Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.58
Printed on 21 October 2022 at 12:33:26

Project Information:

Assessed By: Ben Marsh (STRO005374)

Building Type: Detached House

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 105.29m²

Site Reference : New Project

Plot Reference: Plot 7

Address : plot 7

Client Details:

Name:

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: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	17.51 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	15.80 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	54.0 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	46.5 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.17 (max. 0.70)	OK
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (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: Database: (rev 507, product index 017953):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Vaillant
Model: ecoTEC exclusive 835
Model qualifier: VUW 356/5-7 (H-GB)
(Combi)
Efficiency 89.7 % SEDBUK2009
Minimum 88.0 % OK

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder	

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	OK

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (South East England):	Not assessed	?

10 Key features

Roofs U-value	0.11 W/m²K

Thermal Bridge Report

Property Details: Plot 7

Address:	plot 7
Located in:	England
Region:	South East England

Thermal bridges:

Thermal bridges:

User-defined = UD
Default = D
Approved = A
User-defined (individual PSI-values) Y-Value = 0.0725

External Junctions Details:

Junction Type	PSI-Value	Length	Reference	Type
Other lintels (including other steel lintels)	0.3	12.09	E2	[A]
Sill	0.04	9.147	E3	[A]
Jamb	0.05	26.78	E4	[A]
Ground floor (normal)	0.16	29.9	E5	[A]
Intermediate floor within a dwelling	0.07	29.9	E6	[A]
Eaves (insulation at ceiling level)	0.06	20.7	E10	[A]
Gable (insulation at ceiling level)	0.24	11.9	E12	[A]
Corner (normal)	0.09	19.2	E16	[A]

Predicted Energy Assessment

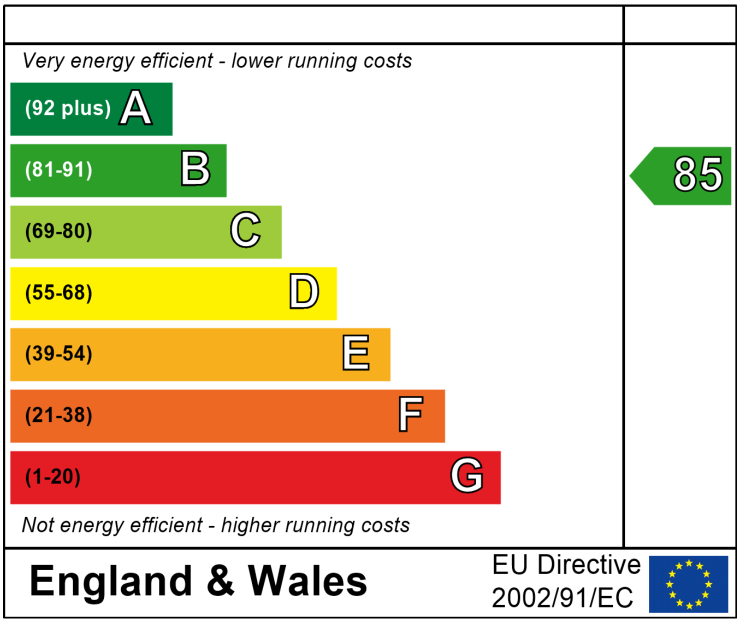
plot 7

Dwelling type:	Detached House
Date of assessment:	21 October 2022
Produced by:	Ben Marsh
Total floor area:	105.29 m²

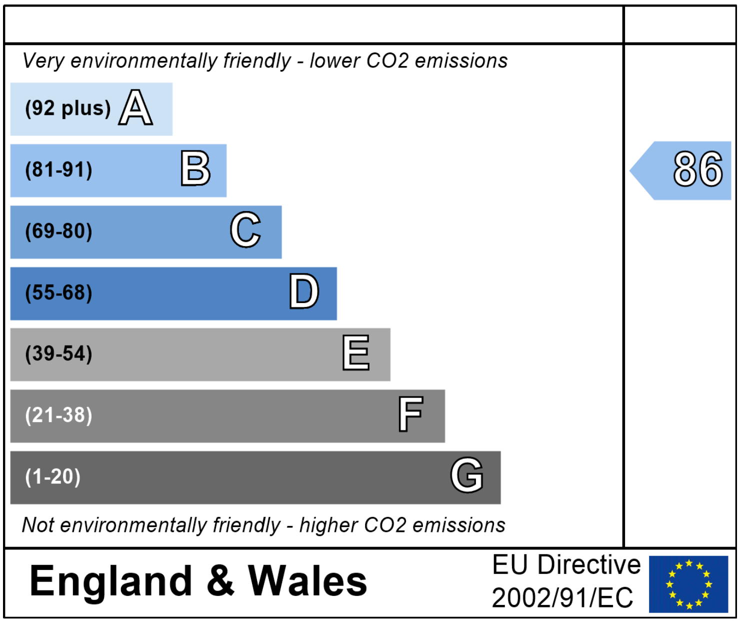
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

