Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.17
Printed on 16 June 2023 at 14:55:52

Project Information:

Assessed By: Ben Talbutt (STRO036639) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 77.11m²

Site Reference : Fosters Estate Block D **Plot Reference:** D1-06

Address :

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: Electricity (c)
Fuel factor: 1.55 (electricity (c))

Target Carbon Dioxide Emission Rate (TER)	27.64 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	11.87 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	55.9 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	50.2 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.20 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.34 (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	3.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Community heating schemes - Heat pump

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

6 Controls

Space heating controls	Charging system linked to use of community heating, programmer and at least two room thermostats	OK
Hot water controls:	No cylinder thermostat No cylinder	

Regulations Compliance Report

7 Low energy lights		
Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**
8 Mechanical ventilation		
Continuous supply and extract system		
Specific fan power:	0.61	
Maximum	1.5	**OK**
MVHR efficiency:	88%	
Minimum	70%	**OK**
9 Summertime temperature		
Overheating risk (Thames valley):	Not assessed	**?**
10 Key features		
Air permeablility	3.0 m^3/m^2h	
Doors U-value	0.91 W/m^2K	
Roofs U-value	0.1 W/m^2K	
Party Walls U-value	0 W/m^2K	
Community heating, heat from electric heat pump		

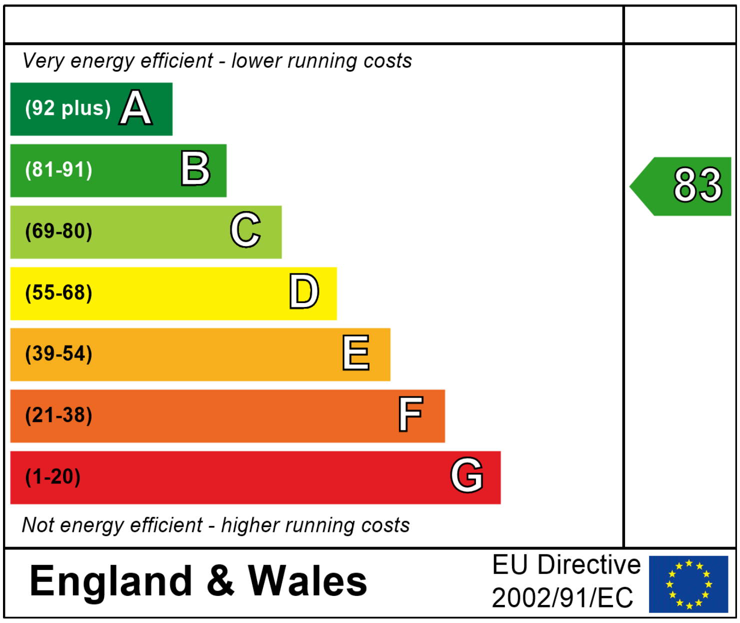
Predicted Energy Assessment

Dwelling type:	Mid floor Flat
Date of assessment:	13 October 2022
Produced by:	Ben Talbutt
Total floor area:	77.11 m²

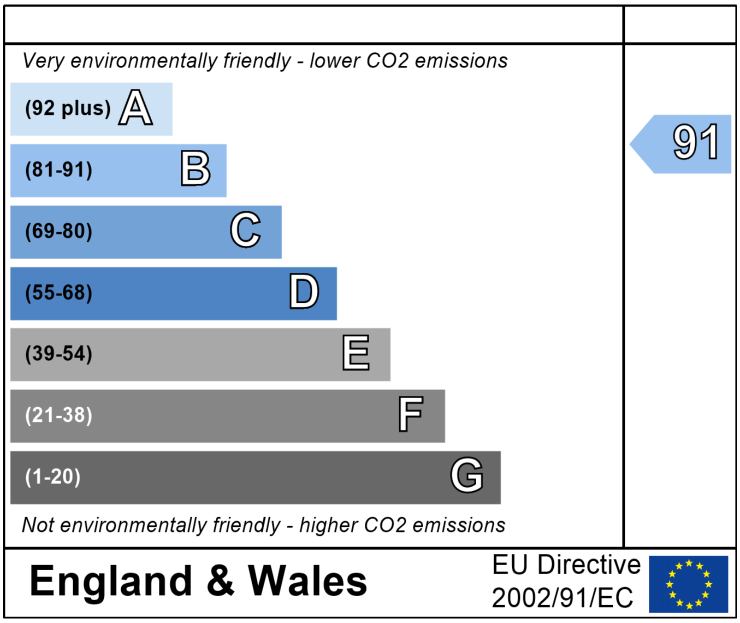
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about 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: D1-06

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	13 October 2022
Date of certificate:	16 June 2023
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	505

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2022	
Floor Location:	Floor area:	Storey height:
Floor 0	77.11 m²	2.82 m
Living area:	27.54 m² (fraction 0.357)	
Front of dwelling faces:	Unspecified	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Front Door	Manufacturer	Solid			Wood
Win 1	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Win 2	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Win 3	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Win 4	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Win 5	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Win 6	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Win 7	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Win 8	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
Front Door	mm	1	0	0.91	2.52	1
Win 1	16mm or more	0.8	0.4	1.4	2.9	1
Win 2	16mm or more	0.8	0.4	1.4	5.45	1
Win 3	16mm or more	0.8	0.4	1.4	1.99	2
Win 4	16mm or more	0.8	0.4	1.4	0.9	1
Win 5	16mm or more	0.8	0.4	1.4	0.62	1
Win 6	16mm or more	0.8	0.4	1.4	1.99	1
Win 7	16mm or more	0.8	0.4	1.4	0.9	2
Win 8	16mm or more	0.8	0.4	1.4	1.99	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Front Door		Ext Wall	North East	1.05	2.4
Win 1		Ext Wall	South East	1.47	1.97
Win 2		Ext Wall	South East	2.27	2.4
Win 3		Ext Wall	North West	1.02	1.95
Win 4		Ext Wall	North West	0.46	1.95
Win 5		Ext Wall	North West	0.46	1.35
Win 6		Ext Wall	South West	1.02	1.95
Win 7		Ext Wall	South West	0.46	1.95

SAP Input

Win 8	Ext Wall	North East	1.02	1.95

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Ext Wall	55.53	22.15	33.38	0.14	0	False	N/A
Common Area Wall	21.38	0	21.38	0.2	0.9	False	N/A
Concrete Column	2.82	0	2.82	0.2	0	False	N/A
Roof	77.11	0	77.11	0.1	0		N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							
Party Wall	25.17						N/A

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0845

	Length	Psi-value		
[Approved]	10.71	0.3	E2	Other lintels (including other steel lintels)
[Approved]	7.39	0.04	E3	Sill
[Approved]	43.54	0.05	E4	Jamb
[Approved]	19.48	0.07	E7	Party floor between dwellings (in blocks of flats)
[Approved]	11.28	0.09	E16	Corner (normal)
	26.41	0.08	E14	Flat roof
[Approved]	2.82	-0.09	E17	Corner (inverted internal area greater than external area)
	2.82	0.12	E25	Staggered party wall between dwellings
[Approved]	0	0.16	E5	Ground floor (normal)
[Approved]	0	0.07	E6	Intermediate floor within a dwelling
	0	0.32	E20	Exposed floor (normal)
[Approved]	0	0.06	E18	Party wall between dwellings
	7.13	0.12	E24	Eaves (insulation at ceiling level - inverted)
	8.93	0	P3	Intermediate floor between dwellings (in blocks of flats)
	8.93	0.24	P4	Roof (insulation at ceiling level)
	0	0.24	P8	Exposed floor (inverted)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, Rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:

Main heating system: Community heating schemes
Heat source: Community heat pump
heat from electric heat pump, heat fraction 1, efficiency 383
Piping>=1991, pre-insulated, low temp, variable flow

Main heating Control:

Main heating Control: Charging system linked to use of community heating, programmer and at least two room thermostats

