

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41
Printed on 09 July 2021 at 09:40:19

Project Information:

Assessed By: Colin Marshall (STRO004020)

Building Type: Semi-detached Bungalow

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 91.4m²

Site Reference : 47 SOUTH WAY

Plot Reference: ZF-57-02 - SAP Design

Address : Unit 2, 47 SOUTH WAY, BOGNOR REGIS, PO21 5EY

Client Details:

Name: Mr. P. Nichol

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) 27.19 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 19.23 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 57.3 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 56.4 kWh/m² OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.12 (max. 0.35)	OK
Openings	1.69 (max. 2.00)	1.80 (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: 2.20 kWh/day Permitted by DBSCG: 2.30 kWh/day	OK
Primary pipework insulated:	Yes	OK

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	90.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (South East England):	Not significant	OK
Based on:		
Overshading:	Average or unknown	
Windows facing: West	0.88m ²	
Windows facing: North	0.88m ²	
Windows facing: North West	3.35m ²	
Windows facing: South East	1.3m ²	
Windows facing: South East	6.3m ²	
Windows facing: South West	4.7m ²	
Ventilation rate:	8.00	
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours	

10 Key features

Roofs U-value	0.12 W/m ² K
Party Walls U-value	0 W/m ² K
Floors U-value	0.11 W/m ² K

SAP Input

Property Details: 21-07-02 - SAP Design

Address: Unit 2, 47 SOUTH WAY, BOGNOR REGIS, PO21 5EY
Located in: England
Region: South East England
UPRN: UPRN-100061705782
Date of assessment: 07 July 2021
Date of certificate: 09 July 2021
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: False
PCDF Version: 479

Property Description

Dwelling type: Bungalow
Detachment: Semi-detached
Year Completed: 2021

Floor Location: **Floor area:** **Storey height:**
 Basement floor 91.4 m² 2.46 m
 Living area: 37 m² (fraction 0.405)
 Front of dwelling faces: North East

Opening types

Name:	Source:	Type:	Glazing:	Argon:	Frame:
front D	Manufacturer	Solid	low-E, En = 0.05, soft coat	Yes	Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	Wood
glazed D	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	Wood
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	Wood

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
front D	16mm or more mm	0.7	0.63	1.8	2.1	1
W	16mm or more	0.7	0.63	1.6	0.88	1
W	16mm or more	0.7	0.63	1.6	0.88	1
W	16mm or more	0.7	0.63	1.6	3.35	1
W	16mm or more	0.7	0.63	1.6	1.3	1
glazed D	16mm or more	0.7	0.63	1.8	6.3	1
W	16mm or more	0.7	0.63	1.6	4.7	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
front D		cavity wall	South West	0	0
W		cavity wall	West	0	0
W		cavity wall	North	0	0
W		cavity wall	North West	0	0
W		cavity wall	South East	0	0
glazed D		cavity wall	South East	0	0
W		cavity wall	South West	0	0

Overshading: Average or unknown

Opening Elements

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
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SAP Input

External Elements

cavity wall	70.4	19.51	50.89	0.25	0	False	N/A
roof	91.4	0	91.4	0.12	0		N/A
ground	91.4			0.11			N/A

Internal Elements

Party Elements

party wall	39.4						N/A
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Thermal bridges:

Thermal bridges:

User-defined (individual PSI-values) Y-Value = 0.0651

Length	Psi-value		
28.6	0.055	E5	Ground floor (normal)
12.5	0.31	E1	Steel lintel with perforated steel base plate
8.1	0.038	E3	Sill
20.4	0.042	E4	Jamb
22.4	0.114	E10	Eaves (insulation at ceiling level)
15.8	0.057	E12	Gable (insulation at ceiling level)
9.84	0.048	E16	Corner (normal)
9.84	-0.068	E17	Corner (inverted internal area greater than external area)
4.92	0.043	E18	Party wall between dwellings
16.01	0.16	P1	Ground floor
16.01	0.24	P4	Roof (insulation at ceiling level)

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:	1
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 : 2013 or later
	Design flow temperature: Unknown
	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

SAP Input

Cylinder volume: 210 litres
Cylinder insulation: Measured loss, 2.2kWh/day
Primary pipework insulation: True
Cylinderstat: True
Cylinder in heated space: True
Flue Gas Heat Recovery System:
Database (rev 479, product index)
Waste Water Heat Recovery System:
Total rooms with shower and/or bath: 1
Product index: 080077, RECOUP Pipe+ System B
Number of mixer showers in rooms with a bath: 1
Number of mixer showers in rooms without a bath: 0
Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Unknown
Conservatory:	No conservatory
Low energy lights:	90%
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: Colin Marshall **Stroma Number:** STRO004020
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.41

Property Address: 2F 67 02 - SAP Design

Address : Unit 2, 47 SOUTH WAY, BOGNOR REGIS, PO21 5EY

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Basement	91.4 (1a)	2.46 (2a)	224.84 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	91.4 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	224.84 (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) =	0.09 (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)			0.34 (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			1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.92 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.31 (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

0.4	0.39	0.38	0.34	0.34	0.3	0.3	0.29	0.31	0.34	0.35	0.37
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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= 0.58 0.58 0.57 0.56 0.56 0.54 0.54 0.54 0.55 0.56 0.56 0.57 (24d)

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

(25)m= 0.58 0.58 0.57 0.56 0.56 0.54 0.54 0.54 0.55 0.56 0.56 0.57 (25)

3. Heat losses and heat loss parameter

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.1	1.8	3.78		(26)
Windows Type 1			0.88	$\times 1/[1/(1.6) + 0.04]$	1.32		(27)
Windows Type 2			0.88	$\times 1/[1/(1.6) + 0.04]$	1.32		(27)
Windows Type 3			3.35	$\times 1/[1/(1.6) + 0.04]$	5.04		(27)
Windows Type 4			1.3	$\times 1/[1/(1.6) + 0.04]$	1.95		(27)
Windows Type 5			6.3	$\times 1/[1/(1.8) + 0.04]$	10.58		(27)
Windows Type 6			4.7	$\times 1/[1/(1.6) + 0.04]$	7.07		(27)
Floor			91.4	0.11	10.054		(28)
Walls	70.4	19.51	50.89	0.25	12.72		(29)
Roof	91.4	0	91.4	0.12	10.97		(30)
Total area of elements, m²			253.2				(31)
Party wall			39.4	0	0		(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 64.81 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 18331.9 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 16.49 (36)

