

**PLANNING CONDITION 22
(SCHEDULE 4)**

Date :	6 August 2021
Statement By :	Joe Solti (Project Director) Accredited SAP Assessor
Our Ref :	ZD-32
Client :	S R Property Partnership LLP
Local Authority :	Arun District Council

Development Details

Site Location :	77 Aldwick Road, Bognor Regis PO21 2NW
Development :	2 No Studio Flats (1 x Conversion/Change of Use) + (1 x New)
Floor Area (Flat) :	37.24m ² (Flat 1) + 37.43m ² (Flat 2)

Therm Energy Ltd, 1 Tarrant Street, Arundel, West Sussex BN18 9DG

SAP - SBEM - EPCs - WATER - PLANNING - AIR/SOUND/FAN TESTING SERVICES

Therm Energy Ltd : Sustainable Design & Construction Report

TABLE 1 : CO2 EMISSIONS

	Energy Rating	CO2 (kg/year)	
		Per m2	Total
Baseline (Flat 1)	43 (Band E)	88.94	3311.01
Baseline (Flat 2)	79 (Band C)	34.59	1294.70
Actual (Flat 1)	73 (Band C)	42.18	1570.78
Actual (Flat 2)	84 (Band B)	26.06	975.43

TABLE 2 : CO2 EMISSIONS (SAVINGS)

	CO2 (kg/year)	
	Total	(%)
Baseline (Flats 1 & 2)	4605.71	-
Actual (Flats 1 & 2)	2546.21	44.72

NOTES

Renewable = ASHPs

Air source heat pump + radiators (suitably sized). Heat pumps to be Products Characteristics Database (SAP Appendix Q) listed.

SAP Input

Property Details: ZD-32(PLAT1)A

Address: BASE CO2, Flat 1, 77 Aldwick Road, Bognor Regis, PO21 2NW
Located in: England
Region: South East England
UPRN: UPRN-566132775536
Date of assessment: 06 August 2021
Date of certificate: 06 August 2021
Assessment type: New dwelling design stage
Transaction type: New dwelling
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Indicative Value Medium
Water use <= 125 litres/ person/ day: True
PCDF Version: 479

Property description:

Dwelling type: Flat
Detachment:
Year Completed: 2021
Floor Location: **Floor area:** **Storey height:**
 Floor 0 37.24 m² 2.4 m
Living area: 31.6 m² (fraction 0.849)
Front of dwelling faces: North

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Front Door	Manufacturer	Solid	low-E, En = 0.05, soft coat	Yes	PVC-U
Windows (W)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
Patio Doors	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Front Door	16mm or more mm	0.7	0.63	1.4	1.9	1
Windows (W)	16mm or more	0.7	0.63	1.6	3.3	1
Patio Doors	16mm or more	0.7	0.63	1.7	3.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Front Door		Wall (common)	North	0	0
Windows (W)		Wall (external)	West	0	0
Patio Doors		Wall (external)	South	0	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Wall (external)	49.3	7.1	42.2	0.45	0	False	N/A
Wall (common)	11.28	1.9	9.38	0.45	0.9	False	N/A
Ground Floor	37.24			0.93			N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

Thermal bridges:

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

Ventilation:

Pressure test: No (Assumed)

SAP Input

Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	2
Number of passive stacks:	0
Number of sides sheltered:	3
Pressure test:	15

Main heating system

Main heating system:	Room heaters Electric (direct acting) room heaters Fuel: Electricity Info Source: SAP Tables SAP Table: 691 Panel, convector or radiant heaters
	Central heating pump : 2013 or later Design flow temperature: Design flow temperature > 45°C Unknown Boiler interlock: Yes

Main heating Control

Main heating Control:	Programmer and appliance thermostats Control code: 2603
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Secondary heating system

Secondary heating system:	None
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Water heating

Water heating:	Electric instantaneous at point of use Water code: 909 Fuel :Electricity No hot water cylinder Solar panel: False
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Others

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

SAP WorkSheet: New dwelling design stage

User Details

Assessor Name: Joe Solti **Stroma Number:** STRO003946
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.41

Property Address: 2D-32(FLAT1)/A

Address : BASE CO2, Flat 1, 77 Aldwick Road, Bognor Regis, PO21 2NW

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	37.24 (1a) ×	2.4 (2a) =	89.38 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	37.24 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	89.38 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0 × 40 =	0 (6a)
Number of open flues	0	0	0	0 × 20 =	0 (6b)
Number of intermittent fans				2 × 10 =	20 (7a)
Number of passive vents				0 × 10 =	0 (7b)
Number of flueless gas fires				0 × 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.22 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]×0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 × (14) ÷ 100] =		0 (15)
Infiltration rate	(8) ÷ (10) ÷ (11) ÷ (12) ÷ (13) ÷ (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			15 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.97 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			3 (19)
Shelter factor	(20) = 1 - [0.075 × (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(21) = (18) × (20) =		0.75 (21)

Infiltration rate modified for monthly wind speed

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

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

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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SAP WorkSheet: New dwelling design stage

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

0.96	0.94	0.92	0.83	0.81	0.72	0.72	0.7	0.75	0.81	0.85	0.89
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

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

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

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

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

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

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

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

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

(24d)m= 0.96 0.94 0.93 0.84 0.83 0.76 0.76 0.74 0.78 0.83 0.86 0.89 (24d)

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

(25)m= 0.96 0.94 0.93 0.84 0.83 0.76 0.76 0.74 0.78 0.83 0.86 0.89 (25)

3. Heat losses and heat capacity 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			1.9	1.4	2.66		(26)
Windows Type 1			3.3	$\times 1/[1/(1.6) + 0.04]$	4.96		(27)
Windows Type 2			3.8	$\times 1/[1/(1.7) + 0.04]$	6.05		(27)
Floor			37.24	0.93	34.6332		(28)
Walls Type1	49.3	7.1	42.2	0.45	18.99		(29)
Walls Type2	11.28	1.9	9.38	0.32	3		(29)
Total area of elements, m²			97.82				(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 70.3 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7707 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 14.67 (36)

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

Total fabric heat loss (33) + (36) = 84.97 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	28.4	27.87	27.35	24.91	24.45	22.33	22.33	21.93	23.15	24.45	25.38	26.34

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

(39)m=	113.37	112.84	112.32	109.88	109.42	107.3	107.3	106.9	108.12	109.42	110.35	111.31		
Average = Sum(39) _{1...12} / 12=													109.88	(39)

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Heat loss parameter (HLP), W/m²K

$$\{40\}m = \{39\}m + \{4\}$$

{40}m=	3.04	3.03	3.02	2.95	2.94	2.88	2.88	2.87	2.9	2.94	2.96	2.99		
Average = Sum{40} / 12 =													2.95	{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 equipment

Assumed occupancy, N

1.34

{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

65.91

{43}

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
{44}m=	72.5	69.86	67.23	64.59	61.95	59.32	59.32	61.95	64.59	67.23	69.86	72.5		
Total = Sum{44} / 12 =													790.89	{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=	107.51	94.03	97.03	84.6	81.17	70.04	64.91	74.48	75.37	87.84	95.88	104.12		
Total = Sum{45} / 12 =													1036.99	{45}

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

{46}m=	0	0	0	0	0	0	0	0	0	0	0	0		{46}
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Water storage loss:

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

0

{47}

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

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

Water storage loss:

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

0

{48}

Temperature factor from Table 2b

0

{49}

Energy lost from water storage, kWh/year

$$\{48\} \times \{49\} =$$

0

{50}

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

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

0

{51}

If community heating see section 4.3

Volume factor from Table 2a

0

{52}

Temperature factor from Table 2b

0

{53}

Energy lost from water storage, kWh/year

$$\{47\} \times \{51\} \times \{52\} \times \{53\} =$$

0

{54}

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

0

{55}

Water storage loss calculated for each month

$$\{56\}m = \{55\} \times \{41\}m$$

{56}m=	0	0	0	0	0	0	0	0	0	0	0	0		{56}
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If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

{57}m=	0	0	0	0	0	0	0	0	0	0	0	0		{57}
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Primary circuit loss (annual) from Table 3

