

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.51
Printed on 01 February 2022 at 11:38:26

Project Information

Assessed By: Colin Marshall (STRO004020)

Building Type: Detached House

Dwelling Details

NEW DWELLING DESIGN STAGE

Total Floor Area: 143.2m²

Site Reference : Sefter School House, Bognor

Plot Reference: AA-18-01 SAP Design

Address : Plot 1, Sefter School House, Sefter Road, BOGNOR REGIS, PO21 3EE

Client Details

Name: Amiga Homes

Address :

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity

Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER)

24.47 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER)

18.25 kg/m²

OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)

59.0 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE)

57.9 kWh/m²

OK

2 Fabric U-values

Element

Average

Highest

External wall

0.23 (max. 0.30)

0.28 (max. 0.70)

OK

Floor

0.15 (max. 0.25)

0.15 (max. 0.70)

OK

Roof

0.13 (max. 0.20)

0.16 (max. 0.35)

OK

Openings

1.51 (max. 2.00)

1.60 (max. 3.30)

OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals

5.00 (design value)

Maximum

10.0

OK

4 Heating efficiency

Main Heating system:

Heat pumps with radiators or underfloor heating - electric

Air source heat pump with flow temperature <= 35°C

Secondary heating system:

None

5 Cylinder insulation

Hot water Storage:

Measured cylinder loss: 2.40 kWh/day

Permitted by DBSCG: 2.56 kWh/day

OK

Primary pipework insulated:

Yes

OK

6 Controls

Space heating controls

TTZC by plumbing and electrical services

OK

Hot water controls:

Cylinderstat

OK

Independent timer for DHW

OK

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7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Not applicable

9 Summer time temperatures

Overheating risk (South East England):	Not significant	OK
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Based on:

Overshading:	Average or unknown
Windows facing: North	5.62m²
Windows facing: South	9.9m²
Windows facing: East	6.56m²
Windows facing: West	5.04m²
Ventilation rate:	8.00

10 Key features

Roofs U-value	0.12 W/m²K
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SAP Input

Property Details: AR-13-01 SAP Design

Address: Plot 1, Sefter School House, Sefter Road, BOGNOR REGIS, PO21 3EE
Located in: England
Region: South East England
UPRN: RRN-2778-3014-6251-5518-1014
Date of assessment: 27 January 2022
Date of certificate: 01 February 2022
Assessment type: New dwelling design stage
Transaction type: Not sale or rental
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Indicative Value Medium
Water use <= 125 litres/person/day: True
PCDF Version: 489

Property description

Dwelling type: House
Detachment: Detached
Year Completed: 2022
Floor Location: **Floor area:** **Storey height:**
 Floor 0 71.6 m² 2.4 m
 Floor 1 71.6 m² 2.79 m
Living area: 19 m² (fraction 0.133)
Front of dwelling faces: North

Opening details

Name:	Source:	Type:	Glazing:	Argon:	Frame:
D	Manufacturer	Solid			
d	Manufacturer	Solid			
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
Folding D	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
D	mm	0	0	1.6	2.14	1
d	mm	0	0	1.6	1.89	1
W	16mm or more	0.7	0.63	1.5	5.62	1
W	16mm or more	0.7	0.63	1.5	9.9	1
W	16mm or more	0.7	0.63	1.5	6.56	1
Folding D	16mm or more	0.7	0.63	1.5	5.04	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
D		brick cavity	North	0	0
d		brick cavity	South	0	0
W		brick cavity	North	0	0
W		brick cavity	South	0	0
W		brick cavity	East	0	0
Folding D		render cavity	West	0	0

Overshading: Average or unknown

Overall Elements

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
brick cavity	152.3	26.11	126.19	0.21	0	False	N/A
render cavity	50.7	5.04	45.66	0.28	0	False	N/A

SAP Input

horiz ceilings	62	0	62	0.12	0	N/A
sloping ceilings	14.6	0	14.6	0.16	0	N/A
ground	71.6			0.15		N/A

Internal Elements

Party Elements

Thermal bridges:

Thermal bridges:	User-defined (individual PSI-values) Y-Value = 0.0498				
	Length	Psi-value			
	19	0.395	E1	Steel lintel with perforated steel base plate	
	14.3	0.034	E3	Sill	
	53.1	0.04	E4	Jamb	
	39.7	0.06	E5	Ground floor (normal)	
	39.7	0	E6	Intermediate floor within a dwelling	
	28.7	0.123	E10	Eaves (insulation at ceiling level)	
	6.1	0.034	E11	Eaves (insulation at rafter level)	
	4.8	0.08	E13	Gable (insulation at rafter level)	
	26	0.058	E16	Corner (normal)	
	9.2	-0.069	E17	Corner (inverted internal area greater than external area)	

Ventilation:

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

Main heating system:

Main heating system:	Heat pumps with radiators or underfloor heating
	Electric heat pumps
	Fuel: Electricity
	Info Source: SAP Tables
	SAP Table: 214
	Air source heat pump with flow temperature <= 35°C
	Underfloor heating, pipes in screed above insulation
	Central heating pump : 2012 or earlier
	Boiler interlock: Yes
	MCS Installation Certificate

Main heating Control:

Main heating Control:	Time and temperature zone control by suitable arrangement of plumbing and electrical services
	Control code: 2207

Secondary heating system:

Secondary heating system:	None
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Water heating:

Water heating:	From main heating system
	Water code: 901
	Fuel :Electricity
	Hot water cylinder
	Cylinder volume: 250 litres
	Cylinder insulation: Measured loss, 2.4kWh/day
	Primary pipework insulation: True
	Cylinderstat: True

SAP Input

Cylinder in heated space: True
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

Basic Details

Assessor Name: Colin Marshall **Stroma Number:** STRO004020
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: 40-46-01 SAP Design

Address : Plot 1, Seftor School House, Seftor Road, BOGNOR REGIS, PO21 3EE

1. Overall dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	71.6 (1a) ×	2.4 (2a) =	171.84 (3a)
First floor	71.6 (1b) ×	2.79 (2b) =	199.76 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	143.2 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	371.6 (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				5 × 10 =	50 (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) =	50	× (5) =	0.13 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]×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)			0.38 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			0 (19)
Shelter factor	(20) = 1 - [0.075 × (19)] =		1 (20)
Infiltration rate incorporating shelter factor	(21) = (18) × (20) =		0.38 (21)
Infiltration rate modified for monthly wind speed			

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

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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SAP WorkSheet: New dwelling design stage

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

	0.49	0.48	0.47	0.42	0.41	0.37	0.37	0.36	0.38	0.41	0.43	0.45
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(23c)