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

SAP WorkSheet: New dwelling design stage

Total fabric heat loss	{33} + {36} =											81.3	{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=	43.03	42.8	42.57	41.51	41.31	40.39	40.39	40.22	40.75	41.31	41.71	42.13		{38}
Heat transfer coefficient, W/K	{39}m = {37} + {38}m													
{39}m=	124.32	124.09	123.87	122.81	122.61	121.69	121.69	121.51	122.04	122.61	123.01	123.43		
	Average = Sum{39} / 12 =											122.81	{39}	
Heat loss parameter (HLP), W/m²K	{40}m = {39}m ÷ {4}													
{40}m=	1.36	1.36	1.36	1.34	1.34	1.33	1.33	1.33	1.34	1.34	1.35	1.35		
	Average = Sum{40} / 12 =											1.34	{40}	
Number of days in month (Table 1a)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
{41}m=	31	28	31	30	31	30	31	31	30	31	30	31		{41}
4. Water heating energy requirement kWh/year														
Assumed occupancy, N												2.64	{42}	
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)														
if TFA ≤ 13.9, N = 1														
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36												102.11	{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=	112.32	108.24	104.15	100.07	95.98	91.9	91.9	95.98	100.07	104.15	108.24	112.32		
	Total = Sum{44} / 12 =											1225.32	{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=	166.57	145.68	150.33	131.06	125.76	108.52	100.56	115.39	116.77	136.09	148.55	161.31		
	Total = Sum{45} / 12 =											1606.59	{45}	
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)														
{46}m=	24.99	21.85	22.55	19.66	18.86	16.28	15.08	17.31	17.52	20.41	22.28	24.2		{46}
Water storage loss:														
Storage volume (litres) including any solar or WWHRS storage within same vessel												210	{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):												2.2	{48}	
Temperature factor from Table 2b												0.54	{49}	
Energy lost from water storage, kWh/year	{48} x {49} =											1.19	{50}	
b) If manufacturer's declared cylinder loss factor is not known:														
Hot water storage loss factor from Table 2 (kWh/litre/day)												0	{51}	
If community heating see section 4.3														
Volume factor from Table 2a												0	{52}	
Temperature factor from Table 2b												0	{53}	
Energy lost from water storage, kWh/year	{47} x {51} x {52} x {53} =											0	{54}	
Enter (50) or (54) in (55)												1.19	{55}	

SAP WorkSheet: New dwelling design stage

Water storage loss calculated for each month

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

(56)m=	36.83	33.26	36.83	35.64	36.83	35.64	36.83	36.83	35.64	36.83	35.64	36.83	(56)
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If cylinder contains dedicated solar storage, $\{(57)\}m = \{(56)\}m \times [(\{(50)\} - (H11)) \div (50)]$, else $\{(57)\}m = \{(56)\}m$ where (H11) is from Appendix H

(57)m=	36.83	33.26	36.83	35.64	36.83	35.64	36.83	36.83	35.64	36.83	35.64	36.83	(57)
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Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss calculated for each month $\{(61)\}m = (60) \div 365 \times (41)m$

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

(62)m=	226.66	199.96	210.42	189.21	185.85	166.67	160.65	175.48	174.92	196.18	206.7	221.4	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
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FGHRs	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)
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WWHRs	-37.49	-32.99	-33.67	-27.72	-25.74	-21.24	-17.99	-21.78	-22.41	-27.69	-32.06	-36.23	(63) (G10)
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Output from water heater

(64)m=	189.17	166.97	176.75	161.5	160.1	145.43	142.66	153.7	152.51	168.49	174.64	185.17	
Output from water heater (annual): _{1..12}												1977.09	(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=	103.46	91.86	98.06	90.1	89.89	82.6	81.51	86.44	85.35	93.32	95.91	101.71	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	158.66	158.66	158.66	158.66	158.66	158.66	158.66	158.66	158.66	158.66	158.66	158.66	(66)

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

(67)m=	60	53.29	43.34	32.81	24.53	20.71	22.38	29.08	39.04	49.57	57.85	61.67	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	360.64	364.38	354.95	334.88	309.53	285.72	269.8	266.06	275.49	295.57	320.91	344.73	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	53.51	53.51	53.51	53.51	53.51	53.51	53.51	53.51	53.51	53.51	53.51	53.51	(69)
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Pumps and fans gains (Table 5a)

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

(71)m=	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	(71)
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Water heating gains (Table 5)

(72)m=	139.05	136.7	131.8	125.14	120.82	114.73	109.55	116.18	118.54	125.43	133.21	136.71	(72)
--------	--------	-------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Total internal gains =

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

(73)m=	669.1	663.77	639.49	602.23	564.28	530.55	511.13	520.73	542.47	579.96	621.37	652.5	(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.

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	0.88	x	10.63	x	0.63	x	0.7	=	2.86	(74)
North	0.9x	0.77	x	0.88	x	20.32	x	0.63	x	0.7	=	5.47	(74)
North	0.9x	0.77	x	0.88	x	34.53	x	0.63	x	0.7	=	9.29	(74)
North	0.9x	0.77	x	0.88	x	55.46	x	0.63	x	0.7	=	14.92	(74)
North	0.9x	0.77	x	0.88	x	74.72	x	0.63	x	0.7	=	20.09	(74)
North	0.9x	0.77	x	0.88	x	79.99	x	0.63	x	0.7	=	21.51	(74)
North	0.9x	0.77	x	0.88	x	74.68	x	0.63	x	0.7	=	20.08	(74)
North	0.9x	0.77	x	0.88	x	59.25	x	0.63	x	0.7	=	15.93	(74)
North	0.9x	0.77	x	0.88	x	41.52	x	0.63	x	0.7	=	11.17	(74)
North	0.9x	0.77	x	0.88	x	24.19	x	0.63	x	0.7	=	6.51	(74)
North	0.9x	0.77	x	0.88	x	13.12	x	0.63	x	0.7	=	3.53	(74)
North	0.9x	0.77	x	0.88	x	8.86	x	0.63	x	0.7	=	2.38	(74)
Southeast	0.9x	0.77	x	1.3	x	36.79	x	0.63	x	0.7	=	14.62	(77)
Southeast	0.9x	0.77	x	6.3	x	36.79	x	0.63	x	0.7	=	70.84	(77)
Southeast	0.9x	0.77	x	1.3	x	62.67	x	0.63	x	0.7	=	24.9	(77)
Southeast	0.9x	0.77	x	6.3	x	62.67	x	0.63	x	0.7	=	120.67	(77)
Southeast	0.9x	0.77	x	1.3	x	85.75	x	0.63	x	0.7	=	34.07	(77)
Southeast	0.9x	0.77	x	6.3	x	85.75	x	0.63	x	0.7	=	165.1	(77)
Southeast	0.9x	0.77	x	1.3	x	106.25	x	0.63	x	0.7	=	42.21	(77)
Southeast	0.9x	0.77	x	6.3	x	106.25	x	0.63	x	0.7	=	204.57	(77)
Southeast	0.9x	0.77	x	1.3	x	119.01	x	0.63	x	0.7	=	47.28	(77)
Southeast	0.9x	0.77	x	6.3	x	119.01	x	0.63	x	0.7	=	229.14	(77)
Southeast	0.9x	0.77	x	1.3	x	118.15	x	0.63	x	0.7	=	46.94	(77)
Southeast	0.9x	0.77	x	6.3	x	118.15	x	0.63	x	0.7	=	227.48	(77)
Southeast	0.9x	0.77	x	1.3	x	113.91	x	0.63	x	0.7	=	45.26	(77)
Southeast	0.9x	0.77	x	6.3	x	113.91	x	0.63	x	0.7	=	219.32	(77)
Southeast	0.9x	0.77	x	1.3	x	104.39	x	0.63	x	0.7	=	41.47	(77)
Southeast	0.9x	0.77	x	6.3	x	104.39	x	0.63	x	0.7	=	200.99	(77)
Southeast	0.9x	0.77	x	1.3	x	92.85	x	0.63	x	0.7	=	36.89	(77)
Southeast	0.9x	0.77	x	6.3	x	92.85	x	0.63	x	0.7	=	178.77	(77)
Southeast	0.9x	0.77	x	1.3	x	69.27	x	0.63	x	0.7	=	27.52	(77)
Southeast	0.9x	0.77	x	6.3	x	69.27	x	0.63	x	0.7	=	133.37	(77)
Southeast	0.9x	0.77	x	1.3	x	44.07	x	0.63	x	0.7	=	17.51	(77)
Southeast	0.9x	0.77	x	6.3	x	44.07	x	0.63	x	0.7	=	84.85	(77)
Southeast	0.9x	0.77	x	1.3	x	31.49	x	0.63	x	0.7	=	12.51	(77)
Southeast	0.9x	0.77	x	6.3	x	31.49	x	0.63	x	0.7	=	60.63	(77)
Southwest	0.9x	0.77	x	4.7	x	36.79		0.63	x	0.7	=	52.85	(79)
Southwest	0.9x	0.77	x	4.7	x	62.67		0.63	x	0.7	=	90.02	(79)
Southwest	0.9x	0.77	x	4.7	x	85.75		0.63	x	0.7	=	123.17	(79)

