m=	46.15	46.04	45.92	45.36	45.25	44.69	44.69	44.58	44.92	45.25	45.48	45.7	

Average = $Sum(39)_{1…12}$ /12= 45.34 (39)

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

(40)m=	1.31	1.31	1.31	1.29	1.29	1.27	1.27	1.27	1.28	1.29	1.29	1.3

Average = $Sum(40)_{1…12}$ /12= 1.29 (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 1.28 (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 64.68 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	71.15	68.56	65.98	63.39	60.8	58.22	58.22	60.8	63.39	65.98	68.56	71.15

Total = $Sum(44)_{1…12}$ = 776.21 (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=	105.52	92.29	95.23	83.02	79.66	68.74	63.7	73.1	73.97	86.21	94.1	102.19

Total = $Sum(45)_{1…12}$ = 1017.73 (45)

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

(46)m=	15.83	13.84	14.28	12.45	11.95	10.31	9.56	10.96	11.1	12.93	14.12	15.33	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
If community heating see section 4.3		
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.6	(53)
Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3	0	(58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	160.79	142.21	150.51	136.52	134.94	122.24	118.98	128.37	127.46	141.48	147.59	157.46	(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=	160.79	142.21	150.51	136.52	134.94	122.24	118.98	128.37	127.46	141.48	147.59	157.46	

Output from water heater (annual)$_{1...12}$ 1668.57 (64)

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

(65)m=	79.31	70.63	75.89	70.4	70.71	65.65	65.4	68.53	67.39	72.89	74.08	78.2	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	77.01	77.01	77.01	77.01	77.01	77.01	77.01	77.01	77.01	77.01	77.01	77.01	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	24.98	22.18	18.04	13.66	10.21	8.62	9.31	12.11	16.25	20.63	24.08	25.67	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	163.41	165.11	160.83	151.74	140.25	129.46	122.25	120.55	124.83	133.92	145.41	156.2	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	43.98	43.98	43.98	43.98	43.98	43.98	43.98	43.98	43.98	43.98	43.98	43.98	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	(71)
Water heating gains (Table 5)													
(72)m=	106.59	105.1	102	97.78	95.04	91.18	87.91	92.11	93.6	97.96	102.89	105.11	(72)

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

(73)m=	364.63	362.04	350.52	332.83	315.16	298.92	289.12	294.42	304.33	322.17	342.04	356.63	(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)	
Northeast 0.9x	0.77	x	1.08	x	11.28	x	0.4	x	0.7	=	2.36	(75)
Northeast 0.9x	0.77	x	0.32	x	11.28	x	0.4	x	0.7	=	0.7	(75)
Northeast 0.9x	0.77	x	1.08	x	22.97	x	0.4	x	0.7	=	4.81	(75)
Northeast 0.9x	0.77	x	0.32	x	22.97	x	0.4	x	0.7	=	1.43	(75)
Northeast 0.9x	0.77	x	1.08	x	41.38	x	0.4	x	0.7	=	8.67	(75)
Northeast 0.9x	0.77	x	0.32	x	41.38	x	0.4	x	0.7	=	2.57	(75)
Northeast 0.9x	0.77	x	1.08	x	67.96	x	0.4	x	0.7	=	14.24	(75)
Northeast 0.9x	0.77	x	0.32	x	67.96	x	0.4	x	0.7	=	4.22	(75)
Northeast 0.9x	0.77	x	1.08	x	91.35	x	0.4	x	0.7	=	19.14	(75)
Northeast 0.9x	0.77	x	0.32	x	91.35	x	0.4	x	0.7	=	5.67	(75)
Northeast 0.9x	0.77	x	1.08	x	97.38	x	0.4	x	0.7	=	20.41	(75)
Northeast 0.9x	0.77	x	0.32	x	97.38	x	0.4	x	0.7	=	6.05	(75)
Northeast 0.9x	0.77	x	1.08	x	91.1	x	0.4	x	0.7	=	19.09	(75)
Northeast 0.9x	0.77	x	0.32	x	91.1	x	0.4	x	0.7	=	5.66	(75)
Northeast 0.9x	0.77	x	1.08	x	72.63	x	0.4	x	0.7	=	15.22	(75)
Northeast 0.9x	0.77	x	0.32	x	72.63	x	0.4	x	0.7	=	4.51	(75)
Northeast 0.9x	0.77	x	1.08	x	50.42	x	0.4	x	0.7	=	10.57	(75)
Northeast 0.9x	0.77	x	0.32	x	50.42	x	0.4	x	0.7	=	3.13	(75)
Northeast 0.9x	0.77	x	1.08	x	28.07	x	0.4	x	0.7	=	5.88	(75)
Northeast 0.9x	0.77	x	0.32	x	28.07	x	0.4	x	0.7	=	1.74	(75)
Northeast 0.9x	0.77	x	1.08	x	14.2	x	0.4	x	0.7	=	2.98	(75)
Northeast 0.9x	0.77	x	0.32	x	14.2	x	0.4	x	0.7	=	0.88	(75)
Northeast 0.9x	0.77	x	1.08	x	9.21	x	0.4	x	0.7	=	1.93	(75)
Northeast 0.9x	0.77	x	0.32	x	9.21	x	0.4	x	0.7	=	0.57	(75)
Southeast 0.9x	0.77	x	1.97	x	36.79	x	0.4	x	0.7	=	14.06	(77)
Southeast 0.9x	0.77	x	1.97	x	62.67	x	0.4	x	0.7	=	23.96	(77)
Southeast 0.9x	0.77	x	1.97	x	85.75	x	0.4	x	0.7	=	32.78	(77)
Southeast 0.9x	0.77	x	1.97	x	106.25	x	0.4	x	0.7	=	40.62	(77)
Southeast 0.9x	0.77	x	1.97	x	119.01	x	0.4	x	0.7	=	45.49	(77)
Southeast 0.9x	0.77	x	1.97	x	118.15	x	0.4	x	0.7	=	45.16	(77)
Southeast 0.9x	0.77	x	1.97	x	113.91	x	0.4	x	0.7	=	43.54	(77)
Southeast 0.9x	0.77	x	1.97	x	104.39	x	0.4	x	0.7	=	39.9	(77)
Southeast 0.9x	0.77	x	1.97	x	92.85	x	0.4	x	0.7	=	35.49	(77)
Southeast 0.9x	0.77	x	1.97	x	69.27	x	0.4	x	0.7	=	26.48	(77)

Southeast 0.9x	0.77	x	1.97	x	44.07	x	0.4	x	0.7	=	16.85	(77)
Southeast 0.9x	0.77	x	1.97	x	31.49	x	0.4	x	0.7	=	12.04	(77)
Southwest 0.9x	0.77	x	1.42	x	36.79		0.4	x	0.7	=	10.14	(79)
Southwest 0.9x	0.77	x	1.45	x	36.79		0.4	x	0.7	=	10.35	(79)
Southwest 0.9x	0.77	x	1.42	x	62.67		0.4	x	0.7	=	17.27	(79)
Southwest 0.9x	0.77	x	1.45	x	62.67		0.4	x	0.7	=	17.63	(79)
Southwest 0.9x	0.77	x	1.42	x	85.75		0.4	x	0.7	=	23.63	(79)
Southwest 0.9x	0.77	x	1.45	x	85.75		0.4	x	0.7	=	24.13	(79)
Southwest 0.9x	0.77	x	1.42	x	106.25		0.4	x	0.7	=	29.28	(79)
Southwest 0.9x	0.77	x	1.45	x	106.25		0.4	x	0.7	=	29.89	(79)
Southwest 0.9x	0.77	x	1.42	x	119.01		0.4	x	0.7	=	32.79	(79)
Southwest 0.9x	0.77	x	1.45	x	119.01		0.4	x	0.7	=	33.48	(79)
Southwest 0.9x	0.77	x	1.42	x	118.15		0.4	x	0.7	=	32.55	(79)
Southwest 0.9x	0.77	x	1.45	x	118.15		0.4	x	0.7	=	33.24	(79)
Southwest 0.9x	0.77	x	1.42	x	113.91		0.4	x	0.7	=	31.39	(79)
Southwest 0.9x	0.77	x	1.45	x	113.91		0.4	x	0.7	=	32.05	(79)
Southwest 0.9x	0.77	x	1.42	x	104.39		0.4	x	0.7	=	28.76	(79)
Southwest 0.9x	0.77	x	1.45	x	104.39		0.4	x	0.7	=	29.37	(79)
Southwest 0.9x	0.77	x	1.42	x	92.85		0.4	x	0.7	=	25.58	(79)
Southwest 0.9x	0.77	x	1.45	x	92.85		0.4	x	0.7	=	26.12	(79)
Southwest 0.9x	0.77	x	1.42	x	69.27		0.4	x	0.7	=	19.09	(79)
Southwest 0.9x	0.77	x	1.45	x	69.27		0.4	x	0.7	=	19.49	(79)
Southwest 0.9x	0.77	x	1.42	x	44.07		0.4	x	0.7	=	12.14	(79)
Southwest 0.9x	0.77	x	1.45	x	44.07		0.4	x	0.7	=	12.4	(79)
Southwest 0.9x	0.77	x	1.42	x	31.49		0.4	x	0.7	=	8.68	(79)
Southwest 0.9x	0.77	x	1.45	x	31.49		0.4	x	0.7	=	8.86	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	37.62	65.1	91.78	118.25	136.58	137.42	131.73	117.77	100.9	72.68	45.25	32.08	(83)

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

(84)m=	402.25	427.14	442.3	451.07	451.74	436.33	420.85	412.19	405.23	394.85	387.28	388.71	(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=	0.89	0.87	0.83	0.77	0.68	0.55	0.43	0.45	0.61	0.77	0.86	0.89	(86)

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

(87)m=	19.01	19.21	19.57	20.03	20.46	20.78	20.91	20.9	20.69	20.19	19.54	18.97	(87)

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

(88)m=	20.34	20.34	20.35	20.35	20.36	20.36	20.36	20.37	20.36	20.36	20.35	20.35	(88)

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

(89)m=	0.88	0.86	0.82	0.76	0.66	0.51	0.37	0.4	0.57	0.75	0.84	0.89	(89)

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

(90)m=	18.48	18.69	19.03	19.49	19.9	20.2	20.31	20.3	20.12	19.65	19.02	18.45	(90)

fLA = Living area ÷ (4) = 0.68 (91)

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

(92)m=	18.84	19.05	19.4	19.86	20.28	20.59	20.72	20.71	20.51	20.01	19.37	18.8	(92)

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

(93)m=	18.84	19.05	19.4	19.86	20.28	20.59	20.72	20.71	20.51	20.01	19.37	18.8	(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=	0.86	0.84	0.8	0.74	0.65	0.53	0.4	0.43	0.58	0.74	0.82	0.87	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	345.36	357.5	354.66	334.87	295.24	229.51	169.75	175.2	235.8	290.41	319.02	336.73	(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=	671.06	651.2	592.26	497.16	388.12	267.79	184.2	192.09	287.99	426.04	558.19	667.4	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	242.32	197.37	176.77	116.85	69.11	0	0	0	0	100.91	172.2	246.01	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1321.54 (98)

Space heating requirement in kWh/m²/year 37.63 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(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)													
	242.32	197.37	176.77	116.85	69.11	0	0	0	0	100.91	172.2	246.01	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	242.32	197.37	176.77	116.85	69.11	0	0	0	0	100.91	172.2	246.01	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1321.54 (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	0

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

Water heating

Water heating from separate community system:

Annual water heating requirement	1668.57	(64)
Fraction of heat from community CHP	1	(303a)

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Factor for charging method for community water heating			1	(305)
Distribution loss factor (Table 12c) for community heating system			1.05	(306)
Water heat from CHP	(64) x (303a) x (305) x (306) =		1752	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =		17.52	(313)
Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1321.54	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		139.02		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		139.02	(231)
Electricity for lighting			176.43	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	174.31	(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 from CHP	(310a) x	4.24	x 0.01 =	74.28	(342a)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	18.34	(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 =	23.27	(250)
Additional standing charges (Table 12)				60	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			350.2	(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] =	1.84	(257)
SAP rating (Section 12)		74.39	(258)

12a. CO_2 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	0.519	=	685.88	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)

Water heating from community system

	Energy **kWh/year**	**Emission factor** **kg CO2/kWh**	**Emissions** **kg CO2/year**	
CO2 from other sources of space and water heating (not CHP)				
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		329	(367a)

CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	276.38	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	9.09	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	285.47	(373)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	72.15	(267)
Electricity for lighting	(232) x	0.519	=	91.57	(268)
Total CO2, kg/year	sum of (265)…(271) =			1135.07	(272)
CO2 emissions per m²	(272) ÷ (4) =			32.32	(273)
EI rating (section 14)				81	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	3.07	=	4057.12	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Water heating from community system					

	Energy kWh/year	Primary factor		Emissions kWh/year	
CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel			329	(367a)
Energy associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	3.07	=	1634.84	(367)
Electrical energy for heat distribution	[(313) x	2.92	=	51.16	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)		=	285.47	(373)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	426.78	(267)
Electricity for lighting	(232) x	0	=	541.64	(268)
‘Total Primary Energy	sum of (265)…(271) =			6711.54	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			191.1	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat type C - ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	35.12	(1a) x	3.09	(2a) =	108.52	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	35.12	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	108.52	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.72	x	1	=	0.72			(26)
Doors Type 3			0.99	x	1	=	0.99			(26)
Doors Type 4			0.72	x	1	=	0.72			(26)
Doors Type 5			0.72	x	1	=	0.72			(26)
Doors Type 6			0.63	x	1	=	0.63			(26)
Windows Type 1			1.08	x1/[1/(1.2)+ 0.04]		=	1.24			(27)
Windows Type 2			1.97	x1/[1/(1.2)+ 0.04]		=	2.26			(27)
Windows Type 3			1.42	x1/[1/(1.2)+ 0.04]		=	1.63			(27)
Windows Type 4			1.45	x1/[1/(1.2)+ 0.04]		=	1.66			(27)
Windows Type 5			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Walls Type1	10.51	3.08	7.43	x	0.13	=	0.97			(29)
Walls Type2	8.06	2.79	5.27	x	0.13	=	0.69			(29)
Walls Type3	19.5	1.97	17.53	x	0.13	=	2.28			(29)
Walls Type4	9.43	2.14	7.29	x	0.13	=	0.95			(29)
Walls Type5	9.02	2.17	6.85	x	0.13	=	0.89			(29)
Roof	35.12	0	35.12	x	0.1	=	3.51			(30)
Total area of elements, m²			91.64							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 22.33 (33)

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Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 316.08 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 13.75 (36)

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

Total fabric heat loss (33) + (36) = 36.08 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	10.07	9.96	9.84	9.28	9.17	8.61	8.61	8.5	8.84	9.17	9.4	9.62	(38)

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

(39)m=	46.15	46.04	45.92	45.36	45.25	44.69	44.69	44.58	44.92	45.25	45.48	45.7	

Average = $Sum(39)_{1…12}$ /12= 45.34 (39)

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

(40)m=	1.31	1.31	1.31	1.29	1.29	1.27	1.27	1.27	1.28	1.29	1.29	1.3

Average = $Sum(40)_{1…12}$ /12= 1.29 (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 1.28 (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 64.68 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	71.15	68.56	65.98	63.39	60.8	58.22	58.22	60.8	63.39	65.98	68.56	71.15

Total = $Sum(44)_{1…12}$ = 776.21 (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=	105.52	92.29	95.23	83.02	79.66	68.74	63.7	73.1	73.97	86.21	94.1	102.19

Total = $Sum(45)_{1…12}$ = 1017.73 (45)

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

(46)m=	15.83	13.84	14.28	12.45	11.95	10.31	9.56	10.96	11.1	12.93	14.12	15.33	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	160.79	142.21	150.51	136.52	134.94	122.24	118.98	128.37	127.46	141.48	147.59	157.46	(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=	160.79	142.21	150.51	136.52	134.94	122.24	118.98	128.37	127.46	141.48	147.59	157.46

Output from water heater (annual)$_{1...12}$ 1668.57 (64)

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

(65)m=	79.31	70.63	75.89	70.4	70.71	65.65	65.4	68.53	67.39	72.89	74.08	78.2	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	(66)

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

(67)m=	9.99	8.87	7.22	5.46	4.08	3.45	3.73	4.84	6.5	8.25	9.63	10.27	(67)

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

(68)m=	109.48	110.62	107.76	101.66	93.97	86.74	81.91	80.77	83.63	89.73	97.42	104.65	(68)

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

(69)m=	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	(71)

Water heating gains (Table 5)

(72)m=	106.59	105.1	102	97.78	95.04	91.18	87.91	92.11	93.6	97.96	102.89	105.11	(72)

DER WorkSheet: New dwelling design stage

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

(73)m=	268.32	266.85	259.22	247.16	235.35	223.62	215.79	219.97	225.98	238.2	252.2	262.28	(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)	
Northeast 0.9x	0.77	x	1.08	x	11.28	x	0.4	x	0.7	=	2.36	(75)
Northeast 0.9x	0.77	x	0.32	x	11.28	x	0.4	x	0.7	=	0.7	(75)
Northeast 0.9x	0.77	x	1.08	x	22.97	x	0.4	x	0.7	=	4.81	(75)
Northeast 0.9x	0.77	x	0.32	x	22.97	x	0.4	x	0.7	=	1.43	(75)
Northeast 0.9x	0.77	x	1.08	x	41.38	x	0.4	x	0.7	=	8.67	(75)
Northeast 0.9x	0.77	x	0.32	x	41.38	x	0.4	x	0.7	=	2.57	(75)
Northeast 0.9x	0.77	x	1.08	x	67.96	x	0.4	x	0.7	=	14.24	(75)
Northeast 0.9x	0.77	x	0.32	x	67.96	x	0.4	x	0.7	=	4.22	(75)
Northeast 0.9x	0.77	x	1.08	x	91.35	x	0.4	x	0.7	=	19.14	(75)
Northeast 0.9x	0.77	x	0.32	x	91.35	x	0.4	x	0.7	=	5.67	(75)
Northeast 0.9x	0.77	x	1.08	x	97.38	x	0.4	x	0.7	=	20.41	(75)
Northeast 0.9x	0.77	x	0.32	x	97.38	x	0.4	x	0.7	=	6.05	(75)
Northeast 0.9x	0.77	x	1.08	x	91.1	x	0.4	x	0.7	=	19.09	(75)
Northeast 0.9x	0.77	x	0.32	x	91.1	x	0.4	x	0.7	=	5.66	(75)
Northeast 0.9x	0.77	x	1.08	x	72.63	x	0.4	x	0.7	=	15.22	(75)
Northeast 0.9x	0.77	x	0.32	x	72.63	x	0.4	x	0.7	=	4.51	(75)
Northeast 0.9x	0.77	x	1.08	x	50.42	x	0.4	x	0.7	=	10.57	(75)
Northeast 0.9x	0.77	x	0.32	x	50.42	x	0.4	x	0.7	=	3.13	(75)
Northeast 0.9x	0.77	x	1.08	x	28.07	x	0.4	x	0.7	=	5.88	(75)
Northeast 0.9x	0.77	x	0.32	x	28.07	x	0.4	x	0.7	=	1.74	(75)
Northeast 0.9x	0.77	x	1.08	x	14.2	x	0.4	x	0.7	=	2.98	(75)
Northeast 0.9x	0.77	x	0.32	x	14.2	x	0.4	x	0.7	=	0.88	(75)
Northeast 0.9x	0.77	x	1.08	x	9.21	x	0.4	x	0.7	=	1.93	(75)
Northeast 0.9x	0.77	x	0.32	x	9.21	x	0.4	x	0.7	=	0.57	(75)
Southeast 0.9x	0.77	x	1.97	x	36.79	x	0.4	x	0.7	=	14.06	(77)
Southeast 0.9x	0.77	x	1.97	x	62.67	x	0.4	x	0.7	=	23.96	(77)
Southeast 0.9x	0.77	x	1.97	x	85.75	x	0.4	x	0.7	=	32.78	(77)
Southeast 0.9x	0.77	x	1.97	x	106.25	x	0.4	x	0.7	=	40.62	(77)
Southeast 0.9x	0.77	x	1.97	x	119.01	x	0.4	x	0.7	=	45.49	(77)
Southeast 0.9x	0.77	x	1.97	x	118.15	x	0.4	x	0.7	=	45.16	(77)
Southeast 0.9x	0.77	x	1.97	x	113.91	x	0.4	x	0.7	=	43.54	(77)
Southeast 0.9x	0.77	x	1.97	x	104.39	x	0.4	x	0.7	=	39.9	(77)
Southeast 0.9x	0.77	x	1.97	x	92.85	x	0.4	x	0.7	=	35.49	(77)
Southeast 0.9x	0.77	x	1.97	x	69.27	x	0.4	x	0.7	=	26.48	(77)

Southeast	0.9x	0.77	x	1.97	x	44.07	x	0.4	x	0.7	=	16.85	(77)
Southeast	0.9x	0.77	x	1.97	x	31.49	x	0.4	x	0.7	=	12.04	(77)
Southwest	0.9x	0.77	x	1.42	x	36.79		0.4	x	0.7	=	10.14	(79)
Southwest	0.9x	0.77	x	1.45	x	36.79		0.4	x	0.7	=	10.35	(79)
Southwest	0.9x	0.77	x	1.42	x	62.67		0.4	x	0.7	=	17.27	(79)
Southwest	0.9x	0.77	x	1.45	x	62.67		0.4	x	0.7	=	17.63	(79)
Southwest	0.9x	0.77	x	1.42	x	85.75		0.4	x	0.7	=	23.63	(79)
Southwest	0.9x	0.77	x	1.45	x	85.75		0.4	x	0.7	=	24.13	(79)
Southwest	0.9x	0.77	x	1.42	x	106.25		0.4	x	0.7	=	29.28	(79)
Southwest	0.9x	0.77	x	1.45	x	106.25		0.4	x	0.7	=	29.89	(79)
Southwest	0.9x	0.77	x	1.42	x	119.01		0.4	x	0.7	=	32.79	(79)
Southwest	0.9x	0.77	x	1.45	x	119.01		0.4	x	0.7	=	33.48	(79)
Southwest	0.9x	0.77	x	1.42	x	118.15		0.4	x	0.7	=	32.55	(79)
Southwest	0.9x	0.77	x	1.45	x	118.15		0.4	x	0.7	=	33.24	(79)
Southwest	0.9x	0.77	x	1.42	x	113.91		0.4	x	0.7	=	31.39	(79)
Southwest	0.9x	0.77	x	1.45	x	113.91		0.4	x	0.7	=	32.05	(79)
Southwest	0.9x	0.77	x	1.42	x	104.39		0.4	x	0.7	=	28.76	(79)
Southwest	0.9x	0.77	x	1.45	x	104.39		0.4	x	0.7	=	29.37	(79)
Southwest	0.9x	0.77	x	1.42	x	92.85		0.4	x	0.7	=	25.58	(79)
Southwest	0.9x	0.77	x	1.45	x	92.85		0.4	x	0.7	=	26.12	(79)
Southwest	0.9x	0.77	x	1.42	x	69.27		0.4	x	0.7	=	19.09	(79)
Southwest	0.9x	0.77	x	1.45	x	69.27		0.4	x	0.7	=	19.49	(79)
Southwest	0.9x	0.77	x	1.42	x	44.07		0.4	x	0.7	=	12.14	(79)
Southwest	0.9x	0.77	x	1.45	x	44.07		0.4	x	0.7	=	12.4	(79)
Southwest	0.9x	0.77	x	1.42	x	31.49		0.4	x	0.7	=	8.68	(79)
Southwest	0.9x	0.77	x	1.45	x	31.49		0.4	x	0.7	=	8.86	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	37.62	65.1	91.78	118.25	136.58	137.42	131.73	117.77	100.9	72.68	45.25	32.08	(83)

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

(84)m=	305.94	331.95	351	365.4	371.93	361.04	347.52	337.74	326.88	310.88	297.45	294.36	(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=	0.93	0.92	0.89	0.84	0.75	0.62	0.5	0.52	0.69	0.84	0.91	0.94	(86)

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

(87)m=	18.66	18.89	19.29	19.82	20.31	20.7	20.88	20.86	20.59	19.98	19.25	18.62	(87)

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

(88)m=	20.34	20.34	20.35	20.35	20.36	20.36	20.36	20.37	20.36	20.36	20.35	20.35	(88)

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

(89)m=	0.93	0.91	0.88	0.82	0.73	0.58	0.44	0.47	0.65	0.82	0.9	0.93	(89)

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

(90)m=	18.14	18.37	18.76	19.29	19.77	20.14	20.29	20.27	20.03	19.45	18.73	18.11	(90)

fLA = Living area ÷ (4) = 0.68 (91)

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

(92)m=	18.5	18.73	19.12	19.65	20.14	20.52	20.69	20.67	20.41	19.81	19.08	18.46	(92)

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

(93)m=	18.5	18.73	19.12	19.65	20.14	20.52	20.69	20.67	20.41	19.81	19.08	18.46	(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=	0.91	0.89	0.86	0.8	0.72	0.59	0.47	0.49	0.66	0.8	0.88	0.91	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	277.81	294.91	300.74	293.22	267.19	214.58	162.73	166.89	215.08	249.99	261.98	269.17	(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=	655.16	636.48	579.63	487.61	381.9	264.68	182.82	190.44	283.54	416.79	544.89	651.6	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	280.75	229.54	207.49	139.96	85.34	0	0	0	0	124.1	203.7	284.53	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1555.42 (98)

Space heating requirement in kWh/m²/year 44.29 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(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)													
	280.75	229.54	207.49	139.96	85.34	0	0	0	0	124.1	203.7	284.53	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	280.75	229.54	207.49	139.96	85.34	0	0	0	0	124.1	203.7	284.53	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1555.42 (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

Water heating from separate community system:

Annual water heating requirement	1668.57	(64)
Fraction of heat from community CHP	1	(303a)

DER WorkSheet: New dwelling design stage

Factor for charging method for community water heating			1	(305)
Distribution loss factor (Table 12c) for community heating system			1.05	(306)
Water heat from CHP	(64) x (303a) x (305) x (306) =		1752	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =		17.52	(313)
Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1555.42	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		139.02		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		139.02	(231)
Electricity for lighting			176.43	(232)

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	0.519	=	807.26	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating from community system					

		Energy kWh/year	**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	276.38	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	9.09	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	285.47	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	72.15	(267)
Electricity for lighting	(232) x		0.519	=	91.57	(268)
Total CO2, kg/year	sum of (265)…(271) =				1256.45	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =				35.78	(273)
EI rating (section 14)					79	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Adam Ritchie
Stroma Number: STRO019516
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.25

Property Address: Flat type C - ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	35.12	(1a) x	3.09	(2a) =	108.52	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	35.12	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	108.52	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =	0.18	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.43	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.55	0.54	0.53	0.48	0.47	0.41	0.41	0.4	0.43	0.47	0.49	0.51

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0.65	0.65	0.64	0.61	0.61	0.59	0.59	0.58	0.59	0.61	0.62	0.63	(24d)

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

(25)m=	0.65	0.65	0.64	0.61	0.61	0.59	0.59	0.58	0.59	0.61	0.62	0.63	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.72	x	1	=	0.72			(26)
Doors Type 3			0.99	x	1	=	0.99			(26)
Doors Type 4			0.72	x	1	=	0.72			(26)
Doors Type 5			0.72	x	1	=	0.72			(26)
Doors Type 6			0.63	x	1	=	0.63			(26)
Windows Type 1			0.5	x1/[1/(1.4)+ 0.04]		=	0.66			(27)
Windows Type 2			0.91	x1/[1/(1.4)+ 0.04]		=	1.21			(27)
Windows Type 3			0.65	x1/[1/(1.4)+ 0.04]		=	0.86			(27)
Windows Type 4			0.67	x1/[1/(1.4)+ 0.04]		=	0.89			(27)
Windows Type 5			0.15	x1/[1/(1.4)+ 0.04]		=	0.2			(27)
Walls Type1	10.51	2.91	7.6	x	0.18	=	1.37			(29)
Walls Type2	8.06	2.21	5.85	x	0.18	=	1.05			(29)
Walls Type3	19.5	0.91	18.59	x	0.18	=	3.35			(29)
Walls Type4	9.43	1.37	8.06	x	0.18	=	1.45			(29)
Walls Type5	9.02	1.39	7.63	x	0.18	=	1.37			(29)
Roof	35.12	0	35.12	x	0.13	=	4.57			(30)
Total area of elements, m²			91.64							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 22.88 (33)

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Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	316.08	(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		4.58	(36)

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

Total fabric heat loss	(33) + (36) =	27.47	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.4	23.18	22.97	21.99	21.81	20.95	20.95	20.8	21.28	21.81	22.18	22.57	(38)

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

(39)m=	50.86	50.65	50.44	49.46	49.28	48.42	48.42	48.26	48.75	49.28	49.65	50.04	

Average = Sum(39)$_{1…12}$ /12= 49.46 (39)

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

(40)m=	1.45	1.44	1.44	1.41	1.4	1.38	1.38	1.37	1.39	1.4	1.41	1.42	

Average = Sum(40)$_{1…12}$ /12= 1.41 (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 1.28 (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 64.68 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	71.15	68.56	65.98	63.39	60.8	58.22	58.22	60.8	63.39	65.98	68.56	71.15	

Total = Sum(44)$_{1…12}$ = 776.21 (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=	105.52	92.29	95.23	83.02	79.66	68.74	63.7	73.1	73.97	86.21	94.1	102.19	

Total = Sum(45)$_{1…12}$ = 1017.73 (45)

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

(46)m=	15.83	13.84	14.28	12.45	11.95	10.31	9.56	10.96	11.1	12.93	14.12	15.33	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (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): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

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

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Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If community heating see section 4.3		
Volume factor from Table 2a	0	(52)
Temperature factor from Table 2b	0	(53)
Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)	0.75	(55)

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

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3	0	(58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	152.11	134.37	141.83	128.12	126.26	113.84	110.3	119.69	119.06	132.8	139.19	148.78	(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=	152.11	134.37	141.83	128.12	126.26	113.84	110.3	119.69	119.06	132.8	139.19	148.78

Output from water heater (annual)$_{1...12}$ 1566.35 (64)

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

(65)m=	72.36	64.35	68.94	63.68	63.76	58.93	58.46	61.58	60.67	65.94	67.36	71.25	(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=	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	(66)

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

(67)m=	11.73	10.42	8.47	6.41	4.79	4.05	4.37	5.68	7.63	9.69	11.31	12.05	(67)

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

(68)m=	109.48	110.62	107.76	101.66	93.97	86.74	81.91	80.77	83.63	89.73	97.42	104.65	(68)

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

(69)m=	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	(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=	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	(71)

Water heating gains (Table 5)

(72)m=	97.26	95.76	92.66	88.44	85.7	81.85	78.57	82.77	84.26	88.63	93.56	95.77	(72)

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

(73)m=	263.72	262.05	254.14	241.77	229.72	217.89	210.1	214.48	220.78	233.3	247.54	257.73	(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)	
Northeast 0.9x	0.77	x	0.5	x	11.28	x	0.63	x	0.7	=	1.72	(75)
Northeast 0.9x	0.77	x	0.15	x	11.28	x	0.63	x	0.7	=	0.52	(75)
Northeast 0.9x	0.77	x	0.5	x	22.97	x	0.63	x	0.7	=	3.51	(75)
Northeast 0.9x	0.77	x	0.15	x	22.97	x	0.63	x	0.7	=	1.05	(75)
Northeast 0.9x	0.77	x	0.5	x	41.38	x	0.63	x	0.7	=	6.32	(75)
Northeast 0.9x	0.77	x	0.15	x	41.38	x	0.63	x	0.7	=	1.9	(75)
Northeast 0.9x	0.77	x	0.5	x	67.96	x	0.63	x	0.7	=	10.38	(75)
Northeast 0.9x	0.77	x	0.15	x	67.96	x	0.63	x	0.7	=	3.12	(75)
Northeast 0.9x	0.77	x	0.5	x	91.35	x	0.63	x	0.7	=	13.96	(75)
Northeast 0.9x	0.77	x	0.15	x	91.35	x	0.63	x	0.7	=	4.19	(75)
Northeast 0.9x	0.77	x	0.5	x	97.38	x	0.63	x	0.7	=	14.88	(75)
Northeast 0.9x	0.77	x	0.15	x	97.38	x	0.63	x	0.7	=	4.46	(75)
Northeast 0.9x	0.77	x	0.5	x	91.1	x	0.63	x	0.7	=	13.92	(75)
Northeast 0.9x	0.77	x	0.15	x	91.1	x	0.63	x	0.7	=	4.18	(75)
Northeast 0.9x	0.77	x	0.5	x	72.63	x	0.63	x	0.7	=	11.1	(75)
Northeast 0.9x	0.77	x	0.15	x	72.63	x	0.63	x	0.7	=	3.33	(75)
Northeast 0.9x	0.77	x	0.5	x	50.42	x	0.63	x	0.7	=	7.7	(75)
Northeast 0.9x	0.77	x	0.15	x	50.42	x	0.63	x	0.7	=	2.31	(75)
Northeast 0.9x	0.77	x	0.5	x	28.07	x	0.63	x	0.7	=	4.29	(75)
Northeast 0.9x	0.77	x	0.15	x	28.07	x	0.63	x	0.7	=	1.29	(75)
Northeast 0.9x	0.77	x	0.5	x	14.2	x	0.63	x	0.7	=	2.17	(75)
Northeast 0.9x	0.77	x	0.15	x	14.2	x	0.63	x	0.7	=	0.65	(75)
Northeast 0.9x	0.77	x	0.5	x	9.21	x	0.63	x	0.7	=	1.41	(75)
Northeast 0.9x	0.77	x	0.15	x	9.21	x	0.63	x	0.7	=	0.42	(75)
Southeast 0.9x	0.77	x	0.91	x	36.79	x	0.63	x	0.7	=	10.23	(77)
Southeast 0.9x	0.77	x	0.91	x	62.67	x	0.63	x	0.7	=	17.43	(77)
Southeast 0.9x	0.77	x	0.91	x	85.75	x	0.63	x	0.7	=	23.85	(77)
Southeast 0.9x	0.77	x	0.91	x	106.25	x	0.63	x	0.7	=	29.55	(77)
Southeast 0.9x	0.77	x	0.91	x	119.01	x	0.63	x	0.7	=	33.1	(77)
Southeast 0.9x	0.77	x	0.91	x	118.15	x	0.63	x	0.7	=	32.86	(77)
Southeast 0.9x	0.77	x	0.91	x	113.91	x	0.63	x	0.7	=	31.68	(77)
Southeast 0.9x	0.77	x	0.91	x	104.39	x	0.63	x	0.7	=	29.03	(77)
Southeast 0.9x	0.77	x	0.91	x	92.85	x	0.63	x	0.7	=	25.82	(77)
Southeast 0.9x	0.77	x	0.91	x	69.27	x	0.63	x	0.7	=	19.26	(77)

Southeast 0.9x	0.77	x	0.91	x	44.07	x	0.63	x	0.7	=	12.26	(77)
Southeast 0.9x	0.77	x	0.91	x	31.49	x	0.63	x	0.7	=	8.76	(77)
Southwest 0.9x	0.77	x	0.65	x	36.79		0.63	x	0.7	=	7.31	(79)
Southwest 0.9x	0.77	x	0.67	x	36.79		0.63	x	0.7	=	7.53	(79)
Southwest 0.9x	0.77	x	0.65	x	62.67		0.63	x	0.7	=	12.45	(79)
Southwest 0.9x	0.77	x	0.67	x	62.67		0.63	x	0.7	=	12.83	(79)
Southwest 0.9x	0.77	x	0.65	x	85.75		0.63	x	0.7	=	17.03	(79)
Southwest 0.9x	0.77	x	0.67	x	85.75		0.63	x	0.7	=	17.56	(79)
Southwest 0.9x	0.77	x	0.65	x	106.25		0.63	x	0.7	=	21.11	(79)
Southwest 0.9x	0.77	x	0.67	x	106.25		0.63	x	0.7	=	21.76	(79)
Southwest 0.9x	0.77	x	0.65	x	119.01		0.63	x	0.7	=	23.64	(79)
Southwest 0.9x	0.77	x	0.67	x	119.01		0.63	x	0.7	=	24.37	(79)
Southwest 0.9x	0.77	x	0.65	x	118.15		0.63	x	0.7	=	23.47	(79)
Southwest 0.9x	0.77	x	0.67	x	118.15		0.63	x	0.7	=	24.19	(79)
Southwest 0.9x	0.77	x	0.65	x	113.91		0.63	x	0.7	=	22.63	(79)
Southwest 0.9x	0.77	x	0.67	x	113.91		0.63	x	0.7	=	23.32	(79)
Southwest 0.9x	0.77	x	0.65	x	104.39		0.63	x	0.7	=	20.74	(79)
Southwest 0.9x	0.77	x	0.67	x	104.39		0.63	x	0.7	=	21.38	(79)
Southwest 0.9x	0.77	x	0.65	x	92.85		0.63	x	0.7	=	18.44	(79)
Southwest 0.9x	0.77	x	0.67	x	92.85		0.63	x	0.7	=	19.01	(79)
Southwest 0.9x	0.77	x	0.65	x	69.27		0.63	x	0.7	=	13.76	(79)
Southwest 0.9x	0.77	x	0.67	x	69.27		0.63	x	0.7	=	14.18	(79)
Southwest 0.9x	0.77	x	0.65	x	44.07		0.63	x	0.7	=	8.75	(79)
Southwest 0.9x	0.77	x	0.67	x	44.07		0.63	x	0.7	=	9.02	(79)
Southwest 0.9x	0.77	x	0.65	x	31.49		0.63	x	0.7	=	6.26	(79)
Southwest 0.9x	0.77	x	0.67	x	31.49		0.63	x	0.7	=	6.45	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	27.32	47.28	66.66	85.91	99.25	99.87	95.73	85.57	73.3	52.78	32.85	23.29	(83)

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

(84)m=	291.04	309.33	320.8	327.68	328.97	317.75	305.83	300.05	294.08	286.08	280.4	281.02	(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	0.99	0.98	0.96	0.92	0.8	0.65	0.68	0.86	0.96	0.99	0.99	(86)

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

(87)m=	19.58	19.71	19.94	20.28	20.6	20.86	20.96	20.95	20.79	20.39	19.95	19.57	(87)

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

(88)m=	19.73	19.73	19.74	19.76	19.76	19.78	19.78	19.78	19.77	19.76	19.75	19.74	(88)

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

(89)m=	0.99	0.99	0.98	0.95	0.88	0.71	0.49	0.53	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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(90)m=	17.88	18.07	18.42	18.91	19.36	19.68	19.76	19.76	19.6	19.08	18.43	17.88		(90)

fLA = Living area ÷ (4) = 0.68 (91)

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

(92)m=	19.04	19.18	19.45	19.84	20.2	20.48	20.58	20.57	20.41	19.97	19.46	19.03	(92)

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

(93)m=	19.04	19.18	19.45	19.84	20.2	20.48	20.58	20.57	20.41	19.97	19.46	19.03	(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=	0.99	0.98	0.97	0.95	0.89	0.77	0.6	0.63	0.83	0.95	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	287.66	304.32	312.51	311.5	294.4	243.53	182.24	188.18	244.19	271.01	274.96	278.19	(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=	749.54	723.49	653.43	541.18	418.99	284.86	192.62	201.3	307.59	461.93	613.77	742.08	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	343.64	281.68	253.65	165.37	92.7	0	0	0	0	142.04	243.94	345.14	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1868.17 (98)

Space heating requirement in kWh/m²/year 53.19 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)													
	343.64	281.68	253.65	165.37	92.7	0	0	0	0	142.04	243.94	345.14	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	367.53	301.27	271.28	176.87	99.15	0	0	0	0	151.92	260.9	369.13	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1998.04 (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

Water heating from separate community system:

Annual water heating requirement 1566.35 (64)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1998.04

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Water heating fuel used			1862.95	
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			207.11	(232)

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	=	431.58	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	402.4	(264)
Space and water heating	(261) + (262) + (263) + (264) =			833.97	(265)

Water heating from community system

	Energy kWh/year	**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Electrical energy for heat distribution	[(313) x	0	=	0	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	0	(373)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	107.49	(268)
Total CO2, kg/year	sum of (265)…(271) =			980.39	(272)

TER =	40.98	(273)

SAP Input

Property Details: Flat Type D - ASHP

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	07 November 2019
Date of certificate:	12 May 2020
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Low
Water use <= 125 litres/person/day:	True
PCDF Version:	460

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2020	
Floor Location:	Floor area:	Storey height:
Floor 0	25 m²	3.09 m
Living area:	21.1 m² (fraction 0.844)	
Front of dwelling faces:	West	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D4_01	Manufacturer	Solid			Metal
Vent_04_02	Manufacturer	Solid			
Vent_04_04	Manufacturer	Solid			
Window_04_01	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_04_05	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Fanlight	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D4_01	mm	0	0	1	2.13	1
Vent_04_02	mm	0	0	1	0.35	1
Vent_04_04	mm	0	0	1	0.99	1
Window_04_01	6mm	0.7	0.4	1.2	0.7	1
Window_04_05	6mm	0.7	0.4	1.2	1.96	1
Fanlight	6mm	0.7	0.4	1.2	0.32	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D4_01		4_01	West	0	0
Vent_04_02		4_01	West	0.295	1.2
Vent_04_04		4_05	East	0.6	1.65
Window_04_01		4_01	West	0.585	1.2
Window_04_05		4_05	East	1.185	1.65
Fanlight		4_01	West	1.01	0.315

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
4_01	10.073	3.5	6.57	0.13	0	False	N/A
4_05	12.978	2.95	10.03	0.13	0	False	N/A
4_03	1.869	0	1.87	0.13	0	False	N/A
4_04	2.905	0	2.9	0.13	0	False	N/A

SAP Input

R4_01	25	0	25	0.1	0	N/A

Internal Elements
Party Elements

Thermal bridges:	
Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)
Ventilation:	
Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: False
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	0
Pressure test:	2.5
Main heating system:	
Main heating system:	Electric underfloor heating Standard tariff Fuel: Electricity Info Source: SAP Tables SAP Table: 425 In timber floor, or immediately below floor covering Underfloor heating, pipes in insulated timber floor Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Room-sealed Boiler interlock: Yes
Main heating Control:	
Main heating Control:	Programmer and room thermostat Control code: 2704
Secondary heating system:	
Secondary heating system:	None
Water heating:	
Water heating:	952 From DHW-only community scheme Heat source: From hot-water only community scheme - heat pump heat from electric heat pump, heat fraction 1, efficiency 329 Piping>=1991, pre-insulated, medium temp, variable flow No hot water cylinder Solar panel: False
Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type D - ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	25	(1a) x	3.09	(2a) =	77.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	25	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	77.25	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.35	x	1	=	0.35			(26)
Doors Type 3			0.99	x	1	=	0.99			(26)
Windows Type 1			0.7	x1/[1/(1.2)+ 0.04]		=	0.8			(27)
Windows Type 2			1.96	x1/[1/(1.2)+ 0.04]		=	2.24			(27)
Windows Type 3			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Walls Type1	10.07	3.5	6.57	x	0.13	=	0.85			(29)
Walls Type2	12.98	2.95	10.03	x	0.13	=	1.3			(29)
Walls Type3	1.87	0	1.87	x	0.13	=	0.24			(29)
Walls Type4	2.9	0	2.9	x	0.13	=	0.38			(29)
Roof	25	0	25	x	0.1	=	2.5			(30)
Total area of elements, m²			52.82							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 12.16 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 225 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 7.92 (36)