SAP Input

	Control code: 2312
Secondary heating system:	
Secondary heating system:	None
Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :heat from boilers – mains gas No hot water cylinder Solar panel: False
Others:	
Electricity tariff:	Standard Tariff
In Smoke Control Area:	Unknown
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Ben Talbutt	**Stroma Number:**	STRO036639
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.17

Property Address: D1-06

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	77.11	(1a)	x	2.82	(2a)	=	217.45	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	77.11	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	217.45	(5)

2. Ventilation rate:

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

Air changes per hour

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

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(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) =	0.13	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

SAP WorkSheet: New dwelling design stage

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	74.8	(23c)

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

(24a)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.52	x	0.91	=	2.2932			(26)
Windows Type 1			2.9	x1/[1/(1.4)+ 0.04]		=	3.84			(27)
Windows Type 2			5.45	x1/[1/(1.4)+ 0.04]		=	7.23			(27)
Windows Type 3			1.99	x1/[1/(1.4)+ 0.04]		=	2.64			(27)
Windows Type 4			0.9	x1/[1/(1.4)+ 0.04]		=	1.19			(27)
Windows Type 5			0.62	x1/[1/(1.4)+ 0.04]		=	0.82			(27)
Windows Type 6			1.99	x1/[1/(1.4)+ 0.04]		=	2.64			(27)
Windows Type 7			0.9	x1/[1/(1.4)+ 0.04]		=	1.19			(27)
Windows Type 8			1.99	x1/[1/(1.4)+ 0.04]		=	2.64			(27)
Walls Type1	55.53	22.15	33.38	x	0.14	=	4.67			(29)
Walls Type2	21.38	0	21.38	x	0.17	=	3.62			(29)
Walls Type3	2.82	0	2.82	x	0.2	=	0.56			(29)
Roof	77.11	0	77.11	x	0.1	=	7.71			(30)
Total area of elements, m²			156.84							(31)
Party wall			25.17	x	0	=	0			(32)

** 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) =	44.89	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(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 | 13.26 | (36)

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

Total fabric heat loss (33) + (36) = | 58.15 | (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=	20.71	20.48	20.25	19.11	18.88	17.73	17.73	17.5	18.19	18.88	19.33	19.79	(38)

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

(39)m=	78.86	78.63	78.4	77.26	77.03	75.88	75.88	75.65	76.34	77.03	77.48	77.94	

Average = Sum(39)$_{1…12}$ /12= | 77.2 | (39)

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

(40)m=	1.02	1.02	1.02	1	1	0.98	0.98	0.98	0.99	1	1	1.01	

Average = Sum(40)$_{1…12}$ /12= | 1 | (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 | 2.41 | (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 | 91.34 | (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	100.47	96.82	93.16	89.51	85.86	82.2	82.2	85.86	89.51	93.16	96.82	100.47	

Total = Sum(44)$_{1…12}$ = | 1096.04 | (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=	148.99	130.31	134.47	117.23	112.49	97.07	89.95	103.22	104.45	121.73	132.87	144.29	

Total = Sum(45)$_{1…12}$ = | 1437.08 | (45)

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

(46)m=	22.35	19.55	20.17	17.59	16.87	14.56	13.49	15.48	15.67	18.26	19.93	21.64	(46)

Water storage loss:

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

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

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

Water storage loss:

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

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

Energy lost from water storage, kWh/year (48) x (49) = | 110 | (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.02 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 1.03 | (52)

Temperature factor from Table 2b | 0.6 | (53)

Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)		1.03	(55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

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

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

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

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

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

(62)m=	204.27	180.24	189.75	170.73	167.77	150.56	145.23	158.49	157.94	177	186.37	199.57	(62)

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

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

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

Output from water heater

(64)m=	204.27	180.24	189.75	170.73	167.77	150.56	145.23	158.49	157.94	177	186.37	199.57

Output from water heater (annual)$_{1...12}$ — 2087.92 (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=	93.76	83.27	88.93	81.78	81.62	75.07	74.13	78.54	77.52	84.7	86.98	92.2	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	144.34	144.34	144.34	144.34	144.34	144.34	144.34	144.34	144.34	144.34	144.34	144.34	(66)

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

(67)m=	47.54	42.22	34.34	26	19.43	16.41	17.73	23.04	30.93	39.27	45.83	48.86	(67)

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

(68)m=	318.35	321.65	313.33	295.61	273.24	252.21	238.16	234.86	243.18	260.91	283.28	304.3	(68)

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

(69)m=	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	(71)

Water heating gains (Table 5)

(72)m=	126.02	123.91	119.53	113.58	109.71	104.26	99.64	105.57	107.67	113.84	120.8	123.92	(72)

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

(73)m=	591.87	587.75	567.16	535.13	502.33	472.84	455.48	463.42	481.74	513.97	549.87	577.04	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	1.99	x	11.28	x	0.4	x	0.8	=	4.98	(75)
Northeast	0.9x	0.77	x	1.99	x	22.97	x	0.4	x	0.8	=	10.14	(75)
Northeast	0.9x	0.77	x	1.99	x	41.38	x	0.4	x	0.8	=	18.26	(75)
Northeast	0.9x	0.77	x	1.99	x	67.96	x	0.4	x	0.8	=	29.99	(75)
Northeast	0.9x	0.77	x	1.99	x	91.35	x	0.4	x	0.8	=	40.31	(75)
Northeast	0.9x	0.77	x	1.99	x	97.38	x	0.4	x	0.8	=	42.98	(75)
Northeast	0.9x	0.77	x	1.99	x	91.1	x	0.4	x	0.8	=	40.2	(75)
Northeast	0.9x	0.77	x	1.99	x	72.63	x	0.4	x	0.8	=	32.05	(75)
Northeast	0.9x	0.77	x	1.99	x	50.42	x	0.4	x	0.8	=	22.25	(75)
Northeast	0.9x	0.77	x	1.99	x	28.07	x	0.4	x	0.8	=	12.39	(75)
Northeast	0.9x	0.77	x	1.99	x	14.2	x	0.4	x	0.8	=	6.27	(75)
Northeast	0.9x	0.77	x	1.99	x	9.21	x	0.4	x	0.8	=	4.07	(75)
Southeast	0.9x	0.77	x	2.9	x	36.79	x	0.4	x	0.8	=	23.66	(77)
Southeast	0.9x	0.77	x	5.45	x	36.79	x	0.4	x	0.8	=	44.47	(77)
Southeast	0.9x	0.77	x	2.9	x	62.67	x	0.4	x	0.8	=	40.31	(77)
Southeast	0.9x	0.77	x	5.45	x	62.67	x	0.4	x	0.8	=	75.75	(77)
Southeast	0.9x	0.77	x	2.9	x	85.75	x	0.4	x	0.8	=	55.15	(77)
Southeast	0.9x	0.77	x	5.45	x	85.75	x	0.4	x	0.8	=	103.64	(77)
Southeast	0.9x	0.77	x	2.9	x	106.25	x	0.4	x	0.8	=	68.33	(77)
Southeast	0.9x	0.77	x	5.45	x	106.25	x	0.4	x	0.8	=	128.41	(77)
Southeast	0.9x	0.77	x	2.9	x	119.01	x	0.4	x	0.8	=	76.54	(77)
Southeast	0.9x	0.77	x	5.45	x	119.01	x	0.4	x	0.8	=	143.84	(77)
Southeast	0.9x	0.77	x	2.9	x	118.15	x	0.4	x	0.8	=	75.98	(77)
Southeast	0.9x	0.77	x	5.45	x	118.15	x	0.4	x	0.8	=	142.8	(77)
Southeast	0.9x	0.77	x	2.9	x	113.91	x	0.4	x	0.8	=	73.26	(77)
Southeast	0.9x	0.77	x	5.45	x	113.91	x	0.4	x	0.8	=	137.67	(77)
Southeast	0.9x	0.77	x	2.9	x	104.39	x	0.4	x	0.8	=	67.13	(77)
Southeast	0.9x	0.77	x	5.45	x	104.39	x	0.4	x	0.8	=	126.17	(77)
Southeast	0.9x	0.77	x	2.9	x	92.85	x	0.4	x	0.8	=	59.71	(77)
Southeast	0.9x	0.77	x	5.45	x	92.85	x	0.4	x	0.8	=	112.22	(77)
Southeast	0.9x	0.77	x	2.9	x	69.27	x	0.4	x	0.8	=	44.55	(77)
Southeast	0.9x	0.77	x	5.45	x	69.27	x	0.4	x	0.8	=	83.72	(77)
Southeast	0.9x	0.77	x	2.9	x	44.07	x	0.4	x	0.8	=	28.34	(77)
Southeast	0.9x	0.77	x	5.45	x	44.07	x	0.4	x	0.8	=	53.26	(77)
Southeast	0.9x	0.77	x	2.9	x	31.49	x	0.4	x	0.8	=	20.25	(77)
Southeast	0.9x	0.77	x	5.45	x	31.49	x	0.4	x	0.8	=	38.06	(77)
Southwest	0.9x	0.77	x	1.99	x	36.79		0.4	x	0.8	=	16.24	(79)
Southwest	0.9x	0.77	x	0.9	x	36.79		0.4	x	0.8	=	14.69	(79)
Southwest	0.9x	0.77	x	1.99	x	62.67		0.4	x	0.8	=	27.66	(79)