SAP WorkSheet: New dwelling design stage

Southwest	0.9x	0.77	x	4.7	x	106.25	0.63	x	0.7	=	152.62	(79)
Southwest	0.9x	0.77	x	4.7	x	119.01	0.63	x	0.7	=	170.94	(79)
Southwest	0.9x	0.77	x	4.7	x	118.15	0.63	x	0.7	=	169.71	(79)
Southwest	0.9x	0.77	x	4.7	x	113.91	0.63	x	0.7	=	163.62	(79)
Southwest	0.9x	0.77	x	4.7	x	104.39	0.63	x	0.7	=	149.94	(79)
Southwest	0.9x	0.77	x	4.7	x	92.85	0.63	x	0.7	=	133.37	(79)
Southwest	0.9x	0.77	x	4.7	x	69.27	0.63	x	0.7	=	99.49	(79)
Southwest	0.9x	0.77	x	4.7	x	44.07	0.63	x	0.7	=	63.3	(79)
Southwest	0.9x	0.77	x	4.7	x	31.49	0.63	x	0.7	=	45.23	(79)
West	0.9x	0.77	x	0.88	x	19.64	0.63	x	0.7	=	5.28	(80)
West	0.9x	0.77	x	0.88	x	38.42	0.63	x	0.7	=	10.33	(80)
West	0.9x	0.77	x	0.88	x	63.27	0.63	x	0.7	=	17.02	(80)
West	0.9x	0.77	x	0.88	x	92.28	0.63	x	0.7	=	24.82	(80)
West	0.9x	0.77	x	0.88	x	113.09	0.63	x	0.7	=	30.42	(80)
West	0.9x	0.77	x	0.88	x	115.77	0.63	x	0.7	=	31.14	(80)
West	0.9x	0.77	x	0.88	x	110.22	0.63	x	0.7	=	29.64	(80)
West	0.9x	0.77	x	0.88	x	94.68	0.63	x	0.7	=	25.46	(80)
West	0.9x	0.77	x	0.88	x	73.59	0.63	x	0.7	=	19.79	(80)
West	0.9x	0.77	x	0.88	x	45.59	0.63	x	0.7	=	12.26	(80)
West	0.9x	0.77	x	0.88	x	24.49	0.63	x	0.7	=	6.59	(80)
West	0.9x	0.77	x	0.88	x	16.15	0.63	x	0.7	=	4.34	(80)
Northwest	0.9x	0.77	x	3.35	x	11.28	0.63	x	0.7	=	11.55	(81)
Northwest	0.9x	0.77	x	3.35	x	22.97	0.63	x	0.7	=	23.51	(81)
Northwest	0.9x	0.77	x	3.35	x	41.38	0.63	x	0.7	=	42.36	(81)
Northwest	0.9x	0.77	x	3.35	x	67.96	0.63	x	0.7	=	69.57	(81)
Northwest	0.9x	0.77	x	3.35	x	91.35	0.63	x	0.7	=	93.52	(81)
Northwest	0.9x	0.77	x	3.35	x	97.38	0.63	x	0.7	=	99.7	(81)
Northwest	0.9x	0.77	x	3.35	x	91.1	0.63	x	0.7	=	93.27	(81)
Northwest	0.9x	0.77	x	3.35	x	72.63	0.63	x	0.7	=	74.36	(81)
Northwest	0.9x	0.77	x	3.35	x	50.42	0.63	x	0.7	=	51.62	(81)
Northwest	0.9x	0.77	x	3.35	x	28.07	0.63	x	0.7	=	28.74	(81)
Northwest	0.9x	0.77	x	3.35	x	14.2	0.63	x	0.7	=	14.53	(81)
Northwest	0.9x	0.77	x	3.35	x	9.21	0.63	x	0.7	=	9.43	(81)

Solar gains in watts, calculated for each month

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

(83)m=	158	274.9	391.01	508.71	591.4	596.48	571.18	508.16	431.61	307.88	190.31	134.53	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	827.1	938.68	1030.51	1110.94	1155.67	1127.03	1082.32	1028.89	974.08	887.84	811.69	787.03	(84)
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7. Mean internal temperature (see Table 9a)

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

21 (85)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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SAP WorkSheet: New dwelling design stage

(86)m=	0.99	0.98	0.96	0.91	0.81	0.64	0.48	0.53	0.75	0.93	0.98	0.99	(86)
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Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20	20.14	20.34	20.59	20.79	20.9	20.93	20.93	20.86	20.6	20.26	19.98	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.79	19.8	19.8	19.81	19.81	19.82	19.82	19.82	19.81	19.81	19.81	19.8	(88)
--------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

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

(89)m=	0.99	0.97	0.95	0.88	0.75	0.54	0.36	0.4	0.66	0.9	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=	18.5	18.69	18.98	19.33	19.58	19.7	19.72	19.72	19.67	19.36	18.87	18.46	(90)
--------	------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.4 \quad (91)$$

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

(92)m=	19.11	19.28	19.53	19.84	20.07	20.19	20.21	20.21	20.15	19.86	19.43	19.08	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	19.11	19.28	19.53	19.84	20.07	20.19	20.21	20.21	20.15	19.86	19.43	19.08	(93)
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4. Space heating requirement

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

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

(94)m=	0.98	0.97	0.95	0.88	0.77	0.58	0.4	0.44	0.69	0.9	0.97	0.99	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	813.48	911.64	974.19	982.76	884.09	650	434.99	455.92	671.85	800.18	787.4	776.36	(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=	1840.86	1784.04	1614.05	1343.24	1026.18	679.96	439.65	463.12	738.24	1135.74	1517.22	1836.08	(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=	764.37	586.26	476.06	259.54	105.71	0	0	0	0	249.65	525.47	788.43	(98)
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$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..12} = 3755.49 \quad (99)$$

Space heating requirement in kWh/m²/year

$$41.09 \quad (99)$$

5a. Energy requirements: Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

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

Fraction of total heating from main system 1

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

Efficiency of main space heating system 1

$$249.9 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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kWh/year

Space heating requirement (calculated above)

764.37	586.26	476.06	259.54	105.71	0	0	0	0	249.65	525.47	788.43
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$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

305.87	234.6	190.5	103.86	42.3	0	0	0	0	99.9	210.27	315.5
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$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..12} = 1502.8 \quad (211)$$

SAP WorkSheet: New dwelling design stage

Space heating fuel (secondary), kWh/month

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

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

Water heating

Output from water heater (calculated above)

	189.17	166.97	176.75	161.5	160.1	145.43	142.66	153.7	152.51	168.49	174.64	185.17		
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=	108.03	95.36	100.94	92.23	91.44	83.05	81.47	87.78	87.1	96.22	99.74	105.75		
Total = Sum(219a) _{1...12} =													1129.12	(219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