0

{58}

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

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

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

(62)m=	91.39	79.93	82.48	71.91	69	59.54	55.17	63.31	64.07	74.66	81.5	88.5	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	(63)
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Output from water heater

(64)m=	91.39	79.93	82.48	71.91	69	59.54	55.17	63.31	64.07	74.66	81.5	88.5	
Output from water heater (annual): _{1, 12}												881.44	(64)

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

(65)m=	22.85	19.98	20.62	17.98	17.25	14.88	13.79	15.83	16.02	18.67	20.37	22.13	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5 Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	80.1	80.1	80.1	80.1	80.1	80.1	80.1	80.1	80.1	80.1	80.1	80.1	(66)

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

(67)m=	25.88	22.99	18.7	14.15	10.58	8.93	9.65	12.55	16.84	21.38	24.95	26.6	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	171.13	172.91	168.44	158.91	146.88	135.58	128.03	126.25	130.73	140.25	152.28	163.58	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	44.35	44.35	44.35	44.35	44.35	44.35	44.35	44.35	44.35	44.35	44.35	44.35	(69)
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Pumps and fans gains (Table 5a)

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

(71)m=	-53.4	-53.4	-53.4	-53.4	-53.4	-53.4	-53.4	-53.4	-53.4	-53.4	-53.4	-53.4	(71)
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Water heating gains (Table 5)

(72)m=	30.71	29.73	27.71	24.97	23.18	20.67	18.54	21.27	22.24	25.09	28.3	29.74	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	298.77	296.68	285.89	269.08	251.69	236.23	227.27	231.12	240.86	257.77	276.58	290.97	(73)
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6 Solar gains:

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

Orientation:	Access Factor Table 6d			Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.8	x	46.75	x	0.63	x	0.7	=	54.29	(78)
South	0.9x	0.77	x	3.8	x	76.57	x	0.63	x	0.7	=	88.92	(78)
South	0.9x	0.77	x	3.8	x	97.53	x	0.63	x	0.7	=	113.27	(78)
South	0.9x	0.77	x	3.8	x	110.23	x	0.63	x	0.7	=	128.02	(78)
South	0.9x	0.77	x	3.8	x	114.87	x	0.63	x	0.7	=	133.4	(78)

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South	0.9x	0.77	x	3.8	x	110.55	x	0.63	x	0.7	=	128.38	(78)
South	0.9x	0.77	x	3.8	x	108.01	x	0.63	x	0.7	=	125.44	(78)
South	0.9x	0.77	x	3.8	x	104.89	x	0.63	x	0.7	=	121.82	(78)
South	0.9x	0.77	x	3.8	x	101.89	x	0.63	x	0.7	=	118.32	(78)
South	0.9x	0.77	x	3.8	x	82.59	x	0.63	x	0.7	=	95.91	(78)
South	0.9x	0.77	x	3.8	x	55.42	x	0.63	x	0.7	=	64.36	(78)
South	0.9x	0.77	x	3.8	x	40.4	x	0.63	x	0.7	=	46.92	(78)
West	0.9x	0.77	x	3.3	x	19.64	x	0.63	x	0.7	=	19.81	(80)
West	0.9x	0.77	x	3.3	x	38.42	x	0.63	x	0.7	=	38.75	(80)
West	0.9x	0.77	x	3.3	x	63.27	x	0.63	x	0.7	=	63.81	(80)
West	0.9x	0.77	x	3.3	x	92.28	x	0.63	x	0.7	=	93.07	(80)
West	0.9x	0.77	x	3.3	x	113.09	x	0.63	x	0.7	=	114.06	(80)
West	0.9x	0.77	x	3.3	x	115.77	x	0.63	x	0.7	=	116.76	(80)
West	0.9x	0.77	x	3.3	x	110.22	x	0.63	x	0.7	=	111.16	(80)
West	0.9x	0.77	x	3.3	x	94.68	x	0.63	x	0.7	=	95.48	(80)
West	0.9x	0.77	x	3.3	x	73.59	x	0.63	x	0.7	=	74.22	(80)
West	0.9x	0.77	x	3.3	x	45.59	x	0.63	x	0.7	=	45.98	(80)
West	0.9x	0.77	x	3.3	x	24.49	x	0.63	x	0.7	=	24.7	(80)
West	0.9x	0.77	x	3.3	x	16.15	x	0.63	x	0.7	=	16.29	(80)

Solar gains in watts, calculated for each month

$$(83)m = \text{Sum}(74)m \dots (82)m$$

(83)m=	74.1	127.67	177.08	221.09	247.46	245.14	236.6	217.3	192.54	141.89	89.06	63.2	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	372.87	424.35	462.97	490.16	499.15	481.37	463.86	448.42	433.4	399.66	365.63	354.17	(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=	0.99	0.98	0.97	0.95	0.91	0.84	0.73	0.76	0.88	0.96	0.98	0.99	(86)

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

(87)m=	18.14	18.37	18.78	19.36	19.93	20.45	20.74	20.71	20.3	19.56	18.77	18.13	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

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

(88)m=	18.73	18.74	18.74	18.77	18.78	18.81	18.81	18.82	18.8	18.78	18.77	18.76	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

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

(89)m=	0.98	0.97	0.96	0.92	0.86	0.7	0.46	0.51	0.78	0.93	0.97	0.98	(89)
--------	------	------	------	------	------	-----	------	------	------	------	------	------	------

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

(90)m=	15.24	15.58	16.17	17.02	17.81	18.49	18.75	18.73	18.32	17.32	16.18	15.24	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) =$$

0.85

(91)

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

(92)m=	17.7	17.95	18.39	19	19.61	20.16	20.44	20.41	20	19.22	18.38	17.69	(92)
--------	------	-------	-------	----	-------	-------	-------	-------	----	-------	-------	-------	------

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

SAP WorkSheet: New dwelling design stage

(93)m=	17.7	17.95	18.39	19	19.61	20.16	20.44	20.41	20	19.22	18.38	17.69	(93)
--------	------	-------	-------	----	-------	-------	-------	-------	----	-------	-------	-------	------

8. Space heating calculation

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

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

Utilisation factor for gains, h_m :

(94)m=	0.98	0.97	0.95	0.93	0.88	0.79	0.68	0.71	0.84	0.93	0.97	0.98	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(95)m=	364.66	411.17	441.83	454.74	439.64	382.67	314.87	316.8	365.57	373.22	354.3	347.32	(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, L_m , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	1519.28	1472.09	1334.96	1110.31	865.45	596.26	412.15	428.4	638.22	943.42	1244.64	1501.68	(97)
--------	---------	---------	---------	---------	--------	--------	--------	-------	--------	--------	---------	---------	------

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

(98)m=	859.03	712.94	664.49	472.01	316.8	0	0	0	0	424.23	641.04	858.85	
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	--

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

4949.4 (98)

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

132.91 (99)

9. Space heating requirements: individual heating systems (including micro CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

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

1 (204)

Efficiency of main space heating system 1

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)

859.03	712.94	664.49	472.01	316.8	0	0	0	0	424.23	641.04	858.85
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(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

859.03	712.94	664.49	472.01	316.8	0	0	0	0	424.23	641.04	858.85
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

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

4949.4 (211)

Space heating fuel (secondary), $kWh/month$

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

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

0 (215)

Water heating

Output from water heater (calculated above)

91.39	79.93	82.48	71.91	69	59.54	55.17	63.31	64.07	74.66	81.5	88.5
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Efficiency of water heater

100 (216)

(217)m=	100	100	100	100	100	100	100	100	100	100	100	(217)
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Fuel for water heating, $kWh/month$

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

(219)m=	91.39	79.93	82.48	71.91	69	59.54	55.17	63.31	64.07	74.66	81.5	88.5	
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Total = $Sum(219a)_{1..12} =$

881.44 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

4949.4

SAP WorkSheet: New dwelling design stage

Water heating fuel used		881.44	
Electricity for pumps, fans and electric keep-hot			
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	0	(231)
Electricity for lighting		182.83	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		6013.67	(338)