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Southwest	0.9x	0.77	x	0.9	x	62.67		0.4	x	0.8	=	25.02	(79)
Southwest	0.9x	0.77	x	1.99	x	85.75		0.4	x	0.8	=	37.84	(79)
Southwest	0.9x	0.77	x	0.9	x	85.75		0.4	x	0.8	=	34.23	(79)
Southwest	0.9x	0.77	x	1.99	x	106.25		0.4	x	0.8	=	46.89	(79)
Southwest	0.9x	0.77	x	0.9	x	106.25		0.4	x	0.8	=	42.41	(79)
Southwest	0.9x	0.77	x	1.99	x	119.01		0.4	x	0.8	=	52.52	(79)
Southwest	0.9x	0.77	x	0.9	x	119.01		0.4	x	0.8	=	47.51	(79)
Southwest	0.9x	0.77	x	1.99	x	118.15		0.4	x	0.8	=	52.14	(79)
Southwest	0.9x	0.77	x	0.9	x	118.15		0.4	x	0.8	=	47.16	(79)
Southwest	0.9x	0.77	x	1.99	x	113.91		0.4	x	0.8	=	50.27	(79)
Southwest	0.9x	0.77	x	0.9	x	113.91		0.4	x	0.8	=	45.47	(79)
Southwest	0.9x	0.77	x	1.99	x	104.39		0.4	x	0.8	=	46.07	(79)
Southwest	0.9x	0.77	x	0.9	x	104.39		0.4	x	0.8	=	41.67	(79)
Southwest	0.9x	0.77	x	1.99	x	92.85		0.4	x	0.8	=	40.98	(79)
Southwest	0.9x	0.77	x	0.9	x	92.85		0.4	x	0.8	=	37.06	(79)
Southwest	0.9x	0.77	x	1.99	x	69.27		0.4	x	0.8	=	30.57	(79)
Southwest	0.9x	0.77	x	0.9	x	69.27		0.4	x	0.8	=	27.65	(79)
Southwest	0.9x	0.77	x	1.99	x	44.07		0.4	x	0.8	=	19.45	(79)
Southwest	0.9x	0.77	x	0.9	x	44.07		0.4	x	0.8	=	17.59	(79)
Southwest	0.9x	0.77	x	1.99	x	31.49		0.4	x	0.8	=	13.9	(79)
Southwest	0.9x	0.77	x	0.9	x	31.49		0.4	x	0.8	=	12.57	(79)
Northwest	0.9x	0.77	x	1.99	x	11.28	x	0.4	x	0.8	=	9.96	(81)
Northwest	0.9x	0.77	x	0.9	x	11.28	x	0.4	x	0.8	=	2.25	(81)
Northwest	0.9x	0.77	x	0.62	x	11.28	x	0.4	x	0.8	=	1.55	(81)
Northwest	0.9x	0.77	x	1.99	x	22.97	x	0.4	x	0.8	=	20.27	(81)
Northwest	0.9x	0.77	x	0.9	x	22.97	x	0.4	x	0.8	=	4.58	(81)
Northwest	0.9x	0.77	x	0.62	x	22.97	x	0.4	x	0.8	=	3.16	(81)
Northwest	0.9x	0.77	x	1.99	x	41.38	x	0.4	x	0.8	=	36.52	(81)
Northwest	0.9x	0.77	x	0.9	x	41.38	x	0.4	x	0.8	=	8.26	(81)
Northwest	0.9x	0.77	x	0.62	x	41.38	x	0.4	x	0.8	=	5.69	(81)
Northwest	0.9x	0.77	x	1.99	x	67.96	x	0.4	x	0.8	=	59.98	(81)
Northwest	0.9x	0.77	x	0.9	x	67.96	x	0.4	x	0.8	=	13.56	(81)
Northwest	0.9x	0.77	x	0.62	x	67.96	x	0.4	x	0.8	=	9.34	(81)
Northwest	0.9x	0.77	x	1.99	x	91.35	x	0.4	x	0.8	=	80.62	(81)
Northwest	0.9x	0.77	x	0.9	x	91.35	x	0.4	x	0.8	=	18.23	(81)
Northwest	0.9x	0.77	x	0.62	x	91.35	x	0.4	x	0.8	=	12.56	(81)
Northwest	0.9x	0.77	x	1.99	x	97.38	x	0.4	x	0.8	=	85.95	(81)
Northwest	0.9x	0.77	x	0.9	x	97.38	x	0.4	x	0.8	=	19.44	(81)
Northwest	0.9x	0.77	x	0.62	x	97.38	x	0.4	x	0.8	=	13.39	(81)
Northwest	0.9x	0.77	x	1.99	x	91.1	x	0.4	x	0.8	=	80.41	(81)
Northwest	0.9x	0.77	x	0.9	x	91.1	x	0.4	x	0.8	=	18.18	(81)

Northwest	0.9x	0.77	x	0.62	x	91.1	x	0.4	x	0.8	=	12.53	(81)
Northwest	0.9x	0.77	x	1.99	x	72.63	x	0.4	x	0.8	=	64.1	(81)
Northwest	0.9x	0.77	x	0.9	x	72.63	x	0.4	x	0.8	=	14.5	(81)
Northwest	0.9x	0.77	x	0.62	x	72.63	x	0.4	x	0.8	=	9.99	(81)
Northwest	0.9x	0.77	x	1.99	x	50.42	x	0.4	x	0.8	=	44.5	(81)
Northwest	0.9x	0.77	x	0.9	x	50.42	x	0.4	x	0.8	=	10.06	(81)
Northwest	0.9x	0.77	x	0.62	x	50.42	x	0.4	x	0.8	=	6.93	(81)
Northwest	0.9x	0.77	x	1.99	x	28.07	x	0.4	x	0.8	=	24.77	(81)
Northwest	0.9x	0.77	x	0.9	x	28.07	x	0.4	x	0.8	=	5.6	(81)
Northwest	0.9x	0.77	x	0.62	x	28.07	x	0.4	x	0.8	=	3.86	(81)
Northwest	0.9x	0.77	x	1.99	x	14.2	x	0.4	x	0.8	=	12.53	(81)
Northwest	0.9x	0.77	x	0.9	x	14.2	x	0.4	x	0.8	=	2.83	(81)
Northwest	0.9x	0.77	x	0.62	x	14.2	x	0.4	x	0.8	=	1.95	(81)
Northwest	0.9x	0.77	x	1.99	x	9.21	x	0.4	x	0.8	=	8.13	(81)
Northwest	0.9x	0.77	x	0.9	x	9.21	x	0.4	x	0.8	=	1.84	(81)
Northwest	0.9x	0.77	x	0.62	x	9.21	x	0.4	x	0.8	=	1.27	(81)