Total electricity for the above, kWh/year

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

30 (231)

Electricity for lighting

423.87 (232)

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

3085.79 (233)

10a Fuel costs - individual heating systems

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	198.22 (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 =	148.93 (247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96 (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 =	55.91 (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) = 407.02 (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] =	1.25	(257)
SAP rating (Section 12)		82.52	(258)

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

SAP WorkSheet: New dwelling design stage

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	{211} x	0.519	=	779.95	{261}
Space heating (secondary)	{215} x	0.519	=	0	{263}
Water heating	{219} x	0.519	=	586.01	{264}
Space and water heating	{261} + {262} + {263} + {264} =			1365.97	{265}
Electricity for pumps, fans and electric keep-hot	{231} x	0.519	=	15.57	{267}
Electricity for lighting	{232} x	0.519	=	219.99	{268}
Total CO2, kg/year		sum of {265}...{271} =		1601.53	{272}
CO2 emissions per m²		{272} ÷ {4} =		17.52	{273}
El rating (section 14)				84	{274}

13a Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	{211} x	3.07	=	4613.59	{261}
Space heating (secondary)	{215} x	3.07	=	0	{263}
Energy for water heating	{219} x	3.07	=	3466.4	{264}
Space and water heating	{261} + {262} + {263} + {264} =			8079.99	{265}
Electricity for pumps, fans and electric keep-hot	{231} x	3.07	=	92.1	{267}
Electricity for lighting	{232} x	0	=	1301.29	{268}
'Total Primary Energy		sum of {265}...{271} =		9473.38	{272}
Primary energy kWh/m²/year		{272} ÷ {4} =		103.65	{273}

DER WorkSheet: New dwelling design stage

User Details

Assessor Name: Colin Marshall

Stroma Number:

STRO004020

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.41

Property Address: 2F 67 02 - SAP Design

Address : Unit 2, 47 SOUTH WAY, BOGNOR REGIS, PO21 5EY

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Basement	91.4 (1a)	2.46 (2a)	224.84 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	91.4 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	224.84 (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) =	0.09 (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)			0.34 (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			1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.92 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.31 (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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DER WorkSheet: New dwelling design stage

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

0.4	0.39	0.38	0.34	0.34	0.3	0.3	0.29	0.31	0.34	0.35	0.37
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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= 0.58 0.58 0.57 0.56 0.56 0.54 0.54 0.54 0.55 0.56 0.56 0.57 (24d)

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

(25)m= 0.58 0.58 0.57 0.56 0.56 0.54 0.54 0.54 0.55 0.56 0.56 0.57 (25)

3. Heat losses and heat loss parameter

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.1	1.8	3.78		(26)
Windows Type 1			0.88	$\times 1/[1/(1.6) + 0.04]$	1.32		(27)
Windows Type 2			0.88	$\times 1/[1/(1.6) + 0.04]$	1.32		(27)
Windows Type 3			3.35	$\times 1/[1/(1.6) + 0.04]$	5.04		(27)
Windows Type 4			1.3	$\times 1/[1/(1.6) + 0.04]$	1.95		(27)
Windows Type 5			6.3	$\times 1/[1/(1.8) + 0.04]$	10.58		(27)
Windows Type 6			4.7	$\times 1/[1/(1.6) + 0.04]$	7.07		(27)
Floor			91.4	0.11	10.054		(28)
Walls	70.4	19.51	50.89	0.25	12.72		(29)
Roof	91.4	0	91.4	0.12	10.97		(30)
Total area of elements, m²			253.2				(31)
Party wall			39.4	0	0		(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 64.81 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 18331.9 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 16.49 (36)

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

DER WorkSheet: New dwelling design stage

Total fabric heat loss (33) + (36) = 81.3 (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=	43.03	42.8	42.57	41.51	41.31	40.39	40.39	40.22	40.75	41.31	41.71	42.13	(38)

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

(39)m=	124.32	124.09	123.87	122.81	122.61	121.69	121.69	121.51	122.04	122.61	123.01	123.43	
Average = Sum(39) _{1...12} / 12=												122.81	(39)

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

(40)m=	1.36	1.36	1.36	1.34	1.34	1.33	1.33	1.33	1.34	1.34	1.35	1.35	
Average = Sum(40) _{1...12} / 12=												1.34	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement kWh/year

Assumed occupancy, N 2.64 (42)

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

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 102.11 (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=	112.32	108.24	104.15	100.07	95.98	91.9	91.9	95.98	100.07	104.15	108.24	112.32	

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

Total = Sum(44) _{1...12} =												1225.32	(44)
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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=	166.57	145.68	150.33	131.06	125.76	108.52	100.56	115.39	116.77	136.09	148.55	161.31	
Total = Sum(45) _{1...12} =												1606.59	(45)

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

(46)m=	24.99	21.85	22.55	19.66	18.86	16.28	15.08	17.31	17.52	20.41	22.28	24.2	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (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): 2.2 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.19 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 1.19 (55)

DER WorkSheet: New dwelling design stage

Water storage loss calculated for each month

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

(56)m=	36.83	33.26	36.83	35.64	36.83	35.64	36.83	36.83	35.64	36.83	35.64	36.83	(56)
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If cylinder contains dedicated solar storage, $\{(57)\}m = \{(56)\}m \times [(\{(50)\} - (H11))] \div \{(50)\}$, else $\{(57)\}m = \{(56)\}m$ where (H11) is from Appendix H

(57)m=	36.83	33.26	36.83	35.64	36.83	35.64	36.83	36.83	35.64	36.83	35.64	36.83	(57)
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Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss calculated for each month $\{(61)\}m = (60) \div 365 \times \{(41)\}m$

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

(62)m=	226.66	199.96	210.42	189.21	185.85	166.67	160.65	175.48	174.92	196.18	206.7	221.4	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
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FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)
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WWHRs	-37.49	-32.99	-33.67	-27.72	-25.74	-21.24	-17.99	-21.78	-22.41	-27.69	-32.06	-36.23	(63) (G10)
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Output from water heater

(64)m=	189.17	166.97	176.75	161.5	160.1	145.43	142.66	153.7	152.51	168.49	174.64	185.17	
Output from water heater (annual): _{1..12}												1977.09	(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=	103.46	91.86	98.06	90.1	89.89	82.6	81.51	86.44	85.35	93.32	95.91	101.71	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	132.22	132.22	132.22	132.22	132.22	132.22	132.22	132.22	132.22	132.22	132.22	132.22	(66)

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

(67)m=	24	21.32	17.34	13.13	9.81	8.28	8.95	11.63	15.61	19.83	23.14	24.67	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	241.63	244.14	237.82	224.37	207.39	191.43	180.77	178.26	184.58	198.03	215.01	230.97	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.22	36.22	36.22	36.22	36.22	36.22	36.22	36.22	36.22	36.22	36.22	36.22	(69)
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Pumps and fans gains (Table 5a)

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

(71)m=	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	(71)
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Water heating gains (Table 5)

(72)m=	139.05	136.7	131.8	125.14	120.82	114.73	109.55	116.18	118.54	125.43	133.21	136.71	(72)
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Total internal gains =

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

(73)m=	470.35	467.82	452.62	428.3	403.68	380.11	364.94	371.74	384.4	408.95	437.03	458.01	(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.