10a Fuel costs - individual heating systems

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year	
Space heating - main system 1	{211} x	13.19	x 0.01 =	652.83 (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}	13.19	x 0.01 =	116.26 (247)
Pumps, fans and electric keep-hot	{231}	13.19	x 0.01 =	0 (249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a				
Energy for lighting	{232}	13.19	x 0.01 =	24.12 (250)
Additional standing charges (Table 12)				0 (251)

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

Total energy cost	(245)...(247) + (250)...(254) =	793.2	(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] =	4.05	(257)
SAP rating (Section 12)		43.49	(258)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating (main system 1)	{211} x	0.519	=	2568.74 (261)
Space heating (secondary)	{215} x	0.519	=	0 (263)
Water heating	{219} x	0.519	=	457.47 (264)
Space and water heating	{261} + {262} + {263} + {264} =			3026.2 (265)
Electricity for pumps, fans and electric keep-hot	{231} x	0.519	=	0 (267)
Electricity for lighting	{232} x	0.519	=	94.89 (268)
Total CO2, kg/year			sum of (265)...(271) =	3121.09 (272)
CO2 emissions per m²			{272} ÷ (4) =	83.81 (273)
EI rating (section 14)				50 (274)

13a Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year	
Space heating (main system 1)	{211} x	3.07	=	15194.65 (261)

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Space heating (secondary)	{215} x	3.07	=	0	{263}
Energy for water heating	{219} x	3.07	=	2706.02	{264}
Space and water heating	{261} + {262} + {263} + {264} =			17900.67	{265}
Electricity for pumps, fans and electric keep-hot	{231} x	3.07	=	0	{267}
Electricity for lighting	{232} x	0	=	561.29	{268}
'Total Primary Energy		sum of {265}...{271} =		18461.96	{272}
Primary energy kWh/m²/year		{272} ÷ {4} =		495.76	{273}

SAP Input

Property Details: ZD-32(PLAT2)A

Address: BASE CO2, Flat 2, 77 Aldwick Road, Bognor Regis, PO21 2NW
Located in: England
Region: South East England
UPRN: UPRN-566132775536
Date of assessment: 06 August 2021
Date of certificate: 06 August 2021
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: 479

Property description:

Dwelling type: Flat
Detachment:
Year Completed: 2021
Floor Location: **Floor area:** **Storey height:**
 Floor 0 37.43 m² 2.4 m
Living area: 31.6 m² (fraction 0.849)
Front of dwelling faces: North

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Front Door	Manufacturer	Solid	low-E, En = 0.05, soft coat	Yes	PVC-U
Windows (S)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
Windows (W)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Front Door	16mm or more mm	0.7	0.63	1.4	1.9	1
Windows (S)	16mm or more	0.7	0.63	1.6	2.2	1
Windows (W)	16mm or more	0.7	0.63	1.6	0.7	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Front Door		Wall (common)	North	0	0
Windows (S)		Wall (external)	South	0	0
Windows (W)		Wall (external)	West	0	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Wall (external)	49.3	2.9	46.4	0.25	0	False	N/A
Wall (common)	11.28	1.9	9.38	0.25	0.9	False	N/A
Roof	37.43	0	37.43	0.14	0		N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0406

Length	Psi-value
3.3	0.171

 E2 Other lintels (including other steel lintels)

SAP Input

[Approved]	2.4	0.04	E3	Sill
[Approved]	8.7	0.05	E4	Jamb
[Approved]	9.6	0.09	E16	Corner (normal)
	25.2	0.08	E14	Flat roof
	25.2	0	P3	Intermediate floor between dwellings (in blocks of flats)

Ventilation

Pressure test:	Yes (As designed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	2
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	5

Main heating system:

Main heating system:	Room heaters
	Electric (direct acting) room heaters
	Fuel: Electricity
	Info Source: SAP Tables
	SAP Table: 691
	Panel, convector or radiant heaters
	Central heating pump : 2013 or later
	Design flow temperature: Design flow temperature > 45°C
	Unknown
	Boiler interlock: Yes

Main heating Control:

Main heating Control:	Programmer and appliance thermostats
	Control code: 2603

Secondary heating system:

Secondary heating system:	None
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Water heating:

Water heating:	Electric instantaneous at point of use
	Water code: 909
	Fuel :Electricity
	No hot water cylinder
	Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Unknown
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	<u>Photovoltaic 1</u>
	Installed Peak power: 0.72
	Tilt of collector: 30°
	Overshading: Modest
	Collector Orientation: South
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details

Assessor Name: Joe Solti **Stroma Number:** STRO003946
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.41

Property Address: 2D-32(FLAT2/A)

Address : BASE CO2, Flat 2, 77 Aldwick Road, Bognor Regis, PO21 2NW

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	37.43 (1a)	2.4 (2a)	89.83 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	37.43 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	89.83 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0 × 40 =	0 (6a)
Number of open flues	0	0	0	0 × 20 =	0 (6b)
Number of intermittent fans				2 × 10 =	20 (7a)
Number of passive vents				0 × 10 =	0 (7b)
Number of flueless gas fires				0 × 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.22 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]×0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 × (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)			0.47 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 × (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) × (20) =		0.4 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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SAP WorkSheet: New dwelling design stage

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

0.51	0.5	0.49	0.44	0.43	0.38	0.38	0.37	0.4	0.43	0.45	0.47
------	-----	------	------	------	------	------	------	-----	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

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

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

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

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

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

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

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

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

(24d)m= 0.63 0.63 0.62 0.6 0.59 0.57 0.57 0.57 0.58 0.59 0.6 0.61 (24d)

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

(25)m= 0.63 0.63 0.62 0.6 0.59 0.57 0.57 0.57 0.58 0.59 0.6 0.61 (25)

3. Heat losses and heat capacity 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			1.9	1.4	2.66		(26)
Windows Type 1			2.2	$\times 1/[1/(1.6) + 0.04]$	3.31		(27)
Windows Type 2			0.7	$\times 1/[1/(1.6) + 0.04]$	1.05		(27)
Walls Type1	49.3	2.9	46.4	0.25	11.6		(29)
Walls Type2	11.28	1.9	9.38	0.2	1.91		(29)
Roof	37.43	0	37.43	0.14	5.24		(30)
Total area of elements, m²			98.01				(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 25.78 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 838.89 (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 3.98 (36)

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

Total fabric heat loss (33) + (36) = 29.75 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	18.71	18.56	18.41	17.72	17.59	16.98	16.98	16.87	17.21	17.59	17.85	18.13

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

(39)m=	48.46	48.31	48.16	47.47	47.34	46.73	46.73	46.62	46.97	47.34	47.6	47.88
Average = Sum(39)...12/12=												47.47 (39)

SAP WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$\{40\}m = \{39\}m + \{4\}$$

{40}m=	1.29	1.29	1.29	1.27	1.26	1.25	1.25	1.25	1.25	1.26	1.27	1.28		
Average = Sum{40} / 12 =													1.27	{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 equipment

Assumed occupancy, N

1.34

{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

66.02

{43}

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
{44}m=	72.62	69.98	67.34	64.7	62.06	59.42	59.42	62.06	64.7	67.34	69.98	72.62		
Total = Sum{44} =													792.25	{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=	107.7	94.19	97.2	84.74	81.31	70.16	65.02	74.61	75.5	87.99	96.05	104.3		
Total = Sum{45} =													1038.77	{45}

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

{46}m=	0	0	0	0	0	0	0	0	0	0	0	0		{46}
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Water storage loss:

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

0

{47}

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

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

Water storage loss:

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

0

{48}

Temperature factor from Table 2b

0

{49}

Energy lost from water storage, kWh/year

$$\{48\} \times \{49\} =$$

0

{50}

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

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

0

{51}

If community heating see section 4.3

Volume factor from Table 2a

0

{52}

Temperature factor from Table 2b

0

{53}

Energy lost from water storage, kWh/year

$$\{47\} \times \{51\} \times \{52\} \times \{53\} =$$

0

{54}

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

0

{55}

Water storage loss calculated for each month

$$\{56\}m = \{55\} \times \{41\}m$$

{56}m=	0	0	0	0	0	0	0	0	0	0	0	0		{56}
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

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

{57}m=	0	0	0	0	0	0	0	0	0	0	0	0		{57}
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