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

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Total fabric heat loss (33) + (36) = 20.08 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	7.17	7.09	7.01	6.61	6.53	6.13	6.13	6.05	6.29	6.53	6.69	6.85	(38)

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

(39)m=	27.25	27.17	27.09	26.69	26.61	26.22	26.22	26.14	26.37	26.61	26.77	26.93	

Average = $Sum(39)_{1...12}$ /12= 26.67 (39)

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

(40)m=	1.09	1.09	1.08	1.07	1.06	1.05	1.05	1.05	1.05	1.06	1.07	1.08

Average = $Sum(40)_{1...12}$ /12= 1.07 (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 1.09 (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 60.05 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	66.06	63.66	61.25	58.85	56.45	54.05	54.05	56.45	58.85	61.25	63.66	66.06

Total = $Sum(44)_{1...12}$ = 720.62 (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=	97.96	85.68	88.41	77.08	73.96	63.82	59.14	67.86	68.67	80.03	87.36	94.87

Total = $Sum(45)_{1...12}$ = 944.85 (45)

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

(46)m=	14.69	12.85	13.26	11.56	11.09	9.57	8.87	10.18	10.3	12	13.1	14.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	153.24	135.6	143.69	130.57	129.24	117.31	114.42	123.14	122.17	135.31	140.86	150.15	(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=	153.24	135.6	143.69	130.57	129.24	117.31	114.42	123.14	122.17	135.31	140.86	150.15

Output from water heater (annual)$_{1...12}$ 1595.69 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	76.79	68.43	73.62	68.42	68.81	64.02	63.89	66.79	65.63	70.83	71.84	75.77	(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=	65.31	65.31	65.31	65.31	65.31	65.31	65.31	65.31	65.31	65.31	65.31	65.31	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	21.45	19.05	15.49	11.73	8.77	7.4	8	10.39	13.95	17.72	20.68	22.04	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	128.81	130.15	126.78	119.61	110.56	102.05	96.37	95.03	98.4	105.57	114.62	123.13	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	42.62	42.62	42.62	42.62	42.62	42.62	42.62	42.62	42.62	42.62	42.62	42.62	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	(71)

Water heating gains (Table 5)

(72)m=	103.22	101.83	98.95	95.03	92.49	88.91	85.87	89.77	91.15	95.2	99.78	101.84	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	317.86	315.41	305.61	290.76	276.2	262.75	254.62	259.58	267.89	282.88	299.47	311.39	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	1.96	x	19.64	x	0.4	x	0.7	=	7.47	(76)
East	0.9x	0.77	x	1.96	x	38.42	x	0.4	x	0.7	=	14.61	(76)
East	0.9x	0.77	x	1.96	x	63.27	x	0.4	x	0.7	=	24.06	(76)
East	0.9x	0.77	x	1.96	x	92.28	x	0.4	x	0.7	=	35.1	(76)
East	0.9x	0.77	x	1.96	x	113.09	x	0.4	x	0.7	=	43.01	(76)
East	0.9x	0.77	x	1.96	x	115.77	x	0.4	x	0.7	=	44.03	(76)
East	0.9x	0.77	x	1.96	x	110.22	x	0.4	x	0.7	=	41.92	(76)
East	0.9x	0.77	x	1.96	x	94.68	x	0.4	x	0.7	=	36.01	(76)
East	0.9x	0.77	x	1.96	x	73.59	x	0.4	x	0.7	=	27.99	(76)
East	0.9x	0.77	x	1.96	x	45.59	x	0.4	x	0.7	=	17.34	(76)
East	0.9x	0.77	x	1.96	x	24.49	x	0.4	x	0.7	=	9.31	(76)
East	0.9x	0.77	x	1.96	x	16.15	x	0.4	x	0.7	=	6.14	(76)
West	0.9x	0.77	x	0.7	x	19.64	x	0.4	x	0.7	=	2.67	(80)
West	0.9x	0.77	x	0.32	x	19.64	x	0.4	x	0.7	=	1.22	(80)
West	0.9x	0.77	x	0.7	x	38.42	x	0.4	x	0.7	=	5.22	(80)
West	0.9x	0.77	x	0.32	x	38.42	x	0.4	x	0.7	=	2.39	(80)
West	0.9x	0.77	x	0.7	x	63.27	x	0.4	x	0.7	=	8.59	(80)
West	0.9x	0.77	x	0.32	x	63.27	x	0.4	x	0.7	=	3.93	(80)
West	0.9x	0.77	x	0.7	x	92.28	x	0.4	x	0.7	=	12.53	(80)
West	0.9x	0.77	x	0.32	x	92.28	x	0.4	x	0.7	=	5.73	(80)
West	0.9x	0.77	x	0.7	x	113.09	x	0.4	x	0.7	=	15.36	(80)
West	0.9x	0.77	x	0.32	x	113.09	x	0.4	x	0.7	=	7.02	(80)
West	0.9x	0.77	x	0.7	x	115.77	x	0.4	x	0.7	=	15.72	(80)
West	0.9x	0.77	x	0.32	x	115.77	x	0.4	x	0.7	=	7.19	(80)
West	0.9x	0.77	x	0.7	x	110.22	x	0.4	x	0.7	=	14.97	(80)
West	0.9x	0.77	x	0.32	x	110.22	x	0.4	x	0.7	=	6.84	(80)
West	0.9x	0.77	x	0.7	x	94.68	x	0.4	x	0.7	=	12.86	(80)
West	0.9x	0.77	x	0.32	x	94.68	x	0.4	x	0.7	=	5.88	(80)
West	0.9x	0.77	x	0.7	x	73.59	x	0.4	x	0.7	=	10	(80)
West	0.9x	0.77	x	0.32	x	73.59	x	0.4	x	0.7	=	4.57	(80)
West	0.9x	0.77	x	0.7	x	45.59	x	0.4	x	0.7	=	6.19	(80)
West	0.9x	0.77	x	0.32	x	45.59	x	0.4	x	0.7	=	2.83	(80)
West	0.9x	0.77	x	0.7	x	24.49	x	0.4	x	0.7	=	3.33	(80)
West	0.9x	0.77	x	0.32	x	24.49	x	0.4	x	0.7	=	1.52	(80)
West	0.9x	0.77	x	0.7	x	16.15	x	0.4	x	0.7	=	2.19	(80)
West	0.9x	0.77	x	0.32	x	16.15	x	0.4	x	0.7	=	1	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	11.36	22.22	36.59	53.36	65.39	66.94	63.73	54.75	42.55	26.36	14.16	9.34	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	329.22	337.63	342.2	344.12	341.6	329.69	318.35	314.33	310.44	309.24	313.63	320.73	(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=	0.83	0.82	0.78	0.71	0.61	0.47	0.35	0.37	0.52	0.69	0.79	0.84	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.68	19.82	20.08	20.42	20.7	20.9	20.97	20.96	20.85	20.53	20.09	19.66	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.45	20.46	20.46	20.47	20.47	20.48	20.48	20.48	20.47	20.47	20.46	20.46	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.83	0.81	0.77	0.69	0.58	0.44	0.31	0.33	0.49	0.67	0.78	0.83	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.22	19.36	19.61	19.95	20.22	20.4	20.45	20.45	20.36	20.06	19.63	19.21	(90)

fLA = Living area ÷ (4) = | 0.84 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.61	19.75	20	20.34	20.63	20.82	20.89	20.88	20.77	20.46	20.02	19.59	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.61	19.75	20	20.34	20.63	20.82	20.89	20.88	20.77	20.46	20.02	19.59	(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=	0.81	0.79	0.75	0.69	0.59	0.46	0.34	0.36	0.51	0.67	0.77	0.82	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	266.46	267.15	258.1	236.5	201.57	150.41	108.21	112.24	157.93	207.19	240.4	261.97	(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=	417.28	403.38	365.81	305.48	237.59	163.05	112.37	117.12	176.05	262.43	345.82	414.53	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	112.21	91.55	80.14	49.67	26.8	0	0	0	0	41.1	75.9	113.51	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 590.87 | (98)

Space heating requirement in kWh/m²/year | 23.63 | (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(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)														
	112.21	91.55	80.14	49.67	26.8	0	0	0	0	41.1	75.9	113.51		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	112.21	91.55	80.14	49.67	26.8	0	0	0	0	41.1	75.9	113.51		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													590.87	(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

Water heating from separate community system:

Annual water heating requirement		1595.69	(64)
Fraction of heat from community CHP		1	(303a)
Factor for charging method for community water heating		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.1	(306)
Water heat from CHP	(64) x (303a) x (305) x (306) =	1755.26	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	17.55	(313)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			590.87	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		98.96		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		98.96	(231)
Electricity for lighting			151.5	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	77.94	(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 from CHP	(310a) x	4.24	x 0.01 =	74.42	(342a)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	13.05	(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 =	19.98	(250)
Additional standing charges (Table 12)				60	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	245.39	(255)

11a. SAP rating - individual heating systems

SAP WorkSheet: New dwelling design stage

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.47	(257)
SAP rating (Section 12)		79.46	(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	0.519	=	306.66	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)

Water heating from community system

		Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	276.89	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	9.11	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	286	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	51.36	(267)
Electricity for lighting	(232) x		0.519	=	78.63	(268)
Total CO2, kg/year	sum of (265)…(271) =				722.65	(272)
CO2 emissions per m²	(272) ÷ (4) =				28.91	(273)
EI rating (section 14)					86	(274)

13a. Primary Energy

	Energy kWh/year		**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211)	x	3.07	=	1813.97	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)

Water heating from community system

		Energy kWh/year	**Primary factor**		**Emissions** kWh/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
Energy associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		3.07	=	1637.89	(367)
Electrical energy for heat distribution	[(313) x		2.92	=	51.25	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)			=	286	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		3.07	=	303.8	(267)
Electricity for lighting	(232) x		0	=	465.09	(268)
'Total Primary Energy	sum of (265)…(271) =				4272	(272)

Primary energy kWh/m²/year	(272) ÷ (4) =	170.88	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type D - ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	25	(1a) x	3.09	(2a) =	77.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	25	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		77.25	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.35	x	1	=	0.35			(26)
Doors Type 3			0.99	x	1	=	0.99			(26)
Windows Type 1			0.7	x1/[1/(1.2)+ 0.04]		=	0.8			(27)
Windows Type 2			1.96	x1/[1/(1.2)+ 0.04]		=	2.24			(27)
Windows Type 3			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Walls Type1	10.07	3.5	6.57	x	0.13	=	0.85			(29)
Walls Type2	12.98	2.95	10.03	x	0.13	=	1.3			(29)
Walls Type3	1.87	0	1.87	x	0.13	=	0.24			(29)
Walls Type4	2.9	0	2.9	x	0.13	=	0.38			(29)
Roof	25	0	25	x	0.1	=	2.5			(30)
Total area of elements, m²			52.82							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 12.16 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 225 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 7.92 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

DER WorkSheet: New dwelling design stage

Total fabric heat loss (33) + (36) = 20.08 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	7.17	7.09	7.01	6.61	6.53	6.13	6.13	6.05	6.29	6.53	6.69	6.85	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	27.25	27.17	27.09	26.69	26.61	26.22	26.22	26.14	26.37	26.61	26.77	26.93	

Average = Sum(39)$_{1…12}$ /12= 26.67 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.09	1.09	1.08	1.07	1.06	1.05	1.05	1.05	1.05	1.06	1.07	1.08	

Average = Sum(40)$_{1…12}$ /12= 1.07 (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 1.09 (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 60.05 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	66.06	63.66	61.25	58.85	56.45	54.05	54.05	56.45	58.85	61.25	63.66	66.06	

Total = Sum(44)$_{1…12}$ = 720.62 (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=	97.96	85.68	88.41	77.08	73.96	63.82	59.14	67.86	68.67	80.03	87.36	94.87	

Total = Sum(45)$_{1…12}$ = 944.85 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	14.69	12.85	13.26	11.56	11.09	9.57	8.87	10.18	10.3	12	13.1	14.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

DER WorkSheet: New dwelling design stage

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	153.24	135.6	143.69	130.57	129.24	117.31	114.42	123.14	122.17	135.31	140.86	150.15	(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=	153.24	135.6	143.69	130.57	129.24	117.31	114.42	123.14	122.17	135.31	140.86	150.15

Output from water heater (annual)$_{1...12}$ 1595.69 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	76.79	68.43	73.62	68.42	68.81	64.02	63.89	66.79	65.63	70.83	71.84	75.77	(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=	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	8.58	7.62	6.2	4.69	3.51	2.96	3.2	4.16	5.58	7.09	8.27	8.82	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	86.3	87.2	84.94	80.14	74.07	68.37	64.56	63.67	65.93	70.73	76.8	82.5	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	(71)

Water heating gains (Table 5)

(72)m=	103.22	101.83	98.95	95.03	92.49	88.91	85.87	89.77	91.15	95.2	99.78	101.84	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	237.43	235.98	229.42	219.19	209.4	199.57	192.96	196.92	201.99	212.35	224.18	232.48	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	1.96	x	19.64	x	0.4	x	0.7	=	7.47	(76)
East	0.9x	0.77	x	1.96	x	38.42	x	0.4	x	0.7	=	14.61	(76)
East	0.9x	0.77	x	1.96	x	63.27	x	0.4	x	0.7	=	24.06	(76)
East	0.9x	0.77	x	1.96	x	92.28	x	0.4	x	0.7	=	35.1	(76)
East	0.9x	0.77	x	1.96	x	113.09	x	0.4	x	0.7	=	43.01	(76)
East	0.9x	0.77	x	1.96	x	115.77	x	0.4	x	0.7	=	44.03	(76)
East	0.9x	0.77	x	1.96	x	110.22	x	0.4	x	0.7	=	41.92	(76)
East	0.9x	0.77	x	1.96	x	94.68	x	0.4	x	0.7	=	36.01	(76)
East	0.9x	0.77	x	1.96	x	73.59	x	0.4	x	0.7	=	27.99	(76)
East	0.9x	0.77	x	1.96	x	45.59	x	0.4	x	0.7	=	17.34	(76)
East	0.9x	0.77	x	1.96	x	24.49	x	0.4	x	0.7	=	9.31	(76)
East	0.9x	0.77	x	1.96	x	16.15	x	0.4	x	0.7	=	6.14	(76)
West	0.9x	0.77	x	0.7	x	19.64	x	0.4	x	0.7	=	2.67	(80)
West	0.9x	0.77	x	0.32	x	19.64	x	0.4	x	0.7	=	1.22	(80)
West	0.9x	0.77	x	0.7	x	38.42	x	0.4	x	0.7	=	5.22	(80)
West	0.9x	0.77	x	0.32	x	38.42	x	0.4	x	0.7	=	2.39	(80)
West	0.9x	0.77	x	0.7	x	63.27	x	0.4	x	0.7	=	8.59	(80)
West	0.9x	0.77	x	0.32	x	63.27	x	0.4	x	0.7	=	3.93	(80)
West	0.9x	0.77	x	0.7	x	92.28	x	0.4	x	0.7	=	12.53	(80)
West	0.9x	0.77	x	0.32	x	92.28	x	0.4	x	0.7	=	5.73	(80)
West	0.9x	0.77	x	0.7	x	113.09	x	0.4	x	0.7	=	15.36	(80)
West	0.9x	0.77	x	0.32	x	113.09	x	0.4	x	0.7	=	7.02	(80)
West	0.9x	0.77	x	0.7	x	115.77	x	0.4	x	0.7	=	15.72	(80)
West	0.9x	0.77	x	0.32	x	115.77	x	0.4	x	0.7	=	7.19	(80)
West	0.9x	0.77	x	0.7	x	110.22	x	0.4	x	0.7	=	14.97	(80)
West	0.9x	0.77	x	0.32	x	110.22	x	0.4	x	0.7	=	6.84	(80)
West	0.9x	0.77	x	0.7	x	94.68	x	0.4	x	0.7	=	12.86	(80)
West	0.9x	0.77	x	0.32	x	94.68	x	0.4	x	0.7	=	5.88	(80)
West	0.9x	0.77	x	0.7	x	73.59	x	0.4	x	0.7	=	10	(80)
West	0.9x	0.77	x	0.32	x	73.59	x	0.4	x	0.7	=	4.57	(80)
West	0.9x	0.77	x	0.7	x	45.59	x	0.4	x	0.7	=	6.19	(80)
West	0.9x	0.77	x	0.32	x	45.59	x	0.4	x	0.7	=	2.83	(80)
West	0.9x	0.77	x	0.7	x	24.49	x	0.4	x	0.7	=	3.33	(80)
West	0.9x	0.77	x	0.32	x	24.49	x	0.4	x	0.7	=	1.52	(80)
West	0.9x	0.77	x	0.7	x	16.15	x	0.4	x	0.7	=	2.19	(80)
West	0.9x	0.77	x	0.32	x	16.15	x	0.4	x	0.7	=	1	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	11.36	22.22	36.59	53.36	65.39	66.94	63.73	54.75	42.55	26.36	14.16	9.34	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	248.78	258.19	266	272.55	274.79	266.51	256.69	251.67	244.54	238.71	238.34	241.81	(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=	0.9	0.89	0.85	0.79	0.69	0.55	0.42	0.44	0.62	0.78	0.87	0.91	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.31	19.47	19.79	20.21	20.58	20.84	20.95	20.94	20.77	20.34	19.79	19.29	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.45	20.46	20.46	20.47	20.47	20.48	20.48	20.48	20.47	20.47	20.46	20.46	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.89	0.88	0.84	0.78	0.67	0.52	0.38	0.4	0.59	0.77	0.86	0.9	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.87	19.02	19.33	19.75	20.11	20.35	20.44	20.43	20.29	19.88	19.34	18.85	(90)

fLA = Living area ÷ (4) = | 0.84 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.24	19.4	19.72	20.14	20.51	20.77	20.87	20.86	20.7	20.27	19.72	19.22	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.24	19.4	19.72	20.14	20.51	20.77	20.87	20.86	20.7	20.27	19.72	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=	0.88	0.86	0.83	0.77	0.67	0.54	0.41	0.43	0.6	0.76	0.84	0.88	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	218.25	222.32	220.22	208.85	184.65	142.87	105.23	108.67	146.76	181.29	201.1	213.65	(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=	407.24	394.09	358.04	299.99	234.37	161.71	111.86	116.5	174	257.32	337.79	404.53	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	140.61	115.42	102.54	65.62	36.99	0	0	0	0	56.57	98.41	142.02	

Total per year (kWh/year) = Sum(98)1...5,9...12 = | 758.17 | (98)

Space heating requirement in kWh/m²/year | 30.33 | (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) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	140.61	115.42	102.54	65.62	36.99	0	0	0	0	56.57	98.41	142.02		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	140.61	115.42	102.54	65.62	36.99	0	0	0	0	56.57	98.41	142.02		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													758.17	(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

Water heating from separate community system:			
Annual water heating requirement		1595.69	(64)
Fraction of heat from community CHP		1	(303a)
Factor for charging method for community water heating		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.1	(306)
Water heat from CHP	(64) x (303a) x (305) x (306) =	1755.26	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	17.55	(313)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			758.17	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		98.96		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		98.96	(231)
Electricity for lighting			151.5	(232)

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	0.519	=	393.49	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating from community system						

		Energy kWh/year	**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)		If there is CHP using two fuels repeat (363) to (366) for the second fuel			329	(367a)
CO2 associated with heat source 1		[(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	276.89	(367)
Electrical energy for heat distribution		[(313) x	0.52	=	9.11	(372)
Total CO2 associated with community systems		(363)…(366) + (368)...(372)		=	286	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	51.36	(267)
Electricity for lighting	(232) x		0.519	=	78.63	(268)

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Total CO_2, kg/year	sum of (265)…(271) =	809.48	(272)
Dwelling CO_2 Emission Rate	(272) ÷ (4) =	32.38	(273)
EI rating (section 14)		85	(274)

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User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type D - ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	25	(1a)	x	3.09	(2a)	=	77.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	25	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	77.25	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =	0.26	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.51	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.51	(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

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.65	0.64	0.62	0.56	0.55	0.48	0.48	0.47	0.51	0.55	0.57	0.6

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0.71	0.7	0.69	0.66	0.65	0.62	0.62	0.61	0.63	0.65	0.66	0.68	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.71	0.7	0.69	0.66	0.65	0.62	0.62	0.61	0.63	0.65	0.66	0.68	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.35	x	1	=	0.35			(26)
Doors Type 3			0.99	x	1	=	0.99			(26)
Windows Type 1			0.65	x1/[1/(1.4)+ 0.04]		=	0.86			(27)
Windows Type 2			1.83	x1/[1/(1.4)+ 0.04]		=	2.43			(27)
Windows Type 3			0.3	x1/[1/(1.4)+ 0.04]		=	0.4			(27)
Walls Type1	10.07	3.43	6.64	x	0.18	=	1.2			(29)
Walls Type2	12.98	2.82	10.16	x	0.18	=	1.83			(29)
Walls Type3	1.87	0	1.87	x	0.18	=	0.34			(29)
Walls Type4	2.9	0	2.9	x	0.18	=	0.52			(29)
Roof	25	0	25	x	0.13	=	3.25			(30)
Total area of elements, m²			52.82							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	14.29	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	225	(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	2.64	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

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Total fabric heat loss (33) + (36) = 16.93 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	18.11	17.9	17.7	16.74	16.56	15.73	15.73	15.57	16.05	16.56	16.92	17.3	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	35.04	34.83	34.63	33.67	33.49	32.66	32.66	32.5	32.98	33.49	33.85	34.23	

Average = $Sum(39)_{1...12}$ /12= 33.67 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.4	1.39	1.39	1.35	1.34	1.31	1.31	1.3	1.32	1.34	1.35	1.37	

Average = $Sum(40)_{1...12}$ /12= 1.35 (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 1.09 (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 60.05 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	66.06	63.66	61.25	58.85	56.45	54.05	54.05	56.45	58.85	61.25	63.66	66.06	

Total = $Sum(44)_{1...12}$ = 720.62 (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=	97.96	85.68	88.41	77.08	73.96	63.82	59.14	67.86	68.67	80.03	87.36	94.87	

Total = $Sum(45)_{1...12}$ = 944.85 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	14.69	12.85	13.26	11.56	11.09	9.57	8.87	10.18	10.3	12	13.1	14.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (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): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	144.56	127.76	135.01	122.17	120.55	108.91	105.73	114.46	113.77	126.63	132.45	141.46	(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=	144.56	127.76	135.01	122.17	120.55	108.91	105.73	114.46	113.77	126.63	132.45	141.46

Output from water heater (annual)$_{1...12}$ — 1493.47 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	69.85	62.16	66.67	61.7	61.87	57.29	56.94	59.84	58.91	63.89	65.12	68.82	(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=	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	8.68	7.71	6.27	4.75	3.55	3	3.24	4.21	5.65	7.17	8.37	8.93	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	86.3	87.2	84.94	80.14	74.07	68.37	64.56	63.67	65.93	70.73	76.8	82.5	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	(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=	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	(71)

Water heating gains (Table 5)

(72)m=	93.88	92.49	89.61	85.7	83.16	79.58	76.53	80.43	81.82	85.87	90.45	92.5	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	231.2	229.73	223.16	212.91	203.11	193.27	186.66	190.64	195.72	206.1	217.94	226.25	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	1.83	x	19.64	x	0.63	x	0.7	=	10.98	(76)
East	0.9x	0.77	x	1.83	x	38.42	x	0.63	x	0.7	=	21.49	(76)
East	0.9x	0.77	x	1.83	x	63.27	x	0.63	x	0.7	=	35.39	(76)
East	0.9x	0.77	x	1.83	x	92.28	x	0.63	x	0.7	=	51.61	(76)
East	0.9x	0.77	x	1.83	x	113.09	x	0.63	x	0.7	=	63.25	(76)
East	0.9x	0.77	x	1.83	x	115.77	x	0.63	x	0.7	=	64.75	(76)
East	0.9x	0.77	x	1.83	x	110.22	x	0.63	x	0.7	=	61.64	(76)
East	0.9x	0.77	x	1.83	x	94.68	x	0.63	x	0.7	=	52.95	(76)
East	0.9x	0.77	x	1.83	x	73.59	x	0.63	x	0.7	=	41.16	(76)
East	0.9x	0.77	x	1.83	x	45.59	x	0.63	x	0.7	=	25.5	(76)
East	0.9x	0.77	x	1.83	x	24.49	x	0.63	x	0.7	=	13.7	(76)
East	0.9x	0.77	x	1.83	x	16.15	x	0.63	x	0.7	=	9.03	(76)
West	0.9x	0.77	x	0.65	x	19.64	x	0.63	x	0.7	=	3.9	(80)
West	0.9x	0.77	x	0.3	x	19.64	x	0.63	x	0.7	=	1.8	(80)
West	0.9x	0.77	x	0.65	x	38.42	x	0.63	x	0.7	=	7.63	(80)
West	0.9x	0.77	x	0.3	x	38.42	x	0.63	x	0.7	=	3.52	(80)
West	0.9x	0.77	x	0.65	x	63.27	x	0.63	x	0.7	=	12.57	(80)
West	0.9x	0.77	x	0.3	x	63.27	x	0.63	x	0.7	=	5.8	(80)
West	0.9x	0.77	x	0.65	x	92.28	x	0.63	x	0.7	=	18.33	(80)
West	0.9x	0.77	x	0.3	x	92.28	x	0.63	x	0.7	=	8.46	(80)
West	0.9x	0.77	x	0.65	x	113.09	x	0.63	x	0.7	=	22.47	(80)
West	0.9x	0.77	x	0.3	x	113.09	x	0.63	x	0.7	=	10.37	(80)
West	0.9x	0.77	x	0.65	x	115.77	x	0.63	x	0.7	=	23	(80)
West	0.9x	0.77	x	0.3	x	115.77	x	0.63	x	0.7	=	10.61	(80)
West	0.9x	0.77	x	0.65	x	110.22	x	0.63	x	0.7	=	21.89	(80)
West	0.9x	0.77	x	0.3	x	110.22	x	0.63	x	0.7	=	10.11	(80)
West	0.9x	0.77	x	0.65	x	94.68	x	0.63	x	0.7	=	18.81	(80)
West	0.9x	0.77	x	0.3	x	94.68	x	0.63	x	0.7	=	8.68	(80)
West	0.9x	0.77	x	0.65	x	73.59	x	0.63	x	0.7	=	14.62	(80)
West	0.9x	0.77	x	0.3	x	73.59	x	0.63	x	0.7	=	6.75	(80)
West	0.9x	0.77	x	0.65	x	45.59	x	0.63	x	0.7	=	9.06	(80)
West	0.9x	0.77	x	0.3	x	45.59	x	0.63	x	0.7	=	4.18	(80)
West	0.9x	0.77	x	0.65	x	24.49	x	0.63	x	0.7	=	4.86	(80)
West	0.9x	0.77	x	0.3	x	24.49	x	0.63	x	0.7	=	2.25	(80)
West	0.9x	0.77	x	0.65	x	16.15	x	0.63	x	0.7	=	3.21	(80)
West	0.9x	0.77	x	0.3	x	16.15	x	0.63	x	0.7	=	1.48	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	16.69	32.64	53.76	78.4	96.08	98.36	93.64	80.44	62.52	38.73	20.81	13.72	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	247.88	262.38	276.91	291.31	299.19	291.63	280.3	271.07	258.24	244.83	238.75	239.97	(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	0.66	0.5	0.53	0.76	0.93	0.97	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.78	19.91	20.15	20.5	20.77	20.94	20.99	20.98	20.89	20.56	20.14	19.78	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.3	20.3	20.31	20.33	20.33	20.35	20.35	20.35	20.34	20.33	20.32	20.32	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.98	0.96	0.91	0.8	0.61	0.43	0.47	0.72	0.91	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.16	19.29	19.54	19.89	20.15	20.31	20.34	20.34	20.26	19.96	19.54	19.18	(90)

fLA = Living area ÷ (4) = 0.84 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.68	19.81	20.06	20.4	20.68	20.84	20.89	20.88	20.79	20.47	20.05	19.68	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.68	19.81	20.06	20.4	20.68	20.84	20.89	20.88	20.79	20.47	20.05	19.68	(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	0.96	0.91	0.82	0.65	0.49	0.52	0.75	0.92	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	243.07	255.41	264.71	265.41	244.94	189.93	136.93	141.6	193.4	224.12	231.04	235.83	(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=	538.94	519.44	469.51	387.33	300.64	203.93	139.98	145.7	220.67	330.43	438.25	530.09	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	220.13	177.43	152.37	87.78	41.44	0	0	0	0	79.09	149.19	218.93	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1126.36 (98)

Space heating requirement in kWh/m²/year — 45.05 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	220.13	177.43	152.37	87.78	41.44	0	0	0	0	79.09	149.19	218.93		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	235.43	189.76	162.96	93.88	44.32	0	0	0	0	84.59	159.57	234.15		
Total (kWh/year) =Sum(211)1...5,10....12=													1204.66	(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

Water heating from separate community system:			
Annual water heating requirement		1493.47	(64)
Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1204.66	
Water heating fuel used		1794.5	
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		153.37	(232)

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	=	260.21	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	387.61	(264)
Space and water heating	(261) + (262) + (263) + (264) =			647.82	(265)
Water heating from community system					

	Energy kWh/year	**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Electrical energy for heat distribution	[(313) x	0	=	0	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	0	(373)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	79.6	(268)
Total CO2, kg/year	sum of (265)…(271) =			766.34	(272)

TER = 44.91 (273)

SAP Input

Property Details: Flat Type E - ASHP

Address:	
Located in:	Wales
Region:	Thames valley
UPRN:	
Date of assessment:	07 November 2019
Date of certificate:	12 May 2020
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Low
Water use <= 125 litres/person/day:	True
PCDF Version:	460

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2020	
Floor Location:	Floor area:	Storey height:
Floor 0	49.68 m²	3.09 m
Living area:	24.05 m² (fraction 0.484)	
Front of dwelling faces:	South	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D9_01	Manufacturer	Solid			
Vent_09_01	Manufacturer	Solid			
Vent_09_09	Manufacturer	Solid			
Vent_09_04	Manufacturer	Solid			
Vent_09_10	Manufacturer	Solid			
Window_09_02	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_09_03	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_09_05	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_09_11	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_09_07	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_09_08	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Fanlight	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D9_01	mm	0	0	1	2.13	1
Vent_09_01	mm	0	0	1	0.7	1
Vent_09_09	mm	0	0	1	0.96	1
Vent_09_04	mm	0	0	1	0.7	1
Vent_09_10	mm	0	0	1	0.7	1
Window_09_02	6mm	0.7	0.4	1.2	1.1	1
Window_09_03	6mm	0.7	0.4	1.2	0.19	1
Window_09_05	6mm	0.7	0.4	1.2	2.01	1
Window_09_11	6mm	0.7	0.4	1.2	1.46	1
Window_09_07	6mm	0.7	0.4	1.2	1.46	1
Window_09_08	6mm	0.7	0.4	1.2	0.99	1
Fanlight	6mm	0.7	0.4	1.2	0.32	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D9_01		9_01	South	0	0
Vent_09_01		9_01	South	0.58	1.2

SAP Input

Vent_09_09	9_09	East	0.58	1.65
Vent_09_04	9_06	North	1.2	0.58
Vent_09_10	9_07	North	0.58	1.2
Window_09_02	9_01	South	0.92	1.2
Window_09_03	9_01	South	0	0
Window_09_05	9_06	North	1.22	1.65
Window_09_11	9_07	North	1.22	1.2
Window_09_07	9_08	North	1.22	1.2
Window_09_08	9_09	East	0.6	1.65
Fanlight	9_01	South	1.01	0.315

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
9_01	12.36	4.44	7.92	0.13	0	False	N/A
9_02	5.871	0	5.87	0.13	0	False	N/A
9_03	5.84	0	5.84	0.13	0	False	N/A
9_04	2.812	0	2.81	0.13	0	False	N/A
9_06	8.498	2.71	5.79	0.13	0	False	N/A
9_07	8.019	2.16	5.86	0.13	0	False	N/A
9_08	10.521	1.46	9.06	0.13	0	False	N/A
9_09	19.467	1.95	17.52	0.13	0	False	N/A
R9_01	49.68	0	49.68	0.1	0		N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test: Yes (As designed)

Ventilation: Balanced with heat recovery
Number of wet rooms: Kitchen + 2
Ductwork: Insulation, rigid
Approved Installation Scheme: False

Number of chimneys: 0
Number of open flues: 0
Number of fans: 0
Number of passive stacks: 0
Number of sides sheltered: 0
Pressure test: 2.5

Main heating system:

Main heating system: Electric underfloor heating
Standard tariff
Fuel: Electricity
Info Source: SAP Tables
SAP Table: 425
In timber floor, or immediately below floor covering
Underfloor heating, pipes in insulated timber floor
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Room-sealed
Boiler interlock: Yes

Main heating Control:

SAP Input

Main heating Control:	Programmer and room thermostat Control code: 2704
Secondary heating system:	
Secondary heating system:	None
Water heating:	
Water heating:	952 From DHW-only community scheme Heat source: From hot-water only community scheme - heat pump heat from electric heat pump, heat fraction 1, efficiency 329 Piping>=1991, pre-insulated, low temp, variable flow No hot water cylinder Solar panel: False
Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type E - ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	49.68	(1a) x	3.09	(2a) =	153.51	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.68	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	153.51	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.95 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.25	0.26	0.26	0.27	0.28	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.25	0.26	0.26	0.27	0.28	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.7	x	1	=	0.7			(26)
Doors Type 3			0.96	x	1	=	0.96			(26)
Doors Type 4			0.7	x	1	=	0.7			(26)
Doors Type 5			0.7	x	1	=	0.7			(26)
Windows Type 1			1.1	x1/[1/(1.2)+ 0.04]		=	1.26			(27)
Windows Type 2			0.19	x1/[1/(1.2)+ 0.04]		=	0.22			(27)
Windows Type 3			2.01	x1/[1/(1.2)+ 0.04]		=	2.3			(27)
Windows Type 4			1.46	x1/[1/(1.2)+ 0.04]		=	1.67			(27)
Windows Type 5			1.46	x1/[1/(1.2)+ 0.04]		=	1.67			(27)
Windows Type 6			0.99	x1/[1/(1.2)+ 0.04]		=	1.13			(27)
Windows Type 7			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Walls Type1	12.36	4.44	7.92	x	0.13	=	1.03			(29)
Walls Type2	5.87	0	5.87	x	0.13	=	0.76			(29)
Walls Type3	5.84	0	5.84	x	0.13	=	0.76			(29)
Walls Type4	2.81	0	2.81	x	0.13	=	0.37			(29)
Walls Type5	8.5	2.71	5.79	x	0.13	=	0.75			(29)
Walls Type6	8.02	2.16	5.86	x	0.13	=	0.76			(29)
Walls Type7	10.52	1.46	9.06	x	0.13	=	1.18			(29)

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Walls Type8	19.47	1.95	17.52	x	0.13	=	2.28			(29)
Roof	49.68	0	49.68	x	0.1	=	4.97			(30)
Total area of elements, m²			123.07							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) — (26)…(30) + (32) = — 26.67 (33)

Heat capacity Cm = S(A x k) — ((28)…(30) + (32) + (32a)…(32e) = — 447.12 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K — Indicative Value: Low — 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 18.46 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss — (33) + (36) = — 45.13 (37)

Ventilation heat loss calculated monthly — (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	14.67	14.51	14.36	13.56	13.41	12.61	12.61	12.46	12.93	13.41	13.72	14.04	(38)

Heat transfer coefficient, W/K — (39)m = (37) + (38)m

(39)m=	59.8	59.64	59.48	58.69	58.53	57.74	57.74	57.58	58.06	58.53	58.85	59.17	

Average = Sum(39)$_{1…12}$ /12= 58.65 (39)

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.2	1.2	1.2	1.18	1.18	1.16	1.16	1.16	1.17	1.18	1.18	1.19

Average = Sum(40)$_{1…12}$ /12= 1.18 (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 — 1.68 (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 — 74.12 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	81.53	78.56	75.6	72.63	69.67	66.7	66.7	69.67	72.63	75.6	78.56	81.53

Total = Sum(44)$_{1…12}$ = 889.39 (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=	120.9	105.74	109.12	95.13	91.28	78.77	72.99	83.76	84.76	98.78	107.82	117.09

Total = Sum(45)$_{1…12}$ = 1166.14 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.14	15.86	16.37	14.27	13.69	11.82	10.95	12.56	12.71	14.82	16.17	17.56	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	110	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02	(51)
If community heating see section 4.3			
Volume factor from Table 2a		1.03	(52)
Temperature factor from Table 2b		0.6	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)		1.03	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	176.18	155.67	164.39	148.62	146.56	132.26	128.27	139.03	138.25	154.05	161.32	172.37	(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=	176.18	155.67	164.39	148.62	146.56	132.26	128.27	139.03	138.25	154.05	161.32	172.37

Output from water heater (annual)$_{1...12}$ — 1816.98 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.42	75.1	80.5	74.43	74.57	68.99	68.49	72.07	70.98	77.06	78.65	83.15	(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=	100.84	100.84	100.84	100.84	100.84	100.84	100.84	100.84	100.84	100.84	100.84	100.84	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	34.46	30.6	24.89	18.84	14.08	11.89	12.85	16.7	22.42	28.46	33.22	35.41	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	218.51	220.78	215.07	202.9	187.55	173.11	163.47	161.21	166.92	179.08	194.44	208.87	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	46.76	46.76	46.76	46.76	46.76	46.76	46.76	46.76	46.76	46.76	46.76	46.76	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	(71)

Water heating gains (Table 5)

(72)m=	113.47	111.76	108.2	103.37	100.23	95.81	92.06	96.87	98.58	103.58	109.23	111.77	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	446.82	443.52	428.54	405.49	382.24	361.2	348.76	355.15	368.29	391.51	417.27	436.43	(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)	
North	0.9x	0.77	x	2.01	x	10.63	x	0.4	x	0.7	=	4.15	(74)
North	0.9x	0.77	x	1.46	x	10.63	x	0.4	x	0.7	=	3.01	(74)
North	0.9x	0.77	x	1.46	x	10.63	x	0.4	x	0.7	=	3.01	(74)
North	0.9x	0.77	x	2.01	x	20.32	x	0.4	x	0.7	=	7.93	(74)
North	0.9x	0.77	x	1.46	x	20.32	x	0.4	x	0.7	=	5.76	(74)
North	0.9x	0.77	x	1.46	x	20.32	x	0.4	x	0.7	=	5.76	(74)
North	0.9x	0.77	x	2.01	x	34.53	x	0.4	x	0.7	=	13.47	(74)
North	0.9x	0.77	x	1.46	x	34.53	x	0.4	x	0.7	=	9.78	(74)
North	0.9x	0.77	x	1.46	x	34.53	x	0.4	x	0.7	=	9.78	(74)
North	0.9x	0.77	x	2.01	x	55.46	x	0.4	x	0.7	=	21.63	(74)
North	0.9x	0.77	x	1.46	x	55.46	x	0.4	x	0.7	=	15.71	(74)
North	0.9x	0.77	x	1.46	x	55.46	x	0.4	x	0.7	=	15.71	(74)
North	0.9x	0.77	x	2.01	x	74.72	x	0.4	x	0.7	=	29.14	(74)
North	0.9x	0.77	x	1.46	x	74.72	x	0.4	x	0.7	=	21.17	(74)
North	0.9x	0.77	x	1.46	x	74.72	x	0.4	x	0.7	=	21.17	(74)
North	0.9x	0.77	x	2.01	x	79.99	x	0.4	x	0.7	=	31.2	(74)
North	0.9x	0.77	x	1.46	x	79.99	x	0.4	x	0.7	=	22.66	(74)
North	0.9x	0.77	x	1.46	x	79.99	x	0.4	x	0.7	=	22.66	(74)
North	0.9x	0.77	x	2.01	x	74.68	x	0.4	x	0.7	=	29.13	(74)
North	0.9x	0.77	x	1.46	x	74.68	x	0.4	x	0.7	=	21.16	(74)
North	0.9x	0.77	x	1.46	x	74.68	x	0.4	x	0.7	=	21.16	(74)
North	0.9x	0.77	x	2.01	x	59.25	x	0.4	x	0.7	=	23.11	(74)
North	0.9x	0.77	x	1.46	x	59.25	x	0.4	x	0.7	=	16.78	(74)
North	0.9x	0.77	x	1.46	x	59.25	x	0.4	x	0.7	=	16.78	(74)
North	0.9x	0.77	x	2.01	x	41.52	x	0.4	x	0.7	=	16.19	(74)
North	0.9x	0.77	x	1.46	x	41.52	x	0.4	x	0.7	=	11.76	(74)
North	0.9x	0.77	x	1.46	x	41.52	x	0.4	x	0.7	=	11.76	(74)
North	0.9x	0.77	x	2.01	x	24.19	x	0.4	x	0.7	=	9.43	(74)
North	0.9x	0.77	x	1.46	x	24.19	x	0.4	x	0.7	=	6.85	(74)
North	0.9x	0.77	x	1.46	x	24.19	x	0.4	x	0.7	=	6.85	(74)