SAP Input

Property Details: Plot 7

Address:	plot 7
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	21 October 2022
Date of certificate:	21 October 2022
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Owner-occupied
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Low
Water use <= 125 litres/person/day:	False
PCDF Version:	507

Property description:

Dwelling type:	House
Detachment:	Detached
Year Completed:	2022

Floor Location:	Floor area:	Storey height:
Floor 0	53.32 m²	2.4 m
Floor 1	51.97 m²	2.4 m

Living area:	18.5 m² (fraction 0.176)
Front of dwelling faces:	West

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Front	Manufacturer	Solid			PVC-U
Front	SAP 2012	Windows	double-glazed	Yes	PVC-U
Rear	SAP 2012	Windows	double-glazed	Yes	PVC-U
Side	SAP 2012	Windows	double-glazed	Yes	PVC-U

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
Front	mm	0.7	0	1.4	2.14	1
Front	16mm or more	0.7	0.76	1.4	5.53	1
Rear	16mm or more	0.7	0.76	1.4	8.43	1
Side	16mm or more	0.7	0.76	1.4	0.714	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Front		Ext Walls		0	0
Front		Ext Walls	Unspecified	0	0
Rear		Ext Walls	Unspecified	0	0
Side		Ext Walls	Unspecified	0	0

Overshading:	Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
Ext Walls	143.52	16.81	126.71	0.17	0	False	N/A
Cold Roof	51.97	0	51.97	0.11	0		N/A
Ground Floor	53.32			0.14			N/A
Internal Elements							
Party Elements							

Thermal bridges:

SAP Input

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0725

	Length	Psi-value		
[Approved]	12.09	0.3	E2	Other lintels (including other steel lintels)
[Approved]	9.147	0.04	E3	Sill
[Approved]	26.78	0.05	E4	Jamb
[Approved]	29.9	0.16	E5	Ground floor (normal)
[Approved]	29.9	0.07	E6	Intermediate floor within a dwelling
[Approved]	20.7	0.06	E10	Eaves (insulation at ceiling level)
[Approved]	11.9	0.24	E12	Gable (insulation at ceiling level)
[Approved]	19.2	0.09	E16	Corner (normal)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	3
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	5

Main heating system:

Main heating system:

Boiler systems with radiators or underfloor heating
Gas boilers and oil boilers
Fuel: mains gas
Info Source: Boiler Database
Database: (rev 507, product index 017953) Efficiency: Winter 85.0 % Summer: 90.6
Has integral PFGHRD
Brand name: Vaillant
Model: ecoTEC exclusive 835
Model qualifier: VUW 356/5-7 (H-GB)
(Combi boiler)
Systems with radiators
Central heating pump : 2013 or later
Design flow temperature: Unknown
Boiler interlock: Yes

Main heating Control:

Main heating Control:

Time and temperature zone control by suitable arrangement of plumbing and electrical services
Control code: 2110

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating:

From main heating system
Water code: 901
Fuel :mains gas
No hot water cylinder
Flue Gas Heat Recovery System:
Database (rev 507, product index)
Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	No
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English

SAP Input

Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Ben Marsh	**Stroma Number:**	STRO005374
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.58

Property Address: Plot 7

Address : plot 7

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	53.32	(1a)	x	2.4	(2a)	=	127.97	(3a)
First floor	51.97	(1b)	x	2.4	(2b)	=	124.73	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	105.29	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	252.7	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.12	(8)