{58}

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

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

{59}m=	0	0	0	0	0	0	0	0	0	0	0	0		{59}
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

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

(61)m=	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=	91.54	80.06	82.62	72.03	69.11	59.64	55.27	63.42	64.18	74.79	81.64	88.65	(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	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	91.54	80.06	82.62	72.03	69.11	59.64	55.27	63.42	64.18	74.79	81.64	88.65	
Output from water heater (annual): 1.12												882.95	(64)

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

(65)m=	22.89	20.02	20.65	18.01	17.28	14.91	13.82	15.85	16.04	18.7	20.41	22.16	(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=	80.39	80.39	80.39	80.39	80.39	80.39	80.39	80.39	80.39	80.39	80.39	80.39	(66)

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

(67)m=	31.16	27.67	22.51	17.04	12.74	10.75	11.62	15.1	20.27	25.74	30.04	32.02	(67)
--------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

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

(68)m=	171.83	173.62	169.12	159.56	147.48	136.13	128.55	126.77	131.26	140.83	152.9	164.25	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	------

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

(69)m=	44.38	44.38	44.38	44.38	44.38	44.38	44.38	44.38	44.38	44.38	44.38	44.38	(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=	-53.59	-53.59	-53.59	-53.59	-53.59	-53.59	-53.59	-53.59	-53.59	-53.59	-53.59	-53.59	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	30.76	29.79	27.76	25.01	23.22	20.71	18.57	21.31	22.28	25.13	28.35	29.79	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	304.93	302.25	290.57	272.78	254.62	238.77	229.92	234.36	244.99	262.87	282.46	297.24	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d			Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	2.2	x	46.75	x	0.63	x	0.7	=	31.43	(78)
South	0.9x	0.77	x	2.2	x	76.57	x	0.63	x	0.7	=	51.48	(78)
South	0.9x	0.77	x	2.2	x	97.53	x	0.63	x	0.7	=	65.58	(78)
South	0.9x	0.77	x	2.2	x	110.23	x	0.63	x	0.7	=	74.12	(78)
South	0.9x	0.77	x	2.2	x	114.87	x	0.63	x	0.7	=	77.23	(78)

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South	0.9x	0.77	x	2.2	x	110.55	x	0.63	x	0.7	=	74.33	(78)
South	0.9x	0.77	x	2.2	x	108.01	x	0.63	x	0.7	=	72.62	(78)
South	0.9x	0.77	x	2.2	x	104.89	x	0.63	x	0.7	=	70.53	(78)
South	0.9x	0.77	x	2.2	x	101.89	x	0.63	x	0.7	=	68.5	(78)
South	0.9x	0.77	x	2.2	x	82.59	x	0.63	x	0.7	=	55.53	(78)
South	0.9x	0.77	x	2.2	x	55.42	x	0.63	x	0.7	=	37.26	(78)
South	0.9x	0.77	x	2.2	x	40.4	x	0.63	x	0.7	=	27.16	(78)
West	0.9x	0.77	x	0.7	x	19.64	x	0.63	x	0.7	=	4.2	(80)
West	0.9x	0.77	x	0.7	x	38.42	x	0.63	x	0.7	=	8.22	(80)
West	0.9x	0.77	x	0.7	x	63.27	x	0.63	x	0.7	=	13.54	(80)
West	0.9x	0.77	x	0.7	x	92.28	x	0.63	x	0.7	=	19.74	(80)
West	0.9x	0.77	x	0.7	x	113.09	x	0.63	x	0.7	=	24.19	(80)
West	0.9x	0.77	x	0.7	x	115.77	x	0.63	x	0.7	=	24.77	(80)
West	0.9x	0.77	x	0.7	x	110.22	x	0.63	x	0.7	=	23.58	(80)
West	0.9x	0.77	x	0.7	x	94.68	x	0.63	x	0.7	=	20.25	(80)
West	0.9x	0.77	x	0.7	x	73.59	x	0.63	x	0.7	=	15.74	(80)
West	0.9x	0.77	x	0.7	x	45.59	x	0.63	x	0.7	=	9.75	(80)
West	0.9x	0.77	x	0.7	x	24.49	x	0.63	x	0.7	=	5.24	(80)
West	0.9x	0.77	x	0.7	x	16.15	x	0.63	x	0.7	=	3.46	(80)

Solar gains in watts, calculated for each month

$$(83)m = \text{Sum}(74)m \dots (82)m$$

(83)m=	35.64	59.7	79.11	93.86	101.43	99.09	96.2	90.78	84.25	65.28	42.5	30.62	(83)
--------	-------	------	-------	-------	--------	-------	------	-------	-------	-------	------	-------	------

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

(84)m=	340.56	361.95	369.68	366.64	356.04	337.86	326.12	325.14	329.24	328.15	324.96	327.86	(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	0.85	0.78	0.67	0.54	0.56	0.71	0.84	0.9	0.93	(86)

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

(87)m=	18.75	18.96	19.31	19.79	20.26	20.66	20.86	20.84	20.58	20	19.31	18.72	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	------

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

(88)m=	19.84	19.85	19.85	19.87	19.87	19.88	19.88	19.88	19.88	19.87	19.86	19.86	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.91	0.9	0.87	0.82	0.74	0.59	0.43	0.45	0.64	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=	16.9	17.2	17.71	18.39	19.04	19.57	19.79	19.78	19.47	18.7	17.72	16.86	(90)
--------	------	------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

$$fLA = \text{Living area} \div (4) =$$

0.84 (91)

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

(92)m=	18.47	18.69	19.06	19.57	20.07	20.49	20.69	20.68	20.41	19.8	19.07	18.43	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

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

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(93)m=	18.47	18.69	19.06	19.57	20.07	20.49	20.69	20.68	20.41	19.8	19.07	18.43	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

8. Space heating calculation

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

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

Utilisation factor for gains, h_m :

(94)m=	0.9	0.88	0.86	0.81	0.75	0.64	0.51	0.53	0.67	0.8	0.87	0.91	(94)
--------	-----	------	------	------	------	------	------	------	------	-----	------	------	------

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

(95)m=	306.23	319.25	316.71	298.76	266.39	215.2	166.39	171.46	221.81	263.69	283.89	296.99	(95)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

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

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	686.51	666.01	605.06	506.69	396.12	275.34	191.31	199.41	296.17	435.42	569.57	681.3	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(98)m=	282.93	233.02	214.53	149.71	96.52	0	0	0	0	127.77	205.69	285.92	
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	--

Total per year ($kWh/year$) = $Sum(98)_{1..12} =$ 1596.09 (98)

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

42.64 (99)

9. Space heating requirements - individual heating systems (including micro CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

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

1 (204)

Efficiency of main space heating system 1

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)

282.93	233.02	214.53	149.71	96.52	0	0	0	0	127.77	205.69	285.92
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

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

282.93	233.02	214.53	149.71	96.52	0	0	0	0	127.77	205.69	285.92
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

Total ($kWh/year$) = $Sum(211)_{1..12} =$ 1596.09 (211)

Space heating fuel (secondary), $kWh/month$

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

(215)m=	0	0	0	0	0	0	0	0	0	0	0	
---------	---	---	---	---	---	---	---	---	---	---	---	--

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

Water heating

Output from water heater (calculated above)

91.54	80.06	82.62	72.03	69.11	59.64	55.27	63.42	64.18	74.79	81.64	88.65
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Efficiency of water heater

100 (216)

(217)m=	100	100	100	100	100	100	100	100	100	100	100	(217)
---------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-------

Fuel for water heating, $kWh/month$

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

(219)m=	91.54	80.06	82.62	72.03	69.11	59.64	55.27	63.42	64.18	74.79	81.64	88.65	
---------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--

Total = $Sum(219a)_{1..12} =$ 882.95 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1596.09

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Water heating fuel used		882.95	
Electricity for pumps, fans and electric keep-hot			
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	0	(231)
Electricity for lighting		220.1	(232)
Electricity generated by PVs		-497.45	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2201.69	(338)