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North	0.9x	0.77	x	2.01	x	13.12	x	0.4	x	0.7	=	5.12	(74)
North	0.9x	0.77	x	1.46	x	13.12	x	0.4	x	0.7	=	3.72	(74)
North	0.9x	0.77	x	1.46	x	13.12	x	0.4	x	0.7	=	3.72	(74)
North	0.9x	0.77	x	2.01	x	8.86	x	0.4	x	0.7	=	3.46	(74)
North	0.9x	0.77	x	1.46	x	8.86	x	0.4	x	0.7	=	2.51	(74)
North	0.9x	0.77	x	1.46	x	8.86	x	0.4	x	0.7	=	2.51	(74)
East	0.9x	0.77	x	0.99	x	19.64	x	0.4	x	0.7	=	3.77	(76)
East	0.9x	0.77	x	0.99	x	38.42	x	0.4	x	0.7	=	7.38	(76)
East	0.9x	0.77	x	0.99	x	63.27	x	0.4	x	0.7	=	12.15	(76)
East	0.9x	0.77	x	0.99	x	92.28	x	0.4	x	0.7	=	17.73	(76)
East	0.9x	0.77	x	0.99	x	113.09	x	0.4	x	0.7	=	21.73	(76)
East	0.9x	0.77	x	0.99	x	115.77	x	0.4	x	0.7	=	22.24	(76)
East	0.9x	0.77	x	0.99	x	110.22	x	0.4	x	0.7	=	21.17	(76)
East	0.9x	0.77	x	0.99	x	94.68	x	0.4	x	0.7	=	18.19	(76)
East	0.9x	0.77	x	0.99	x	73.59	x	0.4	x	0.7	=	14.14	(76)
East	0.9x	0.77	x	0.99	x	45.59	x	0.4	x	0.7	=	8.76	(76)
East	0.9x	0.77	x	0.99	x	24.49	x	0.4	x	0.7	=	4.7	(76)
East	0.9x	0.77	x	0.99	x	16.15	x	0.4	x	0.7	=	3.1	(76)
South	0.9x	0.77	x	1.1	x	46.75	x	0.4	x	0.7	=	9.98	(78)
South	0.9x	0.77	x	0.19	x	46.75	x	0.4	x	0.7	=	1.72	(78)
South	0.9x	0.77	x	0.32	x	46.75	x	0.4	x	0.7	=	2.9	(78)
South	0.9x	0.77	x	1.1	x	76.57	x	0.4	x	0.7	=	16.34	(78)
South	0.9x	0.77	x	0.19	x	76.57	x	0.4	x	0.7	=	2.82	(78)
South	0.9x	0.77	x	0.32	x	76.57	x	0.4	x	0.7	=	4.75	(78)
South	0.9x	0.77	x	1.1	x	97.53	x	0.4	x	0.7	=	20.82	(78)
South	0.9x	0.77	x	0.19	x	97.53	x	0.4	x	0.7	=	3.6	(78)
South	0.9x	0.77	x	0.32	x	97.53	x	0.4	x	0.7	=	6.06	(78)
South	0.9x	0.77	x	1.1	x	110.23	x	0.4	x	0.7	=	23.53	(78)
South	0.9x	0.77	x	0.19	x	110.23	x	0.4	x	0.7	=	4.06	(78)
South	0.9x	0.77	x	0.32	x	110.23	x	0.4	x	0.7	=	6.84	(78)
South	0.9x	0.77	x	1.1	x	114.87	x	0.4	x	0.7	=	24.52	(78)
South	0.9x	0.77	x	0.19	x	114.87	x	0.4	x	0.7	=	4.24	(78)
South	0.9x	0.77	x	0.32	x	114.87	x	0.4	x	0.7	=	7.13	(78)
South	0.9x	0.77	x	1.1	x	110.55	x	0.4	x	0.7	=	23.6	(78)
South	0.9x	0.77	x	0.19	x	110.55	x	0.4	x	0.7	=	4.08	(78)
South	0.9x	0.77	x	0.32	x	110.55	x	0.4	x	0.7	=	6.86	(78)
South	0.9x	0.77	x	1.1	x	108.01	x	0.4	x	0.7	=	23.05	(78)
South	0.9x	0.77	x	0.19	x	108.01	x	0.4	x	0.7	=	3.98	(78)
South	0.9x	0.77	x	0.32	x	108.01	x	0.4	x	0.7	=	6.71	(78)
South	0.9x	0.77	x	1.1	x	104.89	x	0.4	x	0.7	=	22.39	(78)
South	0.9x	0.77	x	0.19	x	104.89	x	0.4	x	0.7	=	3.87	(78)

South	0.9x	0.77	x	0.32	x	104.89	x	0.4	x	0.7	=	6.51	(78)
South	0.9x	0.77	x	1.1	x	101.89	x	0.4	x	0.7	=	21.75	(78)
South	0.9x	0.77	x	0.19	x	101.89	x	0.4	x	0.7	=	3.76	(78)
South	0.9x	0.77	x	0.32	x	101.89	x	0.4	x	0.7	=	6.33	(78)
South	0.9x	0.77	x	1.1	x	82.59	x	0.4	x	0.7	=	17.63	(78)
South	0.9x	0.77	x	0.19	x	82.59	x	0.4	x	0.7	=	3.04	(78)
South	0.9x	0.77	x	0.32	x	82.59	x	0.4	x	0.7	=	5.13	(78)
South	0.9x	0.77	x	1.1	x	55.42	x	0.4	x	0.7	=	11.83	(78)
South	0.9x	0.77	x	0.19	x	55.42	x	0.4	x	0.7	=	2.04	(78)
South	0.9x	0.77	x	0.32	x	55.42	x	0.4	x	0.7	=	3.44	(78)
South	0.9x	0.77	x	1.1	x	40.4	x	0.4	x	0.7	=	8.62	(78)
South	0.9x	0.77	x	0.19	x	40.4	x	0.4	x	0.7	=	1.49	(78)
South	0.9x	0.77	x	0.32	x	40.4	x	0.4	x	0.7	=	2.51	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	28.55	50.74	75.66	105.22	129.09	133.29	126.35	107.63	85.68	57.7	34.57	24.2	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	475.37	494.26	504.19	510.71	511.33	494.49	475.11	462.79	453.97	449.2	451.83	460.63	(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=	0.91	0.9	0.88	0.83	0.74	0.61	0.48	0.51	0.67	0.82	0.89	0.92	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.01	19.18	19.51	19.97	20.41	20.76	20.91	20.89	20.66	20.14	19.52	18.98	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.4	20.4	20.4	20.41	20.41	20.42	20.42	20.42	20.42	20.41	20.41	20.4	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.91	0.89	0.87	0.81	0.72	0.57	0.43	0.46	0.64	0.8	0.88	0.91	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.52	18.69	19.02	19.48	19.9	20.23	20.36	20.35	20.14	19.65	19.04	18.5	(90)

fLA = Living area ÷ (4) = 0.48 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.76	18.93	19.26	19.72	20.15	20.49	20.62	20.61	20.4	19.89	19.27	18.73	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.76	18.93	19.26	19.72	20.15	20.49	20.62	20.61	20.4	19.89	19.27	18.73	(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=	0.89	0.87	0.85	0.79	0.71	0.58	0.45	0.47	0.64	0.78	0.86	0.89	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	422.07	431.48	426.16	404.95	362.01	285.55	212.2	218.54	290.21	352.53	388.33	411.91	(95)

Monthly average external temperature from Table 8

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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=	864.59	836.71	758.87	635.01	494.63	339.85	232.3	242.37	365.5	543.62	716.26	859.67	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	329.24	272.31	247.54	165.64	98.67	0	0	0	0	142.17	236.11	333.13

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1824.81 (98)

Space heating requirement in kWh/m²/year 36.73 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(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)	329.24	272.31	247.54	165.64	98.67	0	0	0	0	142.17	236.11	333.13	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)	329.24	272.31	247.54	165.64	98.67	0	0	0	0	142.17	236.11	333.13	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1824.81 (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

Water heating from separate community system:

Annual water heating requirement		1816.98	(64)
Fraction of heat from community CHP		1	(303a)
Factor for charging method for community water heating		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Water heat from CHP	(64) x (303a) x (305) x (306) =	1907.83	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	19.08	(313)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1824.81	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		215		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		215	(231)
Electricity for lighting			243.4	(232)

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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)	x	13.19	x 0.01 =	240.69	(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 from CHP	(310a)	x	4.24	x 0.01 =	80.89	(342a)
Pumps, fans and electric keep-hot	(231)		13.19	x 0.01 =	28.36	(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 =	32.1	(250)
Additional standing charges (Table 12)					60	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	442.05	(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] =	1.96	(257)
SAP rating (Section 12)		72.65	(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	0.519	=	947.08	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)

Water heating from community system

		Energy kWh/year	**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	300.96	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	9.9	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	310.86	(373)

Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	111.59	(267)
Electricity for lighting	(232)	x	0.519	=	126.33	(268)
Total CO2, kg/year			sum of (265)…(271) =		1495.85	(272)
CO2 emissions per m²			(272) ÷ (4) =		30.11	(273)
EI rating (section 14)					79	(274)

13a. Primary Energy

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	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	3.07	=	5602.18	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Water heating from community system						

		Energy kWh/year	Primary factor		Emissions kWh/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
Energy associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		3.07	=	1780.25	(367)
Electrical energy for heat distribution	[(313) x		2.92	=	55.71	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)			=	310.86	(373)

	Energy kWh/year		Primary factor		P. Energy kWh/year	
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	660.06	(267)
Electricity for lighting	(232)	x	0	=	747.25	(268)
'Total Primary Energy			sum of (265)…(271) =		8845.44	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		178.05	(273)

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User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type E - ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	49.68	(1a) x	3.09	(2a) =	153.51	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.68	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	153.51	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)
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			2.5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.12	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			0	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor		(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.95 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.25	0.26	0.26	0.27	0.28	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.25	0.26	0.26	0.27	0.28	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.7	x	1	=	0.7			(26)
Doors Type 3			0.96	x	1	=	0.96			(26)
Doors Type 4			0.7	x	1	=	0.7			(26)
Doors Type 5			0.7	x	1	=	0.7			(26)
Windows Type 1			1.1	x1/[1/(1.2)+ 0.04]		=	1.26			(27)
Windows Type 2			0.19	x1/[1/(1.2)+ 0.04]		=	0.22			(27)
Windows Type 3			2.01	x1/[1/(1.2)+ 0.04]		=	2.3			(27)
Windows Type 4			1.46	x1/[1/(1.2)+ 0.04]		=	1.67			(27)
Windows Type 5			1.46	x1/[1/(1.2)+ 0.04]		=	1.67			(27)
Windows Type 6			0.99	x1/[1/(1.2)+ 0.04]		=	1.13			(27)
Windows Type 7			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Walls Type1	12.36	4.44	7.92	x	0.13	=	1.03			(29)
Walls Type2	5.87	0	5.87	x	0.13	=	0.76			(29)
Walls Type3	5.84	0	5.84	x	0.13	=	0.76			(29)
Walls Type4	2.81	0	2.81	x	0.13	=	0.37			(29)
Walls Type5	8.5	2.71	5.79	x	0.13	=	0.75			(29)
Walls Type6	8.02	2.16	5.86	x	0.13	=	0.76			(29)
Walls Type7	10.52	1.46	9.06	x	0.13	=	1.18			(29)

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Walls Type8	19.47	1.95	17.52	x	0.13	=	2.28			(29)
Roof	49.68	0	49.68	x	0.1	=	4.97			(30)
Total area of elements, m²			123.07							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	26.67	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	447.12	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Low	100	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		18.46	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	45.13	(37)

Ventilation heat loss calculated monthly — (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	14.67	14.51	14.36	13.56	13.41	12.61	12.61	12.46	12.93	13.41	13.72	14.04	(38)

Heat transfer coefficient, W/K — (39)m = (37) + (38)m

(39)m=	59.8	59.64	59.48	58.69	58.53	57.74	57.74	57.58	58.06	58.53	58.85	59.17	

Average = Sum(39)$_{1…12}$ /12= 58.65 (39)

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.2	1.2	1.2	1.18	1.18	1.16	1.16	1.16	1.17	1.18	1.18	1.19	

Average = Sum(40)$_{1…12}$ /12= 1.18 (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 — 1.68 (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 — 74.12 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	81.53	78.56	75.6	72.63	69.67	66.7	66.7	69.67	72.63	75.6	78.56	81.53	

Total = Sum(44)$_{1…12}$ = 889.39 (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=	120.9	105.74	109.12	95.13	91.28	78.77	72.99	83.76	84.76	98.78	107.82	117.09	

Total = Sum(45)$_{1…12}$ = 1166.14 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.14	15.86	16.37	14.27	13.69	11.82	10.95	12.56	12.71	14.82	16.17	17.56	(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)

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Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	110	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02	(51)
If community heating see section 4.3			
Volume factor from Table 2a		1.03	(52)
Temperature factor from Table 2b		0.6	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)		1.03	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	176.18	155.67	164.39	148.62	146.56	132.26	128.27	139.03	138.25	154.05	161.32	172.37	(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=	176.18	155.67	164.39	148.62	146.56	132.26	128.27	139.03	138.25	154.05	161.32	172.37

Output from water heater (annual)$_{1...12}$ — 1816.98 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.42	75.1	80.5	74.43	74.57	68.99	68.49	72.07	70.98	77.06	78.65	83.15	(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=	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.78	12.24	9.96	7.54	5.63	4.76	5.14	6.68	8.97	11.39	13.29	14.17	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	146.4	147.92	144.09	135.94	125.66	115.99	109.53	108.01	111.84	119.99	130.27	139.94	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	(71)

Water heating gains (Table 5)

(72)m=	113.47	111.76	108.2	103.37	100.23	95.81	92.06	96.87	98.58	103.58	109.23	111.77	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	321.87	320.13	310.46	295.06	279.73	264.77	254.93	259.77	267.59	283.16	301	314.08	(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)	
North	0.9x	0.77	x	2.01	x	10.63	x	0.4	x	0.7	=	4.15	(74)
North	0.9x	0.77	x	1.46	x	10.63	x	0.4	x	0.7	=	3.01	(74)
North	0.9x	0.77	x	1.46	x	10.63	x	0.4	x	0.7	=	3.01	(74)
North	0.9x	0.77	x	2.01	x	20.32	x	0.4	x	0.7	=	7.93	(74)
North	0.9x	0.77	x	1.46	x	20.32	x	0.4	x	0.7	=	5.76	(74)
North	0.9x	0.77	x	1.46	x	20.32	x	0.4	x	0.7	=	5.76	(74)
North	0.9x	0.77	x	2.01	x	34.53	x	0.4	x	0.7	=	13.47	(74)
North	0.9x	0.77	x	1.46	x	34.53	x	0.4	x	0.7	=	9.78	(74)
North	0.9x	0.77	x	1.46	x	34.53	x	0.4	x	0.7	=	9.78	(74)
North	0.9x	0.77	x	2.01	x	55.46	x	0.4	x	0.7	=	21.63	(74)
North	0.9x	0.77	x	1.46	x	55.46	x	0.4	x	0.7	=	15.71	(74)
North	0.9x	0.77	x	1.46	x	55.46	x	0.4	x	0.7	=	15.71	(74)
North	0.9x	0.77	x	2.01	x	74.72	x	0.4	x	0.7	=	29.14	(74)
North	0.9x	0.77	x	1.46	x	74.72	x	0.4	x	0.7	=	21.17	(74)
North	0.9x	0.77	x	1.46	x	74.72	x	0.4	x	0.7	=	21.17	(74)
North	0.9x	0.77	x	2.01	x	79.99	x	0.4	x	0.7	=	31.2	(74)
North	0.9x	0.77	x	1.46	x	79.99	x	0.4	x	0.7	=	22.66	(74)
North	0.9x	0.77	x	1.46	x	79.99	x	0.4	x	0.7	=	22.66	(74)
North	0.9x	0.77	x	2.01	x	74.68	x	0.4	x	0.7	=	29.13	(74)
North	0.9x	0.77	x	1.46	x	74.68	x	0.4	x	0.7	=	21.16	(74)
North	0.9x	0.77	x	1.46	x	74.68	x	0.4	x	0.7	=	21.16	(74)
North	0.9x	0.77	x	2.01	x	59.25	x	0.4	x	0.7	=	23.11	(74)
North	0.9x	0.77	x	1.46	x	59.25	x	0.4	x	0.7	=	16.78	(74)
North	0.9x	0.77	x	1.46	x	59.25	x	0.4	x	0.7	=	16.78	(74)
North	0.9x	0.77	x	2.01	x	41.52	x	0.4	x	0.7	=	16.19	(74)
North	0.9x	0.77	x	1.46	x	41.52	x	0.4	x	0.7	=	11.76	(74)
North	0.9x	0.77	x	1.46	x	41.52	x	0.4	x	0.7	=	11.76	(74)
North	0.9x	0.77	x	2.01	x	24.19	x	0.4	x	0.7	=	9.43	(74)
North	0.9x	0.77	x	1.46	x	24.19	x	0.4	x	0.7	=	6.85	(74)
North	0.9x	0.77	x	1.46	x	24.19	x	0.4	x	0.7	=	6.85	(74)

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North	0.9x	0.77	x	2.01	x	13.12	x	0.4	x	0.7	=	5.12	(74)
North	0.9x	0.77	x	1.46	x	13.12	x	0.4	x	0.7	=	3.72	(74)
North	0.9x	0.77	x	1.46	x	13.12	x	0.4	x	0.7	=	3.72	(74)
North	0.9x	0.77	x	2.01	x	8.86	x	0.4	x	0.7	=	3.46	(74)
North	0.9x	0.77	x	1.46	x	8.86	x	0.4	x	0.7	=	2.51	(74)
North	0.9x	0.77	x	1.46	x	8.86	x	0.4	x	0.7	=	2.51	(74)
East	0.9x	0.77	x	0.99	x	19.64	x	0.4	x	0.7	=	3.77	(76)
East	0.9x	0.77	x	0.99	x	38.42	x	0.4	x	0.7	=	7.38	(76)
East	0.9x	0.77	x	0.99	x	63.27	x	0.4	x	0.7	=	12.15	(76)
East	0.9x	0.77	x	0.99	x	92.28	x	0.4	x	0.7	=	17.73	(76)
East	0.9x	0.77	x	0.99	x	113.09	x	0.4	x	0.7	=	21.73	(76)
East	0.9x	0.77	x	0.99	x	115.77	x	0.4	x	0.7	=	22.24	(76)
East	0.9x	0.77	x	0.99	x	110.22	x	0.4	x	0.7	=	21.17	(76)
East	0.9x	0.77	x	0.99	x	94.68	x	0.4	x	0.7	=	18.19	(76)
East	0.9x	0.77	x	0.99	x	73.59	x	0.4	x	0.7	=	14.14	(76)
East	0.9x	0.77	x	0.99	x	45.59	x	0.4	x	0.7	=	8.76	(76)
East	0.9x	0.77	x	0.99	x	24.49	x	0.4	x	0.7	=	4.7	(76)
East	0.9x	0.77	x	0.99	x	16.15	x	0.4	x	0.7	=	3.1	(76)
South	0.9x	0.77	x	1.1	x	46.75	x	0.4	x	0.7	=	9.98	(78)
South	0.9x	0.77	x	0.19	x	46.75	x	0.4	x	0.7	=	1.72	(78)
South	0.9x	0.77	x	0.32	x	46.75	x	0.4	x	0.7	=	2.9	(78)
South	0.9x	0.77	x	1.1	x	76.57	x	0.4	x	0.7	=	16.34	(78)
South	0.9x	0.77	x	0.19	x	76.57	x	0.4	x	0.7	=	2.82	(78)
South	0.9x	0.77	x	0.32	x	76.57	x	0.4	x	0.7	=	4.75	(78)
South	0.9x	0.77	x	1.1	x	97.53	x	0.4	x	0.7	=	20.82	(78)
South	0.9x	0.77	x	0.19	x	97.53	x	0.4	x	0.7	=	3.6	(78)
South	0.9x	0.77	x	0.32	x	97.53	x	0.4	x	0.7	=	6.06	(78)
South	0.9x	0.77	x	1.1	x	110.23	x	0.4	x	0.7	=	23.53	(78)
South	0.9x	0.77	x	0.19	x	110.23	x	0.4	x	0.7	=	4.06	(78)
South	0.9x	0.77	x	0.32	x	110.23	x	0.4	x	0.7	=	6.84	(78)
South	0.9x	0.77	x	1.1	x	114.87	x	0.4	x	0.7	=	24.52	(78)
South	0.9x	0.77	x	0.19	x	114.87	x	0.4	x	0.7	=	4.24	(78)
South	0.9x	0.77	x	0.32	x	114.87	x	0.4	x	0.7	=	7.13	(78)
South	0.9x	0.77	x	1.1	x	110.55	x	0.4	x	0.7	=	23.6	(78)
South	0.9x	0.77	x	0.19	x	110.55	x	0.4	x	0.7	=	4.08	(78)
South	0.9x	0.77	x	0.32	x	110.55	x	0.4	x	0.7	=	6.86	(78)
South	0.9x	0.77	x	1.1	x	108.01	x	0.4	x	0.7	=	23.05	(78)
South	0.9x	0.77	x	0.19	x	108.01	x	0.4	x	0.7	=	3.98	(78)
South	0.9x	0.77	x	0.32	x	108.01	x	0.4	x	0.7	=	6.71	(78)
South	0.9x	0.77	x	1.1	x	104.89	x	0.4	x	0.7	=	22.39	(78)
South	0.9x	0.77	x	0.19	x	104.89	x	0.4	x	0.7	=	3.87	(78)

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South	0.9x	0.77	x	0.32	x	104.89	x	0.4	x	0.7	=	6.51	(78)
South	0.9x	0.77	x	1.1	x	101.89	x	0.4	x	0.7	=	21.75	(78)
South	0.9x	0.77	x	0.19	x	101.89	x	0.4	x	0.7	=	3.76	(78)
South	0.9x	0.77	x	0.32	x	101.89	x	0.4	x	0.7	=	6.33	(78)
South	0.9x	0.77	x	1.1	x	82.59	x	0.4	x	0.7	=	17.63	(78)
South	0.9x	0.77	x	0.19	x	82.59	x	0.4	x	0.7	=	3.04	(78)
South	0.9x	0.77	x	0.32	x	82.59	x	0.4	x	0.7	=	5.13	(78)
South	0.9x	0.77	x	1.1	x	55.42	x	0.4	x	0.7	=	11.83	(78)
South	0.9x	0.77	x	0.19	x	55.42	x	0.4	x	0.7	=	2.04	(78)
South	0.9x	0.77	x	0.32	x	55.42	x	0.4	x	0.7	=	3.44	(78)
South	0.9x	0.77	x	1.1	x	40.4	x	0.4	x	0.7	=	8.62	(78)
South	0.9x	0.77	x	0.19	x	40.4	x	0.4	x	0.7	=	1.49	(78)
South	0.9x	0.77	x	0.32	x	40.4	x	0.4	x	0.7	=	2.51	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	28.55	50.74	75.66	105.22	129.09	133.29	126.35	107.63	85.68	57.7	34.57	24.2	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	350.42	370.87	386.12	400.28	408.82	398.06	381.29	367.4	353.27	340.86	335.57	338.29	(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=	0.95	0.94	0.92	0.89	0.81	0.69	0.57	0.6	0.76	0.89	0.94	0.96	(86)
Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)													
(87)m=	18.65	18.84	19.21	19.73	20.25	20.67	20.86	20.84	20.53	19.91	19.21	18.62	(87)
Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)													
(88)m=	20.4	20.4	20.4	20.41	20.41	20.42	20.42	20.42	20.42	20.41	20.41	20.4	(88)
Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)													
(89)m=	0.95	0.94	0.92	0.87	0.79	0.66	0.51	0.54	0.73	0.87	0.93	0.95	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m=	18.17	18.36	18.73	19.25	19.75	20.15	20.33	20.31	20.03	19.43	18.74	18.15	(90)

fLA = Living area ÷ (4) = 0.48 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.41	18.6	18.96	19.48	19.99	20.4	20.59	20.56	20.28	19.66	18.97	18.38	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m=	18.41	18.6	18.96	19.48	19.99	20.4	20.59	20.56	20.28	19.66	18.97	18.38	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.93	0.92	0.9	0.85	0.78	0.66	0.53	0.56	0.73	0.86	0.91	0.94	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	327.36	341.91	347.12	342.1	318.32	261.55	200.69	204.7	256.59	291.63	306.82	317.64	(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=	843.55	816.81	741.31	621.24	485.29	335.02	230.11	239.71	358.52	530.31	698.29	838.89	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	384.05	319.13	293.27	200.98	124.23	0	0	0	0	177.57	281.86	387.81	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2168.91 (98)

Space heating requirement in kWh/m²/year 43.66 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(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)	384.05	319.13	293.27	200.98	124.23	0	0	0	0	177.57	281.86	387.81	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	384.05	319.13	293.27	200.98	124.23	0	0	0	0	177.57	281.86	387.81	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2168.91 (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

Water heating from separate community system:

Annual water heating requirement		1816.98	(64)
Fraction of heat from community CHP		1	(303a)
Factor for charging method for community water heating		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Water heat from CHP	(64) x (303a) x (305) x (306) =	1907.83	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	19.08	(313)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2168.91	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		215		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		215	(231)
Electricity for lighting			243.4	(232)

DER WorkSheet: New dwelling design stage

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	0.519	=	1125.66	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating from community system						

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	300.96	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	9.9	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	310.86	(373)

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	111.59	(267)
Electricity for lighting	(232)	x	0.519	=	126.33	(268)
Total CO2, kg/year			sum of (265)…(271) =		1674.44	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		33.7	(273)
EI rating (section 14)					76	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type E - ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	49.68	(1a) x	3.09	(2a) =	153.51	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.68	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		153.51	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =	0.13	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.38	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.48	0.48	0.47	0.42	0.41	0.36	0.36	0.35	0.38	0.41	0.43	0.45

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.7	x	1	=	0.7			(26)
Doors Type 3			0.96	x	1	=	0.96			(26)
Doors Type 4			0.7	x	1	=	0.7			(26)
Doors Type 5			0.7	x	1	=	0.7			(26)
Windows Type 1			1.06	x1/[1/(1.4)+ 0.04]		=	1.41			(27)
Windows Type 2			0.18	x1/[1/(1.4)+ 0.04]		=	0.24			(27)
Windows Type 3			1.93	x1/[1/(1.4)+ 0.04]		=	2.56			(27)
Windows Type 4			1.4	x1/[1/(1.4)+ 0.04]		=	1.86			(27)
Windows Type 5			1.4	x1/[1/(1.4)+ 0.04]		=	1.86			(27)
Windows Type 6			0.95	x1/[1/(1.4)+ 0.04]		=	1.26			(27)
Windows Type 7			0.31	x1/[1/(1.4)+ 0.04]		=	0.41			(27)
Walls Type1	12.36	4.38	7.98	x	0.18	=	1.44			(29)
Walls Type2	5.87	0	5.87	x	0.18	=	1.06			(29)
Walls Type3	5.84	0	5.84	x	0.18	=	1.05			(29)
Walls Type4	2.81	0	2.81	x	0.18	=	0.51			(29)
Walls Type5	8.5	2.63	5.87	x	0.18	=	1.06			(29)
Walls Type6	8.02	2.1	5.92	x	0.18	=	1.07			(29)
Walls Type7	10.52	1.4	9.12	x	0.18	=	1.64			(29)

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Walls Type8	19.47	1.91	17.56	x	0.18	=	3.16			(29)
Roof	49.68	0	49.68	x	0.13	=	6.46			(30)
Total area of elements, m²			123.07							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	32.21	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	447.12	(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 — 6.15 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss — (33) + (36) = — 38.36 (37)

Ventilation heat loss calculated monthly — (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	31.28	31.05	30.83	29.76	29.56	28.64	28.64	28.46	28.99	29.56	29.97	30.39	(38)

Heat transfer coefficient, W/K — (39)m = (37) + (38)m

(39)m=	69.65	69.41	69.19	68.12	67.92	67	67	66.82	67.35	67.92	68.33	68.75	

Average = Sum(39)$_{1…12}$ /12= 68.12 (39)

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.4	1.4	1.39	1.37	1.37	1.35	1.35	1.35	1.36	1.37	1.38	1.38

Average = Sum(40)$_{1…12}$ /12= 1.37 (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 — 1.68 (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 — 74.12 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	81.53	78.56	75.6	72.63	69.67	66.7	66.7	69.67	72.63	75.6	78.56	81.53

Total = Sum(44)$_{1…12}$ = 889.39 (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=	120.9	105.74	109.12	95.13	91.28	78.77	72.99	83.76	84.76	98.78	107.82	117.09

Total = Sum(45)$_{1…12}$ = 1166.14 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.14	15.86	16.37	14.27	13.69	11.82	10.95	12.56	12.71	14.82	16.17	17.56	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (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)

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Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):		1.39	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0.75	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0.75	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	167.5	147.83	155.71	140.22	137.88	123.86	119.59	130.35	129.85	145.37	152.91	163.68	(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=	167.5	147.83	155.71	140.22	137.88	123.86	119.59	130.35	129.85	145.37	152.91	163.68

Output from water heater (annual)$_{1...12}$ 1714.75 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	77.48	68.83	73.56	67.7	67.63	62.26	61.55	65.13	64.26	70.12	71.92	76.21	(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=	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	13.89	12.33	10.03	7.59	5.68	4.79	5.18	6.73	9.03	11.47	13.39	14.27	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	146.4	147.92	144.09	135.94	125.66	115.99	109.53	108.01	111.84	119.99	130.27	139.94	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	(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=	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	(71)

Water heating gains (Table 5)

(72)m=	104.13	102.42	98.87	94.03	90.9	86.48	82.72	87.53	89.24	94.25	99.9	102.43	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	315.63	313.89	304.2	288.78	273.44	258.47	248.64	253.48	261.32	276.91	294.77	307.86	(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)	
North	0.9x	0.77	x	1.93	x	10.63	x	0.63	x	0.7	=	6.27	(74)
North	0.9x	0.77	x	1.4	x	10.63	x	0.63	x	0.7	=	4.55	(74)
North	0.9x	0.77	x	1.4	x	10.63	x	0.63	x	0.7	=	4.55	(74)
North	0.9x	0.77	x	1.93	x	20.32	x	0.63	x	0.7	=	11.99	(74)
North	0.9x	0.77	x	1.4	x	20.32	x	0.63	x	0.7	=	8.69	(74)
North	0.9x	0.77	x	1.4	x	20.32	x	0.63	x	0.7	=	8.69	(74)
North	0.9x	0.77	x	1.93	x	34.53	x	0.63	x	0.7	=	20.37	(74)
North	0.9x	0.77	x	1.4	x	34.53	x	0.63	x	0.7	=	14.77	(74)
North	0.9x	0.77	x	1.4	x	34.53	x	0.63	x	0.7	=	14.77	(74)
North	0.9x	0.77	x	1.93	x	55.46	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	1.4	x	55.46	x	0.63	x	0.7	=	23.73	(74)
North	0.9x	0.77	x	1.4	x	55.46	x	0.63	x	0.7	=	23.73	(74)
North	0.9x	0.77	x	1.93	x	74.72	x	0.63	x	0.7	=	44.07	(74)
North	0.9x	0.77	x	1.4	x	74.72	x	0.63	x	0.7	=	31.97	(74)
North	0.9x	0.77	x	1.4	x	74.72	x	0.63	x	0.7	=	31.97	(74)
North	0.9x	0.77	x	1.93	x	79.99	x	0.63	x	0.7	=	47.18	(74)
North	0.9x	0.77	x	1.4	x	79.99	x	0.63	x	0.7	=	34.22	(74)
North	0.9x	0.77	x	1.4	x	79.99	x	0.63	x	0.7	=	34.22	(74)
North	0.9x	0.77	x	1.93	x	74.68	x	0.63	x	0.7	=	44.05	(74)
North	0.9x	0.77	x	1.4	x	74.68	x	0.63	x	0.7	=	31.95	(74)
North	0.9x	0.77	x	1.4	x	74.68	x	0.63	x	0.7	=	31.95	(74)
North	0.9x	0.77	x	1.93	x	59.25	x	0.63	x	0.7	=	34.95	(74)
North	0.9x	0.77	x	1.4	x	59.25	x	0.63	x	0.7	=	25.35	(74)
North	0.9x	0.77	x	1.4	x	59.25	x	0.63	x	0.7	=	25.35	(74)
North	0.9x	0.77	x	1.93	x	41.52	x	0.63	x	0.7	=	24.49	(74)
North	0.9x	0.77	x	1.4	x	41.52	x	0.63	x	0.7	=	17.76	(74)
North	0.9x	0.77	x	1.4	x	41.52	x	0.63	x	0.7	=	17.76	(74)
North	0.9x	0.77	x	1.93	x	24.19	x	0.63	x	0.7	=	14.27	(74)
North	0.9x	0.77	x	1.4	x	24.19	x	0.63	x	0.7	=	10.35	(74)
North	0.9x	0.77	x	1.4	x	24.19	x	0.63	x	0.7	=	10.35	(74)

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North	0.9x	0.77	x	1.93	x	13.12	x	0.63	x	0.7	=	7.74	(74)
North	0.9x	0.77	x	1.4	x	13.12	x	0.63	x	0.7	=	5.61	(74)
North	0.9x	0.77	x	1.4	x	13.12	x	0.63	x	0.7	=	5.61	(74)
North	0.9x	0.77	x	1.93	x	8.86	x	0.63	x	0.7	=	5.23	(74)
North	0.9x	0.77	x	1.4	x	8.86	x	0.63	x	0.7	=	3.79	(74)
North	0.9x	0.77	x	1.4	x	8.86	x	0.63	x	0.7	=	3.79	(74)
East	0.9x	0.77	x	0.95	x	19.64	x	0.63	x	0.7	=	5.7	(76)
East	0.9x	0.77	x	0.95	x	38.42	x	0.63	x	0.7	=	11.15	(76)
East	0.9x	0.77	x	0.95	x	63.27	x	0.63	x	0.7	=	18.37	(76)
East	0.9x	0.77	x	0.95	x	92.28	x	0.63	x	0.7	=	26.79	(76)
East	0.9x	0.77	x	0.95	x	113.09	x	0.63	x	0.7	=	32.83	(76)
East	0.9x	0.77	x	0.95	x	115.77	x	0.63	x	0.7	=	33.61	(76)
East	0.9x	0.77	x	0.95	x	110.22	x	0.63	x	0.7	=	32	(76)
East	0.9x	0.77	x	0.95	x	94.68	x	0.63	x	0.7	=	27.49	(76)
East	0.9x	0.77	x	0.95	x	73.59	x	0.63	x	0.7	=	21.37	(76)
East	0.9x	0.77	x	0.95	x	45.59	x	0.63	x	0.7	=	13.24	(76)
East	0.9x	0.77	x	0.95	x	24.49	x	0.63	x	0.7	=	7.11	(76)
East	0.9x	0.77	x	0.95	x	16.15	x	0.63	x	0.7	=	4.69	(76)
South	0.9x	0.77	x	1.06	x	46.75	x	0.63	x	0.7	=	15.15	(78)
South	0.9x	0.77	x	0.18	x	46.75	x	0.63	x	0.7	=	2.57	(78)
South	0.9x	0.77	x	0.31	x	46.75	x	0.63	x	0.7	=	4.43	(78)
South	0.9x	0.77	x	1.06	x	76.57	x	0.63	x	0.7	=	24.8	(78)
South	0.9x	0.77	x	0.18	x	76.57	x	0.63	x	0.7	=	4.21	(78)
South	0.9x	0.77	x	0.31	x	76.57	x	0.63	x	0.7	=	7.25	(78)
South	0.9x	0.77	x	1.06	x	97.53	x	0.63	x	0.7	=	31.6	(78)
South	0.9x	0.77	x	0.18	x	97.53	x	0.63	x	0.7	=	5.37	(78)
South	0.9x	0.77	x	0.31	x	97.53	x	0.63	x	0.7	=	9.24	(78)
South	0.9x	0.77	x	1.06	x	110.23	x	0.63	x	0.7	=	35.71	(78)
South	0.9x	0.77	x	0.18	x	110.23	x	0.63	x	0.7	=	6.06	(78)
South	0.9x	0.77	x	0.31	x	110.23	x	0.63	x	0.7	=	10.44	(78)
South	0.9x	0.77	x	1.06	x	114.87	x	0.63	x	0.7	=	37.21	(78)
South	0.9x	0.77	x	0.18	x	114.87	x	0.63	x	0.7	=	6.32	(78)
South	0.9x	0.77	x	0.31	x	114.87	x	0.63	x	0.7	=	10.88	(78)
South	0.9x	0.77	x	1.06	x	110.55	x	0.63	x	0.7	=	35.81	(78)
South	0.9x	0.77	x	0.18	x	110.55	x	0.63	x	0.7	=	6.08	(78)
South	0.9x	0.77	x	0.31	x	110.55	x	0.63	x	0.7	=	10.47	(78)
South	0.9x	0.77	x	1.06	x	108.01	x	0.63	x	0.7	=	34.99	(78)
South	0.9x	0.77	x	0.18	x	108.01	x	0.63	x	0.7	=	5.94	(78)
South	0.9x	0.77	x	0.31	x	108.01	x	0.63	x	0.7	=	10.23	(78)
South	0.9x	0.77	x	1.06	x	104.89	x	0.63	x	0.7	=	33.98	(78)
South	0.9x	0.77	x	0.18	x	104.89	x	0.63	x	0.7	=	5.77	(78)

South	0.9x	0.77	x	0.31	x	104.89	x	0.63	x	0.7	=	9.94	(78)
South	0.9x	0.77	x	1.06	x	101.89	x	0.63	x	0.7	=	33.01	(78)
South	0.9x	0.77	x	0.18	x	101.89	x	0.63	x	0.7	=	5.6	(78)
South	0.9x	0.77	x	0.31	x	101.89	x	0.63	x	0.7	=	9.65	(78)
South	0.9x	0.77	x	1.06	x	82.59	x	0.63	x	0.7	=	26.75	(78)
South	0.9x	0.77	x	0.18	x	82.59	x	0.63	x	0.7	=	4.54	(78)
South	0.9x	0.77	x	0.31	x	82.59	x	0.63	x	0.7	=	7.82	(78)
South	0.9x	0.77	x	1.06	x	55.42	x	0.63	x	0.7	=	17.95	(78)
South	0.9x	0.77	x	0.18	x	55.42	x	0.63	x	0.7	=	3.05	(78)
South	0.9x	0.77	x	0.31	x	55.42	x	0.63	x	0.7	=	5.25	(78)
South	0.9x	0.77	x	1.06	x	40.4	x	0.63	x	0.7	=	13.09	(78)
South	0.9x	0.77	x	0.18	x	40.4	x	0.63	x	0.7	=	2.22	(78)
South	0.9x	0.77	x	0.31	x	40.4	x	0.63	x	0.7	=	3.83	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	43.22	76.8	114.49	159.19	195.25	201.6	191.11	162.82	129.64	87.32	52.32	36.64	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	358.85	390.69	418.69	447.97	468.69	460.07	439.75	416.3	390.97	364.24	347.09	344.49	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.97	0.91	0.79	0.63	0.68	0.88	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.54	19.68	19.93	20.29	20.63	20.88	20.97	20.95	20.78	20.36	19.9	19.53	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.76	19.77	19.77	19.79	19.79	19.8	19.8	19.81	19.8	19.79	19.78	19.78	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.95	0.87	0.69	0.48	0.53	0.81	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.86	18.06	18.42	18.95	19.41	19.72	19.79	19.79	19.62	19.06	18.39	17.84	(90)

fLA = Living area ÷ (4) = | 0.48 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.67	18.84	19.15	19.6	20	20.28	20.36	20.35	20.18	19.69	19.12	18.66	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.67	18.84	19.15	19.6	20	20.28	20.36	20.35	20.18	19.69	19.12	18.66	(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=	0.99	0.99	0.98	0.95	0.88	0.73	0.55	0.6	0.83	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	356.05	385.99	409.51	425.83	412.95	336.44	242.32	250.07	325.92	348.55	342.38	342.24	(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=	1000.99	967.82	875.5	728.75	563.95	380.5	251.88	264.02	409.44	617.23	821.39	993.99	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	479.83	390.99	346.69	218.1	112.34	0	0	0	0	199.9	344.89	484.91

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2577.65 (98)

Space heating requirement in kWh/m²/year 51.89 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)	479.83	390.99	346.69	218.1	112.34	0	0	0	0	199.9	344.89	484.91		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	513.19	418.17	370.79	233.26	120.15	0	0	0	0	213.8	368.86	518.62		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2756.84	(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

Water heating from separate community system:

Annual water heating requirement 1714.75 (64)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2756.84	
Water heating fuel used			2030.49	
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			245.23	(232)

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	=	595.48	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	438.59	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1034.06	(265)
Water heating from community system					

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Electrical energy for heat distribution	[(313) x	0	=	0	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	0	(373)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	127.27	(268)
Total CO2, kg/year	sum of (265)…(271) =			1200.26	(272)

TER = 35.61 (273)

SAP Input

Property Details: Flat Type A - ASHP + PV

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	07 November 2019
Date of certificate:	12 May 2020
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Low
Water use <= 125 litres/person/day:	True
PCDF Version:	460

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2020	
Floor Location:	Floor area:	Storey height:
Floor 0	55.3 m²	3.09 m
Living area:	28.01 m² (fraction 0.507)	
Front of dwelling faces:	North East	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D8_01	Manufacturer	Solid			Metal
Vent_08_03	Manufacturer	Solid			
Vent_08_02	Manufacturer	Solid			
Vent_08_06	Manufacturer	Solid			
V_01	Manufacturer	Solid			Metal
Window_08_07	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_08_01	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_08_04	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_08_05	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Fanlight	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D8_01	mm	0	0	1	2.13	1
Vent_08_03	mm	0	0	1	0.96	1
Vent_08_02	mm	0	0	1	0.96	1
Vent_08_06	mm	0	0	1	0.7	1
V_01	mm	0	0	1	0.2	1
Window_08_07	6mm	0.7	0.4	1.2	0.86	1
Window_08_01	6mm	0.7	0.4	1.2	2.01	1
Window_08_04	6mm	0.7	0.4	1.2	2.01	1
Window_08_05	6mm	0.7	0.4	1.2	1.46	1
Fanlight	6mm	0.7	0.4	1.2	0.32	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D8_01		8_01	North East	0	0
Vent_08_03		8_07	South West	0	0
Vent_08_02		8_07	South West	0	0
Vent_08_06		8_07	South West	0	0
V_01		8_01	North East	1.01	0.2

SAP Input

Window_08_07	8_05	North East	0.6	1.44
Window_08_01	8_07	South West	1.22	1.65
Window_08_04	8_07	South West	1.22	1.65
Window_08_05	8_07	South West	1.22	1.2
Fanlight	8_01	North East	1.01	0.315

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
8_01	15.172	2.65	12.52	0.13	0	False	N/A
8_02	1.854	0	1.85	0.13	0	False	N/A
8_03	6.727	0	6.73	0.13	0	False	N/A
8_04	1.823	0	1.82	0.13	0	False	N/A
8_05	6.365	0.86	5.5	0.13	0	False	N/A
8_07	28.737	8.1	20.64	0.13	0	False	N/A
8_08	19.467	0	19.47	0.13	0.82	False	N/A
Ground	55.3			0.11			N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test: Yes (As designed)

Ventilation: Balanced with heat recovery
Number of wet rooms: Kitchen + 1
Ductwork: Insulation, rigid
Approved Installation Scheme: False

Number of chimneys: 0
Number of open flues: 0
Number of fans: 0
Number of passive stacks: 0
Number of sides sheltered: 0
Pressure test: 2.5

Main heating system:

Main heating system: Electric underfloor heating
Standard tariff
Fuel: Electricity
Info Source: SAP Tables
SAP Table: 425
In timber floor, or immediately below floor covering
Underfloor heating, pipes in insulated timber floor
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Room-sealed
Boiler interlock: Yes

Main heating Control:

Main heating Control: Programmer and room thermostat
Control code: 2704

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating: 952 From DHW-only community scheme

SAP Input

	Heat source: From hot-water only community scheme - heat pump heat from electric heat pump, heat fraction 1, efficiency 329 Piping>=1991, pre-insulated, medium temp, variable flow No hot water cylinder Solar panel: False
Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.386 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South Photovoltaic 2 Installed Peak power: 0.966 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South West Photovoltaic 3 Installed Peak power: 0.362 Tilt of collector: 30° Overshading: None or very little Collector Orientation: East
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type A - ASHP + PV

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	55.3	(1a)	x	3.09	(2a)	=	170.88	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.3	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			170.88	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

SAP WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.96	x	1	=	0.96			(26)
Doors Type 3			0.96	x	1	=	0.96			(26)
Doors Type 4			0.7	x	1	=	0.7			(26)
Doors Type 5			0.2	x	1	=	0.2			(26)
Windows Type 1			0.86	x1/[1/(1.2)+ 0.04]		=	0.98			(27)
Windows Type 2			2.01	x1/[1/(1.2)+ 0.04]		=	2.3			(27)
Windows Type 3			2.01	x1/[1/(1.2)+ 0.04]		=	2.3			(27)
Windows Type 4			1.46	x1/[1/(1.2)+ 0.04]		=	1.67			(27)
Windows Type 5			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Floor			55.3	x	0.11	=	6.083			(28)
Walls Type1	15.17	2.65	12.52	x	0.13	=	1.63			(29)
Walls Type2	1.85	0	1.85	x	0.13	=	0.24			(29)
Walls Type3	6.73	0	6.73	x	0.13	=	0.87			(29)
Walls Type4	1.82	0	1.82	x	0.13	=	0.24			(29)
Walls Type5	6.36	0.86	5.5	x	0.13	=	0.72			(29)
Walls Type6	28.74	8.1	20.64	x	0.13	=	2.68			(29)
Walls Type7	19.47	0	19.47	x	0.12	=	2.29			(29)
Total area of elements, m²			135.44							(31)