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

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

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

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

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

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

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

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

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

(24d)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6
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(24d)

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

(25)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6
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(25)

3. Thermal properties and heat loss calculation

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors Type 1			2.14	1.6	3.424		(26)
Doors Type 2			1.89	1.6	3.024		(26)
Windows Type 1			5.62	$\times 1/[1/(1.5)+0.04]$	7.95		(27)
Windows Type 2			9.9	$\times 1/[1/(1.5)+0.04]$	14.01		(27)
Windows Type 3			6.56	$\times 1/[1/(1.5)+0.04]$	9.28		(27)
Windows Type 4			5.04	$\times 1/[1/(1.5)+0.04]$	7.13		(27)
Floor			71.6	0.15	10.74		(28)
Walls Type1	152.3	26.11	126.19	0.21	26.5		(29)
Walls Type2	50.7	5.04	45.66	0.28	12.78		(29)
Roof Type1	62	0	62	0.12	7.44		(30)
Roof Type2	14.6	0	14.6	0.16	2.34		(30)
Total area of elements, m²			351.2				(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) =

104.63 (33)

Heat capacity Cm = S(A x k)

((28)...(30) + (32) + (32a)...(32e) =

18088.9 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K

Indicative Value: Medium

250 (35)

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

SAP WorkSheet: New dwelling design stage

can be used instead of a detailed calculation.

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

17.49 (36)

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

Total fabric heat loss

(33) + (36) =

122.12 (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=	76.05	75.48	74.92	72.29	71.79	69.5	69.5	69.07	70.38	71.79	72.79	73.83

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=	198.17	197.6	197.04	194.4	193.91	191.62	191.62	191.19	192.5	193.91	194.91	195.95
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Average = Sum(39)_{1...12} / 12 =

194.4 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m + (4)

(40)m=	1.38	1.38	1.38	1.36	1.35	1.34	1.34	1.34	1.34	1.35	1.36	1.37
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Average = Sum(40)_{1...12} / 12 =

1.36 (40)

Number of days in month (Table 1a)

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

(41)

4. Water heating energy requirement

Table 1c

Assumed occupancy, N

2.92

(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

103.62

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	113.98	109.84	105.69	101.55	97.4	93.26	93.26	97.4	101.55	105.69	109.84	113.98
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Total = Sum(44)_{1...12} =

1243.44 (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=	169.03	147.84	152.55	133	127.62	110.12	102.05	117.1	118.5	138.1	150.74	163.7
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Total = Sum(45)_{1...12} =

1630.34 (45)

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

(46)m=	25.35	22.18	22.88	19.95	19.14	16.52	15.31	17.56	17.77	20.71	22.61	24.55
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(46)

Water storage loss:

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

250

(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):

2.4

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

1.3

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

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Energy lost from water storage, kWh/year

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

0

(54)

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

1.3

(55)

Water storage loss calculated for each month

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

(56)m=	40.18	36.29	40.18	38.88	40.18	38.88	40.18	40.18	38.88	40.18	38.88	40.18
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(56)

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

(57)m=	40.18	36.29	40.18	38.88	40.18	38.88	40.18	40.18	38.88	40.18	38.88	40.18
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(57)

Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
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(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(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=	232.47	205.14	215.99	194.39	191.06	171.52	165.48	180.54	179.89	201.54	212.14	227.14
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(62)

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

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

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

Output from water heater

(64)m=	232.47	205.14	215.99	194.39	191.06	171.52	165.48	180.54	179.89	201.54	212.14	227.14
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Output from water heater (annual) =

2377.28

(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=	106.95	94.99	101.47	93.34	93.18	85.73	84.68	89.69	88.51	96.67	99.24	105.18
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(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5 Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m=	175.38	175.38	175.38	175.38	175.38	175.38	175.38	175.38	175.38	175.38	175.38	175.38

(66)

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

(67)m=	70.72	62.81	51.08	38.67	28.91	24.41	26.37	34.28	46.01	58.42	68.18	72.69
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(67)

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

(68)m=	467.2	472.04	459.83	433.82	400.99	370.13	349.52	344.67	356.89	382.9	415.73	446.58
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(68)

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

(69)m=	55.46	55.46	55.46	55.46	55.46	55.46	55.46	55.46	55.46	55.46	55.46	55.46
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(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10
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(70)

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

(71)m=	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92
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(71)

Water heating gains (Table 5)

(72)m=	143.76	141.36	136.39	129.63	125.25	119.07	113.82	120.55	122.94	129.93	137.83	141.37
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(72)

Total internal gains =

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

(73)m=	805.59	800.14	771.22	726.05	679.06	637.53	613.63	623.41	649.75	695.16	745.66	784.56
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(73)