11a. 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 = 210.52 (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)	13.19	x 0.01 = 116.46 (247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 = 0 (249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a			
Energy for lighting	(232)	13.19	x 0.01 = 29.03 (250)
Additional standing charges (Table 12)			0 (251)
	one of (233) to (235) x)	13.19	x 0.01 = -65.61 (252)

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

Total energy cost	(245)...(247) + (250)...(254) =	290.4	(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] =	1.48	(257)
SAP rating (Section 12)		79.36	(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	= 828.37 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.519	= 458.25 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1286.62 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 0 (267)
Electricity for lighting	(232) x	0.519	= 114.23 (268)
Energy saving/generation technologies			
Item 1		0.519	= -258.17 (269)
Total CO2, kg/year	sum of (265)...(271) =		1142.68 (272)

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CO2 emissions per m²

{272} ÷ {4} =

30.53

{273}

EI rating (section 14)

81

{274}

12a Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	{211} x	3.07	=	4899.99	{261}
Space heating (secondary)	{215} x	3.07	=	0	{263}
Energy for water heating	{219} x	3.07	=	2710.66	{264}
Space and water heating	{261} + {262} + {263} + {264} =			7610.65	{265}
Electricity for pumps, fans and electric keep-hot	{231} x	3.07	=	0	{267}
Electricity for lighting	{232} x	0	=	675.69	{268}
Energy saving/generation technologies Item 1		3.07	=	-1527.16	{269}
'Total Primary Energy		sum of {265}...{271} =		6759.19	{272}
Primary energy kWh/m²/year		{272} ÷ {4} =		180.58	{273}

SAP Input

Property Details: ZD-32(PLAT1)B

Address: ACTUAL CO2, Flat 1, 77 Aldwick Road, Bognor Regis, PO21 2NW
Located in: England
Region: South East England
UPRN: UPRN-566132775536
Date of assessment: 06 August 2021
Date of certificate: 06 August 2021
Assessment type: New dwelling design stage
Transaction type: New dwelling
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Indicative Value Medium
Water use <= 125 litres/ person/ day: True
PCDF Version: 479

Property description:

Dwelling type: Flat
Detachment:
Year Completed: 2021
Floor Location: **Floor area:** **Storey height:**
 Floor 0 37.24 m² 2.4 m
Living area: 31.6 m² (fraction 0.849)
Front of dwelling faces: North

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Front Door	Manufacturer	Solid	low-E, En = 0.05, soft coat	Yes	PVC-U
Windows (W)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
Patio Doors	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Front Door	16mm or more mm	0.7	0.63	1.4	1.9	1
Windows (W)	16mm or more	0.7	0.63	1.6	3.3	1
Patio Doors	16mm or more	0.7	0.63	1.7	3.8	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Front Door		Wall (common)	North	0	0
Windows (W)		Wall (external)	West	0	0
Patio Doors		Wall (external)	South	0	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Wall (external)	49.3	7.1	42.2	0.45	0	False	N/A
Wall (common)	11.28	1.9	9.38	0.45	0.9	False	N/A
Ground Floor	37.24			0.93			N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

Thermal bridges:

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

Ventilation:

Pressure test: No (Assumed)

SAP Input

Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	2
Number of passive stacks:	0
Number of sides sheltered:	3
Pressure test:	15

Main heating system

Main heating system:	Heat pumps with radiators or underfloor heating Electric heat pumps Fuel: Electricity Info Source: Boiler Database Database: (rev 479, product index 100011, SEDBUK 351%): Brand name: Daikin Altherma Model: ERHQ006BV3 + EKHBH008B Model qualifier: Radiators (provides DHW all year) Systems with radiators Design flow temperature: Design flow temperature > 45°C Unknown Boiler interlock: Yes
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Main heating Control

Main heating Control:	Programmer and room thermostat Control code: 2204
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Secondary heating system

Secondary heating system:	None
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Water heating

Water heating:	Electric instantaneous at point of use Water code: 909 Fuel :Electricity No hot water cylinder Solar panel: False
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Others

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

SAP WorkSheet: New dwelling design stage

User Details

Assessor Name: Joe Solti **Stroma Number:** STRO003946
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.41

Property Address: 2D-32(FLAT1)B

Address : ACTUAL CO2, Flat 1, 77 Aldwick Road, Bognor Regis, PO21 2NW

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	37.24 (1a)	2.4 (2a)	89.38 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	37.24 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	89.38 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.22 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			15 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.97 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.75 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.96	0.94	0.92	0.83	0.81	0.72	0.72	0.7	0.75	0.81	0.85	0.89
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

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

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

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

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

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

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

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

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

(24d)m= 0.96 0.94 0.93 0.84 0.83 0.76 0.76 0.74 0.78 0.83 0.86 0.89 (24d)

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

(25)m= 0.96 0.94 0.93 0.84 0.83 0.76 0.76 0.74 0.78 0.83 0.86 0.89 (25)

3. Heat losses and heat capacity 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			1.9	1.4	2.66		(26)
Windows Type 1			3.3	$\times 1/[1/(1.6) + 0.04]$	4.96		(27)
Windows Type 2			3.8	$\times 1/[1/(1.7) + 0.04]$	6.05		(27)
Floor			37.24	0.93	34.6332		(28)
Walls Type1	49.3	7.1	42.2	0.45	18.99		(29)
Walls Type2	11.28	1.9	9.38	0.32	3		(29)
Total area of elements, m²			97.82				(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 70.3 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7707 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 14.67 (36)

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

Total fabric heat loss (33) + (36) = 84.97 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	28.4	27.87	27.35	24.91	24.45	22.33	22.33	21.93	23.15	24.45	25.38	26.34

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

(39)m=	113.37	112.84	112.32	109.88	109.42	107.3	107.3	106.9	108.12	109.42	110.35	111.31		
Average = Sum(39) _{1...12} / 12=													109.88	(39)

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Heat loss parameter (HLP), W/m²K

$$\{40\}m = \{39\}m + \{4\}$$

{40}m=	3.04	3.03	3.02	2.95	2.94	2.88	2.88	2.87	2.9	2.94	2.96	2.99		
Average = Sum{40} / 12 =													2.95	{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 equipment

1st year

Assumed occupancy, N

1.34

{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

65.91

{43}

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

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

{44}m=	72.5	69.86	67.23	64.59	61.95	59.32	59.32	61.95	64.59	67.23	69.86	72.5		
Total = Sum{44} / 12 =													790.89	{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=	107.51	94.03	97.03	84.6	81.17	70.04	64.91	74.48	75.37	87.84	95.88	104.12		
Total = Sum{45} / 12 =													1036.99	{45}

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

{46}m=	0	0	0	0	0	0	0	0	0	0	0	0		{46}
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Water storage loss:

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

0

{47}

If community heating and no tank in dwelling, enter 110 litres in {47}

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

Water storage loss:

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

0

{48}

Temperature factor from Table 2b

0

{49}

Energy lost from water storage, kWh/year

$$\{48\} \times \{49\} =$$

0

{50}

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

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

0

{51}

If community heating see section 4.3

Volume factor from Table 2a

0

{52}

Temperature factor from Table 2b

0

{53}

Energy lost from water storage, kWh/year

$$\{47\} \times \{51\} \times \{52\} \times \{53\} =$$

0

{54}

Enter {50} or {54} in {55}

0

{55}

Water storage loss calculated for each month

$$\{56\}m = \{55\} \times \{41\}m$$

{56}m=	0	0	0	0	0	0	0	0	0	0	0	0		{56}
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If cylinder contains dedicated solar storage, {57}m = {56}m x [(50) - (H11)] ÷ (50), else {57}m = {56}m where (H11) is from Appendix H

{57}m=	0	0	0	0	0	0	0	0	0	0	0	0		{57}
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Primary circuit loss (annual) from Table 3

0

{58}

Primary circuit loss calculated for each month {59}m = {58} ÷ 365 x {41}m

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

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

(62)m=	91.39	79.93	82.48	71.91	69	59.54	55.17	63.31	64.07	74.66	81.5	88.5	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	(63)
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Output from water heater

(64)m=	91.39	79.93	82.48	71.91	69	59.54	55.17	63.31	64.07	74.66	81.5	88.5	
Output from water heater (annual): 1.12												881.44	(64)