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

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

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.31	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.58	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			2.14	x	1.4	=	2.996			(26)
Windows Type 1			5.53	x1/[1/(1.4)+ 0.04]		=	7.33			(27)
Windows Type 2			8.43	x1/[1/(1.4)+ 0.04]		=	11.18			(27)
Windows Type 3			0.714	x1/[1/(1.4)+ 0.04]		=	0.95			(27)
Floor			53.32	x	0.14	=	7.4648			(28)
Walls	143.52	16.81	126.71	x	0.17	=	21.54			(29)
Roof	51.97	0	51.97	x	0.11	=	5.72			(30)
Total area of elements, m²			248.81							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 57.17 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7473.28 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 18.03 (36)

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

Total fabric heat loss (33) + (36) = 75.21 (37)

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

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

(38)m=	48.35	48.09	47.84	46.65	46.43	45.39	45.39	45.2	45.79	46.43	46.88	47.35	(38)

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

(39)m=	123.56	123.3	123.05	121.86	121.63	120.6	120.6	120.41	121	121.63	122.08	122.56	

Average = Sum(39)$_{1...12}$ /12= 121.86 (39)

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

(40)m=	1.17	1.17	1.17	1.16	1.16	1.15	1.15	1.14	1.15	1.16	1.16	1.16	

Average = Sum(40)$_{1...12}$ /12= 1.16 (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 2.78 (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) + 36 105.58 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	116.14	111.92	107.7	103.47	99.25	95.03	95.03	99.25	103.47	107.7	111.92	116.14	

Total = Sum(44)$_{1...12}$ = 1267.02 (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=	172.24	150.64	155.45	135.52	130.04	112.21	103.98	119.32	120.74	140.72	153.6	166.8	

Total = Sum(45)$_{1...12}$ = 1661.26 (45)

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

(46)m=	25.84	22.6	23.32	20.33	19.51	16.83	15.6	17.9	18.11	21.11	23.04	25.02	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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Primary circuit loss (annual) from Table 3 | 0 | (58)

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

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

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

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

(61)m=	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=	172.24	150.64	155.45	135.52	130.04	112.21	103.98	119.32	120.74	140.72	153.6	166.8	(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)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	172.24	150.64	155.45	135.52	130.04	112.21	103.98	119.32	120.74	140.72	153.6	166.8	

Output from water heater (annual)$_{1...12}$ | 1661.26 | (64)

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

(65)m=	57.27	50.09	51.69	45.06	43.24	37.31	34.57	39.67	40.15	46.79	51.07	55.46	(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=	167	167	167	167	167	167	167	167	167	167	167	167	(66)

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

(67)m=	63.33	56.25	45.75	34.63	25.89	21.86	23.62	30.7	41.2	52.32	61.06	65.09	(67)

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

(68)m=	394.94	399.03	388.71	366.72	338.97	312.88	295.46	291.36	301.69	323.67	351.43	377.51	(68)

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

(69)m=	54.48	54.48	54.48	54.48	54.48	54.48	54.48	54.48	54.48	54.48	54.48	54.48	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	(71)

Water heating gains (Table 5)

(72)m=	76.97	74.54	69.47	62.58	58.11	51.82	46.47	53.32	55.76	62.89	70.93	74.55	(72)

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

(73)m=	648.39	642.97	617.08	577.09	536.12	499.71	478.7	488.53	511.8	552.03	596.57	630.3	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

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

(83)m=	0	0	0	0	0	0	0	0	0	0	0	0	(83)

SAP WorkSheet: New dwelling design stage

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

(84)m=	648.39	642.97	617.08	577.09	536.12	499.71	478.7	488.53	511.8	552.03	596.57	630.3	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.96	0.96	0.96	0.95	0.92	0.86	0.76	0.77	0.87	0.93	0.96	0.97	(86)

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

(87)m=	18.58	18.7	18.99	19.43	19.92	20.42	20.72	20.7	20.34	19.73	19.09	18.55	(87)

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

(88)m=	19.94	19.94	19.95	19.95	19.96	19.96	19.96	19.97	19.96	19.96	19.95	19.95	(88)

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

(89)m=	0.96	0.96	0.95	0.93	0.9	0.81	0.66	0.68	0.83	0.92	0.95	0.96	(89)