6 Solar gains

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

SAP WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	5.62	x	10.63	x	0.63	x	0.7	=	18.26	(74)
North	0.9x	0.77	x	5.62	x	20.32	x	0.63	x	0.7	=	34.9	(74)
North	0.9x	0.77	x	5.62	x	34.53	x	0.63	x	0.7	=	59.31	(74)
North	0.9x	0.77	x	5.62	x	55.46	x	0.63	x	0.7	=	95.26	(74)
North	0.9x	0.77	x	5.62	x	74.72	x	0.63	x	0.7	=	128.33	(74)
North	0.9x	0.77	x	5.62	x	79.99	x	0.63	x	0.7	=	137.38	(74)
North	0.9x	0.77	x	5.62	x	74.68	x	0.63	x	0.7	=	128.26	(74)
North	0.9x	0.77	x	5.62	x	59.25	x	0.63	x	0.7	=	101.76	(74)
North	0.9x	0.77	x	5.62	x	41.52	x	0.63	x	0.7	=	71.31	(74)
North	0.9x	0.77	x	5.62	x	24.19	x	0.63	x	0.7	=	41.55	(74)
North	0.9x	0.77	x	5.62	x	13.12	x	0.63	x	0.7	=	22.53	(74)
North	0.9x	0.77	x	5.62	x	8.86	x	0.63	x	0.7	=	15.23	(74)
East	0.9x	0.77	x	6.56	x	19.64	x	0.63	x	0.7	=	39.38	(76)
East	0.9x	0.77	x	6.56	x	38.42	x	0.63	x	0.7	=	77.03	(76)
East	0.9x	0.77	x	6.56	x	63.27	x	0.63	x	0.7	=	126.85	(76)
East	0.9x	0.77	x	6.56	x	92.28	x	0.63	x	0.7	=	185.01	(76)
East	0.9x	0.77	x	6.56	x	113.09	x	0.63	x	0.7	=	226.73	(76)
East	0.9x	0.77	x	6.56	x	115.77	x	0.63	x	0.7	=	232.1	(76)
East	0.9x	0.77	x	6.56	x	110.22	x	0.63	x	0.7	=	220.97	(76)
East	0.9x	0.77	x	6.56	x	94.68	x	0.63	x	0.7	=	189.81	(76)
East	0.9x	0.77	x	6.56	x	73.59	x	0.63	x	0.7	=	147.53	(76)
East	0.9x	0.77	x	6.56	x	45.59	x	0.63	x	0.7	=	91.4	(76)
East	0.9x	0.77	x	6.56	x	24.49	x	0.63	x	0.7	=	49.1	(76)
East	0.9x	0.77	x	6.56	x	16.15	x	0.63	x	0.7	=	32.38	(76)
South	0.9x	0.77	x	9.9	x	46.75	x	0.63	x	0.7	=	141.45	(78)
South	0.9x	0.77	x	9.9	x	76.57	x	0.63	x	0.7	=	231.66	(78)
South	0.9x	0.77	x	9.9	x	97.53	x	0.63	x	0.7	=	295.1	(78)
South	0.9x	0.77	x	9.9	x	110.23	x	0.63	x	0.7	=	333.52	(78)
South	0.9x	0.77	x	9.9	x	114.87	x	0.63	x	0.7	=	347.55	(78)
South	0.9x	0.77	x	9.9	x	110.55	x	0.63	x	0.7	=	334.47	(78)
South	0.9x	0.77	x	9.9	x	108.01	x	0.63	x	0.7	=	326.8	(78)
South	0.9x	0.77	x	9.9	x	104.89	x	0.63	x	0.7	=	317.37	(78)
South	0.9x	0.77	x	9.9	x	101.89	x	0.63	x	0.7	=	308.26	(78)
South	0.9x	0.77	x	9.9	x	82.59	x	0.63	x	0.7	=	249.87	(78)
South	0.9x	0.77	x	9.9	x	55.42	x	0.63	x	0.7	=	167.67	(78)
South	0.9x	0.77	x	9.9	x	40.4	x	0.63	x	0.7	=	122.23	(78)
West	0.9x	0.77	x	5.04	x	19.64	x	0.63	x	0.7	=	30.25	(80)
West	0.9x	0.77	x	5.04	x	38.42	x	0.63	x	0.7	=	59.18	(80)
West	0.9x	0.77	x	5.04	x	63.27	x	0.63	x	0.7	=	97.46	(80)

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West	0.9x	0.77	x	5.04	x	92.28	x	0.63	x	0.7	=	142.14	(80)
West	0.9x	0.77	x	5.04	x	113.09	x	0.63	x	0.7	=	174.2	(80)
West	0.9x	0.77	x	5.04	x	115.77	x	0.63	x	0.7	=	178.32	(80)
West	0.9x	0.77	x	5.04	x	110.22	x	0.63	x	0.7	=	169.77	(80)
West	0.9x	0.77	x	5.04	x	94.68	x	0.63	x	0.7	=	145.83	(80)
West	0.9x	0.77	x	5.04	x	73.59	x	0.63	x	0.7	=	113.35	(80)
West	0.9x	0.77	x	5.04	x	45.59	x	0.63	x	0.7	=	70.22	(80)
West	0.9x	0.77	x	5.04	x	24.49	x	0.63	x	0.7	=	37.72	(80)
West	0.9x	0.77	x	5.04	x	16.15	x	0.63	x	0.7	=	24.88	(80)

Solar gains in watts, calculated for each month

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

(83)m=	229.34	402.77	578.71	755.93	876.8	882.27	845.79	754.76	640.45	453.03	277.02	194.71	(83)
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	------

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

(84)m=	1034.93	1202.91	1349.93	1481.97	1555.87	1519.79	1459.42	1378.17	1290.2	1148.2	1022.67	979.27	(84)
--------	---------	---------	---------	---------	---------	---------	---------	---------	--------	--------	---------	--------	------

7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.87	0.72	0.56	0.6	0.83	0.96	0.99	1	(86)

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

(87)m=	19.86	20	20.21	20.49	20.73	20.88	20.92	20.92	20.82	20.51	20.14	19.84	(87)
--------	-------	----	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	19.78	19.78	19.78	19.8	19.8	19.81	19.81	19.81	19.81	19.8	19.79	19.79	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.93	0.82	0.62	0.42	0.46	0.75	0.94	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.28	18.48	18.79	19.19	19.5	19.68	19.72	19.72	19.62	19.22	18.69	18.26	(90)
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fLA = Living area ÷ (4) = 0.13 (91)

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

(92)m=	18.49	18.68	18.98	19.36	19.67	19.84	19.88	19.88	19.78	19.39	18.88	18.47	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.49	18.68	18.98	19.36	19.67	19.84	19.88	19.88	19.78	19.39	18.88	18.47	(93)
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8. Space heating calculation

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

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

(94)m=	0.99	0.98	0.97	0.92	0.81	0.62	0.42	0.47	0.74	0.94	0.98	0.99	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	1026.39	1183.52	1303.61	1360.51	1264.12	944.19	619.52	650.98	958.82	1074.17	1006.33	972.84	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m]

(97)m=	2811.4	2722.61	2458.51	2033.86	1544.61	1004.06	627.92	664.45	1093.43	1705.08	2295.97	2795.57	(97)
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SAP WorkSheet: New dwelling design stage

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

(98)m=	1328.05	1034.27	859.25	484.81	208.68	0	0	0	0	469.39	928.54	1356.11	
Total per year (kWh/year) = $\text{Sum}(98)_{1..12}$ =													6669.1 (98)

Space heating requirement in kWh/m²/year

46.57 (99)

9a Energy calculation - 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

249.9 (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)

1328.05	1034.27	859.25	484.81	208.68	0	0	0	0	469.39	928.54	1356.11
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(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

531.43	413.87	343.84	194	83.51	0	0	0	0	187.83	371.57	542.66
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Total (kWh/year) = $\text{Sum}(211)_{1..12}$ = 2668.71 (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) = $\text{Sum}(215)_{1..12}$ = 0 (215)

Water heating

Output from water heater (calculated above)

232.47	205.14	215.99	194.39	191.06	171.52	165.48	180.54	179.89	201.54	212.14	227.14
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Efficiency of water heater

175.1 (216)

(217)m= 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 (217)

Fuel for water heating, kWh/month

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

(219)m=	132.76	117.15	123.35	111.02	109.11	97.95	94.51	103.11	102.74	115.1	121.15	129.72
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Total = $\text{Sum}(219a)_{1..12}$ = 1357.67 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