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

(83)m=	117.8	206.87	299.59	398.92	472.12	479.83	457.98	401.67	333.72	233.1	142.23	100.08	(83)

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

(84)m=	709.66	794.62	866.74	934.06	974.45	952.67	913.46	865.09	815.46	747.07	692.09	677.12	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.97	0.94	0.85	0.7	0.5	0.36	0.4	0.63	0.88	0.97	0.99	(86)

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

(87)m=	20.23	20.38	20.59	20.82	20.95	20.99	21	21	20.98	20.82	20.49	20.2	(87)

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

(88)m=	20.06	20.07	20.07	20.08	20.08	20.1	20.1	20.1	20.09	20.08	20.08	20.07	(88)

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

(89)m=	0.98	0.96	0.92	0.81	0.64	0.44	0.29	0.32	0.55	0.84	0.96	0.98	(89)

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

(90)m=	19.06	19.28	19.58	19.89	20.04	20.09	20.1	20.1	20.08	19.89	19.45	19.03	(90)

fLA = Living area ÷ (4) = 0.36 (91)

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

(92)m=	19.48	19.68	19.94	20.22	20.37	20.41	20.42	20.42	20.4	20.22	19.82	19.45	(92)

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

(93)m=	19.48	19.68	19.94	20.22	20.37	20.41	20.42	20.42	20.4	20.22	19.82	19.45	(93)

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.98	0.96	0.92	0.82	0.66	0.46	0.32	0.35	0.58	0.85	0.95	0.98	(94)

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

(95)m=	693.05	761.23	794.81	765.77	640.43	438.27	289.5	303.63	470.77	632.01	660.69	664.18	(95)

Monthly average external temperature from Table 8

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

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	1197.09	1161.89	1053.96	874.87	667.6	441.22	289.78	304.13	480.92	741.34	985.82	1188.4	(97)

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

(98)m=	375	269.24	192.81	78.55	20.21	0	0	0	0	81.34	234.1	390.02	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1641.27 (98)

Space heating requirement in kWh/m²/year 21.28 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1641.27	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1723.34	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2087.92	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2192.31	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	39.16	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		202.28	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	202.28	(331)

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Energy for lighting (calculated in Appendix L)			335.82	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =			4453.75	(338)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating from CHP	(307a) x	4.24	x 0.01 =	73.07	(340a)
Water heating from CHP	(310a) x	4.24	x 0.01 =	92.95	(342a)
		Fuel Price			
Pumps and fans	(331)	13.19	x 0.01 =	26.68	(349)
Energy for lighting	(332)	13.19	x 0.01 =	44.29	(350)
Additional standing charges (Table 12)				120	(351)
Total energy cost	= (340a)…(342e) + (345)…(354) =			357	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.23	(357)
SAP rating (section12)		82.87	(358)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				383	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	530.61	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	20.32	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	550.93	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				550.93	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	104.98	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	174.29	(379)
Total CO2, kg/year	sum of (376)…(382) =				830.2	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				10.77	(384)
EI rating (section 14)					90.89	(385)

13b. Primary Energy – Community heating scheme

		Energy kWh/year	Primary factor	P.Energy kWh/year	
Energy from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel			383	(367a)

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Energy associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	3.07	=	3138.65	(367)
Electrical energy for heat distribution	[(313) x		=	120.21	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)		=	3258.86	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)				3258.86	(373)
Energy associated with space heating (secondary)	(309) x	0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x	1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =			3258.86	(376)
Energy associated with space cooling	(315) x	3.07	=	0	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x	3.07	=	621.01	(378)
Energy associated with electricity for lighting	(332))) x	3.07	=	1030.96	(379)
Total Primary Energy, kWh/year	sum of (376)…(382) =			4910.83	(383)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Ben Talbutt	**Stroma Number:**	STRO036639
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.17

Property Address: D1-06

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	77.11	(1a) x	2.82	(2a) =	217.45	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	77.11	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	217.45	(5)

2. Ventilation rate:

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

Air changes per hour

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

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(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) =	0.13	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 74.8 (23c)

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

(24a)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

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

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

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

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

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

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

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

(25)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.52	x	0.91	=	2.2932			(26)
Windows Type 1			2.9	x1/[1/(1.4)+ 0.04]		=	3.84			(27)
Windows Type 2			5.45	x1/[1/(1.4)+ 0.04]		=	7.23			(27)
Windows Type 3			1.99	x1/[1/(1.4)+ 0.04]		=	2.64			(27)
Windows Type 4			0.9	x1/[1/(1.4)+ 0.04]		=	1.19			(27)
Windows Type 5			0.62	x1/[1/(1.4)+ 0.04]		=	0.82			(27)
Windows Type 6			1.99	x1/[1/(1.4)+ 0.04]		=	2.64			(27)
Windows Type 7			0.9	x1/[1/(1.4)+ 0.04]		=	1.19			(27)
Windows Type 8			1.99	x1/[1/(1.4)+ 0.04]		=	2.64			(27)
Walls Type1	55.53	22.15	33.38	x	0.14	=	4.67			(29)
Walls Type2	21.38	0	21.38	x	0.17	=	3.62			(29)
Walls Type3	2.82	0	2.82	x	0.2	=	0.56			(29)
Roof	77.11	0	77.11	x	0.1	=	7.71			(30)
Total area of elements, m²			156.84							(31)
Party wall			25.17	x	0	=	0			(32)

** 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) = 44.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (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 | 13.26 | (36)

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

Total fabric heat loss (33) + (36) = | 58.15 | (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=	20.71	20.48	20.25	19.11	18.88	17.73	17.73	17.5	18.19	18.88	19.33	19.79	(38)

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

(39)m=	78.86	78.63	78.4	77.26	77.03	75.88	75.88	75.65	76.34	77.03	77.48	77.94

Average = Sum(39)$_{1\ldots12}$ /12= | 77.2 | (39)

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

(40)m=	1.02	1.02	1.02	1	1	0.98	0.98	0.98	0.99	1	1	1.01

Average = Sum(40)$_{1\ldots12}$ /12= | 1 | (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 | 2.41 | (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 | 91.34 | (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=	100.47	96.82	93.16	89.51	85.86	82.2	82.2	85.86	89.51	93.16	96.82	100.47

Total = Sum(44)$_{1\ldots12}$ = | 1096.04 | (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=	148.99	130.31	134.47	117.23	112.49	97.07	89.95	103.22	104.45	121.73	132.87	144.29

Total = Sum(45)$_{1\ldots12}$ = | 1437.08 | (45)

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

(46)m=	22.35	19.55	20.17	17.59	16.87	14.56	13.49	15.48	15.67	18.26	19.93	21.64	(46)

Water storage loss:

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

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

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

Water storage loss:

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

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

Energy lost from water storage, kWh/year (48) x (49) = | 110 | (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.02 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 1.03 | (52)

Temperature factor from Table 2b | 0.6 | (53)

Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)		1.03	(55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

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

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

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

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

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

(62)m=	204.27	180.24	189.75	170.73	167.77	150.56	145.23	158.49	157.94	177	186.37	199.57	(62)

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

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

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

Output from water heater

(64)m=	204.27	180.24	189.75	170.73	167.77	150.56	145.23	158.49	157.94	177	186.37	199.57	

Output from water heater (annual)$_{1...12}$ — 2087.92 (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=	93.76	83.27	88.93	81.78	81.62	75.07	74.13	78.54	77.52	84.7	86.98	92.2	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	120.29	120.29	120.29	120.29	120.29	120.29	120.29	120.29	120.29	120.29	120.29	120.29	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	19.02	16.89	13.74	10.4	7.77	6.56	7.09	9.22	12.37	15.71	18.33	19.54	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	213.29	215.51	209.93	198.06	183.07	168.98	159.57	157.36	162.93	174.81	189.8	203.88	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	35.03	35.03	35.03	35.03	35.03	35.03	35.03	35.03	35.03	35.03	35.03	35.03	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	(71)
Water heating gains (Table 5)													
(72)m=	126.02	123.91	119.53	113.58	109.71	104.26	99.64	105.57	107.67	113.84	120.8	123.92	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	417.42	415.4	402.28	381.12	359.64	338.89	325.38	331.23	342.06	363.44	388.01	406.44	(73)