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

(90)m=	16.71	16.88	17.31	17.95	18.66	19.36	19.74	19.72	19.25	18.39	17.47	16.68	(90)

fLA = Living area ÷ (4) = 0.18 (91)

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

(92)m=	17.04	17.2	17.6	18.21	18.88	19.55	19.91	19.89	19.44	18.62	17.75	17.01	(92)

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

(93)m=	17.04	17.2	17.6	18.21	18.88	19.55	19.91	19.89	19.44	18.62	17.75	17.01	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.94	0.93	0.93	0.91	0.87	0.78	0.66	0.67	0.8	0.89	0.92	0.94	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	607.95	600.61	571.03	523.49	465.91	391.82	313.77	325.98	410.15	489.59	551.15	593.42	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1574.02	1516.99	1366.09	1134.53	873.44	596.46	399.58	420.2	646.48	975.78	1300.55	1569.35	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	718.76	615.81	591.53	439.95	303.21	0	0	0	0	361.73	539.56	726.09	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4296.63 (98)

Space heating requirement in kWh/m²/year — 40.81 (99)

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

Space heating:

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

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

Fraction of total heating from main system 1 — (204) = (202) × [1 – (203)] = 1 (204)

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Efficiency of main space heating system 1	90.6	(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)														
	718.76	615.81	591.53	439.95	303.21	0	0	0	0	361.73	539.56	726.09		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	793.33	679.7	652.9	485.6	334.67	0	0	0	0	399.26	595.55	801.42		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													4742.42	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	172.24	150.64	155.45	135.52	130.04	112.21	103.98	119.32	120.74	140.72	153.6	166.8		
Efficiency of water heater													85	(216)
(217)m=	89.46	89.44	89.37	89.22	88.84	85	85	85	85	88.96	89.3	89.5		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	192.53	168.42	173.93	151.9	146.37	132.01	122.33	140.38	142.05	158.18	172.01	186.37		
Total = Sum(219a)$_{1...12}$ =													1886.49	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4742.42	
Water heating fuel used			1886.49	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			447.38	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			7151.29	(338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	165.04	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	65.65	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	59.01	(250)

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Additional standing charges (Table 12)		120	(251)
Appendix Q items: repeat lines (253) and (254) as needed			
Total energy cost	(245)...(247) + (250)…(254) =	419.59	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.17	(257)
SAP rating (Section 12)		83.64	(258)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	1024.36	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	407.48	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1431.85	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	232.19	(268)
Total CO2, kg/year			sum of (265)…(271) =		1702.96	(272)
CO2 emissions per m²			(272) ÷ (4) =		16.17	(273)
EI rating (section 14)					85	(274)

13a. Primary Energy

	Energy kWh/year		**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	5785.75	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	2301.52	(264)
Space and water heating	(261) + (262) + (263) + (264) =				8087.27	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	230.25	(267)
Electricity for lighting	(232)	x	0	=	1373.46	(268)
‘Total Primary Energy			sum of (265)…(271) =		9690.99	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		92.04	(273)

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User Details:

Assessor Name:	Ben Marsh	**Stroma Number:**	STRO005374
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.58

Property Address: Plot 7

Address : plot 7

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	53.32	(1a)	x	2.4	(2a)	=	127.97	(3a)
First floor	51.97	(1b)	x	2.4	(2b)	=	124.73	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	105.29	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	252.7	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.12	(8)

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

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

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.31	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

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

(24d)m=	0.58	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			2.14	x	1.4	=	2.996			(26)
Windows Type 1			5.53	x1/[1/(1.4)+ 0.04]		=	7.33			(27)
Windows Type 2			8.43	x1/[1/(1.4)+ 0.04]		=	11.18			(27)
Windows Type 3			0.714	x1/[1/(1.4)+ 0.04]		=	0.95			(27)
Floor			53.32	x	0.14	=	7.4648			(28)
Walls	143.52	16.81	126.71	x	0.17	=	21.54			(29)
Roof	51.97	0	51.97	x	0.11	=	5.72			(30)
Total area of elements, m²			248.81							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 57.17 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7473.28 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 18.03 (36)

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

Total fabric heat loss (33) + (36) = 75.21 (37)