SAP WorkSheet: New dwelling design stage

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	27.32	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6083	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Low	100	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		20.32	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	47.64	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	15.85	15.68	15.5	14.62	14.44	13.56	13.56	13.39	13.91	14.44	14.8	15.15	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	63.49	63.32	63.14	62.26	62.08	61.2	61.2	61.03	61.56	62.08	62.44	62.79	

Average = $Sum(39)_{1…12}$ /12= 62.22 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.15	1.14	1.14	1.13	1.12	1.11	1.11	1.1	1.11	1.12	1.13	1.14	

Average = $Sum(40)_{1…12}$ /12= 1.13 (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 — 1.85 (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 — 78.05 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	85.85	82.73	79.61	76.49	73.36	70.24	70.24	73.36	76.49	79.61	82.73	85.85	

Total = $Sum(44)_{1…12}$ = 936.55 (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=	127.31	111.35	114.9	100.17	96.12	82.94	76.86	88.2	89.25	104.01	113.54	123.3	

Total = $Sum(45)_{1…12}$ = 1227.97 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.1	16.7	17.24	15.03	14.42	12.44	11.53	13.23	13.39	15.6	17.03	18.49	(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)

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Energy lost from water storage, kWh/year	(48) x (49) =	110	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02	(51)
If community heating see section 4.3			
Volume factor from Table 2a		1.03	(52)
Temperature factor from Table 2b		0.6	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)		1.03	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	182.59	161.28	170.18	153.67	151.4	136.44	132.14	143.48	142.75	159.29	167.03	178.57	(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=	182.59	161.28	170.18	153.67	151.4	136.44	132.14	143.48	142.75	159.29	167.03	178.57

Output from water heater (annual)$_{1...12}$ — 1878.81 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	86.55	76.97	82.43	76.1	76.18	70.37	69.78	73.55	72.47	78.81	80.55	85.22	(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=	110.77	110.77	110.77	110.77	110.77	110.77	110.77	110.77	110.77	110.77	110.77	110.77	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	39.79	35.34	28.74	21.76	16.26	13.73	14.84	19.28	25.88	32.87	38.36	40.89	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	240.24	242.73	236.45	223.07	206.19	190.33	179.73	177.23	183.51	196.89	213.77	229.64	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	47.92	47.92	47.92	47.92	47.92	47.92	47.92	47.92	47.92	47.92	47.92	47.92	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	(71)

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Water heating gains (Table 5)

(72)m=	116.34	114.53	110.79	105.7	102.39	97.74	93.79	98.85	100.65	105.92	111.87	114.54	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	481.2	477.45	460.82	435.38	409.7	386.64	373.19	380.22	394.9	420.52	448.85	469.91	(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)	
Northeast 0.9x	0.77	x	0.86	x	11.28	x	0.4	x	0.7	=	1.88	(75)
Northeast 0.9x	0.77	x	0.32	x	11.28	x	0.4	x	0.7	=	0.7	(75)
Northeast 0.9x	0.77	x	0.86	x	22.97	x	0.4	x	0.7	=	3.83	(75)
Northeast 0.9x	0.77	x	0.32	x	22.97	x	0.4	x	0.7	=	1.43	(75)
Northeast 0.9x	0.77	x	0.86	x	41.38	x	0.4	x	0.7	=	6.91	(75)
Northeast 0.9x	0.77	x	0.32	x	41.38	x	0.4	x	0.7	=	2.57	(75)
Northeast 0.9x	0.77	x	0.86	x	67.96	x	0.4	x	0.7	=	11.34	(75)
Northeast 0.9x	0.77	x	0.32	x	67.96	x	0.4	x	0.7	=	4.22	(75)
Northeast 0.9x	0.77	x	0.86	x	91.35	x	0.4	x	0.7	=	15.24	(75)
Northeast 0.9x	0.77	x	0.32	x	91.35	x	0.4	x	0.7	=	5.67	(75)
Northeast 0.9x	0.77	x	0.86	x	97.38	x	0.4	x	0.7	=	16.25	(75)
Northeast 0.9x	0.77	x	0.32	x	97.38	x	0.4	x	0.7	=	6.05	(75)
Northeast 0.9x	0.77	x	0.86	x	91.1	x	0.4	x	0.7	=	15.2	(75)
Northeast 0.9x	0.77	x	0.32	x	91.1	x	0.4	x	0.7	=	5.66	(75)
Northeast 0.9x	0.77	x	0.86	x	72.63	x	0.4	x	0.7	=	12.12	(75)
Northeast 0.9x	0.77	x	0.32	x	72.63	x	0.4	x	0.7	=	4.51	(75)
Northeast 0.9x	0.77	x	0.86	x	50.42	x	0.4	x	0.7	=	8.41	(75)
Northeast 0.9x	0.77	x	0.32	x	50.42	x	0.4	x	0.7	=	3.13	(75)
Northeast 0.9x	0.77	x	0.86	x	28.07	x	0.4	x	0.7	=	4.68	(75)
Northeast 0.9x	0.77	x	0.32	x	28.07	x	0.4	x	0.7	=	1.74	(75)
Northeast 0.9x	0.77	x	0.86	x	14.2	x	0.4	x	0.7	=	2.37	(75)
Northeast 0.9x	0.77	x	0.32	x	14.2	x	0.4	x	0.7	=	0.88	(75)
Northeast 0.9x	0.77	x	0.86	x	9.21	x	0.4	x	0.7	=	1.54	(75)
Northeast 0.9x	0.77	x	0.32	x	9.21	x	0.4	x	0.7	=	0.57	(75)
Southwest 0.9x	0.77	x	2.01	x	36.79		0.4	x	0.7	=	14.35	(79)
Southwest 0.9x	0.77	x	2.01	x	36.79		0.4	x	0.7	=	14.35	(79)
Southwest 0.9x	0.77	x	1.46	x	36.79		0.4	x	0.7	=	10.42	(79)
Southwest 0.9x	0.77	x	2.01	x	62.67		0.4	x	0.7	=	24.44	(79)
Southwest 0.9x	0.77	x	2.01	x	62.67		0.4	x	0.7	=	24.44	(79)
Southwest 0.9x	0.77	x	1.46	x	62.67		0.4	x	0.7	=	17.76	(79)
Southwest 0.9x	0.77	x	2.01	x	85.75		0.4	x	0.7	=	33.45	(79)
Southwest 0.9x	0.77	x	2.01	x	85.75		0.4	x	0.7	=	33.45	(79)

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Southwest	0.9x	0.77	x	1.46	x	85.75	0.4	x	0.7	=	24.29	(79)
Southwest	0.9x	0.77	x	2.01	x	106.25	0.4	x	0.7	=	41.44	(79)
Southwest	0.9x	0.77	x	2.01	x	106.25	0.4	x	0.7	=	41.44	(79)
Southwest	0.9x	0.77	x	1.46	x	106.25	0.4	x	0.7	=	30.1	(79)
Southwest	0.9x	0.77	x	2.01	x	119.01	0.4	x	0.7	=	46.42	(79)
Southwest	0.9x	0.77	x	2.01	x	119.01	0.4	x	0.7	=	46.42	(79)
Southwest	0.9x	0.77	x	1.46	x	119.01	0.4	x	0.7	=	33.72	(79)
Southwest	0.9x	0.77	x	2.01	x	118.15	0.4	x	0.7	=	46.08	(79)
Southwest	0.9x	0.77	x	2.01	x	118.15	0.4	x	0.7	=	46.08	(79)
Southwest	0.9x	0.77	x	1.46	x	118.15	0.4	x	0.7	=	33.47	(79)
Southwest	0.9x	0.77	x	2.01	x	113.91	0.4	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	2.01	x	113.91	0.4	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	1.46	x	113.91	0.4	x	0.7	=	32.27	(79)
Southwest	0.9x	0.77	x	2.01	x	104.39	0.4	x	0.7	=	40.71	(79)
Southwest	0.9x	0.77	x	2.01	x	104.39	0.4	x	0.7	=	40.71	(79)
Southwest	0.9x	0.77	x	1.46	x	104.39	0.4	x	0.7	=	29.57	(79)
Southwest	0.9x	0.77	x	2.01	x	92.85	0.4	x	0.7	=	36.21	(79)
Southwest	0.9x	0.77	x	2.01	x	92.85	0.4	x	0.7	=	36.21	(79)
Southwest	0.9x	0.77	x	1.46	x	92.85	0.4	x	0.7	=	26.3	(79)
Southwest	0.9x	0.77	x	2.01	x	69.27	0.4	x	0.7	=	27.02	(79)
Southwest	0.9x	0.77	x	2.01	x	69.27	0.4	x	0.7	=	27.02	(79)
Southwest	0.9x	0.77	x	1.46	x	69.27	0.4	x	0.7	=	19.62	(79)
Southwest	0.9x	0.77	x	2.01	x	44.07	0.4	x	0.7	=	17.19	(79)
Southwest	0.9x	0.77	x	2.01	x	44.07	0.4	x	0.7	=	17.19	(79)
Southwest	0.9x	0.77	x	1.46	x	44.07	0.4	x	0.7	=	12.49	(79)
Southwest	0.9x	0.77	x	2.01	x	31.49	0.4	x	0.7	=	12.28	(79)
Southwest	0.9x	0.77	x	2.01	x	31.49	0.4	x	0.7	=	12.28	(79)
Southwest	0.9x	0.77	x	1.46	x	31.49	0.4	x	0.7	=	8.92	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	41.71	71.9	100.66	128.54	147.46	147.93	141.98	127.63	110.28	80.08	50.11	35.59	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	522.91	549.35	561.48	563.92	557.16	534.57	515.18	507.85	505.18	500.6	498.96	505.51	(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=	0.91	0.9	0.87	0.82	0.74	0.61	0.47	0.5	0.66	0.81	0.89	0.92	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.12	19.3	19.62	20.05	20.46	20.78	20.92	20.9	20.7	20.22	19.61	19.08	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.43	20.43	20.43	20.44	20.44	20.45	20.45	20.45	20.44	20.44	20.44	20.43	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.91	0.89	0.86	0.81	0.72	0.57	0.42	0.45	0.63	0.79	0.88	0.91	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.65	18.83	19.15	19.58	19.97	20.27	20.39	20.38	20.2	19.74	19.15	18.62	(90)

fLA = Living area ÷ (4) = 0.51 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.89	19.07	19.38	19.82	20.22	20.53	20.66	20.65	20.46	19.98	19.39	18.86	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.89	19.07	19.38	19.82	20.22	20.53	20.66	20.65	20.46	19.98	19.39	18.86	(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=	0.89	0.87	0.84	0.79	0.71	0.58	0.44	0.47	0.63	0.78	0.86	0.89	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	464.36	478.28	472.44	445.22	393.8	308.43	228.74	236.33	317.81	389.7	428.12	452.36	(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=	926.12	896.95	813.58	679.84	528.85	362.98	248.38	259.21	391.32	582.55	767.07	920.24	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	343.55	281.34	253.8	168.92	100.48	0	0	0	0	143.48	244.04	348.1	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1883.71 (98)

Space heating requirement in kWh/m²/year 34.06 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(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)													
	343.55	281.34	253.8	168.92	100.48	0	0	0	0	143.48	244.04	348.1	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	343.55	281.34	253.8	168.92	100.48	0	0	0	0	143.48	244.04	348.1	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1883.71 (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)

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Water heating

Water heating from separate community system:

Annual water heating requirement		1878.81	(64)
Fraction of heat from community CHP		1	(303a)
Factor for charging method for community water heating		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.1	(306)
Water heat from CHP	(64) x (303a) x (305) x (306) =	2066.69	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	20.67	(313)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1883.71	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		218.89		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		218.89	(231)
Electricity for lighting			281.06	(232)
Electricity generated by PVs			-1391.63	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	248.46	(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 from CHP	(310a) x	4.24	x 0.01 =	87.63	(342a)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	28.87	(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 =	37.07	(250)
Additional standing charges (Table 12)				60	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-183.56	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			278.48	(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] =	1.17	(257)
SAP rating (Section 12)		83.73	(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	0.519	=	977.65	(261)

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Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating from community system						
		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	326.02	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	10.73	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	336.75	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	113.61	(267)
Electricity for lighting	(232) x		0.519	=	145.87	(268)
Energy saving/generation technologies Item 1			0.519	=	-722.25	(269)
Total CO2, kg/year		sum of (265)…(271) =			851.62	(272)
CO2 emissions per m²		(272) ÷ (4) =			15.4	(273)
EI rating (section 14)					89	(274)

13a. Primary Energy

	Energy kWh/year		**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x		3.07	=	5783	(261)
Space heating (secondary)	(215) x		3.07	=	0	(263)
Water heating from community system						
		Energy kWh/year	Primary factor		Emissions kWh/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
Energy associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		3.07	=	1928.49	(367)
Electrical energy for heat distribution	[(313) x		2.92	=	60.35	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)			=	336.75	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		3.07	=	672	(267)
Electricity for lighting	(232) x		0	=	862.85	(268)
Energy saving/generation technologies Item 1			3.07	=	-4272.3	(269)
'Total Primary Energy		sum of (265)…(271) =			5034.39	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =			91.04	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type A - ASHP + PV

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	55.3	(1a)	x	3.09	(2a)	=	170.88	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.3	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	170.88	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)
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			2.5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.12	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.12	(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

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.96	x	1	=	0.96			(26)
Doors Type 3			0.96	x	1	=	0.96			(26)
Doors Type 4			0.7	x	1	=	0.7			(26)
Doors Type 5			0.2	x	1	=	0.2			(26)
Windows Type 1			0.86		x1/[1/(1.2)+ 0.04]	=	0.98			(27)
Windows Type 2			2.01		x1/[1/(1.2)+ 0.04]	=	2.3			(27)
Windows Type 3			2.01		x1/[1/(1.2)+ 0.04]	=	2.3			(27)
Windows Type 4			1.46		x1/[1/(1.2)+ 0.04]	=	1.67			(27)
Windows Type 5			0.32		x1/[1/(1.2)+ 0.04]	=	0.37			(27)
Floor			55.3	x	0.11	=	6.083			(28)
Walls Type1	15.17	2.65	12.52	x	0.13	=	1.63			(29)
Walls Type2	1.85	0	1.85	x	0.13	=	0.24			(29)
Walls Type3	6.73	0	6.73	x	0.13	=	0.87			(29)
Walls Type4	1.82	0	1.82	x	0.13	=	0.24			(29)
Walls Type5	6.36	0.86	5.5	x	0.13	=	0.72			(29)
Walls Type6	28.74	8.1	20.64	x	0.13	=	2.68			(29)
Walls Type7	19.47	0	19.47	x	0.12	=	2.29			(29)
Total area of elements, m²			135.44							(31)

DER WorkSheet: New dwelling design stage

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	27.32	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6083	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Low	100	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		20.32	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	47.64	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	15.85	15.68	15.5	14.62	14.44	13.56	13.56	13.39	13.91	14.44	14.8	15.15	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	63.49	63.32	63.14	62.26	62.08	61.2	61.2	61.03	61.56	62.08	62.44	62.79	

Average = $Sum(39)_{1…12}$ /12= 62.22 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.15	1.14	1.14	1.13	1.12	1.11	1.11	1.1	1.11	1.12	1.13	1.14	

Average = $Sum(40)_{1…12}$ /12= 1.13 (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 1.85 (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 78.05 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	85.85	82.73	79.61	76.49	73.36	70.24	70.24	73.36	76.49	79.61	82.73	85.85	

Total = $Sum(44)_{1…12}$ = 936.55 (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=	127.31	111.35	114.9	100.17	96.12	82.94	76.86	88.2	89.25	104.01	113.54	123.3	

Total = $Sum(45)_{1…12}$ = 1227.97 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.1	16.7	17.24	15.03	14.42	12.44	11.53	13.23	13.39	15.6	17.03	18.49	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year	(48) x (49) =	110	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02	(51)
If community heating see section 4.3			
Volume factor from Table 2a		1.03	(52)
Temperature factor from Table 2b		0.6	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)		1.03	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	182.59	161.28	170.18	153.67	151.4	136.44	132.14	143.48	142.75	159.29	167.03	178.57	(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=	182.59	161.28	170.18	153.67	151.4	136.44	132.14	143.48	142.75	159.29	167.03	178.57

Output from water heater (annual)$_{1...12}$ — 1878.81 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	86.55	76.97	82.43	76.1	76.18	70.37	69.78	73.55	72.47	78.81	80.55	85.22	(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=	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.91	14.14	11.5	8.7	6.51	5.49	5.93	7.71	10.35	13.15	15.34	16.36	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	160.96	162.63	158.42	149.46	138.15	127.52	120.42	118.75	122.95	131.92	143.23	153.86	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	(71)

DER WorkSheet: New dwelling design stage

Water heating gains (Table 5)

(72)m=	116.34	114.53	110.79	105.7	102.39	97.74	93.79	98.85	100.65	105.92	111.87	114.54	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	343.9	341.99	331.4	314.55	297.74	281.44	270.83	276.01	284.65	301.68	321.13	335.45	(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)	
Northeast 0.9x	0.77	x	0.86	x	11.28	x	0.4	x	0.7	=	1.88	(75)
Northeast 0.9x	0.77	x	0.32	x	11.28	x	0.4	x	0.7	=	0.7	(75)
Northeast 0.9x	0.77	x	0.86	x	22.97	x	0.4	x	0.7	=	3.83	(75)
Northeast 0.9x	0.77	x	0.32	x	22.97	x	0.4	x	0.7	=	1.43	(75)
Northeast 0.9x	0.77	x	0.86	x	41.38	x	0.4	x	0.7	=	6.91	(75)
Northeast 0.9x	0.77	x	0.32	x	41.38	x	0.4	x	0.7	=	2.57	(75)
Northeast 0.9x	0.77	x	0.86	x	67.96	x	0.4	x	0.7	=	11.34	(75)
Northeast 0.9x	0.77	x	0.32	x	67.96	x	0.4	x	0.7	=	4.22	(75)
Northeast 0.9x	0.77	x	0.86	x	91.35	x	0.4	x	0.7	=	15.24	(75)
Northeast 0.9x	0.77	x	0.32	x	91.35	x	0.4	x	0.7	=	5.67	(75)
Northeast 0.9x	0.77	x	0.86	x	97.38	x	0.4	x	0.7	=	16.25	(75)
Northeast 0.9x	0.77	x	0.32	x	97.38	x	0.4	x	0.7	=	6.05	(75)
Northeast 0.9x	0.77	x	0.86	x	91.1	x	0.4	x	0.7	=	15.2	(75)
Northeast 0.9x	0.77	x	0.32	x	91.1	x	0.4	x	0.7	=	5.66	(75)
Northeast 0.9x	0.77	x	0.86	x	72.63	x	0.4	x	0.7	=	12.12	(75)
Northeast 0.9x	0.77	x	0.32	x	72.63	x	0.4	x	0.7	=	4.51	(75)
Northeast 0.9x	0.77	x	0.86	x	50.42	x	0.4	x	0.7	=	8.41	(75)
Northeast 0.9x	0.77	x	0.32	x	50.42	x	0.4	x	0.7	=	3.13	(75)
Northeast 0.9x	0.77	x	0.86	x	28.07	x	0.4	x	0.7	=	4.68	(75)
Northeast 0.9x	0.77	x	0.32	x	28.07	x	0.4	x	0.7	=	1.74	(75)
Northeast 0.9x	0.77	x	0.86	x	14.2	x	0.4	x	0.7	=	2.37	(75)
Northeast 0.9x	0.77	x	0.32	x	14.2	x	0.4	x	0.7	=	0.88	(75)
Northeast 0.9x	0.77	x	0.86	x	9.21	x	0.4	x	0.7	=	1.54	(75)
Northeast 0.9x	0.77	x	0.32	x	9.21	x	0.4	x	0.7	=	0.57	(75)
Southwest 0.9x	0.77	x	2.01	x	36.79		0.4	x	0.7	=	14.35	(79)
Southwest 0.9x	0.77	x	2.01	x	36.79		0.4	x	0.7	=	14.35	(79)
Southwest 0.9x	0.77	x	1.46	x	36.79		0.4	x	0.7	=	10.42	(79)
Southwest 0.9x	0.77	x	2.01	x	62.67		0.4	x	0.7	=	24.44	(79)
Southwest 0.9x	0.77	x	2.01	x	62.67		0.4	x	0.7	=	24.44	(79)
Southwest 0.9x	0.77	x	1.46	x	62.67		0.4	x	0.7	=	17.76	(79)
Southwest 0.9x	0.77	x	2.01	x	85.75		0.4	x	0.7	=	33.45	(79)
Southwest 0.9x	0.77	x	2.01	x	85.75		0.4	x	0.7	=	33.45	(79)

Southwest	0.9x	0.77	x	1.46	x	85.75	0.4	x	0.7	=	24.29	(79)
Southwest	0.9x	0.77	x	2.01	x	106.25	0.4	x	0.7	=	41.44	(79)
Southwest	0.9x	0.77	x	2.01	x	106.25	0.4	x	0.7	=	41.44	(79)
Southwest	0.9x	0.77	x	1.46	x	106.25	0.4	x	0.7	=	30.1	(79)
Southwest	0.9x	0.77	x	2.01	x	119.01	0.4	x	0.7	=	46.42	(79)
Southwest	0.9x	0.77	x	2.01	x	119.01	0.4	x	0.7	=	46.42	(79)
Southwest	0.9x	0.77	x	1.46	x	119.01	0.4	x	0.7	=	33.72	(79)
Southwest	0.9x	0.77	x	2.01	x	118.15	0.4	x	0.7	=	46.08	(79)
Southwest	0.9x	0.77	x	2.01	x	118.15	0.4	x	0.7	=	46.08	(79)
Southwest	0.9x	0.77	x	1.46	x	118.15	0.4	x	0.7	=	33.47	(79)
Southwest	0.9x	0.77	x	2.01	x	113.91	0.4	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	2.01	x	113.91	0.4	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	1.46	x	113.91	0.4	x	0.7	=	32.27	(79)
Southwest	0.9x	0.77	x	2.01	x	104.39	0.4	x	0.7	=	40.71	(79)
Southwest	0.9x	0.77	x	2.01	x	104.39	0.4	x	0.7	=	40.71	(79)
Southwest	0.9x	0.77	x	1.46	x	104.39	0.4	x	0.7	=	29.57	(79)
Southwest	0.9x	0.77	x	2.01	x	92.85	0.4	x	0.7	=	36.21	(79)
Southwest	0.9x	0.77	x	2.01	x	92.85	0.4	x	0.7	=	36.21	(79)
Southwest	0.9x	0.77	x	1.46	x	92.85	0.4	x	0.7	=	26.3	(79)
Southwest	0.9x	0.77	x	2.01	x	69.27	0.4	x	0.7	=	27.02	(79)
Southwest	0.9x	0.77	x	2.01	x	69.27	0.4	x	0.7	=	27.02	(79)
Southwest	0.9x	0.77	x	1.46	x	69.27	0.4	x	0.7	=	19.62	(79)
Southwest	0.9x	0.77	x	2.01	x	44.07	0.4	x	0.7	=	17.19	(79)
Southwest	0.9x	0.77	x	2.01	x	44.07	0.4	x	0.7	=	17.19	(79)
Southwest	0.9x	0.77	x	1.46	x	44.07	0.4	x	0.7	=	12.49	(79)
Southwest	0.9x	0.77	x	2.01	x	31.49	0.4	x	0.7	=	12.28	(79)
Southwest	0.9x	0.77	x	2.01	x	31.49	0.4	x	0.7	=	12.28	(79)
Southwest	0.9x	0.77	x	1.46	x	31.49	0.4	x	0.7	=	8.92	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	41.71	71.9	100.66	128.54	147.46	147.93	141.98	127.63	110.28	80.08	50.11	35.59	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	385.61	413.89	432.05	443.09	445.2	429.38	412.81	403.64	394.93	381.76	371.25	371.04	(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=	0.95	0.94	0.92	0.88	0.81	0.69	0.56	0.59	0.75	0.88	0.94	0.96	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.76	18.96	19.32	19.82	20.3	20.69	20.88	20.86	20.58	19.99	19.31	18.73	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.43	20.43	20.43	20.44	20.44	20.45	20.45	20.45	20.44	20.44	20.44	20.43	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.95	0.94	0.91	0.87	0.79	0.66	0.51	0.54	0.72	0.87	0.93	0.95	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.3	18.5	18.86	19.35	19.82	20.2	20.36	20.35	20.1	19.53	18.85	18.27	(90)

fLA = Living area ÷ (4) = 0.51 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.53	18.73	19.09	19.59	20.06	20.45	20.62	20.6	20.34	19.76	19.08	18.5	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.53	18.73	19.09	19.59	20.06	20.45	20.62	20.6	20.34	19.76	19.08	18.5	(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=	0.94	0.92	0.9	0.85	0.78	0.66	0.53	0.55	0.72	0.85	0.91	0.94	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	360.57	381.03	387.29	377.77	346.87	282.86	216.84	222.35	283.22	324.83	339.35	348.87	(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=	903.74	875.97	795.23	665.53	519.14	358	246.18	256.61	384.39	568.84	748.09	898.1	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	404.11	332.6	303.51	207.19	128.17	0	0	0	0	181.54	294.29	408.63	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2260.05 (98)

Space heating requirement in kWh/m²/year 40.87 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 100 (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)													
	404.11	332.6	303.51	207.19	128.17	0	0	0	0	181.54	294.29	408.63	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	404.11	332.6	303.51	207.19	128.17	0	0	0	0	181.54	294.29	408.63	

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 2260.05 (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)

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Water heating

Water heating from separate community system:

Annual water heating requirement			1878.81	(64)
Fraction of heat from community CHP			1	(303a)
Factor for charging method for community water heating			1	(305)
Distribution loss factor (Table 12c) for community heating system			1.1	(306)
Water heat from CHP	(64) x (303a) x (305) x (306) =		2066.69	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =		20.67	(313)
Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2260.05	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		218.89		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		218.89	(231)
Electricity for lighting			281.06	(232)
Electricity generated by PVs			-1391.63	(233)

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	0.519	=	1172.96	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating from community system						

		Energy kWh/year	**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	326.02	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	10.73	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	336.75	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	113.61	(267)
Electricity for lighting	(232) x		0.519	=	145.87	(268)
Energy saving/generation technologies						
Item 1			0.519	=	-722.25	(269)
Total CO2, kg/year	sum of (265)…(271) =				1046.93	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =				18.93	(273)
EI rating (section 14)					86	(274)

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User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type A - ASHP + PV

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	55.3	(1a) x	3.09	(2a) =	170.88	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.3	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		170.88	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =	0.12	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.96	x	1	=	0.96			(26)
Doors Type 3			0.96	x	1	=	0.96			(26)
Doors Type 4			0.7	x	1	=	0.7			(26)
Doors Type 5			0.2	x	1	=	0.2			(26)
Windows Type 1			0.86	x1/[1/(1.4)+ 0.04]		=	1.14			(27)
Windows Type 2			2.01	x1/[1/(1.4)+ 0.04]		=	2.66			(27)
Windows Type 3			2.01	x1/[1/(1.4)+ 0.04]		=	2.66			(27)
Windows Type 4			1.46	x1/[1/(1.4)+ 0.04]		=	1.94			(27)
Windows Type 5			0.32	x1/[1/(1.4)+ 0.04]		=	0.42			(27)
Floor			55.3	x	0.13	=	7.189			(28)
Walls Type1	15.17	2.65	12.52	x	0.18	=	2.25			(29)
Walls Type2	1.85	0	1.85	x	0.18	=	0.33			(29)
Walls Type3	6.73	0	6.73	x	0.18	=	1.21			(29)
Walls Type4	1.82	0	1.82	x	0.18	=	0.33			(29)
Walls Type5	6.36	0.86	5.5	x	0.18	=	0.99			(29)
Walls Type6	28.74	8.1	20.64	x	0.18	=	3.71			(29)
Walls Type7	19.47	0	19.47	x	0.18	=	3.5			(29)
Total area of elements, m²			135.44							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	33.3	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6083	(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		6.77	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	40.08	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	34.37	34.13	33.89	32.79	32.58	31.62	31.62	31.44	31.99	32.58	33	33.44	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	74.45	74.21	73.97	72.87	72.66	71.7	71.7	71.52	72.07	72.66	73.08	73.52

Average = Sum(39)1…12 /12= 72.87 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.35	1.34	1.34	1.32	1.31	1.3	1.3	1.29	1.3	1.31	1.32	1.33

Average = Sum(40)1…12 /12= 1.32 (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 1.85 (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 78.05 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	85.85	82.73	79.61	76.49	73.36	70.24	70.24	73.36	76.49	79.61	82.73	85.85

Total = Sum(44)1…12 = 936.55 (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=	127.31	111.35	114.9	100.17	96.12	82.94	76.86	88.2	89.25	104.01	113.54	123.3

Total = Sum(45)1…12 = 1227.97 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.1	16.7	17.24	15.03	14.42	12.44	11.53	13.23	13.39	15.6	17.03	18.49	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (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): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0.75	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0.75	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	173.91	153.44	161.5	145.27	142.72	128.04	123.46	134.79	134.34	150.61	158.63	169.89	(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=	173.91	153.44	161.5	145.27	142.72	128.04	123.46	134.79	134.34	150.61	158.63	169.89

Output from water heater (annual)$_{1...12}$ — 1776.58 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	79.61	70.69	75.48	69.38	69.24	63.65	62.83	66.6	65.75	71.86	73.83	78.27	(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=	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.91	14.14	11.5	8.7	6.51	5.49	5.93	7.71	10.35	13.15	15.34	16.36	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	160.96	162.63	158.42	149.46	138.15	127.52	120.42	118.75	122.95	131.92	143.23	153.86	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	(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=	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	(71)

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Water heating gains (Table 5)

(72)m=	107	105.2	101.45	96.36	93.06	88.41	84.45	89.52	91.32	96.59	102.54	105.2	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	337.57	335.65	325.06	308.22	291.41	275.11	264.49	269.67	278.32	295.34	314.8	329.11	(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)	
Northeast 0.9x	0.77	x	0.86	x	11.28	x	0.63	x	0.7	=	2.97	(75)
Northeast 0.9x	0.77	x	0.32	x	11.28	x	0.63	x	0.7	=	1.1	(75)
Northeast 0.9x	0.77	x	0.86	x	22.97	x	0.63	x	0.7	=	6.04	(75)
Northeast 0.9x	0.77	x	0.32	x	22.97	x	0.63	x	0.7	=	2.25	(75)
Northeast 0.9x	0.77	x	0.86	x	41.38	x	0.63	x	0.7	=	10.88	(75)
Northeast 0.9x	0.77	x	0.32	x	41.38	x	0.63	x	0.7	=	4.05	(75)
Northeast 0.9x	0.77	x	0.86	x	67.96	x	0.63	x	0.7	=	17.86	(75)
Northeast 0.9x	0.77	x	0.32	x	67.96	x	0.63	x	0.7	=	6.65	(75)
Northeast 0.9x	0.77	x	0.86	x	91.35	x	0.63	x	0.7	=	24.01	(75)
Northeast 0.9x	0.77	x	0.32	x	91.35	x	0.63	x	0.7	=	8.93	(75)
Northeast 0.9x	0.77	x	0.86	x	97.38	x	0.63	x	0.7	=	25.6	(75)
Northeast 0.9x	0.77	x	0.32	x	97.38	x	0.63	x	0.7	=	9.52	(75)
Northeast 0.9x	0.77	x	0.86	x	91.1	x	0.63	x	0.7	=	23.94	(75)
Northeast 0.9x	0.77	x	0.32	x	91.1	x	0.63	x	0.7	=	8.91	(75)
Northeast 0.9x	0.77	x	0.86	x	72.63	x	0.63	x	0.7	=	19.09	(75)
Northeast 0.9x	0.77	x	0.32	x	72.63	x	0.63	x	0.7	=	7.1	(75)
Northeast 0.9x	0.77	x	0.86	x	50.42	x	0.63	x	0.7	=	13.25	(75)
Northeast 0.9x	0.77	x	0.32	x	50.42	x	0.63	x	0.7	=	4.93	(75)
Northeast 0.9x	0.77	x	0.86	x	28.07	x	0.63	x	0.7	=	7.38	(75)
Northeast 0.9x	0.77	x	0.32	x	28.07	x	0.63	x	0.7	=	2.74	(75)
Northeast 0.9x	0.77	x	0.86	x	14.2	x	0.63	x	0.7	=	3.73	(75)
Northeast 0.9x	0.77	x	0.32	x	14.2	x	0.63	x	0.7	=	1.39	(75)
Northeast 0.9x	0.77	x	0.86	x	9.21	x	0.63	x	0.7	=	2.42	(75)
Northeast 0.9x	0.77	x	0.32	x	9.21	x	0.63	x	0.7	=	0.9	(75)
Southwest 0.9x	0.77	x	2.01	x	36.79		0.63	x	0.7	=	22.6	(79)
Southwest 0.9x	0.77	x	2.01	x	36.79		0.63	x	0.7	=	22.6	(79)
Southwest 0.9x	0.77	x	1.46	x	36.79		0.63	x	0.7	=	16.42	(79)
Southwest 0.9x	0.77	x	2.01	x	62.67		0.63	x	0.7	=	38.5	(79)
Southwest 0.9x	0.77	x	2.01	x	62.67		0.63	x	0.7	=	38.5	(79)
Southwest 0.9x	0.77	x	1.46	x	62.67		0.63	x	0.7	=	27.96	(79)
Southwest 0.9x	0.77	x	2.01	x	85.75		0.63	x	0.7	=	52.68	(79)
Southwest 0.9x	0.77	x	2.01	x	85.75		0.63	x	0.7	=	52.68	(79)

Southwest	0.9x	0.77	x	1.46	x	85.75	0.63	x	0.7	=	38.26	(79)
Southwest	0.9x	0.77	x	2.01	x	106.25	0.63	x	0.7	=	65.27	(79)
Southwest	0.9x	0.77	x	2.01	x	106.25	0.63	x	0.7	=	65.27	(79)
Southwest	0.9x	0.77	x	1.46	x	106.25	0.63	x	0.7	=	47.41	(79)
Southwest	0.9x	0.77	x	2.01	x	119.01	0.63	x	0.7	=	73.11	(79)
Southwest	0.9x	0.77	x	2.01	x	119.01	0.63	x	0.7	=	73.11	(79)
Southwest	0.9x	0.77	x	1.46	x	119.01	0.63	x	0.7	=	53.1	(79)
Southwest	0.9x	0.77	x	2.01	x	118.15	0.63	x	0.7	=	72.58	(79)
Southwest	0.9x	0.77	x	2.01	x	118.15	0.63	x	0.7	=	72.58	(79)
Southwest	0.9x	0.77	x	1.46	x	118.15	0.63	x	0.7	=	52.72	(79)
Southwest	0.9x	0.77	x	2.01	x	113.91	0.63	x	0.7	=	69.97	(79)
Southwest	0.9x	0.77	x	2.01	x	113.91	0.63	x	0.7	=	69.97	(79)
Southwest	0.9x	0.77	x	1.46	x	113.91	0.63	x	0.7	=	50.83	(79)
Southwest	0.9x	0.77	x	2.01	x	104.39	0.63	x	0.7	=	64.13	(79)
Southwest	0.9x	0.77	x	2.01	x	104.39	0.63	x	0.7	=	64.13	(79)
Southwest	0.9x	0.77	x	1.46	x	104.39	0.63	x	0.7	=	46.58	(79)
Southwest	0.9x	0.77	x	2.01	x	92.85	0.63	x	0.7	=	57.04	(79)
Southwest	0.9x	0.77	x	2.01	x	92.85	0.63	x	0.7	=	57.04	(79)
Southwest	0.9x	0.77	x	1.46	x	92.85	0.63	x	0.7	=	41.43	(79)
Southwest	0.9x	0.77	x	2.01	x	69.27	0.63	x	0.7	=	42.55	(79)
Southwest	0.9x	0.77	x	2.01	x	69.27	0.63	x	0.7	=	42.55	(79)
Southwest	0.9x	0.77	x	1.46	x	69.27	0.63	x	0.7	=	30.91	(79)
Southwest	0.9x	0.77	x	2.01	x	44.07	0.63	x	0.7	=	27.07	(79)
Southwest	0.9x	0.77	x	2.01	x	44.07	0.63	x	0.7	=	27.07	(79)
Southwest	0.9x	0.77	x	1.46	x	44.07	0.63	x	0.7	=	19.66	(79)
Southwest	0.9x	0.77	x	2.01	x	31.49	0.63	x	0.7	=	19.34	(79)
Southwest	0.9x	0.77	x	2.01	x	31.49	0.63	x	0.7	=	19.34	(79)
Southwest	0.9x	0.77	x	1.46	x	31.49	0.63	x	0.7	=	14.05	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	65.69	113.25	158.54	202.45	232.26	232.99	223.62	201.02	173.69	126.13	78.93	56.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	403.25	448.9	483.6	510.67	523.66	508.1	488.12	470.69	452.01	421.47	393.72	385.17	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.96	0.91	0.78	0.61	0.65	0.86	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.62	19.77	20.02	20.36	20.67	20.89	20.97	20.96	20.82	20.43	19.97	19.6	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.8	19.81	19.81	19.83	19.83	19.84	19.84	19.85	19.84	19.83	19.82	19.82	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.95	0.86	0.68	0.47	0.51	0.78	0.95	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18	18.22	18.58	19.07	19.5	19.77	19.83	19.83	19.69	19.18	18.52	17.98	(90)

fLA = Living area ÷ (4) = 0.51 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.82	19	19.31	19.72	20.09	20.34	20.41	20.4	20.26	19.81	19.25	18.8	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.82	19	19.31	19.72	20.09	20.34	20.41	20.4	20.26	19.81	19.25	18.8	(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=	0.99	0.99	0.98	0.95	0.88	0.72	0.54	0.58	0.81	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	400.06	442.91	471.51	482.82	458.31	368.31	264.38	274.11	367.31	400.57	388.04	382.66	(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=	1080.82	1046.57	947.57	788.66	609.63	411.49	273.2	286.41	444.14	669.22	888.21	1073.2	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	506.48	405.66	354.19	220.2	112.58	0	0	0	0	199.87	360.12	513.77	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2672.88 (98)

Space heating requirement in kWh/m²/year 48.33 (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) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)													
	506.48	405.66	354.19	220.2	112.58	0	0	0	0	199.87	360.12	513.77	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	541.69	433.86	378.81	235.51	120.41	0	0	0	0	213.77	385.16	549.48	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2858.69 (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)

TER WorkSheet: New dwelling design stage

Water heating

Water heating from separate community system:

Annual water heating requirement		1776.58	(64)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2858.69	
Water heating fuel used		2103.94	
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		281.06	(232)

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	=	617.48	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	454.45	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1071.93	(265)

Water heating from community system

	Energy kWh/year	**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Electrical energy for heat distribution	[(313) x	0	=	0	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	0	(373)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	145.87	(268)
Total CO2, kg/year	sum of (265)…(271) =			1256.72	(272)

TER =	33.39	(273)

SAP Input

Property Details: Flat Type B - ASHP + PV

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	07 November 2019
Date of certificate:	12 May 2020
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Low
Water use <= 125 litres/person/day:	True
PCDF Version:	460

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2020	
Floor Location:	Floor area:	Storey height:
Floor 0	35 m²	3.09 m
Living area:	22 m² (fraction 0.594)	
Front of dwelling faces:	North East	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D_5_01	Manufacturer	Solid			Metal
Vent_05_03	Manufacturer	Solid			
Vent_05_01	Manufacturer	Solid			
Vent_D5_08	Manufacturer	Solid			
Window_05_02	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_05_01	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Fanlight	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_05_08	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D_5_01	mm	0	0	1	2.13	1
Vent_05_03	mm	0	0	1	0.94	1
Vent_05_01	mm	0	0	1	0.75	1
Vent_D5_08	mm	0	0	1	0.68	1
Window_05_02	6mm	0.7	0.4	1.2	2	1
Window_05_01	6mm	0.7	0.4	1.2	1.04	1
Fanlight	6mm	0.7	0.4	1.2	0.32	1
Window_05_08	6mm	0.7	0.4	1.2	1.45	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D_5_01		5_01	North East	0	0
Vent_05_03		5_05	South West	0.57	1.65
Vent_05_01		5_01	North East	0.623	1.2
Vent_D5_08		5_05	South West	0.57	1.2
Window_05_02		5_05	South West	1.21	1.65
Window_05_01		5_01	North East	1.2	0.863
Fanlight		5_01	North East	1.01	0.315
Window_05_08		5_05	South West	1.21	1.2

SAP Input

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
5_01	15.481	4.24	11.24	0.13	0	False	N/A
5_02	2.039	0	2.04	0.13	0	False	N/A
5_03	2.874	0	2.87	0.13	0	False	N/A
5_05	18.386	5.07	13.32	0.13	0	False	N/A
R_01	35	0	35	0.1	0		N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: False
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	0
Pressure test:	2.5

Main heating system:

Main heating system:
Electric underfloor heating
Standard tariff
Fuel: Electricity
Info Source: SAP Tables
SAP Table: 425
In timber floor, or immediately below floor covering
Underfloor heating, pipes in insulated timber floor
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Room-sealed
Boiler interlock: Yes

Main heating Control:

Main heating Control:
Programmer and room thermostat
Control code: 2704

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating:
952 From DHW-only community scheme
Heat source: From hot-water only community scheme - heat pump
heat from electric heat pump, heat fraction 1, efficiency 329
Piping>=1991, pre-insulated, medium temp, variable flow
No hot water cylinder
Solar panel: False

Others:

Electricity tariff: Standard Tariff
In Smoke Control Area: Yes

SAP Input

Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.645 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South West Photovoltaic 2 Installed Peak power: 0.258 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South Photovoltaic 3 Installed Peak power: 0.242 Tilt of collector: Horizontal Overshading: None or very little Collector Orientation: East
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type B - ASHP + PV

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	35	(1a) x	3.09	(2a) =	108.15	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	35	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	108.15	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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

SAP WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.94	x	1	=	0.94			(26)
Doors Type 3			0.75	x	1	=	0.75			(26)
Doors Type 4			0.68	x	1	=	0.68			(26)
Windows Type 1			2	x1/[1/(1.2)+ 0.04]		=	2.29			(27)
Windows Type 2			1.04	x1/[1/(1.2)+ 0.04]		=	1.19			(27)
Windows Type 3			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Windows Type 4			1.45	x1/[1/(1.2)+ 0.04]		=	1.66			(27)
Walls Type1	15.48	4.24	11.24	x	0.13	=	1.46			(29)
Walls Type2	2.04	0	2.04	x	0.13	=	0.27			(29)
Walls Type3	2.87	0	2.87	x	0.13	=	0.37			(29)
Walls Type4	18.39	5.07	13.32	x	0.13	=	1.73			(29)
Roof	35	0	35	x	0.1	=	3.5			(30)
Total area of elements, m²			73.78							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 17.34 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 315 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 11.07 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss — (33) + (36) = 28.41 (37)