6. Solar gains:

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

DER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	1.99	x	11.28	x	0.4	x	0.8	=	4.98	(75)
Northeast	0.9x	0.77	x	1.99	x	22.97	x	0.4	x	0.8	=	10.14	(75)
Northeast	0.9x	0.77	x	1.99	x	41.38	x	0.4	x	0.8	=	18.26	(75)
Northeast	0.9x	0.77	x	1.99	x	67.96	x	0.4	x	0.8	=	29.99	(75)
Northeast	0.9x	0.77	x	1.99	x	91.35	x	0.4	x	0.8	=	40.31	(75)
Northeast	0.9x	0.77	x	1.99	x	97.38	x	0.4	x	0.8	=	42.98	(75)
Northeast	0.9x	0.77	x	1.99	x	91.1	x	0.4	x	0.8	=	40.2	(75)
Northeast	0.9x	0.77	x	1.99	x	72.63	x	0.4	x	0.8	=	32.05	(75)
Northeast	0.9x	0.77	x	1.99	x	50.42	x	0.4	x	0.8	=	22.25	(75)
Northeast	0.9x	0.77	x	1.99	x	28.07	x	0.4	x	0.8	=	12.39	(75)
Northeast	0.9x	0.77	x	1.99	x	14.2	x	0.4	x	0.8	=	6.27	(75)
Northeast	0.9x	0.77	x	1.99	x	9.21	x	0.4	x	0.8	=	4.07	(75)
Southeast	0.9x	0.77	x	2.9	x	36.79	x	0.4	x	0.8	=	23.66	(77)
Southeast	0.9x	0.77	x	5.45	x	36.79	x	0.4	x	0.8	=	44.47	(77)
Southeast	0.9x	0.77	x	2.9	x	62.67	x	0.4	x	0.8	=	40.31	(77)
Southeast	0.9x	0.77	x	5.45	x	62.67	x	0.4	x	0.8	=	75.75	(77)
Southeast	0.9x	0.77	x	2.9	x	85.75	x	0.4	x	0.8	=	55.15	(77)
Southeast	0.9x	0.77	x	5.45	x	85.75	x	0.4	x	0.8	=	103.64	(77)
Southeast	0.9x	0.77	x	2.9	x	106.25	x	0.4	x	0.8	=	68.33	(77)
Southeast	0.9x	0.77	x	5.45	x	106.25	x	0.4	x	0.8	=	128.41	(77)
Southeast	0.9x	0.77	x	2.9	x	119.01	x	0.4	x	0.8	=	76.54	(77)
Southeast	0.9x	0.77	x	5.45	x	119.01	x	0.4	x	0.8	=	143.84	(77)
Southeast	0.9x	0.77	x	2.9	x	118.15	x	0.4	x	0.8	=	75.98	(77)
Southeast	0.9x	0.77	x	5.45	x	118.15	x	0.4	x	0.8	=	142.8	(77)
Southeast	0.9x	0.77	x	2.9	x	113.91	x	0.4	x	0.8	=	73.26	(77)
Southeast	0.9x	0.77	x	5.45	x	113.91	x	0.4	x	0.8	=	137.67	(77)
Southeast	0.9x	0.77	x	2.9	x	104.39	x	0.4	x	0.8	=	67.13	(77)
Southeast	0.9x	0.77	x	5.45	x	104.39	x	0.4	x	0.8	=	126.17	(77)
Southeast	0.9x	0.77	x	2.9	x	92.85	x	0.4	x	0.8	=	59.71	(77)
Southeast	0.9x	0.77	x	5.45	x	92.85	x	0.4	x	0.8	=	112.22	(77)
Southeast	0.9x	0.77	x	2.9	x	69.27	x	0.4	x	0.8	=	44.55	(77)
Southeast	0.9x	0.77	x	5.45	x	69.27	x	0.4	x	0.8	=	83.72	(77)
Southeast	0.9x	0.77	x	2.9	x	44.07	x	0.4	x	0.8	=	28.34	(77)
Southeast	0.9x	0.77	x	5.45	x	44.07	x	0.4	x	0.8	=	53.26	(77)
Southeast	0.9x	0.77	x	2.9	x	31.49	x	0.4	x	0.8	=	20.25	(77)
Southeast	0.9x	0.77	x	5.45	x	31.49	x	0.4	x	0.8	=	38.06	(77)
Southwest	0.9x	0.77	x	1.99	x	36.79		0.4	x	0.8	=	16.24	(79)
Southwest	0.9x	0.77	x	0.9	x	36.79		0.4	x	0.8	=	14.69	(79)
Southwest	0.9x	0.77	x	1.99	x	62.67		0.4	x	0.8	=	27.66	(79)

DER WorkSheet: New dwelling design stage

Southwest	0.9x	0.77	x	0.9	x	62.67		0.4	x	0.8	=	25.02	(79)
Southwest	0.9x	0.77	x	1.99	x	85.75		0.4	x	0.8	=	37.84	(79)
Southwest	0.9x	0.77	x	0.9	x	85.75		0.4	x	0.8	=	34.23	(79)
Southwest	0.9x	0.77	x	1.99	x	106.25		0.4	x	0.8	=	46.89	(79)
Southwest	0.9x	0.77	x	0.9	x	106.25		0.4	x	0.8	=	42.41	(79)
Southwest	0.9x	0.77	x	1.99	x	119.01		0.4	x	0.8	=	52.52	(79)
Southwest	0.9x	0.77	x	0.9	x	119.01		0.4	x	0.8	=	47.51	(79)
Southwest	0.9x	0.77	x	1.99	x	118.15		0.4	x	0.8	=	52.14	(79)
Southwest	0.9x	0.77	x	0.9	x	118.15		0.4	x	0.8	=	47.16	(79)
Southwest	0.9x	0.77	x	1.99	x	113.91		0.4	x	0.8	=	50.27	(79)
Southwest	0.9x	0.77	x	0.9	x	113.91		0.4	x	0.8	=	45.47	(79)
Southwest	0.9x	0.77	x	1.99	x	104.39		0.4	x	0.8	=	46.07	(79)
Southwest	0.9x	0.77	x	0.9	x	104.39		0.4	x	0.8	=	41.67	(79)
Southwest	0.9x	0.77	x	1.99	x	92.85		0.4	x	0.8	=	40.98	(79)
Southwest	0.9x	0.77	x	0.9	x	92.85		0.4	x	0.8	=	37.06	(79)
Southwest	0.9x	0.77	x	1.99	x	69.27		0.4	x	0.8	=	30.57	(79)
Southwest	0.9x	0.77	x	0.9	x	69.27		0.4	x	0.8	=	27.65	(79)
Southwest	0.9x	0.77	x	1.99	x	44.07		0.4	x	0.8	=	19.45	(79)
Southwest	0.9x	0.77	x	0.9	x	44.07		0.4	x	0.8	=	17.59	(79)
Southwest	0.9x	0.77	x	1.99	x	31.49		0.4	x	0.8	=	13.9	(79)
Southwest	0.9x	0.77	x	0.9	x	31.49		0.4	x	0.8	=	12.57	(79)
Northwest	0.9x	0.77	x	1.99	x	11.28	x	0.4	x	0.8	=	9.96	(81)
Northwest	0.9x	0.77	x	0.9	x	11.28	x	0.4	x	0.8	=	2.25	(81)
Northwest	0.9x	0.77	x	0.62	x	11.28	x	0.4	x	0.8	=	1.55	(81)
Northwest	0.9x	0.77	x	1.99	x	22.97	x	0.4	x	0.8	=	20.27	(81)
Northwest	0.9x	0.77	x	0.9	x	22.97	x	0.4	x	0.8	=	4.58	(81)
Northwest	0.9x	0.77	x	0.62	x	22.97	x	0.4	x	0.8	=	3.16	(81)
Northwest	0.9x	0.77	x	1.99	x	41.38	x	0.4	x	0.8	=	36.52	(81)
Northwest	0.9x	0.77	x	0.9	x	41.38	x	0.4	x	0.8	=	8.26	(81)
Northwest	0.9x	0.77	x	0.62	x	41.38	x	0.4	x	0.8	=	5.69	(81)
Northwest	0.9x	0.77	x	1.99	x	67.96	x	0.4	x	0.8	=	59.98	(81)
Northwest	0.9x	0.77	x	0.9	x	67.96	x	0.4	x	0.8	=	13.56	(81)
Northwest	0.9x	0.77	x	0.62	x	67.96	x	0.4	x	0.8	=	9.34	(81)
Northwest	0.9x	0.77	x	1.99	x	91.35	x	0.4	x	0.8	=	80.62	(81)
Northwest	0.9x	0.77	x	0.9	x	91.35	x	0.4	x	0.8	=	18.23	(81)
Northwest	0.9x	0.77	x	0.62	x	91.35	x	0.4	x	0.8	=	12.56	(81)
Northwest	0.9x	0.77	x	1.99	x	97.38	x	0.4	x	0.8	=	85.95	(81)
Northwest	0.9x	0.77	x	0.9	x	97.38	x	0.4	x	0.8	=	19.44	(81)
Northwest	0.9x	0.77	x	0.62	x	97.38	x	0.4	x	0.8	=	13.39	(81)
Northwest	0.9x	0.77	x	1.99	x	91.1	x	0.4	x	0.8	=	80.41	(81)
Northwest	0.9x	0.77	x	0.9	x	91.1	x	0.4	x	0.8	=	18.18	(81)