DER 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	0.88	x	10.63	x	0.63	x	0.7	=	2.86	(74)
North	0.9x	0.77	x	0.88	x	20.32	x	0.63	x	0.7	=	5.47	(74)
North	0.9x	0.77	x	0.88	x	34.53	x	0.63	x	0.7	=	9.29	(74)
North	0.9x	0.77	x	0.88	x	55.46	x	0.63	x	0.7	=	14.92	(74)
North	0.9x	0.77	x	0.88	x	74.72	x	0.63	x	0.7	=	20.09	(74)
North	0.9x	0.77	x	0.88	x	79.99	x	0.63	x	0.7	=	21.51	(74)
North	0.9x	0.77	x	0.88	x	74.68	x	0.63	x	0.7	=	20.08	(74)
North	0.9x	0.77	x	0.88	x	59.25	x	0.63	x	0.7	=	15.93	(74)
North	0.9x	0.77	x	0.88	x	41.52	x	0.63	x	0.7	=	11.17	(74)
North	0.9x	0.77	x	0.88	x	24.19	x	0.63	x	0.7	=	6.51	(74)
North	0.9x	0.77	x	0.88	x	13.12	x	0.63	x	0.7	=	3.53	(74)
North	0.9x	0.77	x	0.88	x	8.86	x	0.63	x	0.7	=	2.38	(74)
Southeast	0.9x	0.77	x	1.3	x	36.79	x	0.63	x	0.7	=	14.62	(77)
Southeast	0.9x	0.77	x	6.3	x	36.79	x	0.63	x	0.7	=	70.84	(77)
Southeast	0.9x	0.77	x	1.3	x	62.67	x	0.63	x	0.7	=	24.9	(77)
Southeast	0.9x	0.77	x	6.3	x	62.67	x	0.63	x	0.7	=	120.67	(77)
Southeast	0.9x	0.77	x	1.3	x	85.75	x	0.63	x	0.7	=	34.07	(77)
Southeast	0.9x	0.77	x	6.3	x	85.75	x	0.63	x	0.7	=	165.1	(77)
Southeast	0.9x	0.77	x	1.3	x	106.25	x	0.63	x	0.7	=	42.21	(77)
Southeast	0.9x	0.77	x	6.3	x	106.25	x	0.63	x	0.7	=	204.57	(77)
Southeast	0.9x	0.77	x	1.3	x	119.01	x	0.63	x	0.7	=	47.28	(77)
Southeast	0.9x	0.77	x	6.3	x	119.01	x	0.63	x	0.7	=	229.14	(77)
Southeast	0.9x	0.77	x	1.3	x	118.15	x	0.63	x	0.7	=	46.94	(77)
Southeast	0.9x	0.77	x	6.3	x	118.15	x	0.63	x	0.7	=	227.48	(77)
Southeast	0.9x	0.77	x	1.3	x	113.91	x	0.63	x	0.7	=	45.26	(77)
Southeast	0.9x	0.77	x	6.3	x	113.91	x	0.63	x	0.7	=	219.32	(77)
Southeast	0.9x	0.77	x	1.3	x	104.39	x	0.63	x	0.7	=	41.47	(77)
Southeast	0.9x	0.77	x	6.3	x	104.39	x	0.63	x	0.7	=	200.99	(77)
Southeast	0.9x	0.77	x	1.3	x	92.85	x	0.63	x	0.7	=	36.89	(77)
Southeast	0.9x	0.77	x	6.3	x	92.85	x	0.63	x	0.7	=	178.77	(77)
Southeast	0.9x	0.77	x	1.3	x	69.27	x	0.63	x	0.7	=	27.52	(77)
Southeast	0.9x	0.77	x	6.3	x	69.27	x	0.63	x	0.7	=	133.37	(77)
Southeast	0.9x	0.77	x	1.3	x	44.07	x	0.63	x	0.7	=	17.51	(77)
Southeast	0.9x	0.77	x	6.3	x	44.07	x	0.63	x	0.7	=	84.85	(77)
Southeast	0.9x	0.77	x	1.3	x	31.49	x	0.63	x	0.7	=	12.51	(77)
Southeast	0.9x	0.77	x	6.3	x	31.49	x	0.63	x	0.7	=	60.63	(77)
Southwest	0.9x	0.77	x	4.7	x	36.79		0.63	x	0.7	=	52.85	(79)
Southwest	0.9x	0.77	x	4.7	x	62.67		0.63	x	0.7	=	90.02	(79)
Southwest	0.9x	0.77	x	4.7	x	85.75		0.63	x	0.7	=	123.17	(79)

DER WorkSheet: New dwelling design stage

Southwest	0.9x	0.77	x	4.7	x	106.25	0.63	x	0.7	=	152.62	(79)
Southwest	0.9x	0.77	x	4.7	x	119.01	0.63	x	0.7	=	170.94	(79)
Southwest	0.9x	0.77	x	4.7	x	118.15	0.63	x	0.7	=	169.71	(79)
Southwest	0.9x	0.77	x	4.7	x	113.91	0.63	x	0.7	=	163.62	(79)
Southwest	0.9x	0.77	x	4.7	x	104.39	0.63	x	0.7	=	149.94	(79)
Southwest	0.9x	0.77	x	4.7	x	92.85	0.63	x	0.7	=	133.37	(79)
Southwest	0.9x	0.77	x	4.7	x	69.27	0.63	x	0.7	=	99.49	(79)
Southwest	0.9x	0.77	x	4.7	x	44.07	0.63	x	0.7	=	63.3	(79)
Southwest	0.9x	0.77	x	4.7	x	31.49	0.63	x	0.7	=	45.23	(79)
West	0.9x	0.77	x	0.88	x	19.64	0.63	x	0.7	=	5.28	(80)
West	0.9x	0.77	x	0.88	x	38.42	0.63	x	0.7	=	10.33	(80)
West	0.9x	0.77	x	0.88	x	63.27	0.63	x	0.7	=	17.02	(80)
West	0.9x	0.77	x	0.88	x	92.28	0.63	x	0.7	=	24.82	(80)
West	0.9x	0.77	x	0.88	x	113.09	0.63	x	0.7	=	30.42	(80)
West	0.9x	0.77	x	0.88	x	115.77	0.63	x	0.7	=	31.14	(80)
West	0.9x	0.77	x	0.88	x	110.22	0.63	x	0.7	=	29.64	(80)
West	0.9x	0.77	x	0.88	x	94.68	0.63	x	0.7	=	25.46	(80)
West	0.9x	0.77	x	0.88	x	73.59	0.63	x	0.7	=	19.79	(80)
West	0.9x	0.77	x	0.88	x	45.59	0.63	x	0.7	=	12.26	(80)
West	0.9x	0.77	x	0.88	x	24.49	0.63	x	0.7	=	6.59	(80)
West	0.9x	0.77	x	0.88	x	16.15	0.63	x	0.7	=	4.34	(80)
Northwest	0.9x	0.77	x	3.35	x	11.28	0.63	x	0.7	=	11.55	(81)
Northwest	0.9x	0.77	x	3.35	x	22.97	0.63	x	0.7	=	23.51	(81)
Northwest	0.9x	0.77	x	3.35	x	41.38	0.63	x	0.7	=	42.36	(81)
Northwest	0.9x	0.77	x	3.35	x	67.96	0.63	x	0.7	=	69.57	(81)
Northwest	0.9x	0.77	x	3.35	x	91.35	0.63	x	0.7	=	93.52	(81)
Northwest	0.9x	0.77	x	3.35	x	97.38	0.63	x	0.7	=	99.7	(81)
Northwest	0.9x	0.77	x	3.35	x	91.1	0.63	x	0.7	=	93.27	(81)
Northwest	0.9x	0.77	x	3.35	x	72.63	0.63	x	0.7	=	74.36	(81)
Northwest	0.9x	0.77	x	3.35	x	50.42	0.63	x	0.7	=	51.62	(81)
Northwest	0.9x	0.77	x	3.35	x	28.07	0.63	x	0.7	=	28.74	(81)
Northwest	0.9x	0.77	x	3.35	x	14.2	0.63	x	0.7	=	14.53	(81)
Northwest	0.9x	0.77	x	3.35	x	9.21	0.63	x	0.7	=	9.43	(81)