2668.71

Water heating fuel used

1357.67

Electricity for pumps, fans and electric keep-hot

central heating pump:

120 (230c)

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 120 (231)

Electricity for lighting

499.58 (232)

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

4645.96 (338)

10a Fuel costs - individual heating systems

Fuel
kWh/year

Fuel Price
(Table 12)

Fuel Cost
£/year

SAP WorkSheet: New dwelling design stage

Space heating - main system 1	(211) x	13.19	x 0.01 =	352	(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 =	179.08	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	15.83	(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 =	65.89	(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) = 612.8 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.37	(257)
SAP rating (Section 12)		80.92	(258)

12a. CO2 emissions - individual heating systems including metered CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.519	1385.06 (261)
Space heating (secondary)	(215) x	0.519	0 (263)
Water heating	(219) x	0.519	704.63 (264)
Space and water heating	(261) + (262) + (263) + (264) =		2089.69 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	62.28 (267)
Electricity for lighting	(232) x	0.519	259.28 (268)
Total CO2, kg/year		sum of (265) ... (271) =	2411.25 (272)
CO2 emissions per m²		(272) ÷ (4) =	16.84 (273)
EI rating (section 14)			83 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) x	3.07	8192.93 (261)
Space heating (secondary)	(215) x	3.07	0 (263)
Energy for water heating	(219) x	3.07	4168.05 (264)
Space and water heating	(261) + (262) + (263) + (264) =		12360.98 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	368.4 (267)
Electricity for lighting	(232) x	0	1533.71 (268)
'Total Primary Energy		sum of (265)...(271) =	14263.08 (272)

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Primary energy kWh/m²/year	{272} ÷ {4} =	99.6	{273}
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DER WorkSheet: New dwelling design stage

Basic Details

Assessor Name: Colin Marshall

Stroma Number:

STRO004020

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: 40-46 Old Stn Road

Address : Plot 1, Sefton School House, Sefton Road, BOGNOR REGIS, PO21 3EE

1. Overall dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	71.6 (1a) ×	2.4 (2a) =	171.84 (3a)
First floor	71.6 (1b) ×	2.79 (2b) =	199.76 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	143.2 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	371.6 (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				5	50 (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) =	50	× (5) =	0.13 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]×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)			0.38 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			0 (19)
Shelter factor	(20) = 1 - [0.075 × (19)] =		1 (20)
Infiltration rate incorporating shelter factor	(21) = (18) × (20) =		0.38 (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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DER WorkSheet: New dwelling design stage

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

	0.49	0.48	0.47	0.42	0.41	0.37	0.37	0.36	0.38	0.41	0.43	0.45
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(23c)

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

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

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

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

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

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

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

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

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

(24d)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6
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(24d)

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

(25)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6
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(25)

3. Fabric heat loss and heat capacity calculator

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors Type 1			2.14	1.6	3.424		(26)
Doors Type 2			1.89	1.6	3.024		(26)
Windows Type 1			5.62	$\times 1/[1/(1.5)+0.04]$	7.95		(27)
Windows Type 2			9.9	$\times 1/[1/(1.5)+0.04]$	14.01		(27)
Windows Type 3			6.56	$\times 1/[1/(1.5)+0.04]$	9.28		(27)
Windows Type 4			5.04	$\times 1/[1/(1.5)+0.04]$	7.13		(27)
Floor			71.6	0.15	10.74		(28)
Walls Type1	152.3	26.11	126.19	0.21	26.5		(29)
Walls Type2	50.7	5.04	45.66	0.28	12.78		(29)
Roof Type1	62	0	62	0.12	7.44		(30)
Roof Type2	14.6	0	14.6	0.16	2.34		(30)
Total area of elements, m²			351.2				(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) =

104.63 (33)

Heat capacity Cm = S(A x k)

((28)...(30) + (32) + (32a)...(32e) =

18088.9 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K

Indicative Value: Medium

250 (35)

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

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can be used instead of a detailed calculation.

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

17.49 (36)

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

Total fabric heat loss

(33) + (36) =

122.12 (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=	76.05	75.48	74.92	72.29	71.79	69.5	69.5	69.07	70.38	71.79	72.79	73.83

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=	198.17	197.6	197.04	194.4	193.91	191.62	191.62	191.19	192.5	193.91	194.91	195.95
--------	--------	-------	--------	-------	--------	--------	--------	--------	-------	--------	--------	--------

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

194.4 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m + (4)

(40)m=	1.38	1.38	1.38	1.36	1.35	1.34	1.34	1.34	1.34	1.35	1.36	1.37
--------	------	------	------	------	------	------	------	------	------	------	------	------

Average = Sum(40)_{1...12} / 12 =

1.36 (40)

Number of days in month (Table 1a)

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

(41)

4. Water heating energy requirement

Table 1c

Assumed occupancy, N

2.92

(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

103.62

(43)

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

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

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

(44)m=	113.98	109.84	105.69	101.55	97.4	93.26	93.26	97.4	101.55	105.69	109.84	113.98
--------	--------	--------	--------	--------	------	-------	-------	------	--------	--------	--------	--------

Total = Sum(44)_{1...12} =

1243.44 (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=	169.03	147.84	152.55	133	127.62	110.12	102.05	117.1	118.5	138.1	150.74	163.7
--------	--------	--------	--------	-----	--------	--------	--------	-------	-------	-------	--------	-------

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

1630.34 (45)

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

(46)m=	25.35	22.18	22.88	19.95	19.14	16.52	15.31	17.56	17.77	20.71	22.61	24.55
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(46)

Water storage loss:

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

250

(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):

2.4

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

1.3

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

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Energy lost from water storage, kWh/year

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

0

(54)

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

1.3

(55)

Water storage loss calculated for each month

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

(56)m=	40.18	36.29	40.18	38.88	40.18	38.88	40.18	40.18	38.88	40.18	38.88	40.18
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(56)

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

(57)m=	40.18	36.29	40.18	38.88	40.18	38.88	40.18	40.18	38.88	40.18	38.88	40.18
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(57)

Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0
--------	---	---	---	---	---	---	---	---	---	---	---	---

(61)

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

(62)m=	232.47	205.14	215.99	194.39	191.06	171.52	165.48	180.54	179.89	201.54	212.14	227.14
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(62)

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

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

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

(63)

Output from water heater

(64)m=	232.47	205.14	215.99	194.39	191.06	171.52	165.48	180.54	179.89	201.54	212.14	227.14
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Output from water heater (annual) × 12