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

(65)m=	22.85	19.98	20.62	17.98	17.25	14.88	13.79	15.83	16.02	18.67	20.37	22.13	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	80.1	80.1	80.1	80.1	80.1	80.1	80.1	80.1	80.1	80.1	80.1	80.1	(66)

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

(67)m=	25.88	22.99	18.7	14.15	10.58	8.93	9.65	12.55	16.84	21.38	24.95	26.6	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	171.13	172.91	168.44	158.91	146.88	135.58	128.03	126.25	130.73	140.25	152.28	163.58	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	44.35	44.35	44.35	44.35	44.35	44.35	44.35	44.35	44.35	44.35	44.35	44.35	(69)
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Pumps and fans gains (Table 5a)

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

(71)m=	-53.4	-53.4	-53.4	-53.4	-53.4	-53.4	-53.4	-53.4	-53.4	-53.4	-53.4	-53.4	(71)
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Water heating gains (Table 5)

(72)m=	30.71	29.73	27.71	24.97	23.18	20.67	18.54	21.27	22.24	25.09	28.3	29.74	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	298.77	296.68	285.89	269.08	251.69	236.23	227.27	231.12	240.86	257.77	276.58	290.97	(73)
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6. Solar gains:

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

Orientation:	Access Factor Table 6d			Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.8	x	46.75	x	0.63	x	0.7	=	54.29	(78)
South	0.9x	0.77	x	3.8	x	76.57	x	0.63	x	0.7	=	88.92	(78)
South	0.9x	0.77	x	3.8	x	97.53	x	0.63	x	0.7	=	113.27	(78)
South	0.9x	0.77	x	3.8	x	110.23	x	0.63	x	0.7	=	128.02	(78)
South	0.9x	0.77	x	3.8	x	114.87	x	0.63	x	0.7	=	133.4	(78)

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South	0.9x	0.77	x	3.8	x	110.55	x	0.63	x	0.7	=	128.38	(78)
South	0.9x	0.77	x	3.8	x	108.01	x	0.63	x	0.7	=	125.44	(78)
South	0.9x	0.77	x	3.8	x	104.89	x	0.63	x	0.7	=	121.82	(78)
South	0.9x	0.77	x	3.8	x	101.89	x	0.63	x	0.7	=	118.32	(78)
South	0.9x	0.77	x	3.8	x	82.59	x	0.63	x	0.7	=	95.91	(78)
South	0.9x	0.77	x	3.8	x	55.42	x	0.63	x	0.7	=	64.36	(78)
South	0.9x	0.77	x	3.8	x	40.4	x	0.63	x	0.7	=	46.92	(78)
West	0.9x	0.77	x	3.3	x	19.64	x	0.63	x	0.7	=	19.81	(80)
West	0.9x	0.77	x	3.3	x	38.42	x	0.63	x	0.7	=	38.75	(80)
West	0.9x	0.77	x	3.3	x	63.27	x	0.63	x	0.7	=	63.81	(80)
West	0.9x	0.77	x	3.3	x	92.28	x	0.63	x	0.7	=	93.07	(80)
West	0.9x	0.77	x	3.3	x	113.09	x	0.63	x	0.7	=	114.06	(80)
West	0.9x	0.77	x	3.3	x	115.77	x	0.63	x	0.7	=	116.76	(80)
West	0.9x	0.77	x	3.3	x	110.22	x	0.63	x	0.7	=	111.16	(80)
West	0.9x	0.77	x	3.3	x	94.68	x	0.63	x	0.7	=	95.48	(80)
West	0.9x	0.77	x	3.3	x	73.59	x	0.63	x	0.7	=	74.22	(80)
West	0.9x	0.77	x	3.3	x	45.59	x	0.63	x	0.7	=	45.98	(80)
West	0.9x	0.77	x	3.3	x	24.49	x	0.63	x	0.7	=	24.7	(80)
West	0.9x	0.77	x	3.3	x	16.15	x	0.63	x	0.7	=	16.29	(80)

Solar gains in watts, calculated for each month

$$(83)m = \text{Sum}(74)m \dots (82)m$$

(83)m=	74.1	127.67	177.08	221.09	247.46	245.14	236.6	217.3	192.54	141.89	89.06	63.2	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	372.87	424.35	462.97	490.16	499.15	481.37	463.86	448.42	433.4	399.66	365.63	354.17	(84)
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7. Mean internal temperature (heating season)

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

21

(85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.95	0.91	0.84	0.73	0.76	0.88	0.96	0.98	0.99	(86)

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

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

(88)m=	19.48	19.48	19.49	19.52	19.53	19.56	19.56	19.56	19.55	19.53	19.52	19.51	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.98	0.96	0.93	0.88	0.76	0.58	0.62	0.82	0.94	0.97	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.48	19.48	19.49	19.52	19.53	19.56	19.56	19.56	19.55	19.53	19.52	19.51	(90)
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$$fLA = \text{Living area} \div (4) =$$

0.85

(91)

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

(92)m=	20.77	20.77	20.77	20.78	20.78	20.78	20.78	20.78	20.78	20.78	20.78	20.77	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	20.77	20.77	20.77	20.78	20.78	20.78	20.78	20.78	20.78	20.78	20.78	20.77	(93)
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8. Space heating calculation

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, h_m :

(94)m=	0.99	0.98	0.97	0.95	0.91	0.83	0.71	0.74	0.87	0.95	0.98	0.99	(94)
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Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	367.71	415.79	448.66	464.65	453.01	397.85	329.64	331.32	378.59	380.88	358.26	349.9	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	1867.18	1790.86	1603.02	1305.01	993.3	663.3	448.7	468.52	722.24	1113.67	1509.08	1844.89	(97)
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Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	1115.6	924.05	858.84	605.06	401.97	0	0	0	0	545.19	828.59	1112.27	(98)
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Total per year ($kWh/year$) = $Sum(98)_{1..12} =$ 6391.58 (98)

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

171.63 (99)

9. Space heating requirements - individual heating systems (including micro CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

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

1 (204)

Efficiency of main space heating system 1

350.95 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

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

1115.6	924.05	858.84	605.06	401.97	0	0	0	0	545.19	828.59	1112.27
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	---------

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

317.88	263.3	244.72	172.41	114.54	0	0	0	0	155.35	236.1	316.93
--------	-------	--------	--------	--------	---	---	---	---	--------	-------	--------

Total ($kWh/year$) = $Sum(211)_{1..12} =$ 1821.24 (211)

Space heating fuel (secondary), $kWh/month$

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

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

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

Water heating

Output from water heater (calculated above)

91.39	79.93	82.48	71.91	69	59.54	55.17	63.31	64.07	74.66	81.5	88.5
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Efficiency of water heater

100 (216)

(217)m=	100	100	100	100	100	100	100	100	100	100	100	100	(217)
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Fuel for water heating, $kWh/month$

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

(219)m=	91.39	79.93	82.48	71.91	69	59.54	55.17	63.31	64.07	74.66	81.5	88.5	(219)
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Total = $Sum(219a)_{1..12} =$ 881.44 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1821.24

SAP WorkSheet: New dwelling design stage

Water heating fuel used		881.44	
Electricity for pumps, fans and electric keep-hot			
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	0	(231)
Electricity for lighting		182.83	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2885.51	(238)

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 =	240.22 (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}	13.19	x 0.01 =	116.26 (247)
Pumps, fans and electric keep-hot	{231}	13.19	x 0.01 =	0 (249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a				
Energy for lighting	{232}	13.19	x 0.01 =	24.12 (250)
Additional standing charges (Table 12)				0 (251)

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

Total energy cost	(245)...(247) + (250)...(254) =	380.6	(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] =	1.94	(257)
SAP rating (Section 12)		72.89	(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	=	945.22 (261)
Space heating (secondary)	{215} x	0.519	=	0 (263)
Water heating	{219} x	0.519	=	457.47 (264)
Space and water heating	{261} + {262} + {263} + {264} =			1402.69 (265)
Electricity for pumps, fans and electric keep-hot	{231} x	0.519	=	0 (267)
Electricity for lighting	{232} x	0.519	=	94.89 (268)
Total CO2, kg/year		sum of (265)...(271) =		1497.58 (272)
CO2 emissions per m²		{272} ÷ (4) =		40.21 (273)
EI rating (section 14)				76 (274)