Ventilation heat loss calculated monthly — (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	10.03	9.92	9.81	9.25	9.14	8.58	8.58	8.47	8.81	9.14	9.36	9.59	(38)

Heat transfer coefficient, W/K — (39)m = (37) + (38)m

(39)m=	38.44	38.33	38.22	37.66	37.55	36.99	36.99	36.88	37.21	37.55	37.77	37.99	

Average = Sum(39)$_{1…12}$ /12= 37.63 (39)

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.1	1.1	1.09	1.08	1.07	1.06	1.06	1.05	1.06	1.07	1.08	1.09	

Average = Sum(40)$_{1…12}$ /12= 1.08 (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 — 1.28 (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 — 64.62 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	71.08	68.49	65.91	63.32	60.74	58.16	58.16	60.74	63.32	65.91	68.49	71.08	

Total = Sum(44)$_{1…12}$ = 775.4 (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=	105.41	92.19	95.13	82.94	79.58	68.67	63.64	73.02	73.89	86.12	94	102.08	

Total = Sum(45)$_{1…12}$ = 1016.67 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	15.81	13.83	14.27	12.44	11.94	10.3	9.55	10.95	11.08	12.92	14.1	15.31	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a — 1.03 (52)

Temperature factor from Table 2b — 0.6 (53)

Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)		1.03	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	160.68	142.12	150.41	136.43	134.86	122.17	118.91	128.3	127.39	141.39	147.5	157.36	(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=	160.68	142.12	150.41	136.43	134.86	122.17	118.91	128.3	127.39	141.39	147.5	157.36	

Output from water heater (annual)$_{1...12}$ — 1667.51 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	79.27	70.6	75.85	70.37	70.68	65.63	65.38	68.5	67.36	72.86	74.05	78.16	(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=	76.84	76.84	76.84	76.84	76.84	76.84	76.84	76.84	76.84	76.84	76.84	76.84	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	26.21	23.28	18.94	14.34	10.72	9.05	9.78	12.71	17.05	21.65	25.27	26.94	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	162.98	164.67	160.41	151.33	139.88	129.12	121.93	120.23	124.5	133.57	145.02	155.79	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	43.96	43.96	43.96	43.96	43.96	43.96	43.96	43.96	43.96	43.96	43.96	43.96	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	(71)

Water heating gains (Table 5)

(72)m=	106.54	105.05	101.95	97.74	95	91.15	87.88	92.07	93.56	97.92	102.85	105.06	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	365.32	362.58	350.87	332.99	315.18	298.89	289.16	294.59	304.69	322.73	342.72	357.37	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

SAP WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	1.04	x	11.28	x	0.4	x	0.7	=	2.28	(75)
Northeast 0.9x	0.77	x	0.32	x	11.28	x	0.4	x	0.7	=	0.7	(75)
Northeast 0.9x	0.77	x	1.04	x	22.97	x	0.4	x	0.7	=	4.63	(75)
Northeast 0.9x	0.77	x	0.32	x	22.97	x	0.4	x	0.7	=	1.43	(75)
Northeast 0.9x	0.77	x	1.04	x	41.38	x	0.4	x	0.7	=	8.35	(75)
Northeast 0.9x	0.77	x	0.32	x	41.38	x	0.4	x	0.7	=	2.57	(75)
Northeast 0.9x	0.77	x	1.04	x	67.96	x	0.4	x	0.7	=	13.71	(75)
Northeast 0.9x	0.77	x	0.32	x	67.96	x	0.4	x	0.7	=	4.22	(75)
Northeast 0.9x	0.77	x	1.04	x	91.35	x	0.4	x	0.7	=	18.43	(75)
Northeast 0.9x	0.77	x	0.32	x	91.35	x	0.4	x	0.7	=	5.67	(75)
Northeast 0.9x	0.77	x	1.04	x	97.38	x	0.4	x	0.7	=	19.65	(75)
Northeast 0.9x	0.77	x	0.32	x	97.38	x	0.4	x	0.7	=	6.05	(75)
Northeast 0.9x	0.77	x	1.04	x	91.1	x	0.4	x	0.7	=	18.38	(75)
Northeast 0.9x	0.77	x	0.32	x	91.1	x	0.4	x	0.7	=	5.66	(75)
Northeast 0.9x	0.77	x	1.04	x	72.63	x	0.4	x	0.7	=	14.66	(75)
Northeast 0.9x	0.77	x	0.32	x	72.63	x	0.4	x	0.7	=	4.51	(75)
Northeast 0.9x	0.77	x	1.04	x	50.42	x	0.4	x	0.7	=	10.17	(75)
Northeast 0.9x	0.77	x	0.32	x	50.42	x	0.4	x	0.7	=	3.13	(75)
Northeast 0.9x	0.77	x	1.04	x	28.07	x	0.4	x	0.7	=	5.66	(75)
Northeast 0.9x	0.77	x	0.32	x	28.07	x	0.4	x	0.7	=	1.74	(75)
Northeast 0.9x	0.77	x	1.04	x	14.2	x	0.4	x	0.7	=	2.86	(75)
Northeast 0.9x	0.77	x	0.32	x	14.2	x	0.4	x	0.7	=	0.88	(75)
Northeast 0.9x	0.77	x	1.04	x	9.21	x	0.4	x	0.7	=	1.86	(75)
Northeast 0.9x	0.77	x	0.32	x	9.21	x	0.4	x	0.7	=	0.57	(75)
Southwest 0.9x	0.77	x	2	x	36.79		0.4	x	0.7	=	14.28	(79)
Southwest 0.9x	0.77	x	1.45	x	36.79		0.4	x	0.7	=	10.35	(79)
Southwest 0.9x	0.77	x	2	x	62.67		0.4	x	0.7	=	24.32	(79)
Southwest 0.9x	0.77	x	1.45	x	62.67		0.4	x	0.7	=	17.63	(79)
Southwest 0.9x	0.77	x	2	x	85.75		0.4	x	0.7	=	33.28	(79)
Southwest 0.9x	0.77	x	1.45	x	85.75		0.4	x	0.7	=	24.13	(79)
Southwest 0.9x	0.77	x	2	x	106.25		0.4	x	0.7	=	41.23	(79)
Southwest 0.9x	0.77	x	1.45	x	106.25		0.4	x	0.7	=	29.89	(79)
Southwest 0.9x	0.77	x	2	x	119.01		0.4	x	0.7	=	46.19	(79)
Southwest 0.9x	0.77	x	1.45	x	119.01		0.4	x	0.7	=	33.48	(79)
Southwest 0.9x	0.77	x	2	x	118.15		0.4	x	0.7	=	45.85	(79)
Southwest 0.9x	0.77	x	1.45	x	118.15		0.4	x	0.7	=	33.24	(79)
Southwest 0.9x	0.77	x	2	x	113.91		0.4	x	0.7	=	44.21	(79)
Southwest 0.9x	0.77	x	1.45	x	113.91		0.4	x	0.7	=	32.05	(79)
Southwest 0.9x	0.77	x	2	x	104.39		0.4	x	0.7	=	40.51	(79)

Southwest	0.9x	0.77	x	1.45	x	104.39	0.4	x	0.7	=	29.37	(79)
Southwest	0.9x	0.77	x	2	x	92.85	0.4	x	0.7	=	36.03	(79)
Southwest	0.9x	0.77	x	1.45	x	92.85	0.4	x	0.7	=	26.12	(79)
Southwest	0.9x	0.77	x	2	x	69.27	0.4	x	0.7	=	26.88	(79)
Southwest	0.9x	0.77	x	1.45	x	69.27	0.4	x	0.7	=	19.49	(79)
Southwest	0.9x	0.77	x	2	x	44.07	0.4	x	0.7	=	17.1	(79)
Southwest	0.9x	0.77	x	1.45	x	44.07	0.4	x	0.7	=	12.4	(79)
Southwest	0.9x	0.77	x	2	x	31.49	0.4	x	0.7	=	12.22	(79)
Southwest	0.9x	0.77	x	1.45	x	31.49	0.4	x	0.7	=	8.86	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	27.61	48.02	68.33	89.06	103.78	104.79	100.3	89.05	75.46	53.78	33.25	23.51	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	392.92	410.6	419.2	422.05	418.96	403.69	389.45	383.64	380.16	376.5	375.97	380.88	(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=	0.88	0.86	0.82	0.76	0.66	0.52	0.39	0.41	0.58	0.74	0.84	0.88	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.45	19.62	19.91	20.29	20.62	20.86	20.95	20.94	20.81	20.42	19.9	19.42	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.45	20.45	20.45	20.46	20.46	20.47	20.47	20.47	20.47	20.46	20.46	20.46	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.87	0.85	0.81	0.74	0.64	0.49	0.35	0.37	0.55	0.73	0.83	0.88	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19	19.16	19.45	19.82	20.14	20.37	20.44	20.44	20.31	19.95	19.45	18.97	(90)

fLA = Living area ÷ (4) = | 0.63 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.28	19.45	19.74	20.12	20.44	20.68	20.76	20.76	20.62	20.25	19.73	19.26	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.28	19.45	19.74	20.12	20.44	20.68	20.76	20.76	20.62	20.25	19.73	19.26	(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=	0.85	0.83	0.79	0.73	0.64	0.5	0.38	0.4	0.56	0.72	0.81	0.86	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	333.77	340.41	332.77	308.76	267.09	202.43	146.5	151.83	211.2	270.1	304.95	326.49	(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=	575.94	557.61	505.82	422.4	328.31	224.81	153.97	160.63	242.73	362.28	477.18	572.03	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	180.17	145.96	128.75	81.82	45.55	0	0	0	0	68.58	124.01	182.69

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 957.53 (98)

Space heating requirement in kWh/m²/year 27.36 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 100 (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)													
	180.17	145.96	128.75	81.82	45.55	0	0	0	0	68.58	124.01	182.69	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	180.17	145.96	128.75	81.82	45.55	0	0	0	0	68.58	124.01	182.69	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 957.53 (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

Water heating from separate community system:

Annual water heating requirement 1667.51 (64)

Fraction of heat from community CHP 1 (303a)

Factor for charging method for community water heating 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.1 (306)

Water heat from CHP (64) x (303a) x (305) x (306) = 1834.27 (310a)

Electricity used for heat distribution 0.01 × [(307a)…(307e) + (310a)…(310e)] = 18.34 (313)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		957.53	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	138.54		(230a)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		138.54	(231)
Electricity for lighting		185.19	(232)
Electricity generated by PVs		-937.91	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)	**Fuel Cost** £/year

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Space heating - main system 1	(211) x	13.19	x 0.01 =	126.3	(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 from CHP	(310a) x	4.24	x 0.01 =	77.77	(342a)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	18.27	(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 =	24.43	(250)
Additional standing charges (Table 12)				60	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-123.71	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	183.06	(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] =	0.96	(257)
SAP rating (Section 12)		86.59	(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	0.519	=	496.96	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)

Water heating from community system

	Energy kWh/year	**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel			329	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	289.36	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	9.52	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	298.88	(373)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	71.9	(267)
Electricity for lighting	(232) x	0.519	=	96.11	(268)
Energy saving/generation technologies Item 1		0.519	=	-486.78	(269)
Total CO2, kg/year	sum of (265)…(271) =			477.07	(272)
CO2 emissions per m²	(272) ÷ (4) =			13.63	(273)
EI rating (section 14)				92	(274)

13a. Primary Energy

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	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	3.07	=	2939.6	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Water heating from community system						

		Energy kWh/year	Primary factor		Emissions kWh/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
Energy associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		3.07	=	1711.61	(367)
Electrical energy for heat distribution	[(313) x		2.92	=	53.56	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)			=	298.88	(373)

Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	425.32	(267)
Electricity for lighting	(232)	x	0	=	568.52	(268)
Energy saving/generation technologies						
Item 1			3.07	=	-2879.39	(269)
‘Total Primary Energy			sum of (265)…(271) =		2819.22	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		80.55	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type B - ASHP + PV

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	35	(1a)	x	3.09	(2a)	=	108.15	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	35	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			108.15	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.94	x	1	=	0.94			(26)
Doors Type 3			0.75	x	1	=	0.75			(26)
Doors Type 4			0.68	x	1	=	0.68			(26)
Windows Type 1			2	x1/[1/(1.2)+ 0.04]		=	2.29			(27)
Windows Type 2			1.04	x1/[1/(1.2)+ 0.04]		=	1.19			(27)
Windows Type 3			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Windows Type 4			1.45	x1/[1/(1.2)+ 0.04]		=	1.66			(27)
Walls Type1	15.48	4.24	11.24	x	0.13	=	1.46			(29)
Walls Type2	2.04	0	2.04	x	0.13	=	0.27			(29)
Walls Type3	2.87	0	2.87	x	0.13	=	0.37			(29)
Walls Type4	18.39	5.07	13.32	x	0.13	=	1.73			(29)
Roof	35	0	35	x	0.1	=	3.5			(30)
Total area of elements, m²			73.78							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 17.34 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 315 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 11.07 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss — (33) + (36) = 28.41 (37)

Ventilation heat loss calculated monthly — (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	10.03	9.92	9.81	9.25	9.14	8.58	8.58	8.47	8.81	9.14	9.36	9.59	(38)

Heat transfer coefficient, W/K — (39)m = (37) + (38)m

(39)m=	38.44	38.33	38.22	37.66	37.55	36.99	36.99	36.88	37.21	37.55	37.77	37.99	

Average = Sum(39)$_{1…12}$ /12= 37.63 (39)

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.1	1.1	1.09	1.08	1.07	1.06	1.06	1.05	1.06	1.07	1.08	1.09	

Average = Sum(40)$_{1…12}$ /12= 1.08 (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 — 1.28 (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 — 64.62 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	71.08	68.49	65.91	63.32	60.74	58.16	58.16	60.74	63.32	65.91	68.49	71.08	

Total = Sum(44)$_{1…12}$ = 775.4 (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=	105.41	92.19	95.13	82.94	79.58	68.67	63.64	73.02	73.89	86.12	94	102.08	

Total = Sum(45)$_{1…12}$ = 1016.67 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	15.81	13.83	14.27	12.44	11.94	10.3	9.55	10.95	11.08	12.92	14.1	15.31	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a — 1.03 (52)

Temperature factor from Table 2b — 0.6 (53)

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Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)		1.03	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	160.68	142.12	150.41	136.43	134.86	122.17	118.91	128.3	127.39	141.39	147.5	157.36	(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=	160.68	142.12	150.41	136.43	134.86	122.17	118.91	128.3	127.39	141.39	147.5	157.36	

Output from water heater (annual)$_{1...12}$ | 1667.51 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	79.27	70.6	75.85	70.37	70.68	65.63	65.38	68.5	67.36	72.86	74.05	78.16	(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=	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	10.49	9.31	7.57	5.73	4.29	3.62	3.91	5.08	6.82	8.66	10.11	10.78	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	109.19	110.33	107.47	101.39	93.72	86.51	81.69	80.56	83.41	89.49	97.16	104.38	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	(71)

Water heating gains (Table 5)

(72)m=	106.54	105.05	101.95	97.74	95	91.15	87.88	92.07	93.56	97.92	102.85	105.06	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	268.44	266.9	259.21	247.08	235.22	223.49	215.69	219.92	226.01	238.29	252.33	262.42	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	1.04	x	11.28	x	0.4	x	0.7	=	2.28	(75)
Northeast 0.9x	0.77	x	0.32	x	11.28	x	0.4	x	0.7	=	0.7	(75)
Northeast 0.9x	0.77	x	1.04	x	22.97	x	0.4	x	0.7	=	4.63	(75)
Northeast 0.9x	0.77	x	0.32	x	22.97	x	0.4	x	0.7	=	1.43	(75)
Northeast 0.9x	0.77	x	1.04	x	41.38	x	0.4	x	0.7	=	8.35	(75)
Northeast 0.9x	0.77	x	0.32	x	41.38	x	0.4	x	0.7	=	2.57	(75)
Northeast 0.9x	0.77	x	1.04	x	67.96	x	0.4	x	0.7	=	13.71	(75)
Northeast 0.9x	0.77	x	0.32	x	67.96	x	0.4	x	0.7	=	4.22	(75)
Northeast 0.9x	0.77	x	1.04	x	91.35	x	0.4	x	0.7	=	18.43	(75)
Northeast 0.9x	0.77	x	0.32	x	91.35	x	0.4	x	0.7	=	5.67	(75)
Northeast 0.9x	0.77	x	1.04	x	97.38	x	0.4	x	0.7	=	19.65	(75)
Northeast 0.9x	0.77	x	0.32	x	97.38	x	0.4	x	0.7	=	6.05	(75)
Northeast 0.9x	0.77	x	1.04	x	91.1	x	0.4	x	0.7	=	18.38	(75)
Northeast 0.9x	0.77	x	0.32	x	91.1	x	0.4	x	0.7	=	5.66	(75)
Northeast 0.9x	0.77	x	1.04	x	72.63	x	0.4	x	0.7	=	14.66	(75)
Northeast 0.9x	0.77	x	0.32	x	72.63	x	0.4	x	0.7	=	4.51	(75)
Northeast 0.9x	0.77	x	1.04	x	50.42	x	0.4	x	0.7	=	10.17	(75)
Northeast 0.9x	0.77	x	0.32	x	50.42	x	0.4	x	0.7	=	3.13	(75)
Northeast 0.9x	0.77	x	1.04	x	28.07	x	0.4	x	0.7	=	5.66	(75)
Northeast 0.9x	0.77	x	0.32	x	28.07	x	0.4	x	0.7	=	1.74	(75)
Northeast 0.9x	0.77	x	1.04	x	14.2	x	0.4	x	0.7	=	2.86	(75)
Northeast 0.9x	0.77	x	0.32	x	14.2	x	0.4	x	0.7	=	0.88	(75)
Northeast 0.9x	0.77	x	1.04	x	9.21	x	0.4	x	0.7	=	1.86	(75)
Northeast 0.9x	0.77	x	0.32	x	9.21	x	0.4	x	0.7	=	0.57	(75)
Southwest 0.9x	0.77	x	2	x	36.79		0.4	x	0.7	=	14.28	(79)
Southwest 0.9x	0.77	x	1.45	x	36.79		0.4	x	0.7	=	10.35	(79)
Southwest 0.9x	0.77	x	2	x	62.67		0.4	x	0.7	=	24.32	(79)
Southwest 0.9x	0.77	x	1.45	x	62.67		0.4	x	0.7	=	17.63	(79)
Southwest 0.9x	0.77	x	2	x	85.75		0.4	x	0.7	=	33.28	(79)
Southwest 0.9x	0.77	x	1.45	x	85.75		0.4	x	0.7	=	24.13	(79)
Southwest 0.9x	0.77	x	2	x	106.25		0.4	x	0.7	=	41.23	(79)
Southwest 0.9x	0.77	x	1.45	x	106.25		0.4	x	0.7	=	29.89	(79)
Southwest 0.9x	0.77	x	2	x	119.01		0.4	x	0.7	=	46.19	(79)
Southwest 0.9x	0.77	x	1.45	x	119.01		0.4	x	0.7	=	33.48	(79)
Southwest 0.9x	0.77	x	2	x	118.15		0.4	x	0.7	=	45.85	(79)
Southwest 0.9x	0.77	x	1.45	x	118.15		0.4	x	0.7	=	33.24	(79)
Southwest 0.9x	0.77	x	2	x	113.91		0.4	x	0.7	=	44.21	(79)
Southwest 0.9x	0.77	x	1.45	x	113.91		0.4	x	0.7	=	32.05	(79)
Southwest 0.9x	0.77	x	2	x	104.39		0.4	x	0.7	=	40.51	(79)

Southwest	0.9x	0.77	x	1.45	x	104.39	0.4	x	0.7	=	29.37	(79)
Southwest	0.9x	0.77	x	2	x	92.85	0.4	x	0.7	=	36.03	(79)
Southwest	0.9x	0.77	x	1.45	x	92.85	0.4	x	0.7	=	26.12	(79)
Southwest	0.9x	0.77	x	2	x	69.27	0.4	x	0.7	=	26.88	(79)
Southwest	0.9x	0.77	x	1.45	x	69.27	0.4	x	0.7	=	19.49	(79)
Southwest	0.9x	0.77	x	2	x	44.07	0.4	x	0.7	=	17.1	(79)
Southwest	0.9x	0.77	x	1.45	x	44.07	0.4	x	0.7	=	12.4	(79)
Southwest	0.9x	0.77	x	2	x	31.49	0.4	x	0.7	=	12.22	(79)
Southwest	0.9x	0.77	x	1.45	x	31.49	0.4	x	0.7	=	8.86	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	27.61	48.02	68.33	89.06	103.78	104.79	100.3	89.05	75.46	53.78	33.25	23.51	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	296.04	314.92	327.54	336.14	339	328.28	315.98	308.97	301.47	292.06	285.58	285.93	(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=	0.93	0.91	0.88	0.83	0.74	0.61	0.47	0.5	0.67	0.83	0.9	0.93	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.09	19.28	19.62	20.08	20.49	20.8	20.93	20.91	20.71	20.22	19.6	19.06	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.45	20.45	20.45	20.46	20.46	20.47	20.47	20.47	20.47	20.46	20.46	20.46	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.92	0.91	0.88	0.82	0.72	0.57	0.42	0.45	0.64	0.81	0.89	0.93	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.64	18.84	19.17	19.62	20.02	20.31	20.42	20.41	20.24	19.76	19.16	18.62	(90)

fLA = Living area ÷ (4) = 0.63 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.93	19.12	19.45	19.91	20.31	20.62	20.74	20.73	20.54	20.05	19.44	18.9	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.93	19.12	19.45	19.91	20.31	20.62	20.74	20.73	20.54	20.05	19.44	18.9	(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=	0.91	0.89	0.86	0.8	0.71	0.58	0.45	0.47	0.64	0.8	0.88	0.91	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	268.42	279.9	281.04	269.78	242.12	190.56	141.61	145.98	194.13	233.16	250.67	261.04	(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=	562.21	544.94	495.07	414.5	323.43	222.64	153.11	159.6	239.52	354.83	465.95	558.39	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m=	218.58	178.1	159.23	104.2	60.5	0	0	0	0	90.52	155	221.23	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1187.36 (98)

Space heating requirement in kWh/m²/year 33.92 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(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)	218.58	178.1	159.23	104.2	60.5	0	0	0	0	90.52	155	221.23		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	218.58	178.1	159.23	104.2	60.5	0	0	0	0	90.52	155	221.23		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1187.36	(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

Water heating from separate community system:

Annual water heating requirement		1667.51	(64)
Fraction of heat from community CHP		1	(303a)
Factor for charging method for community water heating		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.1	(306)
Water heat from CHP	(64) x (303a) x (305) x (306) =	1834.27	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	18.34	(313)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1187.36	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		138.54		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		138.54	(231)
Electricity for lighting			185.19	(232)
Electricity generated by PVs			-937.91	(233)

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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Space heating (main system 1)	(211) x	0.519	=	616.24	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating from community system					

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	289.36	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	9.52	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	298.88	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	71.9	(267)
Electricity for lighting	(232) x		0.519	=	96.11	(268)
Energy saving/generation technologies						
Item 1			0.519	=	-486.78	(269)
Total CO2, kg/year	sum of (265)…(271) =				596.35	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =				17.04	(273)
EI rating (section 14)					90	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type B - ASHP + PV

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	35	(1a) x	3.09	(2a) =	108.15	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	35	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	108.15	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =	0.18	(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			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.43	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			0	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor		(21) = (18) x (20) =	0.43	(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

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.55	0.54	0.53	0.48	0.47	0.41	0.41	0.4	0.43	0.47	0.49	0.51

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0.65	0.65	0.64	0.61	0.61	0.59	0.59	0.58	0.59	0.61	0.62	0.63	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.65	0.65	0.64	0.61	0.61	0.59	0.59	0.58	0.59	0.61	0.62	0.63	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.94	x	1	=	0.94			(26)
Doors Type 3			0.75	x	1	=	0.75			(26)
Doors Type 4			0.68	x	1	=	0.68			(26)
Windows Type 1			1.77	x1/[1/(1.4)+ 0.04]		=	2.35			(27)
Windows Type 2			0.92	x1/[1/(1.4)+ 0.04]		=	1.22			(27)
Windows Type 3			0.28	x1/[1/(1.4)+ 0.04]		=	0.37			(27)
Windows Type 4			1.28	x1/[1/(1.4)+ 0.04]		=	1.7			(27)
Walls Type1	15.48	4.08	11.4	x	0.18	=	2.05			(29)
Walls Type2	2.04	0	2.04	x	0.18	=	0.37			(29)
Walls Type3	2.87	0	2.87	x	0.18	=	0.52			(29)
Walls Type4	18.39	4.67	13.72	x	0.18	=	2.47			(29)
Roof	35	0	35	x	0.13	=	4.55			(30)
Total area of elements, m²			73.78							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 20.09 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 315 (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 — 3.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss — (33) + (36) = 23.78 (37)

Ventilation heat loss calculated monthly — (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.33	23.12	22.91	21.93	21.75	20.89	20.89	20.73	21.22	21.75	22.12	22.51	(38)

Heat transfer coefficient, W/K — (39)m = (37) + (38)m

(39)m=	47.11	46.9	46.69	45.71	45.52	44.67	44.67	44.51	45	45.52	45.9	46.28

Average = $Sum(39)_{1...12}$ /12= 45.71 (39)

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.35	1.34	1.33	1.31	1.3	1.28	1.28	1.27	1.29	1.3	1.31	1.32

Average = $Sum(40)_{1...12}$ /12= 1.31 (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 — 1.28 (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 — 64.62 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	71.08	68.49	65.91	63.32	60.74	58.16	58.16	60.74	63.32	65.91	68.49	71.08

Total = $Sum(44)_{1...12}$ = 775.4 (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=	105.41	92.19	95.13	82.94	79.58	68.67	63.64	73.02	73.89	86.12	94	102.08

Total = $Sum(45)_{1...12}$ = 1016.67 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	15.81	13.83	14.27	12.44	11.94	10.3	9.55	10.95	11.08	12.92	14.1	15.31	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (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): — 1.39 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0.75 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

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Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0.75	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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	134.28	141.73	128.03	126.18	113.76	110.23	119.62	118.99	132.71	139.1	148.68	(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	134.28	141.73	128.03	126.18	113.76	110.23	119.62	118.99	132.71	139.1	148.68

Output from water heater (annual)$_{1...12}$ — 1565.29 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	72.32	64.32	68.91	63.65	63.74	58.91	58.43	61.56	60.64	65.91	67.33	71.22	(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=	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	64.04	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	10.78	9.57	7.78	5.89	4.41	3.72	4.02	5.22	7.01	8.9	10.39	11.08	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	109.19	110.33	107.47	101.39	93.72	86.51	81.69	80.56	83.41	89.49	97.16	104.38	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	(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=	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	-51.23	(71)
Water heating gains (Table 5)													
(72)m=	97.21	95.72	92.62	88.4	85.67	81.82	78.54	82.74	84.23	88.59	93.51	95.72	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	262.39	260.83	253.08	240.9	229	217.25	209.46	213.73	219.86	232.19	246.28	256.39	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	0.92	x	11.28	x	0.63	x	0.7	=	3.17	(75)
Northeast	0.9x	0.77	x	0.28	x	11.28	x	0.63	x	0.7	=	0.97	(75)
Northeast	0.9x	0.77	x	0.92	x	22.97	x	0.63	x	0.7	=	6.46	(75)
Northeast	0.9x	0.77	x	0.28	x	22.97	x	0.63	x	0.7	=	1.97	(75)
Northeast	0.9x	0.77	x	0.92	x	41.38	x	0.63	x	0.7	=	11.63	(75)
Northeast	0.9x	0.77	x	0.28	x	41.38	x	0.63	x	0.7	=	3.54	(75)
Northeast	0.9x	0.77	x	0.92	x	67.96	x	0.63	x	0.7	=	19.11	(75)
Northeast	0.9x	0.77	x	0.28	x	67.96	x	0.63	x	0.7	=	5.82	(75)
Northeast	0.9x	0.77	x	0.92	x	91.35	x	0.63	x	0.7	=	25.68	(75)
Northeast	0.9x	0.77	x	0.28	x	91.35	x	0.63	x	0.7	=	7.82	(75)
Northeast	0.9x	0.77	x	0.92	x	97.38	x	0.63	x	0.7	=	27.38	(75)
Northeast	0.9x	0.77	x	0.28	x	97.38	x	0.63	x	0.7	=	8.33	(75)
Northeast	0.9x	0.77	x	0.92	x	91.1	x	0.63	x	0.7	=	25.61	(75)
Northeast	0.9x	0.77	x	0.28	x	91.1	x	0.63	x	0.7	=	7.8	(75)
Northeast	0.9x	0.77	x	0.92	x	72.63	x	0.63	x	0.7	=	20.42	(75)
Northeast	0.9x	0.77	x	0.28	x	72.63	x	0.63	x	0.7	=	6.21	(75)
Northeast	0.9x	0.77	x	0.92	x	50.42	x	0.63	x	0.7	=	14.18	(75)
Northeast	0.9x	0.77	x	0.28	x	50.42	x	0.63	x	0.7	=	4.31	(75)
Northeast	0.9x	0.77	x	0.92	x	28.07	x	0.63	x	0.7	=	7.89	(75)
Northeast	0.9x	0.77	x	0.28	x	28.07	x	0.63	x	0.7	=	2.4	(75)
Northeast	0.9x	0.77	x	0.92	x	14.2	x	0.63	x	0.7	=	3.99	(75)
Northeast	0.9x	0.77	x	0.28	x	14.2	x	0.63	x	0.7	=	1.21	(75)
Northeast	0.9x	0.77	x	0.92	x	9.21	x	0.63	x	0.7	=	2.59	(75)
Northeast	0.9x	0.77	x	0.28	x	9.21	x	0.63	x	0.7	=	0.79	(75)
Southwest	0.9x	0.77	x	1.77	x	36.79		0.63	x	0.7	=	19.9	(79)
Southwest	0.9x	0.77	x	1.28	x	36.79		0.63	x	0.7	=	14.39	(79)
Southwest	0.9x	0.77	x	1.77	x	62.67		0.63	x	0.7	=	33.9	(79)
Southwest	0.9x	0.77	x	1.28	x	62.67		0.63	x	0.7	=	24.52	(79)
Southwest	0.9x	0.77	x	1.77	x	85.75		0.63	x	0.7	=	46.39	(79)
Southwest	0.9x	0.77	x	1.28	x	85.75		0.63	x	0.7	=	33.55	(79)
Southwest	0.9x	0.77	x	1.77	x	106.25		0.63	x	0.7	=	57.48	(79)
Southwest	0.9x	0.77	x	1.28	x	106.25		0.63	x	0.7	=	41.56	(79)
Southwest	0.9x	0.77	x	1.77	x	119.01		0.63	x	0.7	=	64.38	(79)
Southwest	0.9x	0.77	x	1.28	x	119.01		0.63	x	0.7	=	46.56	(79)
Southwest	0.9x	0.77	x	1.77	x	118.15		0.63	x	0.7	=	63.91	(79)
Southwest	0.9x	0.77	x	1.28	x	118.15		0.63	x	0.7	=	46.22	(79)
Southwest	0.9x	0.77	x	1.77	x	113.91		0.63	x	0.7	=	61.62	(79)
Southwest	0.9x	0.77	x	1.28	x	113.91		0.63	x	0.7	=	44.56	(79)
Southwest	0.9x	0.77	x	1.77	x	104.39		0.63	x	0.7	=	56.47	(79)

Southwest0.9x	0.77	x	1.28	x	104.39		0.63	x	0.7	=	40.84	(79)
Southwest0.9x	0.77	x	1.77	x	92.85		0.63	x	0.7	=	50.23	(79)
Southwest0.9x	0.77	x	1.28	x	92.85		0.63	x	0.7	=	36.32	(79)
Southwest0.9x	0.77	x	1.77	x	69.27		0.63	x	0.7	=	37.47	(79)
Southwest0.9x	0.77	x	1.28	x	69.27		0.63	x	0.7	=	27.1	(79)
Southwest0.9x	0.77	x	1.77	x	44.07		0.63	x	0.7	=	23.84	(79)
Southwest0.9x	0.77	x	1.28	x	44.07		0.63	x	0.7	=	17.24	(79)
Southwest0.9x	0.77	x	1.77	x	31.49		0.63	x	0.7	=	17.03	(79)
Southwest0.9x	0.77	x	1.28	x	31.49		0.63	x	0.7	=	12.32	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	38.43	66.84	95.11	123.96	144.43	145.84	139.59	123.94	105.04	74.86	46.29	32.73	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	300.83	327.67	348.19	364.86	373.44	363.1	349.05	337.67	324.9	307.05	292.56	289.12	(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	0.99	0.97	0.94	0.87	0.71	0.55	0.58	0.8	0.95	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.73	19.88	20.12	20.45	20.74	20.93	20.98	20.98	20.87	20.52	20.09	19.72	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.8	19.81	19.81	19.84	19.84	19.86	19.86	19.86	19.85	19.84	19.83	19.82	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.92	0.82	0.61	0.41	0.45	0.72	0.92	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.16	18.38	18.73	19.21	19.59	19.81	19.85	19.85	19.75	19.31	18.69	18.16	(90)

fLA = Living area ÷ (4) = | 0.63 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.15	19.32	19.61	19.99	20.31	20.51	20.56	20.56	20.46	20.07	19.57	19.14	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.15	19.32	19.61	19.99	20.31	20.51	20.56	20.56	20.46	20.07	19.57	19.14	(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=	0.99	0.98	0.96	0.93	0.84	0.67	0.5	0.53	0.77	0.93	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	296.74	320.85	335.54	337.52	313.51	244.36	173.21	179.87	248.68	284.91	285.55	285.77	(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=	699.6	676.31	611.88	507.03	392.1	264.19	177.07	185.2	285.97	431.29	572.3	691.6	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(98)m=	299.73	238.87	205.59	122.04	58.47	0	0	0	0	108.9	206.46	301.94

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1542.01 (98)

Space heating requirement in kWh/m²/year 44.06 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)	299.73	238.87	205.59	122.04	58.47	0	0	0	0	108.9	206.46	301.94	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	320.57	255.48	219.88	130.53	62.54	0	0	0	0	116.47	220.81	322.93	(211)

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1649.21 (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

Water heating from separate community system:

Annual water heating requirement 1565.29 (64)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1649.21	
Water heating fuel used			1870.3	
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			190.32	(232)

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	=	356.23	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	403.98	(264)
Space and water heating	(261) + (262) + (263) + (264) =			760.21	(265)

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Water heating from community system

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Electrical energy for heat distribution		[(313) x	0	=	0	(372)
Total CO2 associated with community systems		(363)…(366) + (368)...(372)		=	0	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	98.78	(268)
Total CO2, kg/year			sum of (265)…(271) =		897.92	(272)

TER =	37.6	(273)

SAP Input

Property Details: Flat Type C - ASHP + PV

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	07 November 2019
Date of certificate:	12 May 2020
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Low
Water use <= 125 litres/person/day:	True
PCDF Version:	460

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2020	
Floor Location:	Floor area:	Storey height:
Floor 0	35.12 m²	3.09 m
Living area:	23.9 m² (fraction 0.681)	
Front of dwelling faces:	North East	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D6_01	Manufacturer	Solid			Metal
Vent_06_01	Manufacturer	Solid			
Vent_06_05	Manufacturer	Solid			
Vent_06_04	Manufacturer	Solid			
Vent_06_06	Manufacturer	Solid			
V_D6_01	Manufacturer	Solid			Metal
Window_06_01	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_06_04	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_06_04	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_06_05	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Fanlight	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D6_01	mm	0	0	1	2.13	1
Vent_06_01	mm	0	0	1	0.72	1
Vent_06_05	mm	0	0	1	0.99	1
Vent_06_04	mm	0	0	1	0.72	1
Vent_06_06	mm	0	0	1	0.72	1
V_D6_01	mm	0	0	1	0.63	1
Window_06_01	6mm	0.7	0.4	1.2	1.08	1
Window_06_04	6mm	0.7	0.4	1.2	1.97	1
Window_06_04	6mm	0.7	0.4	1.2	1.42	1
Window_06_05	6mm	0.7	0.4	1.2	1.45	1
Fanlight	6mm	0.7	0.4	1.2	0.32	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D6_01		06_01	North East	0	0
Vent_06_01		06_03	North East	0.6	1.2
Vent_06_05		06_03	South East	0.6	1.65
Vent_06_04		06_05	South West	0.6	1.2

SAP Input

Vent_06_06	06_06	South West	0.6	1.2
V_D6_01	06_01	North East	0.3	2.11
Window_06_01	06_03	North East	0.9	1.2
Window_06_04	06_04	South East	1.195	1.65
Window_06_04	06_05	South West	1.185	1.2
Window_06_05	06_06	South West	1.21	1.2
Fanlight	06_01	North East	1.01	0.315

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
06_01	10.506	3.08	7.43	0.13	0	False	N/A
06_03	8.065	2.79	5.27	0.13	0	False	N/A
06_04	19.498	1.97	17.53	0.13	0	False	N/A
06_05	9.425	2.14	7.29	0.13	0	False	N/A
06_06	9.023	2.17	6.85	0.13	0	False	N/A
R6_01	35.12	0	35.12	0.1	0		N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test: Yes (As designed)
Ventilation: Balanced with heat recovery
Number of wet rooms: Kitchen + 1
Ductwork: Insulation, rigid
Approved Installation Scheme: False
Number of chimneys: 0
Number of open flues: 0
Number of fans: 0
Number of passive stacks: 0
Number of sides sheltered: 0
Pressure test: 2.5

Main heating system:

Main heating system: Electric underfloor heating
Standard tariff
Fuel: Electricity
Info Source: SAP Tables
SAP Table: 425
In timber floor, or immediately below floor covering
Underfloor heating, pipes in insulated timber floor
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Room-sealed
Boiler interlock: Yes

Main heating Control:

Main heating Control: Programmer and room thermostat
Control code: 2704

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating: 952 From DHW-only community scheme

SAP Input

Heat source: From hot-water only community scheme - heat pump
heat from electric heat pump, heat fraction 1, efficiency 329
Piping>=1991, pre-insulated, low temp, variable flow
No hot water cylinder
Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.608 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South West Photovoltaic 2 Installed Peak power: 0.243 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South Photovoltaic 3 Installed Peak power: 0.228 Tilt of collector: 30° Overshading: None or very little Collector Orientation: East
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type C - ASHP + PV

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	35.12	(1a) x	3.09	(2a) =	108.52	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	35.12	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	108.52	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.72	x	1	=	0.72			(26)
Doors Type 3			0.99	x	1	=	0.99			(26)
Doors Type 4			0.72	x	1	=	0.72			(26)
Doors Type 5			0.72	x	1	=	0.72			(26)
Doors Type 6			0.63	x	1	=	0.63			(26)
Windows Type 1			1.08	x1/[1/(1.2)+ 0.04]		=	1.24			(27)
Windows Type 2			1.97	x1/[1/(1.2)+ 0.04]		=	2.26			(27)
Windows Type 3			1.42	x1/[1/(1.2)+ 0.04]		=	1.63			(27)
Windows Type 4			1.45	x1/[1/(1.2)+ 0.04]		=	1.66			(27)
Windows Type 5			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Walls Type1	10.51	3.08	7.43	x	0.13	=	0.97			(29)
Walls Type2	8.06	2.79	5.27	x	0.13	=	0.69			(29)
Walls Type3	19.5	1.97	17.53	x	0.13	=	2.28			(29)
Walls Type4	9.43	2.14	7.29	x	0.13	=	0.95			(29)
Walls Type5	9.02	2.17	6.85	x	0.13	=	0.89			(29)
Roof	35.12	0	35.12	x	0.1	=	3.51			(30)
Total area of elements, m²			91.64							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 22.33 (33)

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Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 316.08 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 13.75 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 36.08 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	10.07	9.96	9.84	9.28	9.17	8.61	8.61	8.5	8.84	9.17	9.4	9.62	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	46.15	46.04	45.92	45.36	45.25	44.69	44.69	44.58	44.92	45.25	45.48	45.7

Average = Sum(39)$_{1…12}$ /12= 45.34 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.31	1.31	1.29	1.29	1.27	1.27	1.27	1.28	1.29	1.29	1.3

Average = Sum(40)$_{1…12}$ /12= 1.29 (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 1.28 (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 64.68 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	71.15	68.56	65.98	63.39	60.8	58.22	58.22	60.8	63.39	65.98	68.56	71.15

Total = Sum(44)$_{1…12}$ = 776.21 (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=	105.52	92.29	95.23	83.02	79.66	68.74	63.7	73.1	73.97	86.21	94.1	102.19

Total = Sum(45)$_{1…12}$ = 1017.73 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	15.83	13.84	14.28	12.45	11.95	10.31	9.56	10.96	11.1	12.93	14.12	15.33	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

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Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
If community heating see section 4.3		
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.6	(53)
Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	160.79	142.21	150.51	136.52	134.94	122.24	118.98	128.37	127.46	141.48	147.59	157.46	(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=	160.79	142.21	150.51	136.52	134.94	122.24	118.98	128.37	127.46	141.48	147.59	157.46

Output from water heater (annual)$_{1…12}$ — 1668.57 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	79.31	70.63	75.89	70.4	70.71	65.65	65.4	68.53	67.39	72.89	74.08	78.2	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	77.01	77.01	77.01	77.01	77.01	77.01	77.01	77.01	77.01	77.01	77.01	77.01	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	24.98	22.18	18.04	13.66	10.21	8.62	9.31	12.11	16.25	20.63	24.08	25.67	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	163.41	165.11	160.83	151.74	140.25	129.46	122.25	120.55	124.83	133.92	145.41	156.2	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	43.98	43.98	43.98	43.98	43.98	43.98	43.98	43.98	43.98	43.98	43.98	43.98	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	(71)
Water heating gains (Table 5)													
(72)m=	106.59	105.1	102	97.78	95.04	91.18	87.91	92.11	93.6	97.96	102.89	105.11	(72)