2377.28

(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=	106.95	94.99	101.47	93.34	93.18	85.73	84.68	89.69	88.51	96.67	99.24	105.18
--------	--------	-------	--------	-------	-------	-------	-------	-------	-------	-------	-------	--------

(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=	146.15	146.15	146.15	146.15	146.15	146.15	146.15	146.15	146.15	146.15	146.15	146.15

(66)

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

(67)m=	28.29	25.13	20.43	15.47	11.56	9.76	10.55	13.71	18.4	23.37	27.27	29.07
--------	-------	-------	-------	-------	-------	------	-------	-------	------	-------	-------	-------

(67)

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

(68)m=	313.02	316.27	308.08	290.66	268.66	247.99	234.18	230.93	239.11	256.54	278.54	299.21
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(68)

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

(69)m=	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10
--------	----	----	----	----	----	----	----	----	----	----	----	----

(70)

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

(71)m=	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

(71)

Water heating gains (Table 5)

(72)m=	143.76	141.36	136.39	129.63	125.25	119.07	113.82	120.55	122.94	129.93	137.83	141.37
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(72)

Total internal gains =

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

(73)m=	561.91	559.6	541.75	512.61	482.32	453.66	435.39	442.03	457.3	486.68	520.48	546.5
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(73)

6 Solar gains

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

DER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m ²		Flux Table 6a		g _l Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	5.62	x	10.63	x	0.63	x	0.7	=	18.26	(74)
North	0.9x	0.77	x	5.62	x	20.32	x	0.63	x	0.7	=	34.9	(74)
North	0.9x	0.77	x	5.62	x	34.53	x	0.63	x	0.7	=	59.31	(74)
North	0.9x	0.77	x	5.62	x	55.46	x	0.63	x	0.7	=	95.26	(74)
North	0.9x	0.77	x	5.62	x	74.72	x	0.63	x	0.7	=	128.33	(74)
North	0.9x	0.77	x	5.62	x	79.99	x	0.63	x	0.7	=	137.38	(74)
North	0.9x	0.77	x	5.62	x	74.68	x	0.63	x	0.7	=	128.26	(74)
North	0.9x	0.77	x	5.62	x	59.25	x	0.63	x	0.7	=	101.76	(74)
North	0.9x	0.77	x	5.62	x	41.52	x	0.63	x	0.7	=	71.31	(74)
North	0.9x	0.77	x	5.62	x	24.19	x	0.63	x	0.7	=	41.55	(74)
North	0.9x	0.77	x	5.62	x	13.12	x	0.63	x	0.7	=	22.53	(74)
North	0.9x	0.77	x	5.62	x	8.86	x	0.63	x	0.7	=	15.23	(74)
East	0.9x	0.77	x	6.56	x	19.64	x	0.63	x	0.7	=	39.38	(76)
East	0.9x	0.77	x	6.56	x	38.42	x	0.63	x	0.7	=	77.03	(76)
East	0.9x	0.77	x	6.56	x	63.27	x	0.63	x	0.7	=	126.85	(76)
East	0.9x	0.77	x	6.56	x	92.28	x	0.63	x	0.7	=	185.01	(76)
East	0.9x	0.77	x	6.56	x	113.09	x	0.63	x	0.7	=	226.73	(76)
East	0.9x	0.77	x	6.56	x	115.77	x	0.63	x	0.7	=	232.1	(76)
East	0.9x	0.77	x	6.56	x	110.22	x	0.63	x	0.7	=	220.97	(76)
East	0.9x	0.77	x	6.56	x	94.68	x	0.63	x	0.7	=	189.81	(76)
East	0.9x	0.77	x	6.56	x	73.59	x	0.63	x	0.7	=	147.53	(76)
East	0.9x	0.77	x	6.56	x	45.59	x	0.63	x	0.7	=	91.4	(76)
East	0.9x	0.77	x	6.56	x	24.49	x	0.63	x	0.7	=	49.1	(76)
East	0.9x	0.77	x	6.56	x	16.15	x	0.63	x	0.7	=	32.38	(76)
South	0.9x	0.77	x	9.9	x	46.75	x	0.63	x	0.7	=	141.45	(78)
South	0.9x	0.77	x	9.9	x	76.57	x	0.63	x	0.7	=	231.66	(78)
South	0.9x	0.77	x	9.9	x	97.53	x	0.63	x	0.7	=	295.1	(78)
South	0.9x	0.77	x	9.9	x	110.23	x	0.63	x	0.7	=	333.52	(78)
South	0.9x	0.77	x	9.9	x	114.87	x	0.63	x	0.7	=	347.55	(78)
South	0.9x	0.77	x	9.9	x	110.55	x	0.63	x	0.7	=	334.47	(78)
South	0.9x	0.77	x	9.9	x	108.01	x	0.63	x	0.7	=	326.8	(78)
South	0.9x	0.77	x	9.9	x	104.89	x	0.63	x	0.7	=	317.37	(78)
South	0.9x	0.77	x	9.9	x	101.89	x	0.63	x	0.7	=	308.26	(78)
South	0.9x	0.77	x	9.9	x	82.59	x	0.63	x	0.7	=	249.87	(78)
South	0.9x	0.77	x	9.9	x	55.42	x	0.63	x	0.7	=	167.67	(78)
South	0.9x	0.77	x	9.9	x	40.4	x	0.63	x	0.7	=	122.23	(78)
West	0.9x	0.77	x	5.04	x	19.64	x	0.63	x	0.7	=	30.25	(80)
West	0.9x	0.77	x	5.04	x	38.42	x	0.63	x	0.7	=	59.18	(80)
West	0.9x	0.77	x	5.04	x	63.27	x	0.63	x	0.7	=	97.46	(80)

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West	0.9x	0.77	x	5.04	x	92.28	x	0.63	x	0.7	=	142.14	(80)
West	0.9x	0.77	x	5.04	x	113.09	x	0.63	x	0.7	=	174.2	(80)
West	0.9x	0.77	x	5.04	x	115.77	x	0.63	x	0.7	=	178.32	(80)
West	0.9x	0.77	x	5.04	x	110.22	x	0.63	x	0.7	=	169.77	(80)
West	0.9x	0.77	x	5.04	x	94.68	x	0.63	x	0.7	=	145.83	(80)
West	0.9x	0.77	x	5.04	x	73.59	x	0.63	x	0.7	=	113.35	(80)
West	0.9x	0.77	x	5.04	x	45.59	x	0.63	x	0.7	=	70.22	(80)
West	0.9x	0.77	x	5.04	x	24.49	x	0.63	x	0.7	=	37.72	(80)
West	0.9x	0.77	x	5.04	x	16.15	x	0.63	x	0.7	=	24.88	(80)