Solar gains in watts, calculated for each month

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

(83)m=	158	274.9	391.01	508.71	591.4	596.48	571.18	508.16	431.61	307.88	190.31	134.53	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	628.35	742.72	843.63	937.01	995.08	976.59	936.12	879.9	816.01	716.83	627.34	592.53	(84)
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

7. Mean internal temperature (see Table 9a)

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

DER WorkSheet: New dwelling design stage

(86)m=	1	0.99	0.98	0.95	0.87	0.71	0.55	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	20.22	20.49	20.73	20.88	20.92	20.92	20.82	20.5	20.13	19.84	(87)
--------	-------	----	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

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

(88)m=	19.79	19.8	19.8	19.81	19.81	19.82	19.82	19.82	19.81	19.81	19.81	19.8	(88)
--------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

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

(89)m=	1	0.99	0.97	0.93	0.82	0.61	0.41	0.46	0.75	0.95	0.99	1	(89)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	18.29	18.49	18.81	19.21	19.52	19.69	19.72	19.72	19.63	19.23	18.69	18.26	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.4 \quad (91)$$

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

(92)m=	18.93	19.1	19.38	19.73	20.01	20.17	20.21	20.21	20.11	19.75	19.27	18.9	(92)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

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

(93)m=	18.93	19.1	19.38	19.73	20.01	20.17	20.21	20.21	20.11	19.75	19.27	18.9	(93)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

4. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.99	0.97	0.93	0.83	0.65	0.46	0.51	0.77	0.95	0.99	1	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

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

(95)m=	624.52	733.13	819.01	868.43	822.07	631.11	431.2	449.77	629.17	678.16	619.61	589.71	(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)
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Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m - (96)m]

(97)m=	1818.37	1762.72	1595.44	1329.67	1019.06	677.88	439.2	462.41	733.45	1121.27	1497.32	1814.02	(97)
--------	---------	---------	---------	---------	---------	--------	-------	--------	--------	---------	---------	---------	------

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

(98)m=	888.22	691.89	577.66	332.09	146.56	0	0	0	0	329.67	631.95	910.88	(98)
--------	--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..12} = 4508.92 \quad (99)$$

Space heating requirement in kWh/m²/year

$$49.33 \quad (99)$$

5a. Energy requirements - individual heating systems including micro-CHP

Space heating:

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

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

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

Efficiency of main space heating system 1 249.9 (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)

888.22	691.89	577.66	332.09	146.56	0	0	0	0	329.67	631.95	910.88
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

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

355.43	276.87	231.16	132.89	58.65	0	0	0	0	131.92	252.88	364.5
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$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..12} = 1804.29 \quad (211)$$

DER WorkSheet: New dwelling design stage

Space heating fuel (secondary), kWh/month

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

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

Water heating

Output from water heater (calculated above)

	189.17	166.97	176.75	161.5	160.1	145.43	142.66	153.7	152.51	168.49	174.64	185.17		
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=	108.03	95.36	100.94	92.23	91.44	83.05	81.47	87.78	87.1	96.22	99.74	105.75		
Total = Sum(219a) _{1...12} =													1129.12	(219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

Total electricity for the above, kWh/year

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

30 (231)

Electricity for lighting

423.87 (232)

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

3387.28 (238)

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	=	936.43	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	586.01	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1522.44	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	219.99	(268)
Total CO2, kg/year		sum of (265)...(271) =		1758	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		19.23	(273)
EI rating (section 14)				83	(274)

TER WorkSheet: New dwelling design stage

User Details

Assessor Name: Colin Marshall
Software Name: Stroma FSAP 2012

Stroma Number: STRO004020
Software Version: Version: 1.0.5.41

Property Address: 2F 67 02 - SAP Design

Address : Unit 2, 47 SOUTH WAY, BOGNOR REGIS, PO21 5EY

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Basement	91.4 (1a)	2.46 (2a)	224.84 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	91.4 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	224.84 (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				3	30 (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) =	30	÷ (5) =	0.13 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.38 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.92 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.35 (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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TER WorkSheet: New dwelling design stage

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

0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	0.4	0.42
------	------	------	------	------	------	------	------	------	------	-----	------

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

3. Heat losses and heat loss parameter

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.1	1	2.1		(26)
Windows Type 1			0.88	$\times 1/[1/(1.4) + 0.04]$	1.17		(27)
Windows Type 2			0.88	$\times 1/[1/(1.4) + 0.04]$	1.17		(27)
Windows Type 3			3.35	$\times 1/[1/(1.4) + 0.04]$	4.44		(27)
Windows Type 4			1.3	$\times 1/[1/(1.4) + 0.04]$	1.72		(27)
Windows Type 5			6.3	$\times 1/[1/(1.4) + 0.04]$	8.35		(27)
Windows Type 6			4.7	$\times 1/[1/(1.4) + 0.04]$	6.23		(27)
Floor			91.4	0.13	11.882		(28)
Walls	70.4	19.51	50.89	0.18	9.16		(29)
Roof	91.4	0	91.4	0.13	11.88		(30)
Total area of elements, m²			253.2				(31)
Party wall			39.4	0	0		(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 58.11 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 18331.9 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 12.42 (36)

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

TER WorkSheet: New dwelling design stage

Total fabric heat loss	$\{33\} + \{36\} =$											70.52	{37}	
Ventilation heat loss calculated monthly	$\{38\}m = 0.33 \times \{25\}m \times \{5\}$													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
{38}m=	44.69	44.39	44.1	42.75	42.49	41.31	41.31	41.09	41.77	42.49	43.01	43.54		{38}
Heat transfer coefficient, W/K	$\{39\}m = \{37\} + \{38\}m$													
{39}m=	115.21	114.91	114.62	113.27	113.01	111.83	111.83	111.61	112.29	113.01	113.53	114.06		
	Average = $\text{Sum}(\{39\})_{1..12} / 12 =$											113.27	{39}	
Heat loss parameter (HLP), W/m²K	$\{40\}m = \{39\}m \div \{4\}$													
{40}m=	1.26	1.26	1.25	1.24	1.24	1.22	1.22	1.22	1.23	1.24	1.24	1.25		
	Average = $\text{Sum}(\{40\})_{1..12} / 12 =$											1.24	{40}	
Number of days in month (Table 1a)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
{41}m=	31	28	31	30	31	30	31	31	30	31	30	31		{41}
4. Water heating energy requirement kWh/year														
Assumed occupancy, N												2.64	{42}	
if TFA > 13.9, N = $1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$														
if TFA ≤ 13.9, N = 1														
Annual average hot water usage in litres per day Vd,average = $(25 \times N) + 36$												97	{43}	
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x {43}														
{44}m=	106.71	102.82	98.94	95.06	91.18	87.3	87.3	91.18	95.06	98.94	102.82	106.71		
	Total = $\text{Sum}(\{44\})_{1..12} =$											1164.05	{44}	
Energy content of hot water used - calculated monthly = $4.190 \times Vd,m \times nm \times DTm / 3600$ kWh/month (see Tables 1b, 1c, 1d)														
{45}m=	158.24	138.4	142.81	124.51	119.47	103.09	95.53	109.62	110.93	129.28	141.12	153.25		
	Total = $\text{Sum}(\{45\})_{1..12} =$											1526.26	{45}	
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes {46} to {61}														
{46}m=	23.74	20.76	21.42	18.68	17.92	15.46	14.33	16.44	16.64	19.39	21.17	22.99		{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):												1.7	{48}	
Temperature factor from Table 2b												0.54	{49}	
Energy lost from water storage, kWh/year	$\{48\} \times \{49\} =$											0.92	{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}												0.92	{55}	