Northwest	0.9x	0.77	x	0.62	x	91.1	x	0.4	x	0.8	=	12.53	(81)
Northwest	0.9x	0.77	x	1.99	x	72.63	x	0.4	x	0.8	=	64.1	(81)
Northwest	0.9x	0.77	x	0.9	x	72.63	x	0.4	x	0.8	=	14.5	(81)
Northwest	0.9x	0.77	x	0.62	x	72.63	x	0.4	x	0.8	=	9.99	(81)
Northwest	0.9x	0.77	x	1.99	x	50.42	x	0.4	x	0.8	=	44.5	(81)
Northwest	0.9x	0.77	x	0.9	x	50.42	x	0.4	x	0.8	=	10.06	(81)
Northwest	0.9x	0.77	x	0.62	x	50.42	x	0.4	x	0.8	=	6.93	(81)
Northwest	0.9x	0.77	x	1.99	x	28.07	x	0.4	x	0.8	=	24.77	(81)
Northwest	0.9x	0.77	x	0.9	x	28.07	x	0.4	x	0.8	=	5.6	(81)
Northwest	0.9x	0.77	x	0.62	x	28.07	x	0.4	x	0.8	=	3.86	(81)
Northwest	0.9x	0.77	x	1.99	x	14.2	x	0.4	x	0.8	=	12.53	(81)
Northwest	0.9x	0.77	x	0.9	x	14.2	x	0.4	x	0.8	=	2.83	(81)
Northwest	0.9x	0.77	x	0.62	x	14.2	x	0.4	x	0.8	=	1.95	(81)
Northwest	0.9x	0.77	x	1.99	x	9.21	x	0.4	x	0.8	=	8.13	(81)
Northwest	0.9x	0.77	x	0.9	x	9.21	x	0.4	x	0.8	=	1.84	(81)
Northwest	0.9x	0.77	x	0.62	x	9.21	x	0.4	x	0.8	=	1.27	(81)

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

(83)m=	117.8	206.87	299.59	398.92	472.12	479.83	457.98	401.67	333.72	233.1	142.23	100.08	(83)

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

(84)m=	535.22	622.27	701.87	780.04	831.76	818.73	783.36	732.89	675.78	596.54	530.24	506.51	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.91	0.78	0.58	0.42	0.47	0.73	0.94	0.99	1	(86)

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

(87)m=	20.02	20.19	20.43	20.72	20.91	20.99	21	21	20.96	20.7	20.31	19.99	(87)

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

(88)m=	20.06	20.07	20.07	20.08	20.08	20.1	20.1	20.1	20.09	20.08	20.08	20.07	(88)

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

(89)m=	0.99	0.99	0.96	0.89	0.73	0.5	0.34	0.38	0.65	0.92	0.99	1	(89)

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

(90)m=	18.77	19.01	19.36	19.77	20.01	20.09	20.1	20.1	20.06	19.75	19.2	18.73	(90)

fLA = Living area ÷ (4) = | 0.36 | (91)

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

(92)m=	19.22	19.43	19.74	20.11	20.33	20.41	20.42	20.42	20.38	20.09	19.59	19.18	(92)

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

(93)m=	19.22	19.43	19.74	20.11	20.33	20.41	20.42	20.42	20.38	20.09	19.59	19.18	(93)

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.96	0.89	0.74	0.53	0.37	0.41	0.68	0.92	0.98	0.99	(94)

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

(95)m=	531.44	612.31	673.88	693.91	616	434.79	289.11	302.88	457.34	549.41	521.88	503.79	(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=	1176.16	1142.56	1038.33	866	664.79	440.84	289.74	304.05	479.41	731.07	968.03	1167.86	(97)

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

(98)m=	479.67	356.33	271.15	123.91	36.3	0	0	0	0	135.15	321.23	494.07

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2217.81 (98)

Space heating requirement in kWh/m²/year 28.76 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2217.81	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2328.7	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2087.92	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2192.31	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	45.21	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		202.28	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	202.28	(331)

DER WorkSheet: New dwelling design stage

Energy for lighting (calculated in Appendix L)	335.82	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =	5059.12	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				383	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	612.64	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	23.46	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	636.1	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				636.1	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	104.98	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	174.29	(379)
Total CO2, kg/year	sum of (376)…(382) =				915.38	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				11.87	(384)
EI rating (section 14)					89.95	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Ben Talbutt	**Stroma Number:**	STRO036639
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.17

Property Address: D1-06

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	77.11	(1a) x	2.82	(2a) =	217.45	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	77.11	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	217.45	(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) =	0.14	(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)	0.39	(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) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

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

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

(25)m=	0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	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			2.52	x	1	=	2.52			(26)
Windows Type 1			2.48	x1/[1/(1.4)+ 0.04]		=	3.29			(27)
Windows Type 2			4.65	x1/[1/(1.4)+ 0.04]		=	6.16			(27)
Windows Type 3			1.7	x1/[1/(1.4)+ 0.04]		=	2.25			(27)
Windows Type 4			0.77	x1/[1/(1.4)+ 0.04]		=	1.02			(27)
Windows Type 5			0.53	x1/[1/(1.4)+ 0.04]		=	0.7			(27)
Windows Type 6			1.7	x1/[1/(1.4)+ 0.04]		=	2.25			(27)
Windows Type 7			0.77	x1/[1/(1.4)+ 0.04]		=	1.02			(27)
Windows Type 8			1.7	x1/[1/(1.4)+ 0.04]		=	2.25			(27)
Walls Type1	55.53	19.29	36.24	x	0.18	=	6.52			(29)
Walls Type2	21.38	0	21.38	x	0.18	=	3.85			(29)
Walls Type3	2.82	0	2.82	x	0.18	=	0.51			(29)
Roof	77.11	0	77.11	x	0.13	=	10.02			(30)
Total area of elements, m²			156.84							(31)
Party wall			25.17	x	0	=	0			(32)

** 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) =	45.66	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(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 — 10.27 (36)

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

Total fabric heat loss — (33) + (36) = 55.93 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	42.22	41.98	41.73	40.6	40.39	39.4	39.4	39.22	39.78	40.39	40.82	41.27	(38)