Solar gains in watts, calculated for each month

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

(83)m=	229.34	402.77	578.71	755.93	876.8	882.27	845.79	754.76	640.45	453.03	277.02	194.71	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	791.25	962.37	1120.47	1268.53	1359.12	1335.93	1281.18	1196.79	1097.75	939.72	797.5	741.21	(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=	1	1	0.99	0.97	0.91	0.78	0.62	0.67	0.88	0.98	1	1	(86)

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

(87)m=	19.75	19.89	20.11	20.41	20.67	20.85	20.92	20.9	20.77	20.42	20.03	19.73	(87)
--------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

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

(88)m=	19.78	19.78	19.78	19.8	19.8	19.81	19.81	19.81	19.81	19.8	19.79	19.79	(88)
--------	-------	-------	-------	------	------	-------	-------	-------	-------	------	-------	-------	------

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

(89)m=	1	0.99	0.99	0.96	0.87	0.68	0.47	0.53	0.82	0.97	1	1	(89)
--------	---	------	------	------	------	------	------	------	------	------	---	---	------

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

(90)m=	18.11	18.32	18.64	19.08	19.44	19.66	19.71	19.71	19.58	19.1	18.54	18.09	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

fLA = Living area ÷ (4) = 0.13 (91)

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

(92)m=	18.33	18.53	18.84	19.25	19.6	19.82	19.87	19.87	19.73	19.28	18.74	18.31	(92)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.33	18.53	18.84	19.25	19.6	19.82	19.87	19.87	19.73	19.28	18.74	18.31	(93)
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8. Space heating calculation

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

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

(94)m=	1	0.99	0.98	0.95	0.86	0.68	0.48	0.54	0.81	0.96	0.99	1	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	788.84	955.34	1099.59	1201.8	1169.92	913.13	613.65	641.17	890.7	906.7	792.28	739.52	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m]

(97)m=	2780.01	2692.35	2431.28	2012.72	1532.28	1000.19	627.16	663.2	1084.68	1682.85	2267.9	2765.04	(97)
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DER WorkSheet: New dwelling design stage

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

(98)m=	1481.43	1167.28	990.77	583.86	269.6	0	0	0	0	577.45	1062.44	1506.99	
Total per year (kWh/year) = Sum(98) _{1..12} =													7639.82 (98)

Space heating requirement in kWh/m²/year

53.35 (99)

12a Energy requirement for individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system		0 (201)
Fraction of space heat from main system(s)	(202) = 1 - (201) =	1 (202)
Fraction of total heating from main system 1	(204) = (202) × [1 - (203)] =	1 (204)
Efficiency of main space heating system 1		249.9 (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)

1481.43	1167.28	990.77	583.86	269.6	0	0	0	0	577.45	1062.44	1506.99
---------	---------	--------	--------	-------	---	---	---	---	--------	---------	---------

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

592.81	467.1	396.47	233.64	107.88	0	0	0	0	231.07	425.15	603.04
--------	-------	--------	--------	--------	---	---	---	---	--------	--------	--------

Total (kWh/year) = Sum(211)_{1..12} = 3057.15 (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)

232.47	205.14	215.99	194.39	191.06	171.52	165.48	180.54	179.89	201.54	212.14	227.14
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater 175.1 (216)

(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1
---------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Fuel for water heating, kWh/month

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

(219)m=	132.76	117.15	123.35	111.02	109.11	97.95	94.51	103.11	102.74	115.1	121.15	129.72
---------	--------	--------	--------	--------	--------	-------	-------	--------	--------	-------	--------	--------

Total = Sum(219a)_{1..12} = 1357.67 (219)

Annual totals

Space heating fuel used, main system 1 kWh/year 3057.15

Water heating fuel used kWh/year 1357.67

Electricity for pumps, fans and electric keep-hot

central heating pump: 120 (230c)

Total electricity for the above, kWh/year sum of (230a)...(230g) = 120 (231)

Electricity for lighting 499.58 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = 5034.4 (338)

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

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

Space heating (main system 1)	(211) x	0.519	=	1586.66	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	704.63	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2291.29	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	62.28	(267)
Electricity for lighting	(232) x	0.519	=	259.28	(268)
Total CO2, kg/year	sum of (265)...(271) =			2612.85	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			18.25	(273)
El rating (section 14)				81	(274)

TER WorkSheet: New dwelling design stage

Base Details

Assessor Name: Colin Marshall
Software Name: Stroma FSAP 2012

Stroma Number: STRO004020
Software Version: Version: 1.0.5.51

Property Address: 40-46-51 SAP Group

Address : Plot 1, Seftor School House, Seftor Road, BOGNOR REGIS, PO21 3EE

1. Overall dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	71.6 (1a) ×	2.4 (2a) =	171.84 (3a)
First floor	71.6 (1b) ×	2.79 (2b) =	199.76 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	143.2 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	371.6 (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				4 × 10 =	40 (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) =	40	× (5) =	0.11 (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)			0.36 (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			0 (19)
Shelter factor	(20) = 1 - [0.075 × (19)] =		1 (20)
Infiltration rate incorporating shelter factor	(21) = (18) × (20) =		0.36 (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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TER WorkSheet: New dwelling design stage

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

	0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42
--	------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(23c)

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

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

(24a)

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

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

(24b)

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

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

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

(24c)

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

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

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59
---------	-----	-----	-----	------	------	------	------	------	------	------	------	------

(24d)

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

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59
--------	-----	-----	-----	------	------	------	------	------	------	------	------	------

(25)

3. Thermal properties and heat loss calculation

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors Type 1			2.14	1	2.14		(26)
Doors Type 2			1.89	1	1.89		(26)
Windows Type 1			5.62	$\times 1/[1/(1.4) + 0.04]$	7.45		(27)
Windows Type 2			9.9	$\times 1/[1/(1.4) + 0.04]$	13.12		(27)
Windows Type 3			6.56	$\times 1/[1/(1.4) + 0.04]$	8.7		(27)
Windows Type 4			5.04	$\times 1/[1/(1.4) + 0.04]$	6.68		(27)
Floor			71.6	0.13	9.308		(28)
Walls Type1	152.3	26.11	126.19	0.18	22.71		(29)
Walls Type2	50.7	5.04	45.66	0.18	8.22		(29)
Roof Type1	62	0	62	0.13	8.06		(30)
Roof Type2	14.6	0	14.6	0.13	1.9		(30)
Total area of elements, m²			351.2				(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) = 90.18 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 18088.9 (34)

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

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

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can be used instead of a detailed calculation.