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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	364.63	362.04	350.52	332.83	315.16	298.92	289.12	294.42	304.33	322.17	342.04	356.63	(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)	
Northeast 0.9x	0.77	x	1.08	x	11.28	x	0.4	x	0.7	=	2.36	(75)
Northeast 0.9x	0.77	x	0.32	x	11.28	x	0.4	x	0.7	=	0.7	(75)
Northeast 0.9x	0.77	x	1.08	x	22.97	x	0.4	x	0.7	=	4.81	(75)
Northeast 0.9x	0.77	x	0.32	x	22.97	x	0.4	x	0.7	=	1.43	(75)
Northeast 0.9x	0.77	x	1.08	x	41.38	x	0.4	x	0.7	=	8.67	(75)
Northeast 0.9x	0.77	x	0.32	x	41.38	x	0.4	x	0.7	=	2.57	(75)
Northeast 0.9x	0.77	x	1.08	x	67.96	x	0.4	x	0.7	=	14.24	(75)
Northeast 0.9x	0.77	x	0.32	x	67.96	x	0.4	x	0.7	=	4.22	(75)
Northeast 0.9x	0.77	x	1.08	x	91.35	x	0.4	x	0.7	=	19.14	(75)
Northeast 0.9x	0.77	x	0.32	x	91.35	x	0.4	x	0.7	=	5.67	(75)
Northeast 0.9x	0.77	x	1.08	x	97.38	x	0.4	x	0.7	=	20.41	(75)
Northeast 0.9x	0.77	x	0.32	x	97.38	x	0.4	x	0.7	=	6.05	(75)
Northeast 0.9x	0.77	x	1.08	x	91.1	x	0.4	x	0.7	=	19.09	(75)
Northeast 0.9x	0.77	x	0.32	x	91.1	x	0.4	x	0.7	=	5.66	(75)
Northeast 0.9x	0.77	x	1.08	x	72.63	x	0.4	x	0.7	=	15.22	(75)
Northeast 0.9x	0.77	x	0.32	x	72.63	x	0.4	x	0.7	=	4.51	(75)
Northeast 0.9x	0.77	x	1.08	x	50.42	x	0.4	x	0.7	=	10.57	(75)
Northeast 0.9x	0.77	x	0.32	x	50.42	x	0.4	x	0.7	=	3.13	(75)
Northeast 0.9x	0.77	x	1.08	x	28.07	x	0.4	x	0.7	=	5.88	(75)
Northeast 0.9x	0.77	x	0.32	x	28.07	x	0.4	x	0.7	=	1.74	(75)
Northeast 0.9x	0.77	x	1.08	x	14.2	x	0.4	x	0.7	=	2.98	(75)
Northeast 0.9x	0.77	x	0.32	x	14.2	x	0.4	x	0.7	=	0.88	(75)
Northeast 0.9x	0.77	x	1.08	x	9.21	x	0.4	x	0.7	=	1.93	(75)
Northeast 0.9x	0.77	x	0.32	x	9.21	x	0.4	x	0.7	=	0.57	(75)
Southeast 0.9x	0.77	x	1.97	x	36.79	x	0.4	x	0.7	=	14.06	(77)
Southeast 0.9x	0.77	x	1.97	x	62.67	x	0.4	x	0.7	=	23.96	(77)
Southeast 0.9x	0.77	x	1.97	x	85.75	x	0.4	x	0.7	=	32.78	(77)
Southeast 0.9x	0.77	x	1.97	x	106.25	x	0.4	x	0.7	=	40.62	(77)
Southeast 0.9x	0.77	x	1.97	x	119.01	x	0.4	x	0.7	=	45.49	(77)
Southeast 0.9x	0.77	x	1.97	x	118.15	x	0.4	x	0.7	=	45.16	(77)
Southeast 0.9x	0.77	x	1.97	x	113.91	x	0.4	x	0.7	=	43.54	(77)
Southeast 0.9x	0.77	x	1.97	x	104.39	x	0.4	x	0.7	=	39.9	(77)
Southeast 0.9x	0.77	x	1.97	x	92.85	x	0.4	x	0.7	=	35.49	(77)
Southeast 0.9x	0.77	x	1.97	x	69.27	x	0.4	x	0.7	=	26.48	(77)

Southeast	0.9x	0.77	x	1.97	x	44.07	x	0.4	x	0.7	=	16.85	(77)
Southeast	0.9x	0.77	x	1.97	x	31.49	x	0.4	x	0.7	=	12.04	(77)
Southwest	0.9x	0.77	x	1.42	x	36.79		0.4	x	0.7	=	10.14	(79)
Southwest	0.9x	0.77	x	1.45	x	36.79		0.4	x	0.7	=	10.35	(79)
Southwest	0.9x	0.77	x	1.42	x	62.67		0.4	x	0.7	=	17.27	(79)
Southwest	0.9x	0.77	x	1.45	x	62.67		0.4	x	0.7	=	17.63	(79)
Southwest	0.9x	0.77	x	1.42	x	85.75		0.4	x	0.7	=	23.63	(79)
Southwest	0.9x	0.77	x	1.45	x	85.75		0.4	x	0.7	=	24.13	(79)
Southwest	0.9x	0.77	x	1.42	x	106.25		0.4	x	0.7	=	29.28	(79)
Southwest	0.9x	0.77	x	1.45	x	106.25		0.4	x	0.7	=	29.89	(79)
Southwest	0.9x	0.77	x	1.42	x	119.01		0.4	x	0.7	=	32.79	(79)
Southwest	0.9x	0.77	x	1.45	x	119.01		0.4	x	0.7	=	33.48	(79)
Southwest	0.9x	0.77	x	1.42	x	118.15		0.4	x	0.7	=	32.55	(79)
Southwest	0.9x	0.77	x	1.45	x	118.15		0.4	x	0.7	=	33.24	(79)
Southwest	0.9x	0.77	x	1.42	x	113.91		0.4	x	0.7	=	31.39	(79)
Southwest	0.9x	0.77	x	1.45	x	113.91		0.4	x	0.7	=	32.05	(79)
Southwest	0.9x	0.77	x	1.42	x	104.39		0.4	x	0.7	=	28.76	(79)
Southwest	0.9x	0.77	x	1.45	x	104.39		0.4	x	0.7	=	29.37	(79)
Southwest	0.9x	0.77	x	1.42	x	92.85		0.4	x	0.7	=	25.58	(79)
Southwest	0.9x	0.77	x	1.45	x	92.85		0.4	x	0.7	=	26.12	(79)
Southwest	0.9x	0.77	x	1.42	x	69.27		0.4	x	0.7	=	19.09	(79)
Southwest	0.9x	0.77	x	1.45	x	69.27		0.4	x	0.7	=	19.49	(79)
Southwest	0.9x	0.77	x	1.42	x	44.07		0.4	x	0.7	=	12.14	(79)
Southwest	0.9x	0.77	x	1.45	x	44.07		0.4	x	0.7	=	12.4	(79)
Southwest	0.9x	0.77	x	1.42	x	31.49		0.4	x	0.7	=	8.68	(79)
Southwest	0.9x	0.77	x	1.45	x	31.49		0.4	x	0.7	=	8.86	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	37.62	65.1	91.78	118.25	136.58	137.42	131.73	117.77	100.9	72.68	45.25	32.08	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	402.25	427.14	442.3	451.07	451.74	436.33	420.85	412.19	405.23	394.85	387.28	388.71	(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=	0.89	0.87	0.83	0.77	0.68	0.55	0.43	0.45	0.61	0.77	0.86	0.89	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.01	19.21	19.57	20.03	20.46	20.78	20.91	20.9	20.69	20.19	19.54	18.97	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.34	20.34	20.35	20.35	20.36	20.36	20.36	20.37	20.36	20.36	20.35	20.35	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.88	0.86	0.82	0.76	0.66	0.51	0.37	0.4	0.57	0.75	0.84	0.89	(89)

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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.48	18.69	19.03	19.49	19.9	20.2	20.31	20.3	20.12	19.65	19.02	18.45	(90)

fLA = Living area ÷ (4) = 0.68 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.84	19.05	19.4	19.86	20.28	20.59	20.72	20.71	20.51	20.01	19.37	18.8	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.84	19.05	19.4	19.86	20.28	20.59	20.72	20.71	20.51	20.01	19.37	18.8	(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=	0.86	0.84	0.8	0.74	0.65	0.53	0.4	0.43	0.58	0.74	0.82	0.87	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	345.36	357.5	354.66	334.87	295.24	229.51	169.75	175.2	235.8	290.41	319.02	336.73	(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=	671.06	651.2	592.26	497.16	388.12	267.79	184.2	192.09	287.99	426.04	558.19	667.4	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	242.32	197.37	176.77	116.85	69.11	0	0	0	0	100.91	172.2	246.01	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1321.54 (98)

Space heating requirement in kWh/m²/year 37.63 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(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)													
	242.32	197.37	176.77	116.85	69.11	0	0	0	0	100.91	172.2	246.01	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	242.32	197.37	176.77	116.85	69.11	0	0	0	0	100.91	172.2	246.01	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1321.54 (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	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Water heating from separate community system:

Annual water heating requirement	1668.57	(64)
Fraction of heat from community CHP	1	(303a)

Factor for charging method for community water heating			1	(305)
Distribution loss factor (Table 12c) for community heating system			1.05	(306)
Water heat from CHP	(64) x (303a) x (305) x (306) =		1752	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =		17.52	(313)
Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1321.54	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		139.02		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		139.02	(231)
Electricity for lighting			176.43	(232)
Electricity generated by PVs			-876.05	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	174.31	(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 from CHP	(310a) x	4.24	x 0.01 =	74.28	(342a)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	18.34	(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 =	23.27	(250)
Additional standing charges (Table 12)				60	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-115.55	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			234.65	(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)		82.84	(258)

12a. CO_2 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	0.519	=	685.88	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)

Water heating from community system

Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

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CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	276.38	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	9.09	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	285.47	(373)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	72.15	(267)
Electricity for lighting	(232)	x	0.519	=	91.57	(268)
Energy saving/generation technologies						
Item 1			0.519	=	-454.67	(269)
Total CO2, kg/year	sum of (265)…(271) =				680.4	(272)
CO2 emissions per m²	(272) ÷ (4) =				19.37	(273)
EI rating (section 14)					89	(274)

13a. Primary Energy

	Energy kWh/year		**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211)	x	3.07	=	4057.12	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Water heating from community system						

	Energy kWh/year		**Primary factor**		**Emissions kWh/year**	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
Energy associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		3.07	=	1634.84	(367)
Electrical energy for heat distribution	[(313) x		2.92	=	51.16	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)			=	285.47	(373)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	426.78	(267)
Electricity for lighting	(232)	x	0	=	541.64	(268)
Energy saving/generation technologies						
Item 1			3.07	=	-2689.47	(269)
'Total Primary Energy	sum of (265)…(271) =				4022.07	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =				114.52	(273)

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User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type C - ASHP + PV

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	35.12	(1a)	x	3.09	(2a)	=	108.52	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	35.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			108.52	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
(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

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.72	x	1	=	0.72			(26)
Doors Type 3			0.99	x	1	=	0.99			(26)
Doors Type 4			0.72	x	1	=	0.72			(26)
Doors Type 5			0.72	x	1	=	0.72			(26)
Doors Type 6			0.63	x	1	=	0.63			(26)
Windows Type 1			1.08	x1/[1/(1.2)+ 0.04]		=	1.24			(27)
Windows Type 2			1.97	x1/[1/(1.2)+ 0.04]		=	2.26			(27)
Windows Type 3			1.42	x1/[1/(1.2)+ 0.04]		=	1.63			(27)
Windows Type 4			1.45	x1/[1/(1.2)+ 0.04]		=	1.66			(27)
Windows Type 5			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Walls Type1	10.51	3.08	7.43	x	0.13	=	0.97			(29)
Walls Type2	8.06	2.79	5.27	x	0.13	=	0.69			(29)
Walls Type3	19.5	1.97	17.53	x	0.13	=	2.28			(29)
Walls Type4	9.43	2.14	7.29	x	0.13	=	0.95			(29)
Walls Type5	9.02	2.17	6.85	x	0.13	=	0.89			(29)
Roof	35.12	0	35.12	x	0.1	=	3.51			(30)
Total area of elements, m²			91.64							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 22.33 (33)

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Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	316.08	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Low	100	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		13.75	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	36.08	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	10.07	9.96	9.84	9.28	9.17	8.61	8.61	8.5	8.84	9.17	9.4	9.62	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	46.15	46.04	45.92	45.36	45.25	44.69	44.69	44.58	44.92	45.25	45.48	45.7	

Average = $Sum(39)_{1…12}$ /12= 45.34 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.31	1.31	1.29	1.29	1.27	1.27	1.27	1.28	1.29	1.29	1.3	

Average = $Sum(40)_{1…12}$ /12= 1.29 (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 1.28 (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 64.68 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	71.15	68.56	65.98	63.39	60.8	58.22	58.22	60.8	63.39	65.98	68.56	71.15	

Total = $Sum(44)_{1…12}$ = 776.21 (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=	105.52	92.29	95.23	83.02	79.66	68.74	63.7	73.1	73.97	86.21	94.1	102.19	

Total = $Sum(45)_{1…12}$ = 1017.73 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	15.83	13.84	14.28	12.45	11.95	10.31	9.56	10.96	11.1	12.93	14.12	15.33	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		0	(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	110	(50)

b) If manufacturer’s declared cylinder loss factor is not known:

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Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02	(51)
If community heating see section 4.3			
Volume factor from Table 2a		1.03	(52)
Temperature factor from Table 2b		0.6	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)		1.03	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	160.79	142.21	150.51	136.52	134.94	122.24	118.98	128.37	127.46	141.48	147.59	157.46	(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=	160.79	142.21	150.51	136.52	134.94	122.24	118.98	128.37	127.46	141.48	147.59	157.46	

Output from water heater (annual)$_{1...12}$ — 1668.57 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	79.31	70.63	75.89	70.4	70.71	65.65	65.4	68.53	67.39	72.89	74.08	78.2	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	9.99	8.87	7.22	5.46	4.08	3.45	3.73	4.84	6.5	8.25	9.63	10.27	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	109.48	110.62	107.76	101.66	93.97	86.74	81.91	80.77	83.63	89.73	97.42	104.65	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	(71)

Water heating gains (Table 5)

(72)m=	106.59	105.1	102	97.78	95.04	91.18	87.91	92.11	93.6	97.96	102.89	105.11	(72)

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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	268.32	266.85	259.22	247.16	235.35	223.62	215.79	219.97	225.98	238.2	252.2	262.28	(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)	
Northeast	0.9x	0.77	x	1.08	x	11.28	x	0.4	x	0.7	=	2.36	(75)
Northeast	0.9x	0.77	x	0.32	x	11.28	x	0.4	x	0.7	=	0.7	(75)
Northeast	0.9x	0.77	x	1.08	x	22.97	x	0.4	x	0.7	=	4.81	(75)
Northeast	0.9x	0.77	x	0.32	x	22.97	x	0.4	x	0.7	=	1.43	(75)
Northeast	0.9x	0.77	x	1.08	x	41.38	x	0.4	x	0.7	=	8.67	(75)
Northeast	0.9x	0.77	x	0.32	x	41.38	x	0.4	x	0.7	=	2.57	(75)
Northeast	0.9x	0.77	x	1.08	x	67.96	x	0.4	x	0.7	=	14.24	(75)
Northeast	0.9x	0.77	x	0.32	x	67.96	x	0.4	x	0.7	=	4.22	(75)
Northeast	0.9x	0.77	x	1.08	x	91.35	x	0.4	x	0.7	=	19.14	(75)
Northeast	0.9x	0.77	x	0.32	x	91.35	x	0.4	x	0.7	=	5.67	(75)
Northeast	0.9x	0.77	x	1.08	x	97.38	x	0.4	x	0.7	=	20.41	(75)
Northeast	0.9x	0.77	x	0.32	x	97.38	x	0.4	x	0.7	=	6.05	(75)
Northeast	0.9x	0.77	x	1.08	x	91.1	x	0.4	x	0.7	=	19.09	(75)
Northeast	0.9x	0.77	x	0.32	x	91.1	x	0.4	x	0.7	=	5.66	(75)
Northeast	0.9x	0.77	x	1.08	x	72.63	x	0.4	x	0.7	=	15.22	(75)
Northeast	0.9x	0.77	x	0.32	x	72.63	x	0.4	x	0.7	=	4.51	(75)
Northeast	0.9x	0.77	x	1.08	x	50.42	x	0.4	x	0.7	=	10.57	(75)
Northeast	0.9x	0.77	x	0.32	x	50.42	x	0.4	x	0.7	=	3.13	(75)
Northeast	0.9x	0.77	x	1.08	x	28.07	x	0.4	x	0.7	=	5.88	(75)
Northeast	0.9x	0.77	x	0.32	x	28.07	x	0.4	x	0.7	=	1.74	(75)
Northeast	0.9x	0.77	x	1.08	x	14.2	x	0.4	x	0.7	=	2.98	(75)
Northeast	0.9x	0.77	x	0.32	x	14.2	x	0.4	x	0.7	=	0.88	(75)
Northeast	0.9x	0.77	x	1.08	x	9.21	x	0.4	x	0.7	=	1.93	(75)
Northeast	0.9x	0.77	x	0.32	x	9.21	x	0.4	x	0.7	=	0.57	(75)
Southeast	0.9x	0.77	x	1.97	x	36.79	x	0.4	x	0.7	=	14.06	(77)
Southeast	0.9x	0.77	x	1.97	x	62.67	x	0.4	x	0.7	=	23.96	(77)
Southeast	0.9x	0.77	x	1.97	x	85.75	x	0.4	x	0.7	=	32.78	(77)
Southeast	0.9x	0.77	x	1.97	x	106.25	x	0.4	x	0.7	=	40.62	(77)
Southeast	0.9x	0.77	x	1.97	x	119.01	x	0.4	x	0.7	=	45.49	(77)
Southeast	0.9x	0.77	x	1.97	x	118.15	x	0.4	x	0.7	=	45.16	(77)
Southeast	0.9x	0.77	x	1.97	x	113.91	x	0.4	x	0.7	=	43.54	(77)
Southeast	0.9x	0.77	x	1.97	x	104.39	x	0.4	x	0.7	=	39.9	(77)
Southeast	0.9x	0.77	x	1.97	x	92.85	x	0.4	x	0.7	=	35.49	(77)
Southeast	0.9x	0.77	x	1.97	x	69.27	x	0.4	x	0.7	=	26.48	(77)

Southeast 0.9x	0.77	x	1.97	x	44.07	x	0.4	x	0.7	=	16.85	(77)
Southeast 0.9x	0.77	x	1.97	x	31.49	x	0.4	x	0.7	=	12.04	(77)
Southwest 0.9x	0.77	x	1.42	x	36.79		0.4	x	0.7	=	10.14	(79)
Southwest 0.9x	0.77	x	1.45	x	36.79		0.4	x	0.7	=	10.35	(79)
Southwest 0.9x	0.77	x	1.42	x	62.67		0.4	x	0.7	=	17.27	(79)
Southwest 0.9x	0.77	x	1.45	x	62.67		0.4	x	0.7	=	17.63	(79)
Southwest 0.9x	0.77	x	1.42	x	85.75		0.4	x	0.7	=	23.63	(79)
Southwest 0.9x	0.77	x	1.45	x	85.75		0.4	x	0.7	=	24.13	(79)
Southwest 0.9x	0.77	x	1.42	x	106.25		0.4	x	0.7	=	29.28	(79)
Southwest 0.9x	0.77	x	1.45	x	106.25		0.4	x	0.7	=	29.89	(79)
Southwest 0.9x	0.77	x	1.42	x	119.01		0.4	x	0.7	=	32.79	(79)
Southwest 0.9x	0.77	x	1.45	x	119.01		0.4	x	0.7	=	33.48	(79)
Southwest 0.9x	0.77	x	1.42	x	118.15		0.4	x	0.7	=	32.55	(79)
Southwest 0.9x	0.77	x	1.45	x	118.15		0.4	x	0.7	=	33.24	(79)
Southwest 0.9x	0.77	x	1.42	x	113.91		0.4	x	0.7	=	31.39	(79)
Southwest 0.9x	0.77	x	1.45	x	113.91		0.4	x	0.7	=	32.05	(79)
Southwest 0.9x	0.77	x	1.42	x	104.39		0.4	x	0.7	=	28.76	(79)
Southwest 0.9x	0.77	x	1.45	x	104.39		0.4	x	0.7	=	29.37	(79)
Southwest 0.9x	0.77	x	1.42	x	92.85		0.4	x	0.7	=	25.58	(79)
Southwest 0.9x	0.77	x	1.45	x	92.85		0.4	x	0.7	=	26.12	(79)
Southwest 0.9x	0.77	x	1.42	x	69.27		0.4	x	0.7	=	19.09	(79)
Southwest 0.9x	0.77	x	1.45	x	69.27		0.4	x	0.7	=	19.49	(79)
Southwest 0.9x	0.77	x	1.42	x	44.07		0.4	x	0.7	=	12.14	(79)
Southwest 0.9x	0.77	x	1.45	x	44.07		0.4	x	0.7	=	12.4	(79)
Southwest 0.9x	0.77	x	1.42	x	31.49		0.4	x	0.7	=	8.68	(79)
Southwest 0.9x	0.77	x	1.45	x	31.49		0.4	x	0.7	=	8.86	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	37.62	65.1	91.78	118.25	136.58	137.42	131.73	117.77	100.9	72.68	45.25	32.08	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	305.94	331.95	351	365.4	371.93	361.04	347.52	337.74	326.88	310.88	297.45	294.36	(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=	0.93	0.92	0.89	0.84	0.75	0.62	0.5	0.52	0.69	0.84	0.91	0.94	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.66	18.89	19.29	19.82	20.31	20.7	20.88	20.86	20.59	19.98	19.25	18.62	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.34	20.34	20.35	20.35	20.36	20.36	20.36	20.37	20.36	20.36	20.35	20.35	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.93	0.91	0.88	0.82	0.73	0.58	0.44	0.47	0.65	0.82	0.9	0.93	(89)

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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.14	18.37	18.76	19.29	19.77	20.14	20.29	20.27	20.03	19.45	18.73	18.11	(90)

fLA = Living area ÷ (4) = 0.68 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.5	18.73	19.12	19.65	20.14	20.52	20.69	20.67	20.41	19.81	19.08	18.46	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.5	18.73	19.12	19.65	20.14	20.52	20.69	20.67	20.41	19.81	19.08	18.46	(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=	0.91	0.89	0.86	0.8	0.72	0.59	0.47	0.49	0.66	0.8	0.88	0.91	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	277.81	294.91	300.74	293.22	267.19	214.58	162.73	166.89	215.08	249.99	261.98	269.17	(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=	655.16	636.48	579.63	487.61	381.9	264.68	182.82	190.44	283.54	416.79	544.89	651.6	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	280.75	229.54	207.49	139.96	85.34	0	0	0	0	124.1	203.7	284.53	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1555.42 (98)

Space heating requirement in kWh/m²/year 44.29 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(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)													
	280.75	229.54	207.49	139.96	85.34	0	0	0	0	124.1	203.7	284.53	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	280.75	229.54	207.49	139.96	85.34	0	0	0	0	124.1	203.7	284.53	

Total (kWh/year) =$Sum(211)_{1...5,10...12}$= 1555.42 (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

Water heating from separate community system:

Annual water heating requirement	1668.57	(64)
Fraction of heat from community CHP	1	(303a)

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Factor for charging method for community water heating		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Water heat from CHP	(64) x (303a) x (305) x (306) =	1752	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	17.52	(313)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1555.42	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		139.02		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		139.02	(231)
Electricity for lighting			176.43	(232)
Electricity generated by PVs			-876.05	(233)

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	0.519	=	807.26	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating from community system					

		Energy kWh/year	**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
CO2 associated with heat source 1		[(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	276.38	(367)
Electrical energy for heat distribution		[(313) x	0.52	=	9.09	(372)
Total CO2 associated with community systems		(363)…(366) + (368)...(372)		=	285.47	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	72.15	(267)
Electricity for lighting	(232) x		0.519	=	91.57	(268)
Energy saving/generation technologies Item 1			0.519	=	-454.67	(269)
Total CO2, kg/year		sum of (265)…(271) =			801.78	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =			22.83	(273)
EI rating (section 14)					87	(274)

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User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type C - ASHP + PV

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	35.12	(1a)	x	3.09	(2a)	=	108.52	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	35.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	108.52	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =	0.18	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.43	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

0.55	0.54	0.53	0.48	0.47	0.41	0.41	0.4	0.43	0.47	0.49	0.51

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0.65	0.65	0.64	0.61	0.61	0.59	0.59	0.58	0.59	0.61	0.62	0.63	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.65	0.65	0.64	0.61	0.61	0.59	0.59	0.58	0.59	0.61	0.62	0.63	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.72	x	1	=	0.72			(26)
Doors Type 3			0.99	x	1	=	0.99			(26)
Doors Type 4			0.72	x	1	=	0.72			(26)
Doors Type 5			0.72	x	1	=	0.72			(26)
Doors Type 6			0.63	x	1	=	0.63			(26)
Windows Type 1			0.5	x1/[1/(1.4)+ 0.04]		=	0.66			(27)
Windows Type 2			0.91	x1/[1/(1.4)+ 0.04]		=	1.21			(27)
Windows Type 3			0.65	x1/[1/(1.4)+ 0.04]		=	0.86			(27)
Windows Type 4			0.67	x1/[1/(1.4)+ 0.04]		=	0.89			(27)
Windows Type 5			0.15	x1/[1/(1.4)+ 0.04]		=	0.2			(27)
Walls Type1	10.51	2.91	7.6	x	0.18	=	1.37			(29)
Walls Type2	8.06	2.21	5.85	x	0.18	=	1.05			(29)
Walls Type3	19.5	0.91	18.59	x	0.18	=	3.35			(29)
Walls Type4	9.43	1.37	8.06	x	0.18	=	1.45			(29)
Walls Type5	9.02	1.39	7.63	x	0.18	=	1.37			(29)
Roof	35.12	0	35.12	x	0.13	=	4.57			(30)
Total area of elements, m²			91.64							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 22.88 (33)

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Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	316.08	(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		4.58	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	27.47	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.4	23.18	22.97	21.99	21.81	20.95	20.95	20.8	21.28	21.81	22.18	22.57	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	50.86	50.65	50.44	49.46	49.28	48.42	48.42	48.26	48.75	49.28	49.65	50.04	

Average = Sum(39)$_{1…12}$ /12= 49.46 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.45	1.44	1.44	1.41	1.4	1.38	1.38	1.37	1.39	1.4	1.41	1.42	

Average = Sum(40)$_{1…12}$ /12= 1.41 (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 — 1.28 (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 — 64.68 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	71.15	68.56	65.98	63.39	60.8	58.22	58.22	60.8	63.39	65.98	68.56	71.15	

Total = Sum(44)$_{1…12}$ = 776.21 (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=	105.52	92.29	95.23	83.02	79.66	68.74	63.7	73.1	73.97	86.21	94.1	102.19	

Total = Sum(45)$_{1…12}$ = 1017.73 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	15.83	13.84	14.28	12.45	11.95	10.31	9.56	10.96	11.1	12.93	14.12	15.33	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (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): — 1.39 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

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Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 — (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 — (52)

Temperature factor from Table 2b — 0 — (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 0 — (54)

Enter (50) or (54) in (55) — 0.75 — (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 — 0 — (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	152.11	134.37	141.83	128.12	126.26	113.84	110.3	119.69	119.06	132.8	139.19	148.78	(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=	152.11	134.37	141.83	128.12	126.26	113.84	110.3	119.69	119.06	132.8	139.19	148.78

Output from water heater (annual)$_{1...12}$ — 1566.35 — (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	72.36	64.35	68.94	63.68	63.76	58.93	58.46	61.58	60.67	65.94	67.36	71.25	(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=	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	64.18	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	11.73	10.42	8.47	6.41	4.79	4.05	4.37	5.68	7.63	9.69	11.31	12.05	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	109.48	110.62	107.76	101.66	93.97	86.74	81.91	80.77	83.63	89.73	97.42	104.65	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	29.42	(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=	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	-51.34	(71)

Water heating gains (Table 5)

(72)m=	97.26	95.76	92.66	88.44	85.7	81.85	78.57	82.77	84.26	88.63	93.56	95.77	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	263.72	262.05	254.14	241.77	229.72	217.89	210.1	214.48	220.78	233.3	247.54	257.73	(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)	
Northeast 0.9x	0.77	x	0.5	x	11.28	x	0.63	x	0.7	=	1.72	(75)
Northeast 0.9x	0.77	x	0.15	x	11.28	x	0.63	x	0.7	=	0.52	(75)
Northeast 0.9x	0.77	x	0.5	x	22.97	x	0.63	x	0.7	=	3.51	(75)
Northeast 0.9x	0.77	x	0.15	x	22.97	x	0.63	x	0.7	=	1.05	(75)
Northeast 0.9x	0.77	x	0.5	x	41.38	x	0.63	x	0.7	=	6.32	(75)
Northeast 0.9x	0.77	x	0.15	x	41.38	x	0.63	x	0.7	=	1.9	(75)
Northeast 0.9x	0.77	x	0.5	x	67.96	x	0.63	x	0.7	=	10.38	(75)
Northeast 0.9x	0.77	x	0.15	x	67.96	x	0.63	x	0.7	=	3.12	(75)
Northeast 0.9x	0.77	x	0.5	x	91.35	x	0.63	x	0.7	=	13.96	(75)
Northeast 0.9x	0.77	x	0.15	x	91.35	x	0.63	x	0.7	=	4.19	(75)
Northeast 0.9x	0.77	x	0.5	x	97.38	x	0.63	x	0.7	=	14.88	(75)
Northeast 0.9x	0.77	x	0.15	x	97.38	x	0.63	x	0.7	=	4.46	(75)
Northeast 0.9x	0.77	x	0.5	x	91.1	x	0.63	x	0.7	=	13.92	(75)
Northeast 0.9x	0.77	x	0.15	x	91.1	x	0.63	x	0.7	=	4.18	(75)
Northeast 0.9x	0.77	x	0.5	x	72.63	x	0.63	x	0.7	=	11.1	(75)
Northeast 0.9x	0.77	x	0.15	x	72.63	x	0.63	x	0.7	=	3.33	(75)
Northeast 0.9x	0.77	x	0.5	x	50.42	x	0.63	x	0.7	=	7.7	(75)
Northeast 0.9x	0.77	x	0.15	x	50.42	x	0.63	x	0.7	=	2.31	(75)
Northeast 0.9x	0.77	x	0.5	x	28.07	x	0.63	x	0.7	=	4.29	(75)
Northeast 0.9x	0.77	x	0.15	x	28.07	x	0.63	x	0.7	=	1.29	(75)
Northeast 0.9x	0.77	x	0.5	x	14.2	x	0.63	x	0.7	=	2.17	(75)
Northeast 0.9x	0.77	x	0.15	x	14.2	x	0.63	x	0.7	=	0.65	(75)
Northeast 0.9x	0.77	x	0.5	x	9.21	x	0.63	x	0.7	=	1.41	(75)
Northeast 0.9x	0.77	x	0.15	x	9.21	x	0.63	x	0.7	=	0.42	(75)
Southeast 0.9x	0.77	x	0.91	x	36.79	x	0.63	x	0.7	=	10.23	(77)
Southeast 0.9x	0.77	x	0.91	x	62.67	x	0.63	x	0.7	=	17.43	(77)
Southeast 0.9x	0.77	x	0.91	x	85.75	x	0.63	x	0.7	=	23.85	(77)
Southeast 0.9x	0.77	x	0.91	x	106.25	x	0.63	x	0.7	=	29.55	(77)
Southeast 0.9x	0.77	x	0.91	x	119.01	x	0.63	x	0.7	=	33.1	(77)
Southeast 0.9x	0.77	x	0.91	x	118.15	x	0.63	x	0.7	=	32.86	(77)
Southeast 0.9x	0.77	x	0.91	x	113.91	x	0.63	x	0.7	=	31.68	(77)
Southeast 0.9x	0.77	x	0.91	x	104.39	x	0.63	x	0.7	=	29.03	(77)
Southeast 0.9x	0.77	x	0.91	x	92.85	x	0.63	x	0.7	=	25.82	(77)
Southeast 0.9x	0.77	x	0.91	x	69.27	x	0.63	x	0.7	=	19.26	(77)

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Southeast 0.9x	0.77	x	0.91	x	44.07	x	0.63	x	0.7	=	12.26	(77)
Southeast 0.9x	0.77	x	0.91	x	31.49	x	0.63	x	0.7	=	8.76	(77)
Southwest 0.9x	0.77	x	0.65	x	36.79		0.63	x	0.7	=	7.31	(79)
Southwest 0.9x	0.77	x	0.67	x	36.79		0.63	x	0.7	=	7.53	(79)
Southwest 0.9x	0.77	x	0.65	x	62.67		0.63	x	0.7	=	12.45	(79)
Southwest 0.9x	0.77	x	0.67	x	62.67		0.63	x	0.7	=	12.83	(79)
Southwest 0.9x	0.77	x	0.65	x	85.75		0.63	x	0.7	=	17.03	(79)
Southwest 0.9x	0.77	x	0.67	x	85.75		0.63	x	0.7	=	17.56	(79)
Southwest 0.9x	0.77	x	0.65	x	106.25		0.63	x	0.7	=	21.11	(79)
Southwest 0.9x	0.77	x	0.67	x	106.25		0.63	x	0.7	=	21.76	(79)
Southwest 0.9x	0.77	x	0.65	x	119.01		0.63	x	0.7	=	23.64	(79)
Southwest 0.9x	0.77	x	0.67	x	119.01		0.63	x	0.7	=	24.37	(79)
Southwest 0.9x	0.77	x	0.65	x	118.15		0.63	x	0.7	=	23.47	(79)
Southwest 0.9x	0.77	x	0.67	x	118.15		0.63	x	0.7	=	24.19	(79)
Southwest 0.9x	0.77	x	0.65	x	113.91		0.63	x	0.7	=	22.63	(79)
Southwest 0.9x	0.77	x	0.67	x	113.91		0.63	x	0.7	=	23.32	(79)
Southwest 0.9x	0.77	x	0.65	x	104.39		0.63	x	0.7	=	20.74	(79)
Southwest 0.9x	0.77	x	0.67	x	104.39		0.63	x	0.7	=	21.38	(79)
Southwest 0.9x	0.77	x	0.65	x	92.85		0.63	x	0.7	=	18.44	(79)
Southwest 0.9x	0.77	x	0.67	x	92.85		0.63	x	0.7	=	19.01	(79)
Southwest 0.9x	0.77	x	0.65	x	69.27		0.63	x	0.7	=	13.76	(79)
Southwest 0.9x	0.77	x	0.67	x	69.27		0.63	x	0.7	=	14.18	(79)
Southwest 0.9x	0.77	x	0.65	x	44.07		0.63	x	0.7	=	8.75	(79)
Southwest 0.9x	0.77	x	0.67	x	44.07		0.63	x	0.7	=	9.02	(79)
Southwest 0.9x	0.77	x	0.65	x	31.49		0.63	x	0.7	=	6.26	(79)
Southwest 0.9x	0.77	x	0.67	x	31.49		0.63	x	0.7	=	6.45	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	27.32	47.28	66.66	85.91	99.25	99.87	95.73	85.57	73.3	52.78	32.85	23.29	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	291.04	309.33	320.8	327.68	328.97	317.75	305.83	300.05	294.08	286.08	280.4	281.02	(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	0.99	0.98	0.96	0.92	0.8	0.65	0.68	0.86	0.96	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.58	19.71	19.94	20.28	20.6	20.86	20.96	20.95	20.79	20.39	19.95	19.57	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.73	19.73	19.74	19.76	19.76	19.78	19.78	19.78	19.77	19.76	19.75	19.74	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.95	0.88	0.71	0.49	0.53	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=	17.88	18.07	18.42	18.91	19.36	19.68	19.76	19.76	19.6	19.08	18.43	17.88	(90)

fLA = Living area ÷ (4) = 0.68 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.04	19.18	19.45	19.84	20.2	20.48	20.58	20.57	20.41	19.97	19.46	19.03	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.04	19.18	19.45	19.84	20.2	20.48	20.58	20.57	20.41	19.97	19.46	19.03	(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=	0.99	0.98	0.97	0.95	0.89	0.77	0.6	0.63	0.83	0.95	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	287.66	304.32	312.51	311.5	294.4	243.53	182.24	188.18	244.19	271.01	274.96	278.19	(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=	749.54	723.49	653.43	541.18	418.99	284.86	192.62	201.3	307.59	461.93	613.77	742.08	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	343.64	281.68	253.65	165.37	92.7	0	0	0	0	142.04	243.94	345.14	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1868.17 (98)

Space heating requirement in kWh/m²/year 53.19 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)													
	343.64	281.68	253.65	165.37	92.7	0	0	0	0	142.04	243.94	345.14	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	367.53	301.27	271.28	176.87	99.15	0	0	0	0	151.92	260.9	369.13	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1998.04 (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

Water heating from separate community system:

Annual water heating requirement 1566.35 (64)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1998.04

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Water heating fuel used			1862.95	
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			207.11	(232)

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	=	431.58	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	402.4	(264)
Space and water heating	(261) + (262) + (263) + (264) =			833.97	(265)

Water heating from community system

	Energy kWh/year	**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Electrical energy for heat distribution	[(313) x	0	=	0	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	0	(373)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	107.49	(268)
Total CO2, kg/year	sum of (265)…(271) =			980.39	(272)

TER =	40.98	(273)

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 12 May 2020

Property Details: Flat Type C - ASHP + PV

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	Yes
Number of storeys:	1
Front of dwelling faces:	North East
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Low
Night ventilation:	False
Blinds, curtains, shutters:	
Ventilation rate during hot weather (ach):	0.8 (Windows slightly open (50 mm))

Overheating Details:

Summer ventilation heat loss coefficient:	28.65	**(P1)**
Transmission heat loss coefficient:	36.1	
Summer heat loss coefficient:	64.73	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
North East (Window_06_01)	0	1
South East (Window_06_04)	0	1
South West (Window_06_04)	0	1
South West (Window_06_05)	0	1
North East (Fanlight)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
North East (Window_06_01)	1	0.9	1	0.9	**(P8)**
South East (Window_06_04)	1	0.9	1	0.9	**(P8)**
South West (Window_06_04)	1	0.9	1	0.9	**(P8)**
South West (Window_06_05)	1	0.9	1	0.9	**(P8)**
North East (Fanlight)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
North East (Window_06_01)	0.9 x	1.08	98.85	0.4	0.7	0.9	24.21	
South East (Window_06_04)	0.9 x	1.97	119.92	0.4	0.7	0.9	53.58	
South West (Window_06_04)	0.9 x	1.42	119.92	0.4	0.7	0.9	38.62	
South West (Window_06_05)	0.9 x	1.45	119.92	0.4	0.7	0.9	39.44	
North East (Fanlight)	0.9 x	0.32	98.85	0.4	0.7	0.9	7.17	
						Total	163.03	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	298.92	289.12	294.42	
Total summer gains	470.99	452.15	442.9	**(P5)**
Summer gain/loss ratio	7.28	6.99	6.84	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	

SAP 2012 Overheating Assessment

Thermal mass temperature increment	1.3	1.3	1.3	
Threshold temperature	24.58	26.19	25.94	**(P7)**
Likelihood of high internal temperature	**High**	**High**	**High**	

Assessment of likelihood of high internal temperature: High

SAP Input

Property Details: Flat Type D - ASHP + PV

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	07 November 2019
Date of certificate:	12 May 2020
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Low
Water use <= 125 litres/person/day:	True
PCDF Version:	460

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2020	
Floor Location:	Floor area:	Storey height:
Floor 0	25 m²	3.09 m
Living area:	21.1 m² (fraction 0.844)	
Front of dwelling faces:	West	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D4_01	Manufacturer	Solid			Metal
Vent_04_02	Manufacturer	Solid			
Vent_04_04	Manufacturer	Solid			
Window_04_01	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_04_05	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Fanlight	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D4_01	mm	0	0	1	2.13	1
Vent_04_02	mm	0	0	1	0.35	1
Vent_04_04	mm	0	0	1	0.99	1
Window_04_01	6mm	0.7	0.4	1.2	0.7	1
Window_04_05	6mm	0.7	0.4	1.2	1.96	1
Fanlight	6mm	0.7	0.4	1.2	0.32	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D4_01		4_01	West	0	0
Vent_04_02		4_01	West	0.295	1.2
Vent_04_04		4_05	East	0.6	1.65
Window_04_01		4_01	West	0.585	1.2
Window_04_05		4_05	East	1.185	1.65
Fanlight		4_01	West	1.01	0.315

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
4_01	10.073	3.5	6.57	0.13	0	False	N/A
4_05	12.978	2.95	10.03	0.13	0	False	N/A
4_03	1.869	0	1.87	0.13	0	False	N/A
4_04	2.905	0	2.9	0.13	0	False	N/A

SAP Input

R4_01	25	0	25	0.1	0	N/A

Internal Elements
Party Elements

Thermal bridges:

Thermal bridges:	No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: False
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	0
Pressure test:	2.5

Main heating system:

Main heating system:	Electric underfloor heating Standard tariff Fuel: Electricity Info Source: SAP Tables SAP Table: 425 In timber floor, or immediately below floor covering Underfloor heating, pipes in insulated timber floor Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Room-sealed Boiler interlock: Yes

Main heating Control:

Main heating Control:	Programmer and room thermostat Control code: 2704

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	952 From DHW-only community scheme Heat source: From hot-water only community scheme - heat pump heat from electric heat pump, heat fraction 1, efficiency 329 Piping>=1991, pre-insulated, medium temp, variable flow No hot water cylinder Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.448 Tilt of collector: 30° Overshading: None or very little

SAP Input

	Collector Orientation: South West
	<u>Photovoltaic 2</u> Installed Peak power: 0.179 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
	<u>Photovoltaic 3</u> Installed Peak power: 0.168 Tilt of collector: 30° Overshading: None or very little Collector Orientation: East
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type D - ASHP + PV

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	25	(1a) x	3.09	(2a) =	77.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	25	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		77.25	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.35	x	1	=	0.35			(26)
Doors Type 3			0.99	x	1	=	0.99			(26)
Windows Type 1			0.7	x1/[1/(1.2)+ 0.04]		=	0.8			(27)
Windows Type 2			1.96	x1/[1/(1.2)+ 0.04]		=	2.24			(27)
Windows Type 3			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Walls Type1	10.07	3.5	6.57	x	0.13	=	0.85			(29)
Walls Type2	12.98	2.95	10.03	x	0.13	=	1.3			(29)
Walls Type3	1.87	0	1.87	x	0.13	=	0.24			(29)
Walls Type4	2.9	0	2.9	x	0.13	=	0.38			(29)
Roof	25	0	25	x	0.1	=	2.5			(30)
Total area of elements, m²			52.82							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 12.16 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 225 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 7.92 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

SAP WorkSheet: New dwelling design stage

Total fabric heat loss (33) + (36) = 20.08 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	7.17	7.09	7.01	6.61	6.53	6.13	6.13	6.05	6.29	6.53	6.69	6.85	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	27.25	27.17	27.09	26.69	26.61	26.22	26.22	26.14	26.37	26.61	26.77	26.93	

Average = Sum(39)$_{1...12}$ /12= 26.67 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.09	1.09	1.08	1.07	1.06	1.05	1.05	1.05	1.05	1.06	1.07	1.08	

Average = Sum(40)$_{1...12}$ /12= 1.07 (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 1.09 (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 60.05 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	66.06	63.66	61.25	58.85	56.45	54.05	54.05	56.45	58.85	61.25	63.66	66.06

Total = Sum(44)$_{1...12}$ = 720.62 (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=	97.96	85.68	88.41	77.08	73.96	63.82	59.14	67.86	68.67	80.03	87.36	94.87

Total = Sum(45)$_{1...12}$ = 944.85 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	14.69	12.85	13.26	11.56	11.09	9.57	8.87	10.18	10.3	12	13.1	14.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

SAP WorkSheet: New dwelling design stage

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	153.24	135.6	143.69	130.57	129.24	117.31	114.42	123.14	122.17	135.31	140.86	150.15	(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=	153.24	135.6	143.69	130.57	129.24	117.31	114.42	123.14	122.17	135.31	140.86	150.15

Output from water heater (annual)$_{1...12}$ 1595.69 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	76.79	68.43	73.62	68.42	68.81	64.02	63.89	66.79	65.63	70.83	71.84	75.77	(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=	65.31	65.31	65.31	65.31	65.31	65.31	65.31	65.31	65.31	65.31	65.31	65.31	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	21.45	19.05	15.49	11.73	8.77	7.4	8	10.39	13.95	17.72	20.68	22.04	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	128.81	130.15	126.78	119.61	110.56	102.05	96.37	95.03	98.4	105.57	114.62	123.13	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	42.62	42.62	42.62	42.62	42.62	42.62	42.62	42.62	42.62	42.62	42.62	42.62	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	(71)