13a Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year	
Space heating (main system 1)	{211} x	3.07	=	5591.21 (261)

SAP WorkSheet: New dwelling design stage

Space heating (secondary)	{215} x	3.07	=	0	{263}
Energy for water heating	{219} x	3.07	=	2706.02	{264}
Space and water heating	{261} + {262} + {263} + {264} =			8297.22	{265}
Electricity for pumps, fans and electric keep-hot	{231} x	3.07	=	0	{267}
Electricity for lighting	{232} x	0	=	561.29	{268}
'Total Primary Energy		sum of {265}...{271} =		8858.52	{272}
Primary energy kWh/m²/year		{272} ÷ {4} =		237.88	{273}

SAP Input

Property Details: ZD-32(PLAT2)B

Address: ACTUAL CO2, Flat 2, 77 Aldwick Road, Bognor Regis, PO21 2NW
Located in: England
Region: South East England
UPRN: UPRN-566132775536
Date of assessment: 06 August 2021
Date of certificate: 06 August 2021
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: 479

Property description:

Dwelling type: Flat
Detachment:
Year Completed: 2021
Floor Location: **Floor area:** **Storey height:**
 Floor 0 37.43 m² 2.4 m
Living area: 31.6 m² (fraction 0.849)
Front of dwelling faces: North

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Front Door	Manufacturer	Solid	low-E, En = 0.05, soft coat	Yes	PVC-U
Windows (S)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
Windows (W)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Front Door	16mm or more mm	0.7	0.63	1.4	1.9	1
Windows (S)	16mm or more	0.7	0.63	1.6	2.2	1
Windows (W)	16mm or more	0.7	0.63	1.6	0.7	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Front Door		Wall (common)	North	0	0
Windows (S)		Wall (external)	South	0	0
Windows (W)		Wall (external)	West	0	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Wall (external)	49.3	2.9	46.4	0.25	0	False	N/A
Wall (common)	11.28	1.9	9.38	0.25	0.9	False	N/A
Roof	37.43	0	37.43	0.14	0		N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0406
Length **Psi-value**
 3.3 0.171 E2 Other lintels (including other steel lintels)

SAP Input

[Approved]	2.4	0.04	E3	Sill
[Approved]	8.7	0.05	E4	Jamb
[Approved]	9.6	0.09	E16	Corner (normal)
	25.2	0.08	E14	Flat roof
	25.2	0	P3	Intermediate floor between dwellings (in blocks of flats)

Ventilation

Pressure test:	Yes (As designed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	2
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	5

Main heating system:

Main heating system:	Heat pumps with radiators or underfloor heating
	Electric heat pumps
	Fuel: Electricity
	Info Source: Boiler Database
	Database: (rev 479, product index 100011, SEDBUK 314%):
	Brand name: Daikin Altherma
	Model: ERHQ006BV3 + EKHBH008B
	Model qualifier: Radiators
	(provides DHW all year)
	Systems with radiators
	Design flow temperature: Design flow temperature > 45°C
	Unknown
	Boiler interlock: Yes

Main heating Control

Main heating Control:	Programmer and room thermostat
	Control code: 2204

Secondary heating system

Secondary heating system:	None
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Water heating

Water heating:	Electric instantaneous at point of use
	Water code: 909
	Fuel :Electricity
	No hot water cylinder
	Solar panel: False

Others:

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

SAP WorkSheet: New dwelling design stage

User Details

Assessor Name: Joe Solti **Stroma Number:** STRO003946
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.41

Property Address: 2D-32(FLAT2)B

Address : ACTUAL CO2, Flat 2, 77 Aldwick Road, Bognor Regis, PO21 2NW

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	37.43 (1a)	2.4 (2a)	89.83 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	37.43 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	89.83 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.22 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) ÷ (10) ÷ (11) ÷ (12) ÷ (13) ÷ (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.47 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.4 (21)
Infiltration rate modified for monthly wind speed			

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

Monthly average wind speed from Table 7

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

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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SAP WorkSheet: New dwelling design stage

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

0.51	0.5	0.49	0.44	0.43	0.38	0.38	0.37	0.4	0.43	0.45	0.47
------	-----	------	------	------	------	------	------	-----	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

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

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

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

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

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

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

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

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

(24d)m= 0.63 0.63 0.62 0.6 0.59 0.57 0.57 0.57 0.58 0.59 0.6 0.61 (24d)

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

(25)m= 0.63 0.63 0.62 0.6 0.59 0.57 0.57 0.57 0.58 0.59 0.6 0.61 (25)

3. Heat losses and heat capacity 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			1.9	1.4	2.66		(26)
Windows Type 1			2.2	$\times 1/[1/(1.6) + 0.04]$	3.31		(27)
Windows Type 2			0.7	$\times 1/[1/(1.6) + 0.04]$	1.05		(27)
Walls Type1	49.3	2.9	46.4	0.25	11.6		(29)
Walls Type2	11.28	1.9	9.38	0.2	1.91		(29)
Roof	37.43	0	37.43	0.14	5.24		(30)
Total area of elements, m²			98.01				(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 25.78 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 838.89 (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 3.98 (36)

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

Total fabric heat loss (33) + (36) = 29.75 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	18.71	18.56	18.41	17.72	17.59	16.98	16.98	16.87	17.21	17.59	17.85	18.13

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

(39)m=	48.46	48.31	48.16	47.47	47.34	46.73	46.73	46.62	46.97	47.34	47.6	47.88
Average = Sum(39)...12/12=												47.47 (39)

SAP WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$\{40\}m = \{39\}m + \{4\}$$

{40}m=	1.29	1.29	1.29	1.27	1.26	1.25	1.25	1.25	1.25	1.26	1.27	1.28		
Average = Sum{40} / 12 =													1.27	{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 equipment

Assumed occupancy, N

1.34

{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

66.02

{43}

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
{44}m=	72.62	69.98	67.34	64.7	62.06	59.42	59.42	62.06	64.7	67.34	69.98	72.62		
Total = Sum{44} =													792.25	{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=	107.7	94.19	97.2	84.74	81.31	70.16	65.02	74.61	75.5	87.99	96.05	104.3		
Total = Sum{45} =													1038.77	{45}

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

{46}m=	0	0	0	0	0	0	0	0	0	0	0	0		{46}
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Water storage loss:

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

0

{47}

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

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

Water storage loss:

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

0

{48}

Temperature factor from Table 2b

0

{49}

Energy lost from water storage, kWh/year

$$\{48\} \times \{49\} =$$

0

{50}

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

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

0

{51}

If community heating see section 4.3

Volume factor from Table 2a

0

{52}

Temperature factor from Table 2b

0

{53}

Energy lost from water storage, kWh/year

$$\{47\} \times \{51\} \times \{52\} \times \{53\} =$$

0

{54}

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

0

{55}

Water storage loss calculated for each month

$$\{56\}m = \{55\} \times \{41\}m$$

{56}m=	0	0	0	0	0	0	0	0	0	0	0	0		{56}
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

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

{57}m=	0	0	0	0	0	0	0	0	0	0	0	0		{57}
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Primary circuit loss (annual) from Table 3

0

{58}

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

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

{59}m=	0	0	0	0	0	0	0	0	0	0	0	0		{59}
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SAP WorkSheet: New dwelling design stage

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	(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=	91.54	80.06	82.62	72.03	69.11	59.64	55.27	63.42	64.18	74.79	81.64	88.65	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

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

Output from water heater

(64)m=	91.54	80.06	82.62	72.03	69.11	59.64	55.27	63.42	64.18	74.79	81.64	88.65	
Output from water heater (annual): 1.12												882.95	(64)

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

(65)m=	22.89	20.02	20.65	18.01	17.28	14.91	13.82	15.85	16.04	18.7	20.41	22.16	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	80.39	80.39	80.39	80.39	80.39	80.39	80.39	80.39	80.39	80.39	80.39	80.39	(66)