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

14.53 (36)

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

Total fabric heat loss

(33) + (36) =

104.72 (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=	74.06	73.57	73.08	70.8	70.38	68.39	68.39	68.02	69.16	70.38	71.24	72.14

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=	178.78	178.29	177.8	175.52	175.1	173.11	173.11	172.74	173.87	175.1	175.96	176.86
--------	--------	--------	-------	--------	-------	--------	--------	--------	--------	-------	--------	--------

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

175.52 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m + (4)

(40)m=	1.25	1.25	1.24	1.23	1.22	1.21	1.21	1.21	1.21	1.22	1.23	1.24
--------	------	------	------	------	------	------	------	------	------	------	------	------

Average = Sum(40)_{1...12} / 12 =

1.23 (40)

Number of days in month (Table 1a)

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

(41)

4. Water heating energy requirement

Table 1c

Assumed occupancy, N

2.92

(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

103.62

(43)

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

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

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

(44)m=	113.98	109.84	105.69	101.55	97.4	93.26	93.26	97.4	101.55	105.69	109.84	113.98
--------	--------	--------	--------	--------	------	-------	-------	------	--------	--------	--------	--------

Total = Sum(44)_{1...12} =

1243.44 (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=	169.03	147.84	152.55	133	127.62	110.12	102.05	117.1	118.5	138.1	150.74	163.7
--------	--------	--------	--------	-----	--------	--------	--------	-------	-------	-------	--------	-------

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

1630.34 (45)

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

(46)m=	25.35	22.18	22.88	19.95	19.14	16.52	15.31	17.56	17.77	20.71	22.61	24.55
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(46)

Water storage loss:

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

150

(47)

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

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

Water storage loss:

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

1.89

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

1.02

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

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Energy lost from water storage, kWh/year

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

0

(54)

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

1.02

(55)

Water storage loss calculated for each month

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

(56)m=	31.64	28.58	31.64	30.62	31.64	30.62	31.64	31.64	30.62	31.64	30.62	31.64
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(56)

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

(57)m=	31.64	28.58	31.64	30.62	31.64	30.62	31.64	31.64	30.62	31.64	30.62	31.64
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(57)

Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
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(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(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=	223.94	197.43	207.46	186.14	182.52	163.26	156.95	172.01	171.63	193	203.88	218.61
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(62)

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

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

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

(63)

Output from water heater

(64)m=	223.94	197.43	207.46	186.14	182.52	163.26	156.95	172.01	171.63	193	203.88	218.61
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-----	--------	--------

Output from water heater (annual) × 12

2276.83

(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=	100.13	88.83	94.65	86.73	86.36	79.12	77.86	82.86	81.91	89.84	92.63	98.36
--------	--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(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=	146.15	146.15	146.15	146.15	146.15	146.15	146.15	146.15	146.15	146.15	146.15	146.15

(66)

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

(67)m=	28.29	25.13	20.43	15.47	11.56	9.76	10.55	13.71	18.4	23.37	27.27	29.07
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(67)

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

(68)m=	313.02	316.27	308.08	290.66	268.66	247.99	234.18	230.93	239.11	256.54	278.54	299.21
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(68)

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

(69)m=	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(69)

Pumps and fans gains (Table 5a)

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

(70)

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

(71)m=	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92	-116.92
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(71)

Water heating gains (Table 5)

(72)m=	134.58	132.19	127.22	120.46	116.07	109.9	104.64	111.37	113.76	120.76	128.65	132.2
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(72)

Total internal gains =

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

(73)m=	545.74	543.43	525.58	496.43	466.14	437.49	419.21	425.86	441.12	470.51	504.31	530.33
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(73)

6 Solar gains

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

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Orientation:		Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	5.62	x	10.63	x	0.63	x	0.7	=	18.26	(74)
North	0.9x	0.77	x	5.62	x	20.32	x	0.63	x	0.7	=	34.9	(74)
North	0.9x	0.77	x	5.62	x	34.53	x	0.63	x	0.7	=	59.31	(74)
North	0.9x	0.77	x	5.62	x	55.46	x	0.63	x	0.7	=	95.26	(74)
North	0.9x	0.77	x	5.62	x	74.72	x	0.63	x	0.7	=	128.33	(74)
North	0.9x	0.77	x	5.62	x	79.99	x	0.63	x	0.7	=	137.38	(74)
North	0.9x	0.77	x	5.62	x	74.68	x	0.63	x	0.7	=	128.26	(74)
North	0.9x	0.77	x	5.62	x	59.25	x	0.63	x	0.7	=	101.76	(74)
North	0.9x	0.77	x	5.62	x	41.52	x	0.63	x	0.7	=	71.31	(74)
North	0.9x	0.77	x	5.62	x	24.19	x	0.63	x	0.7	=	41.55	(74)
North	0.9x	0.77	x	5.62	x	13.12	x	0.63	x	0.7	=	22.53	(74)
North	0.9x	0.77	x	5.62	x	8.86	x	0.63	x	0.7	=	15.23	(74)
East	0.9x	0.77	x	6.56	x	19.64	x	0.63	x	0.7	=	39.38	(76)
East	0.9x	0.77	x	6.56	x	38.42	x	0.63	x	0.7	=	77.03	(76)
East	0.9x	0.77	x	6.56	x	63.27	x	0.63	x	0.7	=	126.85	(76)
East	0.9x	0.77	x	6.56	x	92.28	x	0.63	x	0.7	=	185.01	(76)
East	0.9x	0.77	x	6.56	x	113.09	x	0.63	x	0.7	=	226.73	(76)
East	0.9x	0.77	x	6.56	x	115.77	x	0.63	x	0.7	=	232.1	(76)
East	0.9x	0.77	x	6.56	x	110.22	x	0.63	x	0.7	=	220.97	(76)
East	0.9x	0.77	x	6.56	x	94.68	x	0.63	x	0.7	=	189.81	(76)
East	0.9x	0.77	x	6.56	x	73.59	x	0.63	x	0.7	=	147.53	(76)
East	0.9x	0.77	x	6.56	x	45.59	x	0.63	x	0.7	=	91.4	(76)
East	0.9x	0.77	x	6.56	x	24.49	x	0.63	x	0.7	=	49.1	(76)
East	0.9x	0.77	x	6.56	x	16.15	x	0.63	x	0.7	=	32.38	(76)
South	0.9x	0.77	x	9.9	x	46.75	x	0.63	x	0.7	=	141.45	(78)
South	0.9x	0.77	x	9.9	x	76.57	x	0.63	x	0.7	=	231.66	(78)
South	0.9x	0.77	x	9.9	x	97.53	x	0.63	x	0.7	=	295.1	(78)
South	0.9x	0.77	x	9.9	x	110.23	x	0.63	x	0.7	=	333.52	(78)
South	0.9x	0.77	x	9.9	x	114.87	x	0.63	x	0.7	=	347.55	(78)
South	0.9x	0.77	x	9.9	x	110.55	x	0.63	x	0.7	=	334.47	(78)
South	0.9x	0.77	x	9.9	x	108.01	x	0.63	x	0.7	=	326.8	(78)
South	0.9x	0.77	x	9.9	x	104.89	x	0.63	x	0.7	=	317.37	(78)
South	0.9x	0.77	x	9.9	x	101.89	x	0.63	x	0.7	=	308.26	(78)
South	0.9x	0.77	x	9.9	x	82.59	x	0.63	x	0.7	=	249.87	(78)
South	0.9x	0.77	x	9.9	x	55.42	x	0.63	x	0.7	=	167.67	(78)
South	0.9x	0.77	x	9.9	x	40.4	x	0.63	x	0.7	=	122.23	(78)
West	0.9x	0.77	x	5.04	x	19.64	x	0.63	x	0.7	=	30.25	(80)
West	0.9x	0.77	x	5.04	x	38.42	x	0.63	x	0.7	=	59.18	(80)
West	0.9x	0.77	x	5.04	x	63.27	x	0.63	x	0.7	=	97.46	(80)