Water heating gains (Table 5)

(72)m=	103.22	101.83	98.95	95.03	92.49	88.91	85.87	89.77	91.15	95.2	99.78	101.84	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	317.86	315.41	305.61	290.76	276.2	262.75	254.62	259.58	267.89	282.88	299.47	311.39	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	1.96	x	19.64	x	0.4	x	0.7	=	7.47	(76)
East	0.9x	0.77	x	1.96	x	38.42	x	0.4	x	0.7	=	14.61	(76)
East	0.9x	0.77	x	1.96	x	63.27	x	0.4	x	0.7	=	24.06	(76)
East	0.9x	0.77	x	1.96	x	92.28	x	0.4	x	0.7	=	35.1	(76)
East	0.9x	0.77	x	1.96	x	113.09	x	0.4	x	0.7	=	43.01	(76)
East	0.9x	0.77	x	1.96	x	115.77	x	0.4	x	0.7	=	44.03	(76)
East	0.9x	0.77	x	1.96	x	110.22	x	0.4	x	0.7	=	41.92	(76)
East	0.9x	0.77	x	1.96	x	94.68	x	0.4	x	0.7	=	36.01	(76)
East	0.9x	0.77	x	1.96	x	73.59	x	0.4	x	0.7	=	27.99	(76)
East	0.9x	0.77	x	1.96	x	45.59	x	0.4	x	0.7	=	17.34	(76)
East	0.9x	0.77	x	1.96	x	24.49	x	0.4	x	0.7	=	9.31	(76)
East	0.9x	0.77	x	1.96	x	16.15	x	0.4	x	0.7	=	6.14	(76)
West	0.9x	0.77	x	0.7	x	19.64	x	0.4	x	0.7	=	2.67	(80)
West	0.9x	0.77	x	0.32	x	19.64	x	0.4	x	0.7	=	1.22	(80)
West	0.9x	0.77	x	0.7	x	38.42	x	0.4	x	0.7	=	5.22	(80)
West	0.9x	0.77	x	0.32	x	38.42	x	0.4	x	0.7	=	2.39	(80)
West	0.9x	0.77	x	0.7	x	63.27	x	0.4	x	0.7	=	8.59	(80)
West	0.9x	0.77	x	0.32	x	63.27	x	0.4	x	0.7	=	3.93	(80)
West	0.9x	0.77	x	0.7	x	92.28	x	0.4	x	0.7	=	12.53	(80)
West	0.9x	0.77	x	0.32	x	92.28	x	0.4	x	0.7	=	5.73	(80)
West	0.9x	0.77	x	0.7	x	113.09	x	0.4	x	0.7	=	15.36	(80)
West	0.9x	0.77	x	0.32	x	113.09	x	0.4	x	0.7	=	7.02	(80)
West	0.9x	0.77	x	0.7	x	115.77	x	0.4	x	0.7	=	15.72	(80)
West	0.9x	0.77	x	0.32	x	115.77	x	0.4	x	0.7	=	7.19	(80)
West	0.9x	0.77	x	0.7	x	110.22	x	0.4	x	0.7	=	14.97	(80)
West	0.9x	0.77	x	0.32	x	110.22	x	0.4	x	0.7	=	6.84	(80)
West	0.9x	0.77	x	0.7	x	94.68	x	0.4	x	0.7	=	12.86	(80)
West	0.9x	0.77	x	0.32	x	94.68	x	0.4	x	0.7	=	5.88	(80)
West	0.9x	0.77	x	0.7	x	73.59	x	0.4	x	0.7	=	10	(80)
West	0.9x	0.77	x	0.32	x	73.59	x	0.4	x	0.7	=	4.57	(80)
West	0.9x	0.77	x	0.7	x	45.59	x	0.4	x	0.7	=	6.19	(80)
West	0.9x	0.77	x	0.32	x	45.59	x	0.4	x	0.7	=	2.83	(80)
West	0.9x	0.77	x	0.7	x	24.49	x	0.4	x	0.7	=	3.33	(80)
West	0.9x	0.77	x	0.32	x	24.49	x	0.4	x	0.7	=	1.52	(80)
West	0.9x	0.77	x	0.7	x	16.15	x	0.4	x	0.7	=	2.19	(80)
West	0.9x	0.77	x	0.32	x	16.15	x	0.4	x	0.7	=	1	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	11.36	22.22	36.59	53.36	65.39	66.94	63.73	54.75	42.55	26.36	14.16	9.34	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	329.22	337.63	342.2	344.12	341.6	329.69	318.35	314.33	310.44	309.24	313.63	320.73	(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=	0.83	0.82	0.78	0.71	0.61	0.47	0.35	0.37	0.52	0.69	0.79	0.84	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.68	19.82	20.08	20.42	20.7	20.9	20.97	20.96	20.85	20.53	20.09	19.66	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.45	20.46	20.46	20.47	20.47	20.48	20.48	20.48	20.47	20.47	20.46	20.46	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.83	0.81	0.77	0.69	0.58	0.44	0.31	0.33	0.49	0.67	0.78	0.83	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.22	19.36	19.61	19.95	20.22	20.4	20.45	20.45	20.36	20.06	19.63	19.21	(90)

fLA = Living area ÷ (4) = 0.84 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.61	19.75	20	20.34	20.63	20.82	20.89	20.88	20.77	20.46	20.02	19.59	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.61	19.75	20	20.34	20.63	20.82	20.89	20.88	20.77	20.46	20.02	19.59	(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=	0.81	0.79	0.75	0.69	0.59	0.46	0.34	0.36	0.51	0.67	0.77	0.82	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	266.46	267.15	258.1	236.5	201.57	150.41	108.21	112.24	157.93	207.19	240.4	261.97	(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=	417.28	403.38	365.81	305.48	237.59	163.05	112.37	117.12	176.05	262.43	345.82	414.53	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	112.21	91.55	80.14	49.67	26.8	0	0	0	0	41.1	75.9	113.51	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 590.87 (98)

Space heating requirement in kWh/m²/year — 23.63 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	112.21	91.55	80.14	49.67	26.8	0	0	0	0	41.1	75.9	113.51		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	112.21	91.55	80.14	49.67	26.8	0	0	0	0	41.1	75.9	113.51		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													590.87	(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

Water heating from separate community system:			
Annual water heating requirement		1595.69	(64)
Fraction of heat from community CHP		1	(303a)
Factor for charging method for community water heating		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.1	(306)
Water heat from CHP	(64) x (303a) x (305) x (306) =	1755.26	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	17.55	(313)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			590.87	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		98.96		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		98.96	(231)
Electricity for lighting			151.5	(232)
Electricity generated by PVs			-645.46	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	77.94	(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 from CHP	(310a) x	4.24	x 0.01 =	74.42	(342a)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	13.05	(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 =	19.98	(250)
Additional standing charges (Table 12)				60	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-85.14	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			160.26	(255)

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11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.96	(257)
SAP rating (Section 12)		86.59	(258)

12a. CO_2 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	0.519	=	306.66	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating from community system						

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	276.89	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	9.11	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	286	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	51.36	(267)
Electricity for lighting	(232) x		0.519	=	78.63	(268)
Energy saving/generation technologies						
Item 1			0.519	=	-335	(269)
Total CO2, kg/year	sum of (265)…(271) =				387.65	(272)
CO2 emissions per m²	(272) ÷ (4) =				15.51	(273)
EI rating (section 14)					93	(274)

13a. Primary Energy

	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	3.07	=	1813.97	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Water heating from community system						

		Energy kWh/year	Primary factor		Emissions kWh/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
Energy associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		3.07	=	1637.89	(367)
Electrical energy for heat distribution	[(313) x		2.92	=	51.25	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)			=	286	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		3.07	=	303.8	(267)

Electricity for lighting	(232) x	0	=	465.09	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-1981.57	(269)
'Total Primary Energy	sum of (265)…(271) =			2290.42	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			91.62	(273)

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User Details:

Assessor Name: Adam Ritchie
Stroma Number: STRO019516
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.25

Property Address: Flat Type D - ASHP + PV

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	25	(1a) x	3.09	(2a) =	77.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	25	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	77.25	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.65 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.28	0.27	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.35	x	1	=	0.35			(26)
Doors Type 3			0.99	x	1	=	0.99			(26)
Windows Type 1			0.7	x1/[1/(1.2)+ 0.04]		=	0.8			(27)
Windows Type 2			1.96	x1/[1/(1.2)+ 0.04]		=	2.24			(27)
Windows Type 3			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Walls Type1	10.07	3.5	6.57	x	0.13	=	0.85			(29)
Walls Type2	12.98	2.95	10.03	x	0.13	=	1.3			(29)
Walls Type3	1.87	0	1.87	x	0.13	=	0.24			(29)
Walls Type4	2.9	0	2.9	x	0.13	=	0.38			(29)
Roof	25	0	25	x	0.1	=	2.5			(30)
Total area of elements, m²			52.82							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 12.16 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 225 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 7.92 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

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Total fabric heat loss (33) + (36) = 20.08 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	7.17	7.09	7.01	6.61	6.53	6.13	6.13	6.05	6.29	6.53	6.69	6.85	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	27.25	27.17	27.09	26.69	26.61	26.22	26.22	26.14	26.37	26.61	26.77	26.93	

Average = $Sum(39)_{1...12}$ /12= 26.67 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.09	1.09	1.08	1.07	1.06	1.05	1.05	1.05	1.05	1.06	1.07	1.08	

Average = $Sum(40)_{1...12}$ /12= 1.07 (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 1.09 (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 60.05 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	66.06	63.66	61.25	58.85	56.45	54.05	54.05	56.45	58.85	61.25	63.66	66.06

Total = $Sum(44)_{1...12}$ = 720.62 (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=	97.96	85.68	88.41	77.08	73.96	63.82	59.14	67.86	68.67	80.03	87.36	94.87

Total = $Sum(45)_{1...12}$ = 944.85 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	14.69	12.85	13.26	11.56	11.09	9.57	8.87	10.18	10.3	12	13.1	14.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	153.24	135.6	143.69	130.57	129.24	117.31	114.42	123.14	122.17	135.31	140.86	150.15	(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=	153.24	135.6	143.69	130.57	129.24	117.31	114.42	123.14	122.17	135.31	140.86	150.15	

Output from water heater (annual)$_{1...12}$ — 1595.69 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	76.79	68.43	73.62	68.42	68.81	64.02	63.89	66.79	65.63	70.83	71.84	75.77	(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=	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	8.58	7.62	6.2	4.69	3.51	2.96	3.2	4.16	5.58	7.09	8.27	8.82	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	86.3	87.2	84.94	80.14	74.07	68.37	64.56	63.67	65.93	70.73	76.8	82.5	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	(71)

Water heating gains (Table 5)

(72)m=	103.22	101.83	98.95	95.03	92.49	88.91	85.87	89.77	91.15	95.2	99.78	101.84	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	237.43	235.98	229.42	219.19	209.4	199.57	192.96	196.92	201.99	212.35	224.18	232.48	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	1.96	x	19.64	x	0.4	x	0.7	=	7.47	(76)
East	0.9x	0.77	x	1.96	x	38.42	x	0.4	x	0.7	=	14.61	(76)
East	0.9x	0.77	x	1.96	x	63.27	x	0.4	x	0.7	=	24.06	(76)
East	0.9x	0.77	x	1.96	x	92.28	x	0.4	x	0.7	=	35.1	(76)
East	0.9x	0.77	x	1.96	x	113.09	x	0.4	x	0.7	=	43.01	(76)
East	0.9x	0.77	x	1.96	x	115.77	x	0.4	x	0.7	=	44.03	(76)
East	0.9x	0.77	x	1.96	x	110.22	x	0.4	x	0.7	=	41.92	(76)
East	0.9x	0.77	x	1.96	x	94.68	x	0.4	x	0.7	=	36.01	(76)
East	0.9x	0.77	x	1.96	x	73.59	x	0.4	x	0.7	=	27.99	(76)
East	0.9x	0.77	x	1.96	x	45.59	x	0.4	x	0.7	=	17.34	(76)
East	0.9x	0.77	x	1.96	x	24.49	x	0.4	x	0.7	=	9.31	(76)
East	0.9x	0.77	x	1.96	x	16.15	x	0.4	x	0.7	=	6.14	(76)
West	0.9x	0.77	x	0.7	x	19.64	x	0.4	x	0.7	=	2.67	(80)
West	0.9x	0.77	x	0.32	x	19.64	x	0.4	x	0.7	=	1.22	(80)
West	0.9x	0.77	x	0.7	x	38.42	x	0.4	x	0.7	=	5.22	(80)
West	0.9x	0.77	x	0.32	x	38.42	x	0.4	x	0.7	=	2.39	(80)
West	0.9x	0.77	x	0.7	x	63.27	x	0.4	x	0.7	=	8.59	(80)
West	0.9x	0.77	x	0.32	x	63.27	x	0.4	x	0.7	=	3.93	(80)
West	0.9x	0.77	x	0.7	x	92.28	x	0.4	x	0.7	=	12.53	(80)
West	0.9x	0.77	x	0.32	x	92.28	x	0.4	x	0.7	=	5.73	(80)
West	0.9x	0.77	x	0.7	x	113.09	x	0.4	x	0.7	=	15.36	(80)
West	0.9x	0.77	x	0.32	x	113.09	x	0.4	x	0.7	=	7.02	(80)
West	0.9x	0.77	x	0.7	x	115.77	x	0.4	x	0.7	=	15.72	(80)
West	0.9x	0.77	x	0.32	x	115.77	x	0.4	x	0.7	=	7.19	(80)
West	0.9x	0.77	x	0.7	x	110.22	x	0.4	x	0.7	=	14.97	(80)
West	0.9x	0.77	x	0.32	x	110.22	x	0.4	x	0.7	=	6.84	(80)
West	0.9x	0.77	x	0.7	x	94.68	x	0.4	x	0.7	=	12.86	(80)
West	0.9x	0.77	x	0.32	x	94.68	x	0.4	x	0.7	=	5.88	(80)
West	0.9x	0.77	x	0.7	x	73.59	x	0.4	x	0.7	=	10	(80)
West	0.9x	0.77	x	0.32	x	73.59	x	0.4	x	0.7	=	4.57	(80)
West	0.9x	0.77	x	0.7	x	45.59	x	0.4	x	0.7	=	6.19	(80)
West	0.9x	0.77	x	0.32	x	45.59	x	0.4	x	0.7	=	2.83	(80)
West	0.9x	0.77	x	0.7	x	24.49	x	0.4	x	0.7	=	3.33	(80)
West	0.9x	0.77	x	0.32	x	24.49	x	0.4	x	0.7	=	1.52	(80)
West	0.9x	0.77	x	0.7	x	16.15	x	0.4	x	0.7	=	2.19	(80)
West	0.9x	0.77	x	0.32	x	16.15	x	0.4	x	0.7	=	1	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	11.36	22.22	36.59	53.36	65.39	66.94	63.73	54.75	42.55	26.36	14.16	9.34	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	248.78	258.19	266	272.55	274.79	266.51	256.69	251.67	244.54	238.71	238.34	241.81	(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=	0.9	0.89	0.85	0.79	0.69	0.55	0.42	0.44	0.62	0.78	0.87	0.91	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.31	19.47	19.79	20.21	20.58	20.84	20.95	20.94	20.77	20.34	19.79	19.29	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.45	20.46	20.46	20.47	20.47	20.48	20.48	20.48	20.47	20.47	20.46	20.46	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.89	0.88	0.84	0.78	0.67	0.52	0.38	0.4	0.59	0.77	0.86	0.9	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.87	19.02	19.33	19.75	20.11	20.35	20.44	20.43	20.29	19.88	19.34	18.85	(90)

fLA = Living area ÷ (4) = | 0.84 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.24	19.4	19.72	20.14	20.51	20.77	20.87	20.86	20.7	20.27	19.72	19.22	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.24	19.4	19.72	20.14	20.51	20.77	20.87	20.86	20.7	20.27	19.72	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=	0.88	0.86	0.83	0.77	0.67	0.54	0.41	0.43	0.6	0.76	0.84	0.88	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	218.25	222.32	220.22	208.85	184.65	142.87	105.23	108.67	146.76	181.29	201.1	213.65	(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=	407.24	394.09	358.04	299.99	234.37	161.71	111.86	116.5	174	257.32	337.79	404.53	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	140.61	115.42	102.54	65.62	36.99	0	0	0	0	56.57	98.41	142.02	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 758.17 | (98)

Space heating requirement in kWh/m²/year | 30.33 | (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) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(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)														
	140.61	115.42	102.54	65.62	36.99	0	0	0	0	56.57	98.41	142.02		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	140.61	115.42	102.54	65.62	36.99	0	0	0	0	56.57	98.41	142.02		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													758.17	(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

Water heating from separate community system:

Annual water heating requirement		1595.69	(64)
Fraction of heat from community CHP		1	(303a)
Factor for charging method for community water heating		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.1	(306)
Water heat from CHP	(64) x (303a) x (305) x (306) =	1755.26	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	17.55	(313)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			758.17	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		98.96		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		98.96	(231)
Electricity for lighting			151.5	(232)
Electricity generated by PVs			-645.46	(233)

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	0.519	=	393.49	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)

Water heating from community system

	Energy kWh/year	**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel			329	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	276.89	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	9.11	(372)
Total CO2 associated with community systems	(363)…(366) + (368)…(372)		=	286	(373)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	51.36	(267)

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Electricity for lighting	(232) x	0.519	=	78.63	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-335	(269)
Total CO2, kg/year	sum of (265)…(271) =			474.48	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			18.98	(273)
EI rating (section 14)				91	(274)

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User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type D - ASHP + PV

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	25	(1a) x	3.09	(2a) =	77.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	25	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	77.25	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =	0.26	(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		5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.51	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.51	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.65	0.64	0.62	0.56	0.55	0.48	0.48	0.47	0.51	0.55	0.57	0.6

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0.71	0.7	0.69	0.66	0.65	0.62	0.62	0.61	0.63	0.65	0.66	0.68	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.71	0.7	0.69	0.66	0.65	0.62	0.62	0.61	0.63	0.65	0.66	0.68	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.35	x	1	=	0.35			(26)
Doors Type 3			0.99	x	1	=	0.99			(26)
Windows Type 1			0.65	x1/[1/(1.4)+ 0.04]		=	0.86			(27)
Windows Type 2			1.83	x1/[1/(1.4)+ 0.04]		=	2.43			(27)
Windows Type 3			0.3	x1/[1/(1.4)+ 0.04]		=	0.4			(27)
Walls Type1	10.07	3.43	6.64	x	0.18	=	1.2			(29)
Walls Type2	12.98	2.82	10.16	x	0.18	=	1.83			(29)
Walls Type3	1.87	0	1.87	x	0.18	=	0.34			(29)
Walls Type4	2.9	0	2.9	x	0.18	=	0.52			(29)
Roof	25	0	25	x	0.13	=	3.25			(30)
Total area of elements, m²			52.82							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 14.29 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 225 (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 2.64 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

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Total fabric heat loss (33) + (36) = 16.93 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	18.11	17.9	17.7	16.74	16.56	15.73	15.73	15.57	16.05	16.56	16.92	17.3	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	35.04	34.83	34.63	33.67	33.49	32.66	32.66	32.5	32.98	33.49	33.85	34.23	

Average = $Sum(39)_{1...12}$ /12= 33.67 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.4	1.39	1.39	1.35	1.34	1.31	1.31	1.3	1.32	1.34	1.35	1.37	

Average = $Sum(40)_{1...12}$ /12= 1.35 (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 1.09 (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 60.05 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	66.06	63.66	61.25	58.85	56.45	54.05	54.05	56.45	58.85	61.25	63.66	66.06	

Total = $Sum(44)_{1...12}$ = 720.62 (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=	97.96	85.68	88.41	77.08	73.96	63.82	59.14	67.86	68.67	80.03	87.36	94.87	

Total = $Sum(45)_{1...12}$ = 944.85 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	14.69	12.85	13.26	11.56	11.09	9.57	8.87	10.18	10.3	12	13.1	14.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (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): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	144.56	127.76	135.01	122.17	120.55	108.91	105.73	114.46	113.77	126.63	132.45	141.46	(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=	144.56	127.76	135.01	122.17	120.55	108.91	105.73	114.46	113.77	126.63	132.45	141.46

Output from water heater (annual)$_{1...12}$ — 1493.47 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	69.85	62.16	66.67	61.7	61.87	57.29	56.94	59.84	58.91	63.89	65.12	68.82	(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=	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	54.43	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	8.68	7.71	6.27	4.75	3.55	3	3.24	4.21	5.65	7.17	8.37	8.93	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	86.3	87.2	84.94	80.14	74.07	68.37	64.56	63.67	65.93	70.73	76.8	82.5	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	28.44	(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=	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	-43.54	(71)

Water heating gains (Table 5)

(72)m=	93.88	92.49	89.61	85.7	83.16	79.58	76.53	80.43	81.82	85.87	90.45	92.5	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	231.2	229.73	223.16	212.91	203.11	193.27	186.66	190.64	195.72	206.1	217.94	226.25	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	1.83	x	19.64	x	0.63	x	0.7	=	10.98	(76)
East	0.9x	0.77	x	1.83	x	38.42	x	0.63	x	0.7	=	21.49	(76)
East	0.9x	0.77	x	1.83	x	63.27	x	0.63	x	0.7	=	35.39	(76)
East	0.9x	0.77	x	1.83	x	92.28	x	0.63	x	0.7	=	51.61	(76)
East	0.9x	0.77	x	1.83	x	113.09	x	0.63	x	0.7	=	63.25	(76)
East	0.9x	0.77	x	1.83	x	115.77	x	0.63	x	0.7	=	64.75	(76)
East	0.9x	0.77	x	1.83	x	110.22	x	0.63	x	0.7	=	61.64	(76)
East	0.9x	0.77	x	1.83	x	94.68	x	0.63	x	0.7	=	52.95	(76)
East	0.9x	0.77	x	1.83	x	73.59	x	0.63	x	0.7	=	41.16	(76)
East	0.9x	0.77	x	1.83	x	45.59	x	0.63	x	0.7	=	25.5	(76)
East	0.9x	0.77	x	1.83	x	24.49	x	0.63	x	0.7	=	13.7	(76)
East	0.9x	0.77	x	1.83	x	16.15	x	0.63	x	0.7	=	9.03	(76)
West	0.9x	0.77	x	0.65	x	19.64	x	0.63	x	0.7	=	3.9	(80)
West	0.9x	0.77	x	0.3	x	19.64	x	0.63	x	0.7	=	1.8	(80)
West	0.9x	0.77	x	0.65	x	38.42	x	0.63	x	0.7	=	7.63	(80)
West	0.9x	0.77	x	0.3	x	38.42	x	0.63	x	0.7	=	3.52	(80)
West	0.9x	0.77	x	0.65	x	63.27	x	0.63	x	0.7	=	12.57	(80)
West	0.9x	0.77	x	0.3	x	63.27	x	0.63	x	0.7	=	5.8	(80)
West	0.9x	0.77	x	0.65	x	92.28	x	0.63	x	0.7	=	18.33	(80)
West	0.9x	0.77	x	0.3	x	92.28	x	0.63	x	0.7	=	8.46	(80)
West	0.9x	0.77	x	0.65	x	113.09	x	0.63	x	0.7	=	22.47	(80)
West	0.9x	0.77	x	0.3	x	113.09	x	0.63	x	0.7	=	10.37	(80)
West	0.9x	0.77	x	0.65	x	115.77	x	0.63	x	0.7	=	23	(80)
West	0.9x	0.77	x	0.3	x	115.77	x	0.63	x	0.7	=	10.61	(80)
West	0.9x	0.77	x	0.65	x	110.22	x	0.63	x	0.7	=	21.89	(80)
West	0.9x	0.77	x	0.3	x	110.22	x	0.63	x	0.7	=	10.11	(80)
West	0.9x	0.77	x	0.65	x	94.68	x	0.63	x	0.7	=	18.81	(80)
West	0.9x	0.77	x	0.3	x	94.68	x	0.63	x	0.7	=	8.68	(80)
West	0.9x	0.77	x	0.65	x	73.59	x	0.63	x	0.7	=	14.62	(80)
West	0.9x	0.77	x	0.3	x	73.59	x	0.63	x	0.7	=	6.75	(80)
West	0.9x	0.77	x	0.65	x	45.59	x	0.63	x	0.7	=	9.06	(80)
West	0.9x	0.77	x	0.3	x	45.59	x	0.63	x	0.7	=	4.18	(80)
West	0.9x	0.77	x	0.65	x	24.49	x	0.63	x	0.7	=	4.86	(80)
West	0.9x	0.77	x	0.3	x	24.49	x	0.63	x	0.7	=	2.25	(80)
West	0.9x	0.77	x	0.65	x	16.15	x	0.63	x	0.7	=	3.21	(80)
West	0.9x	0.77	x	0.3	x	16.15	x	0.63	x	0.7	=	1.48	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	16.69	32.64	53.76	78.4	96.08	98.36	93.64	80.44	62.52	38.73	20.81	13.72	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	247.88	262.38	276.91	291.31	299.19	291.63	280.3	271.07	258.24	244.83	238.75	239.97	(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	0.66	0.5	0.53	0.76	0.93	0.97	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.78	19.91	20.15	20.5	20.77	20.94	20.99	20.98	20.89	20.56	20.14	19.78	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.3	20.3	20.31	20.33	20.33	20.35	20.35	20.35	20.34	20.33	20.32	20.32	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.98	0.96	0.91	0.8	0.61	0.43	0.47	0.72	0.91	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.16	19.29	19.54	19.89	20.15	20.31	20.34	20.34	20.26	19.96	19.54	19.18	(90)

fLA = Living area ÷ (4) = | 0.84 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.68	19.81	20.06	20.4	20.68	20.84	20.89	20.88	20.79	20.47	20.05	19.68	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.68	19.81	20.06	20.4	20.68	20.84	20.89	20.88	20.79	20.47	20.05	19.68	(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	0.96	0.91	0.82	0.65	0.49	0.52	0.75	0.92	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	243.07	255.41	264.71	265.41	244.94	189.93	136.93	141.6	193.4	224.12	231.04	235.83	(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=	538.94	519.44	469.51	387.33	300.64	203.93	139.98	145.7	220.67	330.43	438.25	530.09	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	220.13	177.43	152.37	87.78	41.44	0	0	0	0	79.09	149.19	218.93	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 1126.36 | (98)

Space heating requirement in kWh/m²/year | 45.05 | (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	220.13	177.43	152.37	87.78	41.44	0	0	0	0	79.09	149.19	218.93		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	235.43	189.76	162.96	93.88	44.32	0	0	0	0	84.59	159.57	234.15		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1204.66	(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

Water heating from separate community system:			
Annual water heating requirement		1493.47	(64)
Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1204.66	
Water heating fuel used		1794.5	
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		153.37	(232)

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	=	260.21	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	387.61	(264)
Space and water heating	(261) + (262) + (263) + (264) =			647.82	(265)
Water heating from community system					

	Energy kWh/year	**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Electrical energy for heat distribution	[(313) x	0	=	0	(372)
Total CO2 associated with community systems	(363)…(366) + (368)…(372)		=	0	(373)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	79.6	(268)
Total CO2, kg/year	sum of (265)…(271) =			766.34	(272)

TER = 44.91 (273)

SAP Input

Property Details: Flat Type E - ASHP + PV

Address:	
Located in:	Wales
Region:	Thames valley
UPRN:	
Date of assessment:	07 November 2019
Date of certificate:	12 May 2020
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Low
Water use <= 125 litres/person/day:	True
PCDF Version:	460

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2020	
Floor Location:	Floor area:	Storey height:
Floor 0	49.68 m²	3.09 m
Living area:	24.05 m² (fraction 0.484)	
Front of dwelling faces:	South	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D9_01	Manufacturer	Solid			
Vent_09_01	Manufacturer	Solid			
Vent_09_09	Manufacturer	Solid			
Vent_09_04	Manufacturer	Solid			
Vent_09_10	Manufacturer	Solid			
Window_09_02	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_09_03	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_09_05	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_09_11	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_09_07	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Window_09_08	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Fanlight	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
D9_01	mm	0	0	1	2.13	1
Vent_09_01	mm	0	0	1	0.7	1
Vent_09_09	mm	0	0	1	0.96	1
Vent_09_04	mm	0	0	1	0.7	1
Vent_09_10	mm	0	0	1	0.7	1
Window_09_02	6mm	0.7	0.4	1.2	1.1	1
Window_09_03	6mm	0.7	0.4	1.2	0.19	1
Window_09_05	6mm	0.7	0.4	1.2	2.01	1
Window_09_11	6mm	0.7	0.4	1.2	1.46	1
Window_09_07	6mm	0.7	0.4	1.2	1.46	1
Window_09_08	6mm	0.7	0.4	1.2	0.99	1
Fanlight	6mm	0.7	0.4	1.2	0.32	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D9_01		9_01	South	0	0
Vent_09_01		9_01	South	0.58	1.2

SAP Input

Vent_09_09	9_09	East	0.58	1.65
Vent_09_04	9_06	North	1.2	0.58
Vent_09_10	9_07	North	0.58	1.2
Window_09_02	9_01	South	0.92	1.2
Window_09_03	9_01	South	0	0
Window_09_05	9_06	North	1.22	1.65
Window_09_11	9_07	North	1.22	1.2
Window_09_07	9_08	North	1.22	1.2
Window_09_08	9_09	East	0.6	1.65
Fanlight	9_01	South	1.01	0.315

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
9_01	12.36	4.44	7.92	0.13	0	False	N/A
9_02	5.871	0	5.87	0.13	0	False	N/A
9_03	5.84	0	5.84	0.13	0	False	N/A
9_04	2.812	0	2.81	0.13	0	False	N/A
9_06	8.498	2.71	5.79	0.13	0	False	N/A
9_07	8.019	2.16	5.86	0.13	0	False	N/A
9_08	10.521	1.46	9.06	0.13	0	False	N/A
9_09	19.467	1.95	17.52	0.13	0	False	N/A
R9_01	49.68	0	49.68	0.1	0		N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test: Yes (As designed)

Ventilation: Balanced with heat recovery
Number of wet rooms: Kitchen + 2
Ductwork: Insulation, rigid
Approved Installation Scheme: False

Number of chimneys: 0
Number of open flues: 0
Number of fans: 0
Number of passive stacks: 0
Number of sides sheltered: 0
Pressure test: 2.5

Main heating system:

Main heating system: Electric underfloor heating
Standard tariff
Fuel: Electricity
Info Source: SAP Tables
SAP Table: 425
In timber floor, or immediately below floor covering
Underfloor heating, pipes in insulated timber floor
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Room-sealed
Boiler interlock: Yes

Main heating Control:

SAP Input

Main heating Control:	Programmer and room thermostat Control code: 2704
Secondary heating system:	
Secondary heating system:	None
Water heating:	
Water heating:	952 From DHW-only community scheme Heat source: From hot-water only community scheme - heat pump heat from electric heat pump, heat fraction 1, efficiency 329 Piping>=1991, pre-insulated, low temp, variable flow No hot water cylinder Solar panel: False
Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Yes
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.868 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South West Photovoltaic 2 Installed Peak power: 0.347 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South Photovoltaic 3 Installed Peak power: 0.326 Tilt of collector: 30° Overshading: None or very little Collector Orientation: East
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type E - ASHP + PV

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.68	(1a)	x	3.09	(2a)	=	153.51	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.68	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	153.51	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.95 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.25	0.26	0.26	0.27	0.28	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.25	0.26	0.26	0.27	0.28	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.7	x	1	=	0.7			(26)
Doors Type 3			0.96	x	1	=	0.96			(26)
Doors Type 4			0.7	x	1	=	0.7			(26)
Doors Type 5			0.7	x	1	=	0.7			(26)
Windows Type 1			1.1	x1/[1/(1.2)+ 0.04]		=	1.26			(27)
Windows Type 2			0.19	x1/[1/(1.2)+ 0.04]		=	0.22			(27)
Windows Type 3			2.01	x1/[1/(1.2)+ 0.04]		=	2.3			(27)
Windows Type 4			1.46	x1/[1/(1.2)+ 0.04]		=	1.67			(27)
Windows Type 5			1.46	x1/[1/(1.2)+ 0.04]		=	1.67			(27)
Windows Type 6			0.99	x1/[1/(1.2)+ 0.04]		=	1.13			(27)
Windows Type 7			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Walls Type1	12.36	4.44	7.92	x	0.13	=	1.03			(29)
Walls Type2	5.87	0	5.87	x	0.13	=	0.76			(29)
Walls Type3	5.84	0	5.84	x	0.13	=	0.76			(29)
Walls Type4	2.81	0	2.81	x	0.13	=	0.37			(29)
Walls Type5	8.5	2.71	5.79	x	0.13	=	0.75			(29)
Walls Type6	8.02	2.16	5.86	x	0.13	=	0.76			(29)
Walls Type7	10.52	1.46	9.06	x	0.13	=	1.18			(29)

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Walls Type8	19.47	1.95	17.52	x	0.13	=	2.28				(29)
Roof	49.68	0	49.68	x	0.1	=	4.97				(30)
Total area of elements, m²			123.07								(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	26.67	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	447.12	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Low	100	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		18.46	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	45.13	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	14.67	14.51	14.36	13.56	13.41	12.61	12.61	12.46	12.93	13.41	13.72	14.04	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	59.8	59.64	59.48	58.69	58.53	57.74	57.74	57.58	58.06	58.53	58.85	59.17	

Average = $Sum(39)_{1…12}$ /12= 58.65 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.2	1.2	1.2	1.18	1.18	1.16	1.16	1.16	1.17	1.18	1.18	1.19	

Average = $Sum(40)_{1…12}$ /12= 1.18 (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 1.68 (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 74.12 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	81.53	78.56	75.6	72.63	69.67	66.7	66.7	69.67	72.63	75.6	78.56	81.53	

Total = $Sum(44)_{1…12}$ = 889.39 (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=	120.9	105.74	109.12	95.13	91.28	78.77	72.99	83.76	84.76	98.78	107.82	117.09	

Total = $Sum(45)_{1…12}$ = 1166.14 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.14	15.86	16.37	14.27	13.69	11.82	10.95	12.56	12.71	14.82	16.17	17.56	(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)

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Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	110	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02	(51)
If community heating see section 4.3			
Volume factor from Table 2a		1.03	(52)
Temperature factor from Table 2b		0.6	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)		1.03	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	176.18	155.67	164.39	148.62	146.56	132.26	128.27	139.03	138.25	154.05	161.32	172.37	(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=	176.18	155.67	164.39	148.62	146.56	132.26	128.27	139.03	138.25	154.05	161.32	172.37

Output from water heater (annual)$_{1...12}$ — 1816.98 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.42	75.1	80.5	74.43	74.57	68.99	68.49	72.07	70.98	77.06	78.65	83.15	(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=	100.84	100.84	100.84	100.84	100.84	100.84	100.84	100.84	100.84	100.84	100.84	100.84	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	34.46	30.6	24.89	18.84	14.08	11.89	12.85	16.7	22.42	28.46	33.22	35.41	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	218.51	220.78	215.07	202.9	187.55	173.11	163.47	161.21	166.92	179.08	194.44	208.87	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	46.76	46.76	46.76	46.76	46.76	46.76	46.76	46.76	46.76	46.76	46.76	46.76	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	(71)

Water heating gains (Table 5)

(72)m=	113.47	111.76	108.2	103.37	100.23	95.81	92.06	96.87	98.58	103.58	109.23	111.77	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	446.82	443.52	428.54	405.49	382.24	361.2	348.76	355.15	368.29	391.51	417.27	436.43	(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)	
North	0.9x	0.77	x	2.01	x	10.63	x	0.4	x	0.7	=	4.15	(74)
North	0.9x	0.77	x	1.46	x	10.63	x	0.4	x	0.7	=	3.01	(74)
North	0.9x	0.77	x	1.46	x	10.63	x	0.4	x	0.7	=	3.01	(74)
North	0.9x	0.77	x	2.01	x	20.32	x	0.4	x	0.7	=	7.93	(74)
North	0.9x	0.77	x	1.46	x	20.32	x	0.4	x	0.7	=	5.76	(74)
North	0.9x	0.77	x	1.46	x	20.32	x	0.4	x	0.7	=	5.76	(74)
North	0.9x	0.77	x	2.01	x	34.53	x	0.4	x	0.7	=	13.47	(74)
North	0.9x	0.77	x	1.46	x	34.53	x	0.4	x	0.7	=	9.78	(74)
North	0.9x	0.77	x	1.46	x	34.53	x	0.4	x	0.7	=	9.78	(74)
North	0.9x	0.77	x	2.01	x	55.46	x	0.4	x	0.7	=	21.63	(74)
North	0.9x	0.77	x	1.46	x	55.46	x	0.4	x	0.7	=	15.71	(74)
North	0.9x	0.77	x	1.46	x	55.46	x	0.4	x	0.7	=	15.71	(74)
North	0.9x	0.77	x	2.01	x	74.72	x	0.4	x	0.7	=	29.14	(74)
North	0.9x	0.77	x	1.46	x	74.72	x	0.4	x	0.7	=	21.17	(74)
North	0.9x	0.77	x	1.46	x	74.72	x	0.4	x	0.7	=	21.17	(74)
North	0.9x	0.77	x	2.01	x	79.99	x	0.4	x	0.7	=	31.2	(74)
North	0.9x	0.77	x	1.46	x	79.99	x	0.4	x	0.7	=	22.66	(74)
North	0.9x	0.77	x	1.46	x	79.99	x	0.4	x	0.7	=	22.66	(74)
North	0.9x	0.77	x	2.01	x	74.68	x	0.4	x	0.7	=	29.13	(74)
North	0.9x	0.77	x	1.46	x	74.68	x	0.4	x	0.7	=	21.16	(74)
North	0.9x	0.77	x	1.46	x	74.68	x	0.4	x	0.7	=	21.16	(74)
North	0.9x	0.77	x	2.01	x	59.25	x	0.4	x	0.7	=	23.11	(74)
North	0.9x	0.77	x	1.46	x	59.25	x	0.4	x	0.7	=	16.78	(74)
North	0.9x	0.77	x	1.46	x	59.25	x	0.4	x	0.7	=	16.78	(74)
North	0.9x	0.77	x	2.01	x	41.52	x	0.4	x	0.7	=	16.19	(74)
North	0.9x	0.77	x	1.46	x	41.52	x	0.4	x	0.7	=	11.76	(74)
North	0.9x	0.77	x	1.46	x	41.52	x	0.4	x	0.7	=	11.76	(74)
North	0.9x	0.77	x	2.01	x	24.19	x	0.4	x	0.7	=	9.43	(74)
North	0.9x	0.77	x	1.46	x	24.19	x	0.4	x	0.7	=	6.85	(74)
North	0.9x	0.77	x	1.46	x	24.19	x	0.4	x	0.7	=	6.85	(74)

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North	0.9x	0.77	x	2.01	x	13.12	x	0.4	x	0.7	=	5.12	(74)
North	0.9x	0.77	x	1.46	x	13.12	x	0.4	x	0.7	=	3.72	(74)
North	0.9x	0.77	x	1.46	x	13.12	x	0.4	x	0.7	=	3.72	(74)
North	0.9x	0.77	x	2.01	x	8.86	x	0.4	x	0.7	=	3.46	(74)
North	0.9x	0.77	x	1.46	x	8.86	x	0.4	x	0.7	=	2.51	(74)
North	0.9x	0.77	x	1.46	x	8.86	x	0.4	x	0.7	=	2.51	(74)
East	0.9x	0.77	x	0.99	x	19.64	x	0.4	x	0.7	=	3.77	(76)
East	0.9x	0.77	x	0.99	x	38.42	x	0.4	x	0.7	=	7.38	(76)
East	0.9x	0.77	x	0.99	x	63.27	x	0.4	x	0.7	=	12.15	(76)
East	0.9x	0.77	x	0.99	x	92.28	x	0.4	x	0.7	=	17.73	(76)
East	0.9x	0.77	x	0.99	x	113.09	x	0.4	x	0.7	=	21.73	(76)
East	0.9x	0.77	x	0.99	x	115.77	x	0.4	x	0.7	=	22.24	(76)
East	0.9x	0.77	x	0.99	x	110.22	x	0.4	x	0.7	=	21.17	(76)
East	0.9x	0.77	x	0.99	x	94.68	x	0.4	x	0.7	=	18.19	(76)
East	0.9x	0.77	x	0.99	x	73.59	x	0.4	x	0.7	=	14.14	(76)
East	0.9x	0.77	x	0.99	x	45.59	x	0.4	x	0.7	=	8.76	(76)
East	0.9x	0.77	x	0.99	x	24.49	x	0.4	x	0.7	=	4.7	(76)
East	0.9x	0.77	x	0.99	x	16.15	x	0.4	x	0.7	=	3.1	(76)
South	0.9x	0.77	x	1.1	x	46.75	x	0.4	x	0.7	=	9.98	(78)
South	0.9x	0.77	x	0.19	x	46.75	x	0.4	x	0.7	=	1.72	(78)
South	0.9x	0.77	x	0.32	x	46.75	x	0.4	x	0.7	=	2.9	(78)
South	0.9x	0.77	x	1.1	x	76.57	x	0.4	x	0.7	=	16.34	(78)
South	0.9x	0.77	x	0.19	x	76.57	x	0.4	x	0.7	=	2.82	(78)
South	0.9x	0.77	x	0.32	x	76.57	x	0.4	x	0.7	=	4.75	(78)
South	0.9x	0.77	x	1.1	x	97.53	x	0.4	x	0.7	=	20.82	(78)
South	0.9x	0.77	x	0.19	x	97.53	x	0.4	x	0.7	=	3.6	(78)
South	0.9x	0.77	x	0.32	x	97.53	x	0.4	x	0.7	=	6.06	(78)
South	0.9x	0.77	x	1.1	x	110.23	x	0.4	x	0.7	=	23.53	(78)
South	0.9x	0.77	x	0.19	x	110.23	x	0.4	x	0.7	=	4.06	(78)
South	0.9x	0.77	x	0.32	x	110.23	x	0.4	x	0.7	=	6.84	(78)
South	0.9x	0.77	x	1.1	x	114.87	x	0.4	x	0.7	=	24.52	(78)
South	0.9x	0.77	x	0.19	x	114.87	x	0.4	x	0.7	=	4.24	(78)
South	0.9x	0.77	x	0.32	x	114.87	x	0.4	x	0.7	=	7.13	(78)
South	0.9x	0.77	x	1.1	x	110.55	x	0.4	x	0.7	=	23.6	(78)
South	0.9x	0.77	x	0.19	x	110.55	x	0.4	x	0.7	=	4.08	(78)
South	0.9x	0.77	x	0.32	x	110.55	x	0.4	x	0.7	=	6.86	(78)
South	0.9x	0.77	x	1.1	x	108.01	x	0.4	x	0.7	=	23.05	(78)
South	0.9x	0.77	x	0.19	x	108.01	x	0.4	x	0.7	=	3.98	(78)
South	0.9x	0.77	x	0.32	x	108.01	x	0.4	x	0.7	=	6.71	(78)
South	0.9x	0.77	x	1.1	x	104.89	x	0.4	x	0.7	=	22.39	(78)
South	0.9x	0.77	x	0.19	x	104.89	x	0.4	x	0.7	=	3.87	(78)