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

(39)m=	98.15	97.9	97.66	96.53	96.32	95.33	95.33	95.15	95.71	96.32	96.75	97.19	

Average = Sum(39)$_{1…12}$ /12= 96.53 (39)

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

(40)m=	1.27	1.27	1.27	1.25	1.25	1.24	1.24	1.23	1.24	1.25	1.25	1.26

Average = Sum(40)$_{1…12}$ /12= 1.25 (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 — 2.41 (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 — 91.34 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	100.47	96.82	93.16	89.51	85.86	82.2	82.2	85.86	89.51	93.16	96.82	100.47

Total = Sum(44)$_{1…12}$ = 1096.04 (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=	148.99	130.31	134.47	117.23	112.49	97.07	89.95	103.22	104.45	121.73	132.87	144.29

Total = Sum(45)$_{1…12}$ = 1437.08 (45)

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

(46)m=	22.35	19.55	20.17	17.59	16.87	14.56	13.49	15.48	15.67	18.26	19.93	21.64	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.39 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0.75 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0.75	(55)

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

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

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

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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

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

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

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

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

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

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

(62)m=	195.59	172.4	181.06	162.33	159.08	142.16	136.54	149.81	149.54	168.32	177.97	190.89	(62)

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

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

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

Output from water heater

(64)m=	195.59	172.4	181.06	162.33	159.08	142.16	136.54	149.81	149.54	168.32	177.97	190.89	

Output from water heater (annual)$_{1...12}$ — 1985.69 (64)

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

(65)m=	86.82	77	81.99	75.05	74.68	68.35	67.18	71.6	70.8	77.75	80.25	85.25	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	120.29	120.29	120.29	120.29	120.29	120.29	120.29	120.29	120.29	120.29	120.29	120.29	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	19.03	16.9	13.75	10.41	7.78	6.57	7.1	9.22	12.38	15.72	18.35	19.56	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	213.29	215.51	209.93	198.06	183.07	168.98	159.57	157.36	162.93	174.81	189.8	203.88	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	35.03	35.03	35.03	35.03	35.03	35.03	35.03	35.03	35.03	35.03	35.03	35.03	(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=	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	-96.23	(71)
Water heating gains (Table 5)													
(72)m=	116.69	114.58	110.2	104.24	100.37	94.93	90.3	96.23	98.34	104.5	111.46	114.59	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	411.1	409.08	395.96	374.79	353.31	332.56	319.05	324.9	335.74	357.12	381.69	400.12	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	1.7	x	11.28	x	0.63	x	0.7	=	5.86	(75)
Northeast	0.9x	0.77	x	1.7	x	22.97	x	0.63	x	0.7	=	11.93	(75)
Northeast	0.9x	0.77	x	1.7	x	41.38	x	0.63	x	0.7	=	21.5	(75)
Northeast	0.9x	0.77	x	1.7	x	67.96	x	0.63	x	0.7	=	35.31	(75)
Northeast	0.9x	0.77	x	1.7	x	91.35	x	0.63	x	0.7	=	47.46	(75)
Northeast	0.9x	0.77	x	1.7	x	97.38	x	0.63	x	0.7	=	50.6	(75)
Northeast	0.9x	0.77	x	1.7	x	91.1	x	0.63	x	0.7	=	47.33	(75)
Northeast	0.9x	0.77	x	1.7	x	72.63	x	0.63	x	0.7	=	37.73	(75)
Northeast	0.9x	0.77	x	1.7	x	50.42	x	0.63	x	0.7	=	26.2	(75)
Northeast	0.9x	0.77	x	1.7	x	28.07	x	0.63	x	0.7	=	14.58	(75)
Northeast	0.9x	0.77	x	1.7	x	14.2	x	0.63	x	0.7	=	7.38	(75)
Northeast	0.9x	0.77	x	1.7	x	9.21	x	0.63	x	0.7	=	4.79	(75)
Southeast	0.9x	0.77	x	2.48	x	36.79	x	0.63	x	0.7	=	27.89	(77)
Southeast	0.9x	0.77	x	4.65	x	36.79	x	0.63	x	0.7	=	52.29	(77)
Southeast	0.9x	0.77	x	2.48	x	62.67	x	0.63	x	0.7	=	47.5	(77)
Southeast	0.9x	0.77	x	4.65	x	62.67	x	0.63	x	0.7	=	89.07	(77)
Southeast	0.9x	0.77	x	2.48	x	85.75	x	0.63	x	0.7	=	64.99	(77)
Southeast	0.9x	0.77	x	4.65	x	85.75	x	0.63	x	0.7	=	121.86	(77)
Southeast	0.9x	0.77	x	2.48	x	106.25	x	0.63	x	0.7	=	80.53	(77)
Southeast	0.9x	0.77	x	4.65	x	106.25	x	0.63	x	0.7	=	150.99	(77)
Southeast	0.9x	0.77	x	2.48	x	119.01	x	0.63	x	0.7	=	90.2	(77)
Southeast	0.9x	0.77	x	4.65	x	119.01	x	0.63	x	0.7	=	169.13	(77)
Southeast	0.9x	0.77	x	2.48	x	118.15	x	0.63	x	0.7	=	89.55	(77)
Southeast	0.9x	0.77	x	4.65	x	118.15	x	0.63	x	0.7	=	167.9	(77)
Southeast	0.9x	0.77	x	2.48	x	113.91	x	0.63	x	0.7	=	86.33	(77)
Southeast	0.9x	0.77	x	4.65	x	113.91	x	0.63	x	0.7	=	161.88	(77)
Southeast	0.9x	0.77	x	2.48	x	104.39	x	0.63	x	0.7	=	79.12	(77)
Southeast	0.9x	0.77	x	4.65	x	104.39	x	0.63	x	0.7	=	148.35	(77)
Southeast	0.9x	0.77	x	2.48	x	92.85	x	0.63	x	0.7	=	70.37	(77)
Southeast	0.9x	0.77	x	4.65	x	92.85	x	0.63	x	0.7	=	131.95	(77)
Southeast	0.9x	0.77	x	2.48	x	69.27	x	0.63	x	0.7	=	52.5	(77)
Southeast	0.9x	0.77	x	4.65	x	69.27	x	0.63	x	0.7	=	98.44	(77)
Southeast	0.9x	0.77	x	2.48	x	44.07	x	0.63	x	0.7	=	33.4	(77)
Southeast	0.9x	0.77	x	4.65	x	44.07	x	0.63	x	0.7	=	62.63	(77)
Southeast	0.9x	0.77	x	2.48	x	31.49	x	0.63	x	0.7	=	23.87	(77)
Southeast	0.9x	0.77	x	4.65	x	31.49	x	0.63	x	0.7	=	44.75	(77)
Southwest	0.9x	0.77	x	1.7	x	36.79		0.63	x	0.7	=	19.12	(79)
Southwest	0.9x	0.77	x	0.77	x	36.79		0.63	x	0.7	=	17.32	(79)
Southwest	0.9x	0.77	x	1.7	x	62.67		0.63	x	0.7	=	32.56	(79)