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West	0.9x	0.77	x	5.04	x	92.28	x	0.63	x	0.7	=	142.14	(80)
West	0.9x	0.77	x	5.04	x	113.09	x	0.63	x	0.7	=	174.2	(80)
West	0.9x	0.77	x	5.04	x	115.77	x	0.63	x	0.7	=	178.32	(80)
West	0.9x	0.77	x	5.04	x	110.22	x	0.63	x	0.7	=	169.77	(80)
West	0.9x	0.77	x	5.04	x	94.68	x	0.63	x	0.7	=	145.83	(80)
West	0.9x	0.77	x	5.04	x	73.59	x	0.63	x	0.7	=	113.35	(80)
West	0.9x	0.77	x	5.04	x	45.59	x	0.63	x	0.7	=	70.22	(80)
West	0.9x	0.77	x	5.04	x	24.49	x	0.63	x	0.7	=	37.72	(80)
West	0.9x	0.77	x	5.04	x	16.15	x	0.63	x	0.7	=	24.88	(80)

Solar gains in watts, calculated for each month

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

(83)m=	229.34	402.77	578.71	755.93	876.8	882.27	845.79	754.76	640.45	453.03	277.02	194.71	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	775.08	946.2	1104.29	1252.36	1342.95	1319.76	1265.01	1180.62	1081.58	923.54	781.32	725.04	(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=	1	1	0.99	0.97	0.9	0.75	0.58	0.64	0.87	0.98	1	1	(86)

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

(87)m=	19.58	19.76	20.04	20.41	20.73	20.92	20.98	20.97	20.83	20.41	19.92	19.55	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.88	19.88	19.89	19.9	19.9	19.91	19.91	19.91	19.91	19.9	19.9	19.89	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.95	0.85	0.65	0.45	0.5	0.8	0.97	1	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.98	18.25	18.67	19.2	19.63	19.86	19.91	19.9	19.77	19.21	18.5	17.95	(90)
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fLA = Living area ÷ (4) =

0.13 (91)

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

(92)m=	18.19	18.45	18.85	19.36	19.77	20	20.05	20.05	19.91	19.37	18.69	18.16	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.19	18.45	18.85	19.36	19.77	20	20.05	20.05	19.91	19.37	18.69	18.16	(93)
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8. Space heating calculation

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

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

(94)m=	1	0.99	0.98	0.94	0.85	0.66	0.47	0.52	0.8	0.96	0.99	1	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	772.86	939.26	1082.58	1180.44	1138.36	875.41	588.57	615.29	863.72	889.4	776.33	723.52	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m]

(97)m=	2484.01	2415.9	2195.64	1835.92	1413.53	934.99	597.07	629.7	1010.29	1534.98	2039.35	2469.62	(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=	1273.1	992.3	828.12	471.94	204.73	0	0	0	0	480.31	909.37	1299.1	
Total per year (kWh/year) = Sum(98) _{1...12} =													6458.97 (98)

Space heating requirement in kWh/m²/year

45.1 (99)

9a Energy calculation - Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system		0 (201)
Fraction of space heat from main system(s)	(202) = 1 - (201) =	1 (202)
Fraction of total heating from main system 1	(204) = (202) × [1 - (203)] =	1 (204)
Efficiency of main space heating system 1		93.5 (206)
Efficiency of secondary/supplementary heating system, %		0 (208)

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

1273.1	992.3	828.12	471.94	204.73	0	0	0	0	480.31	909.37	1299.1
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(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

1361.6	1061.29	885.69	504.75	218.96	0	0	0	0	513.7	972.59	1389.42
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Total (kWh/year) = Sum(211)_{1...12} = 6907.99 (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)

223.94	197.43	207.46	186.14	182.52	163.26	156.95	172.01	171.63	193	203.88	218.61
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Efficiency of water heater 79.8 (216)

(217)m=	88.72	88.53	88.13	87.19	85.12	79.8	79.8	79.8	79.8	87.15	88.33	88.79	(217)
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Fuel for water heating, kWh/month

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

(219)m=	252.41	223.01	235.4	213.48	214.43	204.59	196.68	215.55	215.08	221.46	230.81	246.22	
Total = Sum(219a) _{1...12} =													2669.1 (219)

Annual totals

Space heating fuel used, main system 1 kWh/year 6907.99

Water heating fuel used kWh/year 2669.1

Electricity for pumps, fans and electric keep-hot

central heating pump: 30 (230c)

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

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

Electricity for lighting 499.58 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = 10151.67 (338)

9b CO₂ emissions - Individual heating systems including micro-CHP

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	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) ×	0.216	≡	1492.13	(261)
Space heating (secondary)	(215) ×	0.519	≡	0	(263)
Water heating	(219) ×	0.216	≡	576.53	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2068.65	(265)
Electricity for pumps, fans and electric keep-hot	(231) ×	0.519	≡	38.93	(267)
Electricity for lighting	(232) ×	0.519	≡	259.28	(268)
Total CO2, kg/year		sum of (265)...(271) ≡		2366.86	(272)
TER =				24.47	(273)