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

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

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(38)m=	48.35	48.09	47.84	46.65	46.43	45.39	45.39	45.2	45.79	46.43	46.88	47.35	(38)

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

(39)m=	123.56	123.3	123.05	121.86	121.63	120.6	120.6	120.41	121	121.63	122.08	122.56

Average = $Sum(39)_{1...12}$ /12= 121.86 (39)

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

(40)m=	1.17	1.17	1.17	1.16	1.16	1.15	1.15	1.14	1.15	1.16	1.16	1.16

Average = $Sum(40)_{1...12}$ /12= 1.16 (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 2.78 (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) + 36 105.58 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

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

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

(44)m=	116.14	111.92	107.7	103.47	99.25	95.03	95.03	99.25	103.47	107.7	111.92	116.14

Total = $Sum(44)_{1...12}$ = 1267.02 (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=	172.24	150.64	155.45	135.52	130.04	112.21	103.98	119.32	120.74	140.72	153.6	166.8

Total = $Sum(45)_{1...12}$ = 1661.26 (45)

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

(46)m=	25.84	22.6	23.32	20.33	19.51	16.83	15.6	17.9	18.11	21.11	23.04	25.02	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

Primary circuit loss (annual) from Table 3	0	(58)

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

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

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

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

(61)m=	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=	172.24	150.64	155.45	135.52	130.04	112.21	103.98	119.32	120.74	140.72	153.6	166.8	(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)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	172.24	150.64	155.45	135.52	130.04	112.21	103.98	119.32	120.74	140.72	153.6	166.8	

Output from water heater (annual)$_{1...12}$ 1661.26 (64)

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

(65)m=	57.27	50.09	51.69	45.06	43.24	37.31	34.57	39.67	40.15	46.79	51.07	55.46	(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=	139.17	139.17	139.17	139.17	139.17	139.17	139.17	139.17	139.17	139.17	139.17	139.17	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	25.33	22.5	18.3	13.85	10.36	8.74	9.45	12.28	16.48	20.93	24.42	26.04	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	264.61	267.35	260.43	245.7	227.11	209.63	197.96	195.21	202.13	216.86	235.46	252.93	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.92	36.92	36.92	36.92	36.92	36.92	36.92	36.92	36.92	36.92	36.92	36.92	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	(71)
Water heating gains (Table 5)													
(72)m=	76.97	74.54	69.47	62.58	58.11	51.82	46.47	53.32	55.76	62.89	70.93	74.55	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	434.67	432.14	415.95	389.89	363.33	337.95	321.62	328.57	342.12	368.43	398.57	421.27	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

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

(83)m=	0	0	0	0	0	0	0	0	0	0	0	0	(83)

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

(84)m=	434.67	432.14	415.95	389.89	363.33	337.95	321.62	328.57	342.12	368.43	398.57	421.27	(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=	0.99	0.98	0.98	0.98	0.96	0.93	0.87	0.88	0.94	0.97	0.98	0.99	(86)

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

(87)m=	18.25	18.37	18.68	19.15	19.68	20.22	20.58	20.55	20.13	19.46	18.79	18.23	(87)

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

(88)m=	19.94	19.94	19.95	19.95	19.96	19.96	19.96	19.97	19.96	19.96	19.95	19.95	(88)

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

(89)m=	0.98	0.98	0.98	0.97	0.95	0.9	0.8	0.81	0.92	0.96	0.98	0.98	(89)

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

(90)m=	16.23	16.41	16.87	17.55	18.32	19.11	19.6	19.56	18.98	18.01	17.03	16.2	(90)

fLA = Living area ÷ (4) = | 0.18 | (91)

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

(92)m=	16.59	16.76	17.18	17.83	18.56	19.31	19.77	19.73	19.18	18.27	17.34	16.56	(92)

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

(93)m=	16.59	16.76	17.18	17.83	18.56	19.31	19.77	19.73	19.18	18.27	17.34	16.56	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.97	0.97	0.96	0.95	0.93	0.88	0.78	0.79	0.89	0.94	0.96	0.97	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	422.18	418.88	401.19	372.12	338.55	296.4	251.68	260.14	304.78	347.84	384.39	410.11	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1517.95	1462.12	1314.67	1088.69	834.66	567.86	382.03	401.48	614.67	932.72	1250.29	1514.41	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	815.26	701.06	679.63	515.93	369.1	0	0	0	0	435.15	623.45	821.6	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 4961.18 | (98)