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

(67)m=	31.16	27.67	22.51	17.04	12.74	10.75	11.62	15.1	20.27	25.74	30.04	32.02	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	171.83	173.62	169.12	159.56	147.48	136.13	128.55	126.77	131.26	140.83	152.9	164.25	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	44.38	44.38	44.38	44.38	44.38	44.38	44.38	44.38	44.38	44.38	44.38	44.38	(69)
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Pumps and fans gains (Table 5a)

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

(71)m=	-53.59	-53.59	-53.59	-53.59	-53.59	-53.59	-53.59	-53.59	-53.59	-53.59	-53.59	-53.59	(71)
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Water heating gains (Table 5)

(72)m=	30.76	29.79	27.76	25.01	23.22	20.71	18.57	21.31	22.28	25.13	28.35	29.79	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	304.93	302.25	290.57	272.78	254.62	238.77	229.92	234.36	244.99	262.87	282.46	297.24	(73)
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6. Solar gains:

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

Orientation:	Access Factor Table 6d			Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	2.2	x	46.75	x	0.63	x	0.7	=	31.43	(78)
South	0.9x	0.77	x	2.2	x	76.57	x	0.63	x	0.7	=	51.48	(78)
South	0.9x	0.77	x	2.2	x	97.53	x	0.63	x	0.7	=	65.58	(78)
South	0.9x	0.77	x	2.2	x	110.23	x	0.63	x	0.7	=	74.12	(78)
South	0.9x	0.77	x	2.2	x	114.87	x	0.63	x	0.7	=	77.23	(78)

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South	0.9x	0.77	x	2.2	x	110.55	x	0.63	x	0.7	=	74.33	(78)
South	0.9x	0.77	x	2.2	x	108.01	x	0.63	x	0.7	=	72.62	(78)
South	0.9x	0.77	x	2.2	x	104.89	x	0.63	x	0.7	=	70.53	(78)
South	0.9x	0.77	x	2.2	x	101.89	x	0.63	x	0.7	=	68.5	(78)
South	0.9x	0.77	x	2.2	x	82.59	x	0.63	x	0.7	=	55.53	(78)
South	0.9x	0.77	x	2.2	x	55.42	x	0.63	x	0.7	=	37.26	(78)
South	0.9x	0.77	x	2.2	x	40.4	x	0.63	x	0.7	=	27.16	(78)
West	0.9x	0.77	x	0.7	x	19.64	x	0.63	x	0.7	=	4.2	(80)
West	0.9x	0.77	x	0.7	x	38.42	x	0.63	x	0.7	=	8.22	(80)
West	0.9x	0.77	x	0.7	x	63.27	x	0.63	x	0.7	=	13.54	(80)
West	0.9x	0.77	x	0.7	x	92.28	x	0.63	x	0.7	=	19.74	(80)
West	0.9x	0.77	x	0.7	x	113.09	x	0.63	x	0.7	=	24.19	(80)
West	0.9x	0.77	x	0.7	x	115.77	x	0.63	x	0.7	=	24.77	(80)
West	0.9x	0.77	x	0.7	x	110.22	x	0.63	x	0.7	=	23.58	(80)
West	0.9x	0.77	x	0.7	x	94.68	x	0.63	x	0.7	=	20.25	(80)
West	0.9x	0.77	x	0.7	x	73.59	x	0.63	x	0.7	=	15.74	(80)
West	0.9x	0.77	x	0.7	x	45.59	x	0.63	x	0.7	=	9.75	(80)
West	0.9x	0.77	x	0.7	x	24.49	x	0.63	x	0.7	=	5.24	(80)
West	0.9x	0.77	x	0.7	x	16.15	x	0.63	x	0.7	=	3.46	(80)

Solar gains in watts, calculated for each month

$$(83)m = \text{Sum}(74)m \dots (82)m$$

(83)m=	35.64	59.7	79.11	93.86	101.43	99.09	96.2	90.78	84.25	65.28	42.5	30.62	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	340.56	361.95	369.68	366.64	356.04	337.86	326.12	325.14	329.24	328.15	324.96	327.86	(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	0.91	0.89	0.85	0.78	0.67	0.54	0.56	0.71	0.84	0.9	0.93	(86)

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

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

(88)m=	20.35	20.35	20.36	20.37	20.37	20.38	20.38	20.38	20.37	20.37	20.36	20.36	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.92	0.9	0.88	0.83	0.76	0.63	0.48	0.5	0.67	0.82	0.89	0.93	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	20.35	20.35	20.36	20.37	20.37	20.38	20.38	20.38	20.37	20.37	20.36	20.36	(90)
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$$fLA = \text{Living area} \div (4) =$$

0.84 (91)

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

(92)m=	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	(93)
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8. Space heating calculation

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, h_m :

(94)m=	0.92	0.91	0.89	0.85	0.78	0.66	0.53	0.55	0.7	0.83	0.9	0.93	(94)
--------	------	------	------	------	------	------	------	------	-----	------	-----	------	------

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

(95)m=	314.9	329.19	327.64	310.16	277.35	223.85	172.59	177.9	230.96	273.98	293.01	304.98	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	804.43	772.95	693.54	569.67	435.58	294.54	201.08	209.93	319.47	487.65	656.94	799.54	(97)
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Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	364.21	298.21	272.22	186.85	117.72	0	0	0	0	158.97	262.03	367.96	
Total per year ($kWh/year$) = $Sum(98)_{1..12} =$												2028.16	(98)

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

54.19	(99)
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9. Energy requirements - individual heating systems (including micro-CHP)

Space heating:

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

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

Fraction of total heating from main system 1 $(204) = (202) \times [1 - (203)] =$ 1 (204)

Efficiency of main space heating system 1 314.44 (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)

364.21	298.21	272.22	186.85	117.72	0	0	0	0	158.97	262.03	367.96
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(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

115.83	94.84	86.57	59.42	37.44	0	0	0	0	50.56	83.33	117.02
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Total ($kWh/year$) = $Sum(211)_{1..12} =$ 645 (211)

Space heating fuel (secondary), $kWh/month$

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

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

Water heating

Output from water heater (calculated above)

91.54	80.06	82.62	72.03	69.11	59.64	55.27	63.42	64.18	74.79	81.64	88.65
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Efficiency of water heater 100 (216)

(217)m= 100 100 100 100 100 100 100 100 100 100 100 100 (217)

Fuel for water heating, $kWh/month$

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

(219)m=	91.54	80.06	82.62	72.03	69.11	59.64	55.27	63.42	64.18	74.79	81.64	88.65	
Total = $Sum(219a)_{1..12} =$												882.95	(219)

Annual totals

$kWh/year$

$kWh/year$

Space heating fuel used, main system 1

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Water heating fuel used		882.95	
Electricity for pumps, fans and electric keep-hot			
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	0	(231)
Electricity for lighting		220.1	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		1748.05	(338)

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 =	85.08 (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)	13.19	x 0.01 =	116.46 (247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	0 (249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a				
Energy for lighting	(232)	13.19	x 0.01 =	29.03 (250)
Additional standing charges (Table 12)				0 (251)

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

Total energy cost	(245)...(247) + (250)...(254) =	230.57	(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] =	1.17	(257)
SAP rating (Section 12)		83.61	(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	=	334.76 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.519	=	458.25 (264)
Space and water heating	(261) + (262) + (263) + (264) =			793.01 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	0 (267)
Electricity for lighting	(232) x	0.519	=	114.23 (268)
Total CO2, kg/year		sum of (265)...(271) =		907.24 (272)
CO2 emissions per m²		(272) ÷ (4) =		24.24 (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	3.07	=	1980.15 (261)

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Space heating (secondary)	{215} x	3.07	=	0	{263}
Energy for water heating	{219} x	3.07	=	2710.66	{264}
Space and water heating	{261} + {262} + {263} + {264} =			4690.81	{265}
Electricity for pumps, fans and electric keep-hot	{231} x	3.07	=	0	{267}
Electricity for lighting	{232} x	0	=	675.69	{268}
'Total Primary Energy		sum of {265}...{271} =		5366.51	{272}
Primary energy kWh/m²/year		{272} ÷ {4} =		143.37	{273}