South	0.9x	0.77	x	0.32	x	104.89	x	0.4	x	0.7	=	6.51	(78)
South	0.9x	0.77	x	1.1	x	101.89	x	0.4	x	0.7	=	21.75	(78)
South	0.9x	0.77	x	0.19	x	101.89	x	0.4	x	0.7	=	3.76	(78)
South	0.9x	0.77	x	0.32	x	101.89	x	0.4	x	0.7	=	6.33	(78)
South	0.9x	0.77	x	1.1	x	82.59	x	0.4	x	0.7	=	17.63	(78)
South	0.9x	0.77	x	0.19	x	82.59	x	0.4	x	0.7	=	3.04	(78)
South	0.9x	0.77	x	0.32	x	82.59	x	0.4	x	0.7	=	5.13	(78)
South	0.9x	0.77	x	1.1	x	55.42	x	0.4	x	0.7	=	11.83	(78)
South	0.9x	0.77	x	0.19	x	55.42	x	0.4	x	0.7	=	2.04	(78)
South	0.9x	0.77	x	0.32	x	55.42	x	0.4	x	0.7	=	3.44	(78)
South	0.9x	0.77	x	1.1	x	40.4	x	0.4	x	0.7	=	8.62	(78)
South	0.9x	0.77	x	0.19	x	40.4	x	0.4	x	0.7	=	1.49	(78)
South	0.9x	0.77	x	0.32	x	40.4	x	0.4	x	0.7	=	2.51	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	28.55	50.74	75.66	105.22	129.09	133.29	126.35	107.63	85.68	57.7	34.57	24.2	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	475.37	494.26	504.19	510.71	511.33	494.49	475.11	462.79	453.97	449.2	451.83	460.63	(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=	0.91	0.9	0.88	0.83	0.74	0.61	0.48	0.51	0.67	0.82	0.89	0.92	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.01	19.18	19.51	19.97	20.41	20.76	20.91	20.89	20.66	20.14	19.52	18.98	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.4	20.4	20.4	20.41	20.41	20.42	20.42	20.42	20.42	20.41	20.41	20.4	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.91	0.89	0.87	0.81	0.72	0.57	0.43	0.46	0.64	0.8	0.88	0.91	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.52	18.69	19.02	19.48	19.9	20.23	20.36	20.35	20.14	19.65	19.04	18.5	(90)

fLA = Living area ÷ (4) = 0.48 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.76	18.93	19.26	19.72	20.15	20.49	20.62	20.61	20.4	19.89	19.27	18.73	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.76	18.93	19.26	19.72	20.15	20.49	20.62	20.61	20.4	19.89	19.27	18.73	(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=	0.89	0.87	0.85	0.79	0.71	0.58	0.45	0.47	0.64	0.78	0.86	0.89	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	422.07	431.48	426.16	404.95	362.01	285.55	212.2	218.54	290.21	352.53	388.33	411.91	(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=	864.59	836.71	758.87	635.01	494.63	339.85	232.3	242.37	365.5	543.62	716.26	859.67	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	329.24	272.31	247.54	165.64	98.67	0	0	0	0	142.17	236.11	333.13

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1824.81 (98)

Space heating requirement in kWh/m²/year 36.73 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(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)	329.24	272.31	247.54	165.64	98.67	0	0	0	0	142.17	236.11	333.13	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)	329.24	272.31	247.54	165.64	98.67	0	0	0	0	142.17	236.11	333.13	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1824.81 (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

Water heating from separate community system:

Annual water heating requirement		1816.98	(64)
Fraction of heat from community CHP		1	(303a)
Factor for charging method for community water heating		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Water heat from CHP	(64) x (303a) x (305) x (306) =	1907.83	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	19.08	(313)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1824.81	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		215		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		215	(231)
Electricity for lighting			243.4	(232)

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Electricity generated by PVs				-1251.11	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	240.69	(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 from CHP	(310a) x	4.24	x 0.01 =	80.89	(342a)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	28.36	(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 =	32.1	(250)
Additional standing charges (Table 12)				60	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-165.02	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			277.03	(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)		82.86	(258)

12a. CO_2 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	0.519	=	947.08	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating from community system					

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel			329	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	300.96	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	9.9	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	310.86	(373)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	111.59	(267)
Electricity for lighting	(232) x	0.519	=	126.33	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-649.33	(269)
Total CO2, kg/year	sum of (265)…(271) =			846.53	(272)

CO2 emissions per m²		(272) ÷ (4) =	17.04	(273)
EI rating (section 14)			88	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	3.07	=	5602.18	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Water heating from community system					

		Energy kWh/year	Primary factor		Emissions kWh/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				329	(367a)
Energy associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		3.07	=	1780.25	(367)
Electrical energy for heat distribution	[(313) x		2.92	=	55.71	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)			=	310.86	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		3.07	=	660.06	(267)
Electricity for lighting	(232) x		0	=	747.25	(268)
Energy saving/generation technologies						
Item 1			3.07	=	-3840.91	(269)
'Total Primary Energy	sum of (265)…(271) =				5004.53	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =				100.74	(273)

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User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type E - ASHP + PV

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.68	(1a)	x	3.09	(2a)	=	153.51	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.68	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	153.51	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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		2.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.12	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.95 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.25	0.26	0.26	0.27	0.28	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.25	0.26	0.26	0.27	0.28	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.7	x	1	=	0.7			(26)
Doors Type 3			0.96	x	1	=	0.96			(26)
Doors Type 4			0.7	x	1	=	0.7			(26)
Doors Type 5			0.7	x	1	=	0.7			(26)
Windows Type 1			1.1	x1/[1/(1.2)+ 0.04]		=	1.26			(27)
Windows Type 2			0.19	x1/[1/(1.2)+ 0.04]		=	0.22			(27)
Windows Type 3			2.01	x1/[1/(1.2)+ 0.04]		=	2.3			(27)
Windows Type 4			1.46	x1/[1/(1.2)+ 0.04]		=	1.67			(27)
Windows Type 5			1.46	x1/[1/(1.2)+ 0.04]		=	1.67			(27)
Windows Type 6			0.99	x1/[1/(1.2)+ 0.04]		=	1.13			(27)
Windows Type 7			0.32	x1/[1/(1.2)+ 0.04]		=	0.37			(27)
Walls Type1	12.36	4.44	7.92	x	0.13	=	1.03			(29)
Walls Type2	5.87	0	5.87	x	0.13	=	0.76			(29)
Walls Type3	5.84	0	5.84	x	0.13	=	0.76			(29)
Walls Type4	2.81	0	2.81	x	0.13	=	0.37			(29)
Walls Type5	8.5	2.71	5.79	x	0.13	=	0.75			(29)
Walls Type6	8.02	2.16	5.86	x	0.13	=	0.76			(29)
Walls Type7	10.52	1.46	9.06	x	0.13	=	1.18			(29)

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Walls Type8	19.47	1.95	17.52	x	0.13	=	2.28			(29)
Roof	49.68	0	49.68	x	0.1	=	4.97			(30)
Total area of elements, m²			123.07							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 26.67 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 447.12 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.46 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 45.13 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	14.67	14.51	14.36	13.56	13.41	12.61	12.61	12.46	12.93	13.41	13.72	14.04	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	59.8	59.64	59.48	58.69	58.53	57.74	57.74	57.58	58.06	58.53	58.85	59.17	

Average = Sum(39)$_{1…12}$ /12= 58.65 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.2	1.2	1.2	1.18	1.18	1.16	1.16	1.16	1.17	1.18	1.18	1.19	

Average = Sum(40)$_{1…12}$ /12= 1.18 (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 1.68 (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 74.12 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	81.53	78.56	75.6	72.63	69.67	66.7	66.7	69.67	72.63	75.6	78.56	81.53	
											Total = Sum(44)$_{1…12}$ =	889.39	(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=	120.9	105.74	109.12	95.13	91.28	78.77	72.99	83.76	84.76	98.78	107.82	117.09	
											Total = Sum(45)$_{1…12}$ =	1166.14	(45)
	If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)												
(46)m=	18.14	15.86	16.37	14.27	13.69	11.82	10.95	12.56	12.71	14.82	16.17	17.56	(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)

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Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	110	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02	(51)
If community heating see section 4.3			
Volume factor from Table 2a		1.03	(52)
Temperature factor from Table 2b		0.6	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)		1.03	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	176.18	155.67	164.39	148.62	146.56	132.26	128.27	139.03	138.25	154.05	161.32	172.37	(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=	176.18	155.67	164.39	148.62	146.56	132.26	128.27	139.03	138.25	154.05	161.32	172.37

Output from water heater (annual)$_{1...12}$ — 1816.98 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.42	75.1	80.5	74.43	74.57	68.99	68.49	72.07	70.98	77.06	78.65	83.15	(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=	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.78	12.24	9.96	7.54	5.63	4.76	5.14	6.68	8.97	11.39	13.29	14.17	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	146.4	147.92	144.09	135.94	125.66	115.99	109.53	108.01	111.84	119.99	130.27	139.94	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	(71)

Water heating gains (Table 5)

(72)m=	113.47	111.76	108.2	103.37	100.23	95.81	92.06	96.87	98.58	103.58	109.23	111.77	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	321.87	320.13	310.46	295.06	279.73	264.77	254.93	259.77	267.59	283.16	301	314.08	(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)	
North	0.9x	0.77	x	2.01	x	10.63	x	0.4	x	0.7	=	4.15	(74)
North	0.9x	0.77	x	1.46	x	10.63	x	0.4	x	0.7	=	3.01	(74)
North	0.9x	0.77	x	1.46	x	10.63	x	0.4	x	0.7	=	3.01	(74)
North	0.9x	0.77	x	2.01	x	20.32	x	0.4	x	0.7	=	7.93	(74)
North	0.9x	0.77	x	1.46	x	20.32	x	0.4	x	0.7	=	5.76	(74)
North	0.9x	0.77	x	1.46	x	20.32	x	0.4	x	0.7	=	5.76	(74)
North	0.9x	0.77	x	2.01	x	34.53	x	0.4	x	0.7	=	13.47	(74)
North	0.9x	0.77	x	1.46	x	34.53	x	0.4	x	0.7	=	9.78	(74)
North	0.9x	0.77	x	1.46	x	34.53	x	0.4	x	0.7	=	9.78	(74)
North	0.9x	0.77	x	2.01	x	55.46	x	0.4	x	0.7	=	21.63	(74)
North	0.9x	0.77	x	1.46	x	55.46	x	0.4	x	0.7	=	15.71	(74)
North	0.9x	0.77	x	1.46	x	55.46	x	0.4	x	0.7	=	15.71	(74)
North	0.9x	0.77	x	2.01	x	74.72	x	0.4	x	0.7	=	29.14	(74)
North	0.9x	0.77	x	1.46	x	74.72	x	0.4	x	0.7	=	21.17	(74)
North	0.9x	0.77	x	1.46	x	74.72	x	0.4	x	0.7	=	21.17	(74)
North	0.9x	0.77	x	2.01	x	79.99	x	0.4	x	0.7	=	31.2	(74)
North	0.9x	0.77	x	1.46	x	79.99	x	0.4	x	0.7	=	22.66	(74)
North	0.9x	0.77	x	1.46	x	79.99	x	0.4	x	0.7	=	22.66	(74)
North	0.9x	0.77	x	2.01	x	74.68	x	0.4	x	0.7	=	29.13	(74)
North	0.9x	0.77	x	1.46	x	74.68	x	0.4	x	0.7	=	21.16	(74)
North	0.9x	0.77	x	1.46	x	74.68	x	0.4	x	0.7	=	21.16	(74)
North	0.9x	0.77	x	2.01	x	59.25	x	0.4	x	0.7	=	23.11	(74)
North	0.9x	0.77	x	1.46	x	59.25	x	0.4	x	0.7	=	16.78	(74)
North	0.9x	0.77	x	1.46	x	59.25	x	0.4	x	0.7	=	16.78	(74)
North	0.9x	0.77	x	2.01	x	41.52	x	0.4	x	0.7	=	16.19	(74)
North	0.9x	0.77	x	1.46	x	41.52	x	0.4	x	0.7	=	11.76	(74)
North	0.9x	0.77	x	1.46	x	41.52	x	0.4	x	0.7	=	11.76	(74)
North	0.9x	0.77	x	2.01	x	24.19	x	0.4	x	0.7	=	9.43	(74)
North	0.9x	0.77	x	1.46	x	24.19	x	0.4	x	0.7	=	6.85	(74)
North	0.9x	0.77	x	1.46	x	24.19	x	0.4	x	0.7	=	6.85	(74)

North	0.9x	0.77	x	2.01	x	13.12	x	0.4	x	0.7	=	5.12	(74)
North	0.9x	0.77	x	1.46	x	13.12	x	0.4	x	0.7	=	3.72	(74)
North	0.9x	0.77	x	1.46	x	13.12	x	0.4	x	0.7	=	3.72	(74)
North	0.9x	0.77	x	2.01	x	8.86	x	0.4	x	0.7	=	3.46	(74)
North	0.9x	0.77	x	1.46	x	8.86	x	0.4	x	0.7	=	2.51	(74)
North	0.9x	0.77	x	1.46	x	8.86	x	0.4	x	0.7	=	2.51	(74)
East	0.9x	0.77	x	0.99	x	19.64	x	0.4	x	0.7	=	3.77	(76)
East	0.9x	0.77	x	0.99	x	38.42	x	0.4	x	0.7	=	7.38	(76)
East	0.9x	0.77	x	0.99	x	63.27	x	0.4	x	0.7	=	12.15	(76)
East	0.9x	0.77	x	0.99	x	92.28	x	0.4	x	0.7	=	17.73	(76)
East	0.9x	0.77	x	0.99	x	113.09	x	0.4	x	0.7	=	21.73	(76)
East	0.9x	0.77	x	0.99	x	115.77	x	0.4	x	0.7	=	22.24	(76)
East	0.9x	0.77	x	0.99	x	110.22	x	0.4	x	0.7	=	21.17	(76)
East	0.9x	0.77	x	0.99	x	94.68	x	0.4	x	0.7	=	18.19	(76)
East	0.9x	0.77	x	0.99	x	73.59	x	0.4	x	0.7	=	14.14	(76)
East	0.9x	0.77	x	0.99	x	45.59	x	0.4	x	0.7	=	8.76	(76)
East	0.9x	0.77	x	0.99	x	24.49	x	0.4	x	0.7	=	4.7	(76)
East	0.9x	0.77	x	0.99	x	16.15	x	0.4	x	0.7	=	3.1	(76)
South	0.9x	0.77	x	1.1	x	46.75	x	0.4	x	0.7	=	9.98	(78)
South	0.9x	0.77	x	0.19	x	46.75	x	0.4	x	0.7	=	1.72	(78)
South	0.9x	0.77	x	0.32	x	46.75	x	0.4	x	0.7	=	2.9	(78)
South	0.9x	0.77	x	1.1	x	76.57	x	0.4	x	0.7	=	16.34	(78)
South	0.9x	0.77	x	0.19	x	76.57	x	0.4	x	0.7	=	2.82	(78)
South	0.9x	0.77	x	0.32	x	76.57	x	0.4	x	0.7	=	4.75	(78)
South	0.9x	0.77	x	1.1	x	97.53	x	0.4	x	0.7	=	20.82	(78)
South	0.9x	0.77	x	0.19	x	97.53	x	0.4	x	0.7	=	3.6	(78)
South	0.9x	0.77	x	0.32	x	97.53	x	0.4	x	0.7	=	6.06	(78)
South	0.9x	0.77	x	1.1	x	110.23	x	0.4	x	0.7	=	23.53	(78)
South	0.9x	0.77	x	0.19	x	110.23	x	0.4	x	0.7	=	4.06	(78)
South	0.9x	0.77	x	0.32	x	110.23	x	0.4	x	0.7	=	6.84	(78)
South	0.9x	0.77	x	1.1	x	114.87	x	0.4	x	0.7	=	24.52	(78)
South	0.9x	0.77	x	0.19	x	114.87	x	0.4	x	0.7	=	4.24	(78)
South	0.9x	0.77	x	0.32	x	114.87	x	0.4	x	0.7	=	7.13	(78)
South	0.9x	0.77	x	1.1	x	110.55	x	0.4	x	0.7	=	23.6	(78)
South	0.9x	0.77	x	0.19	x	110.55	x	0.4	x	0.7	=	4.08	(78)
South	0.9x	0.77	x	0.32	x	110.55	x	0.4	x	0.7	=	6.86	(78)
South	0.9x	0.77	x	1.1	x	108.01	x	0.4	x	0.7	=	23.05	(78)
South	0.9x	0.77	x	0.19	x	108.01	x	0.4	x	0.7	=	3.98	(78)
South	0.9x	0.77	x	0.32	x	108.01	x	0.4	x	0.7	=	6.71	(78)
South	0.9x	0.77	x	1.1	x	104.89	x	0.4	x	0.7	=	22.39	(78)
South	0.9x	0.77	x	0.19	x	104.89	x	0.4	x	0.7	=	3.87	(78)

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South	0.9x	0.77	x	0.32	x	104.89	x	0.4	x	0.7	=	6.51	(78)
South	0.9x	0.77	x	1.1	x	101.89	x	0.4	x	0.7	=	21.75	(78)
South	0.9x	0.77	x	0.19	x	101.89	x	0.4	x	0.7	=	3.76	(78)
South	0.9x	0.77	x	0.32	x	101.89	x	0.4	x	0.7	=	6.33	(78)
South	0.9x	0.77	x	1.1	x	82.59	x	0.4	x	0.7	=	17.63	(78)
South	0.9x	0.77	x	0.19	x	82.59	x	0.4	x	0.7	=	3.04	(78)
South	0.9x	0.77	x	0.32	x	82.59	x	0.4	x	0.7	=	5.13	(78)
South	0.9x	0.77	x	1.1	x	55.42	x	0.4	x	0.7	=	11.83	(78)
South	0.9x	0.77	x	0.19	x	55.42	x	0.4	x	0.7	=	2.04	(78)
South	0.9x	0.77	x	0.32	x	55.42	x	0.4	x	0.7	=	3.44	(78)
South	0.9x	0.77	x	1.1	x	40.4	x	0.4	x	0.7	=	8.62	(78)
South	0.9x	0.77	x	0.19	x	40.4	x	0.4	x	0.7	=	1.49	(78)
South	0.9x	0.77	x	0.32	x	40.4	x	0.4	x	0.7	=	2.51	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	28.55	50.74	75.66	105.22	129.09	133.29	126.35	107.63	85.68	57.7	34.57	24.2	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	350.42	370.87	386.12	400.28	408.82	398.06	381.29	367.4	353.27	340.86	335.57	338.29	(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=	0.95	0.94	0.92	0.89	0.81	0.69	0.57	0.6	0.76	0.89	0.94	0.96	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.65	18.84	19.21	19.73	20.25	20.67	20.86	20.84	20.53	19.91	19.21	18.62	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.4	20.4	20.4	20.41	20.41	20.42	20.42	20.42	20.42	20.41	20.41	20.4	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.95	0.94	0.92	0.87	0.79	0.66	0.51	0.54	0.73	0.87	0.93	0.95	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.17	18.36	18.73	19.25	19.75	20.15	20.33	20.31	20.03	19.43	18.74	18.15	(90)

fLA = Living area ÷ (4) = 0.48 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.41	18.6	18.96	19.48	19.99	20.4	20.59	20.56	20.28	19.66	18.97	18.38	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.41	18.6	18.96	19.48	19.99	20.4	20.59	20.56	20.28	19.66	18.97	18.38	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.93	0.92	0.9	0.85	0.78	0.66	0.53	0.56	0.73	0.86	0.91	0.94	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	327.36	341.91	347.12	342.1	318.32	261.55	200.69	204.7	256.59	291.63	306.82	317.64	(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=	843.55	816.81	741.31	621.24	485.29	335.02	230.11	239.71	358.52	530.31	698.29	838.89	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	384.05	319.13	293.27	200.98	124.23	0	0	0	0	177.57	281.86	387.81	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2168.91 (98)

Space heating requirement in kWh/m²/year 43.66 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(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)	384.05	319.13	293.27	200.98	124.23	0	0	0	0	177.57	281.86	387.81	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	384.05	319.13	293.27	200.98	124.23	0	0	0	0	177.57	281.86	387.81	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2168.91 (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

Water heating from separate community system:

Annual water heating requirement		1816.98	(64)
Fraction of heat from community CHP		1	(303a)
Factor for charging method for community water heating		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Water heat from CHP	(64) x (303a) x (305) x (306) =	1907.83	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	19.08	(313)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2168.91	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		215		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		215	(231)
Electricity for lighting			243.4	(232)

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Electricity generated by PVs			-1251.11	(233)

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	0.519 =	1125.66	(261)
Space heating (secondary)	(215) x	0.519 =	0	(263)
Water heating from community system				

		Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel			329	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52 =	300.96	(367)
Electrical energy for heat distribution	[(313) x		0.52 =	9.9	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	310.86	(373)

Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	111.59	(267)
Electricity for lighting	(232) x	0.519 =	126.33	(268)
Energy saving/generation technologies Item 1		0.519 =	-649.33	(269)
Total CO2, kg/year	sum of (265)…(271) =		1025.11	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =		20.63	(273)
EI rating (section 14)			85	(274)

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User Details:

Assessor Name:	Adam Ritchie	**Stroma Number:**	STRO019516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat Type E - ASHP + PV

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	49.68	(1a) x	3.09	(2a) =	153.51	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.68	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	153.51	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =	0.13	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.38	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.48	0.48	0.47	0.42	0.41	0.36	0.36	0.35	0.38	0.41	0.43	0.45

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			2.13	x	1	=	2.13			(26)
Doors Type 2			0.7	x	1	=	0.7			(26)
Doors Type 3			0.96	x	1	=	0.96			(26)
Doors Type 4			0.7	x	1	=	0.7			(26)
Doors Type 5			0.7	x	1	=	0.7			(26)
Windows Type 1			1.06	x1/[1/(1.4)+ 0.04]		=	1.41			(27)
Windows Type 2			0.18	x1/[1/(1.4)+ 0.04]		=	0.24			(27)
Windows Type 3			1.93	x1/[1/(1.4)+ 0.04]		=	2.56			(27)
Windows Type 4			1.4	x1/[1/(1.4)+ 0.04]		=	1.86			(27)
Windows Type 5			1.4	x1/[1/(1.4)+ 0.04]		=	1.86			(27)
Windows Type 6			0.95	x1/[1/(1.4)+ 0.04]		=	1.26			(27)
Windows Type 7			0.31	x1/[1/(1.4)+ 0.04]		=	0.41			(27)
Walls Type1	12.36	4.38	7.98	x	0.18	=	1.44			(29)
Walls Type2	5.87	0	5.87	x	0.18	=	1.06			(29)
Walls Type3	5.84	0	5.84	x	0.18	=	1.05			(29)
Walls Type4	2.81	0	2.81	x	0.18	=	0.51			(29)
Walls Type5	8.5	2.63	5.87	x	0.18	=	1.06			(29)
Walls Type6	8.02	2.1	5.92	x	0.18	=	1.07			(29)
Walls Type7	10.52	1.4	9.12	x	0.18	=	1.64			(29)

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Walls Type8	19.47	1.91	17.56	x	0.18	=	3.16			(29)
Roof	49.68	0	49.68	x	0.13	=	6.46			(30)
Total area of elements, m²			123.07							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	32.21	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	447.12	(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 — 6.15 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss — (33) + (36) = 38.36 (37)

Ventilation heat loss calculated monthly — (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	31.28	31.05	30.83	29.76	29.56	28.64	28.64	28.46	28.99	29.56	29.97	30.39	(38)

Heat transfer coefficient, W/K — (39)m = (37) + (38)m

(39)m=	69.65	69.41	69.19	68.12	67.92	67	67	66.82	67.35	67.92	68.33	68.75	

Average = Sum(39)$_{1…12}$ /12= 68.12 (39)

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.4	1.4	1.39	1.37	1.37	1.35	1.35	1.35	1.36	1.37	1.38	1.38	

Average = Sum(40)$_{1…12}$ /12= 1.37 (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 — 1.68 (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 — 74.12 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	81.53	78.56	75.6	72.63	69.67	66.7	66.7	69.67	72.63	75.6	78.56	81.53

Total = Sum(44)$_{1…12}$ = 889.39 (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=	120.9	105.74	109.12	95.13	91.28	78.77	72.99	83.76	84.76	98.78	107.82	117.09

Total = Sum(45)$_{1…12}$ = 1166.14 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.14	15.86	16.37	14.27	13.69	11.82	10.95	12.56	12.71	14.82	16.17	17.56	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (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)

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Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):		1.39	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0.75	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0.75	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(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=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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=	167.5	147.83	155.71	140.22	137.88	123.86	119.59	130.35	129.85	145.37	152.91	163.68	(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=	167.5	147.83	155.71	140.22	137.88	123.86	119.59	130.35	129.85	145.37	152.91	163.68

Output from water heater (annual)$_{1...12}$ — 1714.75 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	77.48	68.83	73.56	67.7	67.63	62.26	61.55	65.13	64.26	70.12	71.92	76.21	(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=	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	13.89	12.33	10.03	7.59	5.68	4.79	5.18	6.73	9.03	11.47	13.39	14.27	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	146.4	147.92	144.09	135.94	125.66	115.99	109.53	108.01	111.84	119.99	130.27	139.94	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	31.4	(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=	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	(71)

Water heating gains (Table 5)

(72)m=	104.13	102.42	98.87	94.03	90.9	86.48	82.72	87.53	89.24	94.25	99.9	102.43	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	315.63	313.89	304.2	288.78	273.44	258.47	248.64	253.48	261.32	276.91	294.77	307.86	(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)	
North	0.9x	0.77	x	1.93	x	10.63	x	0.63	x	0.7	=	6.27	(74)
North	0.9x	0.77	x	1.4	x	10.63	x	0.63	x	0.7	=	4.55	(74)
North	0.9x	0.77	x	1.4	x	10.63	x	0.63	x	0.7	=	4.55	(74)
North	0.9x	0.77	x	1.93	x	20.32	x	0.63	x	0.7	=	11.99	(74)
North	0.9x	0.77	x	1.4	x	20.32	x	0.63	x	0.7	=	8.69	(74)
North	0.9x	0.77	x	1.4	x	20.32	x	0.63	x	0.7	=	8.69	(74)
North	0.9x	0.77	x	1.93	x	34.53	x	0.63	x	0.7	=	20.37	(74)
North	0.9x	0.77	x	1.4	x	34.53	x	0.63	x	0.7	=	14.77	(74)
North	0.9x	0.77	x	1.4	x	34.53	x	0.63	x	0.7	=	14.77	(74)
North	0.9x	0.77	x	1.93	x	55.46	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	1.4	x	55.46	x	0.63	x	0.7	=	23.73	(74)
North	0.9x	0.77	x	1.4	x	55.46	x	0.63	x	0.7	=	23.73	(74)
North	0.9x	0.77	x	1.93	x	74.72	x	0.63	x	0.7	=	44.07	(74)
North	0.9x	0.77	x	1.4	x	74.72	x	0.63	x	0.7	=	31.97	(74)
North	0.9x	0.77	x	1.4	x	74.72	x	0.63	x	0.7	=	31.97	(74)
North	0.9x	0.77	x	1.93	x	79.99	x	0.63	x	0.7	=	47.18	(74)
North	0.9x	0.77	x	1.4	x	79.99	x	0.63	x	0.7	=	34.22	(74)
North	0.9x	0.77	x	1.4	x	79.99	x	0.63	x	0.7	=	34.22	(74)
North	0.9x	0.77	x	1.93	x	74.68	x	0.63	x	0.7	=	44.05	(74)
North	0.9x	0.77	x	1.4	x	74.68	x	0.63	x	0.7	=	31.95	(74)
North	0.9x	0.77	x	1.4	x	74.68	x	0.63	x	0.7	=	31.95	(74)
North	0.9x	0.77	x	1.93	x	59.25	x	0.63	x	0.7	=	34.95	(74)
North	0.9x	0.77	x	1.4	x	59.25	x	0.63	x	0.7	=	25.35	(74)
North	0.9x	0.77	x	1.4	x	59.25	x	0.63	x	0.7	=	25.35	(74)
North	0.9x	0.77	x	1.93	x	41.52	x	0.63	x	0.7	=	24.49	(74)
North	0.9x	0.77	x	1.4	x	41.52	x	0.63	x	0.7	=	17.76	(74)
North	0.9x	0.77	x	1.4	x	41.52	x	0.63	x	0.7	=	17.76	(74)
North	0.9x	0.77	x	1.93	x	24.19	x	0.63	x	0.7	=	14.27	(74)
North	0.9x	0.77	x	1.4	x	24.19	x	0.63	x	0.7	=	10.35	(74)
North	0.9x	0.77	x	1.4	x	24.19	x	0.63	x	0.7	=	10.35	(74)

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North	0.9x	0.77	x	1.93	x	13.12	x	0.63	x	0.7	=	7.74	(74)
North	0.9x	0.77	x	1.4	x	13.12	x	0.63	x	0.7	=	5.61	(74)
North	0.9x	0.77	x	1.4	x	13.12	x	0.63	x	0.7	=	5.61	(74)
North	0.9x	0.77	x	1.93	x	8.86	x	0.63	x	0.7	=	5.23	(74)
North	0.9x	0.77	x	1.4	x	8.86	x	0.63	x	0.7	=	3.79	(74)
North	0.9x	0.77	x	1.4	x	8.86	x	0.63	x	0.7	=	3.79	(74)
East	0.9x	0.77	x	0.95	x	19.64	x	0.63	x	0.7	=	5.7	(76)
East	0.9x	0.77	x	0.95	x	38.42	x	0.63	x	0.7	=	11.15	(76)
East	0.9x	0.77	x	0.95	x	63.27	x	0.63	x	0.7	=	18.37	(76)
East	0.9x	0.77	x	0.95	x	92.28	x	0.63	x	0.7	=	26.79	(76)
East	0.9x	0.77	x	0.95	x	113.09	x	0.63	x	0.7	=	32.83	(76)
East	0.9x	0.77	x	0.95	x	115.77	x	0.63	x	0.7	=	33.61	(76)
East	0.9x	0.77	x	0.95	x	110.22	x	0.63	x	0.7	=	32	(76)
East	0.9x	0.77	x	0.95	x	94.68	x	0.63	x	0.7	=	27.49	(76)
East	0.9x	0.77	x	0.95	x	73.59	x	0.63	x	0.7	=	21.37	(76)
East	0.9x	0.77	x	0.95	x	45.59	x	0.63	x	0.7	=	13.24	(76)
East	0.9x	0.77	x	0.95	x	24.49	x	0.63	x	0.7	=	7.11	(76)
East	0.9x	0.77	x	0.95	x	16.15	x	0.63	x	0.7	=	4.69	(76)
South	0.9x	0.77	x	1.06	x	46.75	x	0.63	x	0.7	=	15.15	(78)
South	0.9x	0.77	x	0.18	x	46.75	x	0.63	x	0.7	=	2.57	(78)
South	0.9x	0.77	x	0.31	x	46.75	x	0.63	x	0.7	=	4.43	(78)
South	0.9x	0.77	x	1.06	x	76.57	x	0.63	x	0.7	=	24.8	(78)
South	0.9x	0.77	x	0.18	x	76.57	x	0.63	x	0.7	=	4.21	(78)
South	0.9x	0.77	x	0.31	x	76.57	x	0.63	x	0.7	=	7.25	(78)
South	0.9x	0.77	x	1.06	x	97.53	x	0.63	x	0.7	=	31.6	(78)
South	0.9x	0.77	x	0.18	x	97.53	x	0.63	x	0.7	=	5.37	(78)
South	0.9x	0.77	x	0.31	x	97.53	x	0.63	x	0.7	=	9.24	(78)
South	0.9x	0.77	x	1.06	x	110.23	x	0.63	x	0.7	=	35.71	(78)
South	0.9x	0.77	x	0.18	x	110.23	x	0.63	x	0.7	=	6.06	(78)
South	0.9x	0.77	x	0.31	x	110.23	x	0.63	x	0.7	=	10.44	(78)
South	0.9x	0.77	x	1.06	x	114.87	x	0.63	x	0.7	=	37.21	(78)
South	0.9x	0.77	x	0.18	x	114.87	x	0.63	x	0.7	=	6.32	(78)
South	0.9x	0.77	x	0.31	x	114.87	x	0.63	x	0.7	=	10.88	(78)
South	0.9x	0.77	x	1.06	x	110.55	x	0.63	x	0.7	=	35.81	(78)
South	0.9x	0.77	x	0.18	x	110.55	x	0.63	x	0.7	=	6.08	(78)
South	0.9x	0.77	x	0.31	x	110.55	x	0.63	x	0.7	=	10.47	(78)
South	0.9x	0.77	x	1.06	x	108.01	x	0.63	x	0.7	=	34.99	(78)
South	0.9x	0.77	x	0.18	x	108.01	x	0.63	x	0.7	=	5.94	(78)
South	0.9x	0.77	x	0.31	x	108.01	x	0.63	x	0.7	=	10.23	(78)
South	0.9x	0.77	x	1.06	x	104.89	x	0.63	x	0.7	=	33.98	(78)
South	0.9x	0.77	x	0.18	x	104.89	x	0.63	x	0.7	=	5.77	(78)

South	0.9x	0.77	x	0.31	x	104.89	x	0.63	x	0.7	=	9.94	(78)
South	0.9x	0.77	x	1.06	x	101.89	x	0.63	x	0.7	=	33.01	(78)
South	0.9x	0.77	x	0.18	x	101.89	x	0.63	x	0.7	=	5.6	(78)
South	0.9x	0.77	x	0.31	x	101.89	x	0.63	x	0.7	=	9.65	(78)
South	0.9x	0.77	x	1.06	x	82.59	x	0.63	x	0.7	=	26.75	(78)
South	0.9x	0.77	x	0.18	x	82.59	x	0.63	x	0.7	=	4.54	(78)
South	0.9x	0.77	x	0.31	x	82.59	x	0.63	x	0.7	=	7.82	(78)
South	0.9x	0.77	x	1.06	x	55.42	x	0.63	x	0.7	=	17.95	(78)
South	0.9x	0.77	x	0.18	x	55.42	x	0.63	x	0.7	=	3.05	(78)
South	0.9x	0.77	x	0.31	x	55.42	x	0.63	x	0.7	=	5.25	(78)
South	0.9x	0.77	x	1.06	x	40.4	x	0.63	x	0.7	=	13.09	(78)
South	0.9x	0.77	x	0.18	x	40.4	x	0.63	x	0.7	=	2.22	(78)
South	0.9x	0.77	x	0.31	x	40.4	x	0.63	x	0.7	=	3.83	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	43.22	76.8	114.49	159.19	195.25	201.6	191.11	162.82	129.64	87.32	52.32	36.64	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	358.85	390.69	418.69	447.97	468.69	460.07	439.75	416.3	390.97	364.24	347.09	344.49	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.97	0.91	0.79	0.63	0.68	0.88	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.54	19.68	19.93	20.29	20.63	20.88	20.97	20.95	20.78	20.36	19.9	19.53	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.76	19.77	19.77	19.79	19.79	19.8	19.8	19.81	19.8	19.79	19.78	19.78	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.95	0.87	0.69	0.48	0.53	0.81	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.86	18.06	18.42	18.95	19.41	19.72	19.79	19.79	19.62	19.06	18.39	17.84	(90)

fLA = Living area ÷ (4) = 0.48 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.67	18.84	19.15	19.6	20	20.28	20.36	20.35	20.18	19.69	19.12	18.66	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.67	18.84	19.15	19.6	20	20.28	20.36	20.35	20.18	19.69	19.12	18.66	(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=	0.99	0.99	0.98	0.95	0.88	0.73	0.55	0.6	0.83	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	356.05	385.99	409.51	425.83	412.95	336.44	242.32	250.07	325.92	348.55	342.38	342.24	(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=	1000.99	967.82	875.5	728.75	563.95	380.5	251.88	264.02	409.44	617.23	821.39	993.99	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	479.83	390.99	346.69	218.1	112.34	0	0	0	0	199.9	344.89	484.91

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2577.65 (98)

Space heating requirement in kWh/m²/year 51.89 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 93.5 (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)	479.83	390.99	346.69	218.1	112.34	0	0	0	0	199.9	344.89	484.91	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)	513.19	418.17	370.79	233.26	120.15	0	0	0	0	213.8	368.86	518.62	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2756.84 (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

Water heating from separate community system:
Annual water heating requirement 1714.75 (64)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2756.84	
Water heating fuel used		2030.49	
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		245.23	(232)

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 =	595.48	(261)

TER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	438.59	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1034.06	(265)
Water heating from community system					

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Electrical energy for heat distribution	[(313) x		0	=	0	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	0	(373)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	127.27	(268)
Total CO2, kg/year		sum of (265)…(271) =			1200.26	(272)

TER = 35.61 (273)

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

CR As designed

Date: Mon May 11 17:19:28 2020

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.a.0

Interface to calculation engine: iSBEM

Interface to calculation engine version: v5.6.a

BRUKL compliance check version: v5.6.a.0

Owner Details

Name: Information not provided by the user

Telephone number: Information not provided by the user

Address: Information not provided by the user, Information not provided by the user, Information not provided by the user

Certifier details

Name: Ritche+Daffin

Telephone number: +44 (0)20 70433417

Address: 49-50 Eagle Wharf Road, London, N1 7ED

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	30.2
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	30.2
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	27.5
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.13	0.13	Z1 Office/e
Floor	0.25	0.09	0.1	Z4 Garden Room/f
Roof	0.25	0.1	0.1	Z4 Garden Room/c.1
Windows***, roof windows, and rooflights	2.2	1.2	1.2	Z1 Office/e/g
Personnel doors	2.2	0.61	1	Bin Store Door
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]

U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	2.5

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- Elec Htg & Nat vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

1- Default HWS

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	3.56	0.015
Standard value	2*	N/A
* Standard shown is for all types except absorption and gas engine heat pumps.		

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
Z2 WC	1.5	-	-	-	-	-	-	-	-	-	N/A
Z6L Staff WC	-	-	-	1.5	-	-	-	-	-	0.75	0.5

General lighting and display lighting

Zone name	Luminous efficacy [lm/W] Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Z7L Furniture Store	90	-	-	20
Z8L Plantrooms	90	-	-	84
Z9L Cleaners	-	90	-	23
Z1 Office	90	-	-	136
Z2 WC	-	90	-	9
Z3 Entrance	-	90	15	71
Z4 Garden Room	-	90	15	60
Z5L Staff Room	90	-	-	186
Z6L Staff WC	-	90	-	27

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Z10L Corridor	-	90	-	65

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Z1 Office	NO (-69.6%)	NO
Z3 Entrance	NO (-80.9%)	NO
Z4 Garden Room	YES (+15.7%)	NO
Z5L Staff Room	NO (-83%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	194.3	194.3
External area [m^2]	519	519
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	5
Average conductance [W/K]	111.66	238.06
Average U-value [W/m^{2}K]	0.22	0.46
Alpha value* [%]	44.17	19.02

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	17.98	35.16
Cooling	0	0
Auxiliary	2.12	0.95
Lighting	16.24	12.47
Hot water	18.03	24.15
Equipment*	41.16	41.16
TOTAL**	**54.36**	**72.72**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	163.29	207.03
Primary energy* [kWh/m^2]	162.73	151.11
Total emissions [kg/m^2]	27.5	30.2

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] No Heating or Cooling										
	Actual	40.8	1.8	0	0	0	0	0	0	0
	Notional	65.2	1.1	0	0	0	0	0	----	----
[ST] Central heating using water: floor heating, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	88.8	130.2	26.3	0	3.1	0.94	0	1	0
	Notional	151.5	120.4	51.4	0	1.4	0.82	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.12	Z10L Corridor/su
Floor	0.2	0.09	Z1 Office/f
Roof	0.15	0.1	Z4 Garden Room/c.1
Windows, roof windows, and rooflights	1.5	1.2	Z1 Office/e/g
Personnel doors	1.5	0.4	Lobby Door to Courtyard
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	2.5

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

CR As designed

Date: Mon May 11 17:50:56 2020

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.a.0

Interface to calculation engine: iSBEM

Interface to calculation engine version: v5.6.a

BRUKL compliance check version: v5.6.a.0

Owner Details

Name: Information not provided by the user

Telephone number: Information not provided by the user

Address: Information not provided by the user, Information not provided by the user, Information not provided by the user

Certifier details

Name: Ritche+Daffin

Telephone number: +44 (0)20 70433417

Address: 49-50 Eagle Wharf Road, London, N1 7ED

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	30.2
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	30.2
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	22.1
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.13	0.13	Z1 Office/e
Floor	0.25	0.09	0.1	Z4 Garden Room/f
Roof	0.25	0.1	0.1	Z4 Garden Room/c.1
Windows***, roof windows, and rooflights	2.2	1.2	1.2	Z1 Office/e/g
Personnel doors	2.2	0.61	1	Bin Store Door
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	2.5

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- Elec Htg & Nat vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

1- Default HWS

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	3.56	0.015
Standard value	2*	N/A
* Standard shown is for all types except absorption and gas engine heat pumps.		

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
Z2 WC	1.5	-	-	-	-	-	-	-	-	-	N/A
Z6L Staff WC	-	-	-	1.5	-	-	-	-	-	0.75	0.5

General lighting and display lighting

Zone name	Luminous efficacy [lm/W] Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Z7L Furniture Store	90	-	-	20
Z8L Plantrooms	90	-	-	84
Z9L Cleaners	-	90	-	23
Z1 Office	90	-	-	136
Z2 WC	-	90	-	9
Z3 Entrance	-	90	15	71
Z4 Garden Room	-	90	15	60
Z5L Staff Room	90	-	-	186
Z6L Staff WC	-	90	-	27

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Z10L Corridor	-	90	-	65

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Z1 Office	NO (-69.6%)	NO
Z3 Entrance	NO (-80.9%)	NO
Z4 Garden Room	NO (-30.8%)	YES
Z5L Staff Room	NO (-83%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	194.3	194.3
External area [m²]	519	519
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	5
Average conductance [W/K]	111.66	238.06
Average U-value [W/m²K]	0.22	0.46
Alpha value* [%]	44.17	19.02

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	18.92	35.16
Cooling	0	0
Auxiliary	2.12	0.95
Lighting	16.24	12.47
Hot water	18.03	24.15
Equipment*	41.16	41.16
TOTAL**	**55.31**	**72.72**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	11.26	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	144.76	207.03
Primary energy* [kWh/m²]	165.56	151.11
Total emissions [kg/m²]	22.1	30.2

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] No Heating or Cooling										
	Actual	40.8	1.8	0	0	0	0	0	0	0
	Notional	65.2	1.1	0	0	0	0	0	----	----
[ST] Central heating using water: floor heating, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	93.5	98.4	27.7	0	3.1	0.94	0	1	0
	Notional	151.5	120.4	51.4	0	1.4	0.82	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.12	Z10L Corridor/su
Floor	0.2	0.09	Z1 Office/f
Roof	0.15	0.1	Z4 Garden Room/c.1
Windows, roof windows, and rooflights	1.5	1.2	Z1 Office/e/g
Personnel doors	1.5	0.4	Lobby Door to Courtyard
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	2.5