TER WorkSheet: New dwelling design stage

Water storage loss calculated for each month

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

(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)
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Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=	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 $\{(61)\}m = (60) \div 365 \times (41)m$

(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 $\{(62)\}m = 0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

(62)m=	209.99	185.14	194.56	174.59	171.22	153.17	147.28	161.37	161.01	181.03	191.2	204.99	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
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FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)
------	---	---	---	---	---	---	---	---	---	---	---	---	-----------

WWHRs	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G10)
-------	---	---	---	---	---	---	---	---	---	---	---	---	------------

Output from water heater

(64)m=	209.99	185.14	194.56	174.59	171.22	153.17	147.28	161.37	161.01	181.03	191.2	204.99	
Output from water heater (annual) L12												2135.53	(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=	94.01	83.41	88.88	81.46	81.12	74.34	73.16	77.85	76.95	84.38	86.98	92.35	(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=	132.22	132.22	132.22	132.22	132.22	132.22	132.22	132.22	132.22	132.22	132.22	132.22	(66)

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

(67)m=	21.82	19.38	15.76	11.93	8.92	7.53	8.14	10.58	14.2	18.02	21.04	22.43	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	241.63	244.14	237.82	224.37	207.39	191.43	180.77	178.26	184.58	198.03	215.01	230.97	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.22	36.22	36.22	36.22	36.22	36.22	36.22	36.22	36.22	36.22	36.22	36.22	(69)
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Pumps and fans gains (Table 5a)

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

(71)m=	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	-105.78	(71)
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Water heating gains (Table 5)

(72)m=	126.36	124.12	119.47	113.14	109.03	103.25	98.34	104.63	106.87	113.42	120.81	124.13	(72)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

Total internal gains =

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

(73)m=	455.48	453.3	438.71	415.11	391.01	367.88	352.91	359.14	371.31	395.14	422.52	443.19	(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.

TER 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	0.88	x	10.63	x	0.63	x	0.7	=	2.86 {74}
North	0.9x	0.77	x	0.88	x	20.32	x	0.63	x	0.7	=	5.47 {74}
North	0.9x	0.77	x	0.88	x	34.53	x	0.63	x	0.7	=	9.29 {74}
North	0.9x	0.77	x	0.88	x	55.46	x	0.63	x	0.7	=	14.92 {74}
North	0.9x	0.77	x	0.88	x	74.72	x	0.63	x	0.7	=	20.09 {74}
North	0.9x	0.77	x	0.88	x	79.99	x	0.63	x	0.7	=	21.51 {74}
North	0.9x	0.77	x	0.88	x	74.68	x	0.63	x	0.7	=	20.08 {74}
North	0.9x	0.77	x	0.88	x	59.25	x	0.63	x	0.7	=	15.93 {74}
North	0.9x	0.77	x	0.88	x	41.52	x	0.63	x	0.7	=	11.17 {74}
North	0.9x	0.77	x	0.88	x	24.19	x	0.63	x	0.7	=	6.51 {74}
North	0.9x	0.77	x	0.88	x	13.12	x	0.63	x	0.7	=	3.53 {74}
North	0.9x	0.77	x	0.88	x	8.86	x	0.63	x	0.7	=	2.38 {74}
Southeast	0.9x	0.77	x	1.3	x	36.79	x	0.63	x	0.7	=	14.62 {77}
Southeast	0.9x	0.77	x	6.3	x	36.79	x	0.63	x	0.7	=	70.84 {77}
Southeast	0.9x	0.77	x	1.3	x	62.67	x	0.63	x	0.7	=	24.9 {77}
Southeast	0.9x	0.77	x	6.3	x	62.67	x	0.63	x	0.7	=	120.67 {77}
Southeast	0.9x	0.77	x	1.3	x	85.75	x	0.63	x	0.7	=	34.07 {77}
Southeast	0.9x	0.77	x	6.3	x	85.75	x	0.63	x	0.7	=	165.1 {77}
Southeast	0.9x	0.77	x	1.3	x	106.25	x	0.63	x	0.7	=	42.21 {77}
Southeast	0.9x	0.77	x	6.3	x	106.25	x	0.63	x	0.7	=	204.57 {77}
Southeast	0.9x	0.77	x	1.3	x	119.01	x	0.63	x	0.7	=	47.28 {77}
Southeast	0.9x	0.77	x	6.3	x	119.01	x	0.63	x	0.7	=	229.14 {77}
Southeast	0.9x	0.77	x	1.3	x	118.15	x	0.63	x	0.7	=	46.94 {77}
Southeast	0.9x	0.77	x	6.3	x	118.15	x	0.63	x	0.7	=	227.48 {77}
Southeast	0.9x	0.77	x	1.3	x	113.91	x	0.63	x	0.7	=	45.26 {77}
Southeast	0.9x	0.77	x	6.3	x	113.91	x	0.63	x	0.7	=	219.32 {77}
Southeast	0.9x	0.77	x	1.3	x	104.39	x	0.63	x	0.7	=	41.47 {77}
Southeast	0.9x	0.77	x	6.3	x	104.39	x	0.63	x	0.7	=	200.99 {77}
Southeast	0.9x	0.77	x	1.3	x	92.85	x	0.63	x	0.7	=	36.89 {77}
Southeast	0.9x	0.77	x	6.3	x	92.85	x	0.63	x	0.7	=	178.77 {77}
Southeast	0.9x	0.77	x	1.3	x	69.27	x	0.63	x	0.7	=	27.52 {77}
Southeast	0.9x	0.77	x	6.3	x	69.27	x	0.63	x	0.7	=	133.37 {77}
Southeast	0.9x	0.77	x	1.3	x	44.07	x	0.63	x	0.7	=	17.51 {77}
Southeast	0.9x	0.77	x	6.3	x	44.07	x	0.63	x	0.7	=	84.85 {77}
Southeast	0.9x	0.77	x	1.3	x	31.49	x	0.63	x	0.7	=	12.51 {77}
Southeast	0.9x	0.77	x	6.3	x	31.49	x	0.63	x	0.7	=	60.63 {77}
Southwest	0.9x	0.77	x	4.7	x	36.79		0.63	x	0.7	=	52.85 {79}
Southwest	0.9x	0.77	x	4.7	x	62.67		0.63	x	0.7	=	90.02 {79}
Southwest	0.9x	0.77	x	4.7	x	85.75		0.63	x	0.7	=	123.17 {79}