Space heating requirement in kWh/m²/year | 47.12 | (99)

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

Space heating:

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

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

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = | 1 | (204)

DER WorkSheet: New dwelling design stage

Efficiency of main space heating system 1	90.6	(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)	815.26	701.06	679.63	515.93	369.1	0	0	0	0	435.15	623.45	821.6		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	899.84	773.79	750.14	569.46	407.4	0	0	0	0	480.3	688.13	906.85		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													5475.92	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	172.24	150.64	155.45	135.52	130.04	112.21	103.98	119.32	120.74	140.72	153.6	166.8		
Efficiency of water heater													85	(216)
(217)m=	89.57	89.56	89.5	89.38	89.07	85	85	85	85	89.16	89.44	89.6		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	192.29	168.21	173.68	151.63	145.99	132.01	122.33	140.38	142.05	157.82	171.75	186.16		
Total = Sum(219a)$_{1...12}$ =													1884.3	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			5475.92	
Water heating fuel used			1884.3	
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			447.38	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			7882.6	(338)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	1182.8	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	407.01	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1589.81	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	232.19	(268)
Total CO2, kg/year			sum of (265)…(271) =		1860.92	(272)

DER WorkSheet: New dwelling design stage

Dwelling CO2 Emission Rate	(272) ÷ (4) =	17.67	(273)
EI rating (section 14)		83	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Ben Marsh	**Stroma Number:**	STRO005374
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.58

Property Address: Plot 7

Address : plot 7

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	53.32	(1a)	x	2.4	(2a)	=	127.97	(3a)
First floor	51.97	(1b)	x	2.4	(2b)	=	124.73	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	105.29	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	252.7	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.16	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.41	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.35	(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

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

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

0.44	0.43	0.43	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

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

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

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

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(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			2.14	x	1	=	2.14			(26)
Windows Type 1			5.53	x1/[1/(1.4)+ 0.04]		=	7.33			(27)
Windows Type 2			8.43	x1/[1/(1.4)+ 0.04]		=	11.18			(27)
Windows Type 3			0.714	x1/[1/(1.4)+ 0.04]		=	0.95			(27)
Floor			53.32	x	0.13	=	6.9316			(28)
Walls	143.52	16.81	126.71	x	0.18	=	22.81			(29)
Roof	51.97	0	51.97	x	0.13	=	6.76			(30)
Total area of elements, m²			248.81							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 58.09 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7473.28 (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 10.87 (36)

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

Total fabric heat loss (33) + (36) = 68.96 (37)

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

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

(38)m=	49.86	49.54	49.23	47.77	47.5	46.23	46.23	45.99	46.72	47.5	48.05	48.63	(38)

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

(39)m=	118.82	118.5	118.19	116.73	116.46	115.18	115.18	114.95	115.67	116.46	117.01	117.59

Average = $Sum(39)_{1...12}$ /12= 116.73 (39)

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

(40)m=	1.13	1.13	1.12	1.11	1.11	1.09	1.09	1.09	1.1	1.11	1.11	1.12

Average = $Sum(40)_{1...12}$ /12= 1.11 (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 2.78 (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) + 36 100.31 (43)

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

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

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

(44)m=	110.34	106.32	102.31	98.3	94.29	90.28	90.28	94.29	98.3	102.31	106.32	110.34

Total = $Sum(44)_{1...12}$ = 1203.67 (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=	163.63	143.11	147.67	128.75	123.54	106.6	98.78	113.35	114.71	133.68	145.92	158.46

Total = $Sum(45)_{1...12}$ = 1578.2 (45)

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

(46)m=	24.54	21.47	22.15	19.31	18.53	15.99	14.82	17	17.21	20.05	21.89	23.77	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

Primary circuit loss (annual) from Table 3 | 0 | (58)

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

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

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

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

(61)m=	50.96	46.03	50.96	48.48	48.05	44.52	46	48.05	48.48	50.96	49.32	50.96	(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=	214.58	189.14	198.63	177.22	171.58	151.12	144.79	161.4	163.18	184.64	195.24	209.42	(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)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	214.58	189.14	198.63	177.22	171.58	151.12	144.79	161.4	163.18	184.64	195.24	209.42	

Output from water heater (annual)$_{1…12}$ | 2160.95 | (64)

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

(65)m=	67.15	59.09	61.84	54.93	53.09	46.57	44.35	49.7	50.26	57.19	60.85	65.43	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	139.17	139.17	139.17	139.17	139.17	139.17	139.17	139.17	139.17	139.17	139.17	139.17	(66)

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

(67)m=	25.33	22.5	18.3	13.85	10.36	8.74	9.45	12.28	16.48	20.93	24.42	26.04	(67)

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

(68)m=	264.61	267.35	260.43	245.7	227.11	209.63	197.96	195.21	202.13	216.86	235.46	252.93	(68)

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

(69)m=	36.92	36.92	36.92	36.92	36.92	36.92	36.92	36.92	36.92	36.92	36.92	36.92	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	-111.34	(71)

Water heating gains (Table 5)

(72)m=	90.25	87.93	83.12	76.29	71.35	64.69	59.6	66.8	69.8	76.87	84.51	87.94	(72)

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

(73)m=	447.94	445.54	429.6	403.6	376.57	350.81	334.76	342.05	356.17	382.4	412.14	434.66	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

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

(83)m=	0	0	0	0	0	0	0	0	0	0	0	0	(83)

TER WorkSheet: New dwelling design stage

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

(84)m=	447.94	445.54	429.6	403.6	376.57	350.81	334.76	342.05	356.17	382.4	412.14	434.66	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	1	1	0.99	0.96	0.96	0.99	1	1	1	(86)

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

(87)m=	19.62	19.69	19.85	20.09	20.36	20.65	20.83	20.82	20.6	20.25	19.91	19.62	(87)

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

(88)m=	19.98	19.98	19.98	19.99	20	20.01	20.01	20.01	20	20	19.99	19.99	(88)

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

(89)m=	1	1	1	1	1	0.98	0.9	0.91	0.98	1	1	1	(89)

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

(90)m=	18.12	18.22	18.45	18.82	19.22	19.64	19.88	19.87	19.56	19.06	18.55	18.12	(90)

fLA = Living area ÷ (4) = | 0.18 | (91)

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

(92)m=	18.39	18.48	18.7	19.04	19.42	19.81	20.05	20.04	19.75	19.27	18.79	18.38	(92)

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

(93)m=	18.39	18.48	18.7	19.04	19.42	19.81	20.05	20.04	19.75	19.27	18.79	18.38	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	1	0.99	0.97	0.9	0.91	0.98	1	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	447.55	445.08	428.99	402.58	374.16	341.74	302.04	311.63	349.14	380.85	411.55	434.34	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1673.61	1608.95	1441.77	1184.02	898.89	600.62	397.54	418.1	653.05	1009.37	1367.56	1667.56	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	912.19	782.12	753.51	562.63	390.4	0	0	0	0	467.62	688.33	917.51	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 5474.31 | (98)

Space heating requirement in kWh/m²/year | 51.99 | (99)

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

Space heating:

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

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

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = | 1 | (204)

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Efficiency of main space heating system 1	93.4	(206)
Efficiency of secondary/supplementary heating system, %	0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	912.19	782.12	753.51	562.63	390.4	0	0	0	0	467.62	688.33	917.51		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	976.65	837.38	806.75	602.39	417.99	0	0	0	0	500.66	736.97	982.35		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													5861.14	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	214.58	189.14	198.63	177.22	171.58	151.12	144.79	161.4	163.18	184.64	195.24	209.42		
Efficiency of water heater													80.3	(216)
(217)m=	88.29	88.24	88.09	87.76	87.06	80.3	80.3	80.3	80.3	87.29	87.96	88.34		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	243.06	214.34	225.49	201.95	197.09	188.2	180.31	201	203.22	211.52	221.97	237.08		
Total = Sum(219a)$_{1...12}$ =													2525.22	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			5861.14	
Water heating fuel used			2525.22	
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			447.38	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			8908.75	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	1266.01	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	545.45	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1811.45	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	232.19	(268)
Total CO2, kg/year		sum of (265)…(271) =		2082.57	(272)

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TER =	19.78	(273)