TER WorkSheet: New dwelling design stage

Southwest	0.9x	0.77	x	4.7	x	106.25	0.63	x	0.7	=	152.62	(79)
Southwest	0.9x	0.77	x	4.7	x	119.01	0.63	x	0.7	=	170.94	(79)
Southwest	0.9x	0.77	x	4.7	x	118.15	0.63	x	0.7	=	169.71	(79)
Southwest	0.9x	0.77	x	4.7	x	113.91	0.63	x	0.7	=	163.62	(79)
Southwest	0.9x	0.77	x	4.7	x	104.39	0.63	x	0.7	=	149.94	(79)
Southwest	0.9x	0.77	x	4.7	x	92.85	0.63	x	0.7	=	133.37	(79)
Southwest	0.9x	0.77	x	4.7	x	69.27	0.63	x	0.7	=	99.49	(79)
Southwest	0.9x	0.77	x	4.7	x	44.07	0.63	x	0.7	=	63.3	(79)
Southwest	0.9x	0.77	x	4.7	x	31.49	0.63	x	0.7	=	45.23	(79)
West	0.9x	0.77	x	0.88	x	19.64	0.63	x	0.7	=	5.28	(80)
West	0.9x	0.77	x	0.88	x	38.42	0.63	x	0.7	=	10.33	(80)
West	0.9x	0.77	x	0.88	x	63.27	0.63	x	0.7	=	17.02	(80)
West	0.9x	0.77	x	0.88	x	92.28	0.63	x	0.7	=	24.82	(80)
West	0.9x	0.77	x	0.88	x	113.09	0.63	x	0.7	=	30.42	(80)
West	0.9x	0.77	x	0.88	x	115.77	0.63	x	0.7	=	31.14	(80)
West	0.9x	0.77	x	0.88	x	110.22	0.63	x	0.7	=	29.64	(80)
West	0.9x	0.77	x	0.88	x	94.68	0.63	x	0.7	=	25.46	(80)
West	0.9x	0.77	x	0.88	x	73.59	0.63	x	0.7	=	19.79	(80)
West	0.9x	0.77	x	0.88	x	45.59	0.63	x	0.7	=	12.26	(80)
West	0.9x	0.77	x	0.88	x	24.49	0.63	x	0.7	=	6.59	(80)
West	0.9x	0.77	x	0.88	x	16.15	0.63	x	0.7	=	4.34	(80)
Northwest	0.9x	0.77	x	3.35	x	11.28	0.63	x	0.7	=	11.55	(81)
Northwest	0.9x	0.77	x	3.35	x	22.97	0.63	x	0.7	=	23.51	(81)
Northwest	0.9x	0.77	x	3.35	x	41.38	0.63	x	0.7	=	42.36	(81)
Northwest	0.9x	0.77	x	3.35	x	67.96	0.63	x	0.7	=	69.57	(81)
Northwest	0.9x	0.77	x	3.35	x	91.35	0.63	x	0.7	=	93.52	(81)
Northwest	0.9x	0.77	x	3.35	x	97.38	0.63	x	0.7	=	99.7	(81)
Northwest	0.9x	0.77	x	3.35	x	91.1	0.63	x	0.7	=	93.27	(81)
Northwest	0.9x	0.77	x	3.35	x	72.63	0.63	x	0.7	=	74.36	(81)
Northwest	0.9x	0.77	x	3.35	x	50.42	0.63	x	0.7	=	51.62	(81)
Northwest	0.9x	0.77	x	3.35	x	28.07	0.63	x	0.7	=	28.74	(81)
Northwest	0.9x	0.77	x	3.35	x	14.2	0.63	x	0.7	=	14.53	(81)
Northwest	0.9x	0.77	x	3.35	x	9.21	0.63	x	0.7	=	9.43	(81)

Solar gains in watts, calculated for each month

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

(83)m=	158	274.9	391.01	508.71	591.4	596.48	571.18	508.16	431.61	307.88	190.31	134.53	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	613.48	728.21	829.73	923.82	982.4	964.36	924.09	867.29	802.92	703.02	612.84	577.71	(84)
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7. Mean internal temperature (see Table 9a)

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

21 (85)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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TER WorkSheet: New dwelling design stage

(86)m=	1	0.99	0.98	0.94	0.85	0.69	0.52	0.57	0.81	0.96	0.99	1	(86)
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Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.68	19.86	20.14	20.5	20.78	20.95	20.99	20.98	20.88	20.5	20.02	19.65	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.87	19.87	19.88	19.89	19.89	19.9	19.9	19.9	19.9	19.89	19.89	19.88	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.97	0.92	0.8	0.59	0.4	0.45	0.73	0.95	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=	18.13	18.4	18.81	19.31	19.68	19.87	19.9	19.9	19.8	19.32	18.64	18.09	(90)
--------	-------	------	-------	-------	-------	-------	------	------	------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.4 \quad (91)$$

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

(92)m=	18.75	18.99	19.35	19.79	20.13	20.3	20.34	20.34	20.24	19.8	19.2	18.72	(92)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	------	------	-------	------

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

(93)m=	18.75	18.99	19.35	19.79	20.13	20.3	20.34	20.34	20.24	19.8	19.2	18.72	(93)
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4. Space heating requirement

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

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

(94)m=	0.99	0.99	0.97	0.92	0.81	0.63	0.45	0.5	0.76	0.94	0.99	1	(94)
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Useful gains, hmGm, W = (94)m x (84)m

(95)m=	609.82	718.6	804.2	850.93	798.67	604.88	412.91	430.77	608.63	663.2	605.28	575.07	(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 = [(93)m - (96)m]

(97)m=	1665.25	1619.27	1472.6	1233.39	952.66	637.77	418.12	439.26	689.01	1039.26	1373.26	1656.14	(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=	785.24	605.25	497.29	275.37	114.57	0	0	0	0	279.79	552.95	804.31	(98)
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$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..12} = 3914.77 \quad (99)$$

Space heating requirement in kWh/m²/year

$$42.83 \quad (99)$$

5a. Energy requirements: Individual heating systems including micro-CHP

Space heating:

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

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

Fraction of total heating from main system 1 (204) = (202) × [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)

785.24	605.25	497.29	275.37	114.57	0	0	0	0	279.79	552.95	804.31
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

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

839.83	647.33	531.86	294.52	122.53	0	0	0	0	299.24	591.39	860.23
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$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..12} = 4186.92 \quad (211)$$

TER WorkSheet: New dwelling design stage

Space heating fuel (secondary), kWh/month

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

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

Water heating

Output from water heater (calculated above)

	209.99	185.14	194.56	174.59	171.22	153.17	147.28	161.37	161.01	181.03	191.2	204.99		
Efficiency of water heater													79.8	(216)
(217)m=	88.01	87.74	87.21	86.02	83.77	79.8	79.8	79.8	79.8	85.97	87.49	88.1		(217)

Fuel for water heating, kWh/month

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

(219)m=	238.59	211	223.09	202.95	204.39	191.94	184.56	202.22	201.77	210.57	218.55	232.68		
Total = Sum(219a) _{1..12} =													2522.3	(219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

4186.92

Water heating fuel used

2522.3

Electricity for pumps, fans and electric keep-hot

central heating pump:

30

(230c)

boiler with a fan-assisted flue

45

(230e)

Total electricity for the above, kWh/year

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

75

(231)

Electricity for lighting

385.34

(232)

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

7169.56

(238)

TER CO2 emissions - individual heating systems (main system 1, main CHP)

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	904.37	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	544.82	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1449.19	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	199.99	(268)
Total CO2, kg/year		sum of (265)...(271) =		1688.11	(272)

TER =

27.19

(273)