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Southwest	0.9x	0.77	x	0.77	x	62.67		0.63	x	0.7	=	29.5	(79)
Southwest	0.9x	0.77	x	1.7	x	85.75		0.63	x	0.7	=	44.55	(79)
Southwest	0.9x	0.77	x	0.77	x	85.75		0.63	x	0.7	=	40.36	(79)
Southwest	0.9x	0.77	x	1.7	x	106.25		0.63	x	0.7	=	55.2	(79)
Southwest	0.9x	0.77	x	0.77	x	106.25		0.63	x	0.7	=	50.01	(79)
Southwest	0.9x	0.77	x	1.7	x	119.01		0.63	x	0.7	=	61.83	(79)
Southwest	0.9x	0.77	x	0.77	x	119.01		0.63	x	0.7	=	56.01	(79)
Southwest	0.9x	0.77	x	1.7	x	118.15		0.63	x	0.7	=	61.38	(79)
Southwest	0.9x	0.77	x	0.77	x	118.15		0.63	x	0.7	=	55.61	(79)
Southwest	0.9x	0.77	x	1.7	x	113.91		0.63	x	0.7	=	59.18	(79)
Southwest	0.9x	0.77	x	0.77	x	113.91		0.63	x	0.7	=	53.61	(79)
Southwest	0.9x	0.77	x	1.7	x	104.39		0.63	x	0.7	=	54.24	(79)
Southwest	0.9x	0.77	x	0.77	x	104.39		0.63	x	0.7	=	49.13	(79)
Southwest	0.9x	0.77	x	1.7	x	92.85		0.63	x	0.7	=	48.24	(79)
Southwest	0.9x	0.77	x	0.77	x	92.85		0.63	x	0.7	=	43.7	(79)
Southwest	0.9x	0.77	x	1.7	x	69.27		0.63	x	0.7	=	35.99	(79)
Southwest	0.9x	0.77	x	0.77	x	69.27		0.63	x	0.7	=	32.6	(79)
Southwest	0.9x	0.77	x	1.7	x	44.07		0.63	x	0.7	=	22.9	(79)
Southwest	0.9x	0.77	x	0.77	x	44.07		0.63	x	0.7	=	20.74	(79)
Southwest	0.9x	0.77	x	1.7	x	31.49		0.63	x	0.7	=	16.36	(79)
Southwest	0.9x	0.77	x	0.77	x	31.49		0.63	x	0.7	=	14.82	(79)
Northwest	0.9x	0.77	x	1.7	x	11.28	x	0.63	x	0.7	=	11.72	(81)
Northwest	0.9x	0.77	x	0.77	x	11.28	x	0.63	x	0.7	=	2.66	(81)
Northwest	0.9x	0.77	x	0.53	x	11.28	x	0.63	x	0.7	=	1.83	(81)
Northwest	0.9x	0.77	x	1.7	x	22.97	x	0.63	x	0.7	=	23.86	(81)
Northwest	0.9x	0.77	x	0.77	x	22.97	x	0.63	x	0.7	=	5.4	(81)
Northwest	0.9x	0.77	x	0.53	x	22.97	x	0.63	x	0.7	=	3.72	(81)
Northwest	0.9x	0.77	x	1.7	x	41.38	x	0.63	x	0.7	=	43	(81)
Northwest	0.9x	0.77	x	0.77	x	41.38	x	0.63	x	0.7	=	9.74	(81)
Northwest	0.9x	0.77	x	0.53	x	41.38	x	0.63	x	0.7	=	6.7	(81)
Northwest	0.9x	0.77	x	1.7	x	67.96	x	0.63	x	0.7	=	70.61	(81)
Northwest	0.9x	0.77	x	0.77	x	67.96	x	0.63	x	0.7	=	15.99	(81)
Northwest	0.9x	0.77	x	0.53	x	67.96	x	0.63	x	0.7	=	11.01	(81)
Northwest	0.9x	0.77	x	1.7	x	91.35	x	0.63	x	0.7	=	94.92	(81)
Northwest	0.9x	0.77	x	0.77	x	91.35	x	0.63	x	0.7	=	21.5	(81)
Northwest	0.9x	0.77	x	0.53	x	91.35	x	0.63	x	0.7	=	14.8	(81)
Northwest	0.9x	0.77	x	1.7	x	97.38	x	0.63	x	0.7	=	101.19	(81)
Northwest	0.9x	0.77	x	0.77	x	97.38	x	0.63	x	0.7	=	22.92	(81)
Northwest	0.9x	0.77	x	0.53	x	97.38	x	0.63	x	0.7	=	15.77	(81)
Northwest	0.9x	0.77	x	1.7	x	91.1	x	0.63	x	0.7	=	94.66	(81)
Northwest	0.9x	0.77	x	0.77	x	91.1	x	0.63	x	0.7	=	21.44	(81)

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Northwest 0.9x	0.77	x	0.53	x	91.1	x	0.63	x	0.7	=	14.76	(81)
Northwest 0.9x	0.77	x	1.7	x	72.63	x	0.63	x	0.7	=	75.47	(81)
Northwest 0.9x	0.77	x	0.77	x	72.63	x	0.63	x	0.7	=	17.09	(81)
Northwest 0.9x	0.77	x	0.53	x	72.63	x	0.63	x	0.7	=	11.76	(81)
Northwest 0.9x	0.77	x	1.7	x	50.42	x	0.63	x	0.7	=	52.39	(81)
Northwest 0.9x	0.77	x	0.77	x	50.42	x	0.63	x	0.7	=	11.87	(81)
Northwest 0.9x	0.77	x	0.53	x	50.42	x	0.63	x	0.7	=	8.17	(81)
Northwest 0.9x	0.77	x	1.7	x	28.07	x	0.63	x	0.7	=	29.16	(81)
Northwest 0.9x	0.77	x	0.77	x	28.07	x	0.63	x	0.7	=	6.6	(81)
Northwest 0.9x	0.77	x	0.53	x	28.07	x	0.63	x	0.7	=	4.55	(81)
Northwest 0.9x	0.77	x	1.7	x	14.2	x	0.63	x	0.7	=	14.75	(81)
Northwest 0.9x	0.77	x	0.77	x	14.2	x	0.63	x	0.7	=	3.34	(81)
Northwest 0.9x	0.77	x	0.53	x	14.2	x	0.63	x	0.7	=	2.3	(81)
Northwest 0.9x	0.77	x	1.7	x	9.21	x	0.63	x	0.7	=	9.57	(81)
Northwest 0.9x	0.77	x	0.77	x	9.21	x	0.63	x	0.7	=	2.17	(81)
Northwest 0.9x	0.77	x	0.53	x	9.21	x	0.63	x	0.7	=	1.49	(81)

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

(83)m=	138.68	243.55	352.7	469.65	555.84	564.92	539.19	472.89	392.89	274.42	167.44	117.81	(83)

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

(84)m=	549.78	652.62	748.66	844.44	909.14	897.48	858.24	797.78	728.62	631.54	549.13	517.93	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.93	0.82	0.64	0.48	0.53	0.78	0.95	0.99	1	(86)

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

(87)m=	19.7	19.89	20.18	20.54	20.82	20.96	20.99	20.99	20.89	20.52	20.04	19.67	(87)

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

(88)m=	19.86	19.86	19.87	19.88	19.88	19.89	19.89	19.89	19.89	19.88	19.88	19.87	(88)

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

(89)m=	0.99	0.99	0.97	0.9	0.76	0.55	0.36	0.41	0.7	0.93	0.99	1	(89)

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

(90)m=	18.15	18.43	18.85	19.36	19.71	19.86	19.89	19.89	19.81	19.35	18.66	18.11	(90)

fLA = Living area ÷ (4) = 0.36 (91)

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

(92)m=	18.7	18.95	19.33	19.78	20.11	20.26	20.28	20.28	20.19	19.77	19.16	18.67	(92)

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

(93)m=	18.7	18.95	19.33	19.78	20.11	20.26	20.28	20.28	20.19	19.77	19.16	18.67	(93)

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.96	0.9	0.77	0.58	0.41	0.46	0.72	0.93	0.98	0.99	(94)

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

(95)m=	545.55	641.74	719.65	760.99	703.6	518.85	348.01	364	526.91	587.96	540.52	514.84	(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=	1413.76	1375.83	1252.63	1050.35	809.8	539.11	351.01	369.15	583.28	882.98	1166.3	1406.03	(97)

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

(98)m=	645.95	493.31	396.53	208.34	79.02	0	0	0	0	219.49	450.56	663.04

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3156.25 (98)

Space heating requirement in kWh/m²/year 40.93 (99)

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

Space heating:

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	645.95	493.31	396.53	208.34	79.02	0	0	0	0	219.49	450.56	663.04	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	690.86	527.6	424.1	222.83	84.51	0	0	0	0	234.75	481.89	709.13	(211)

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3375.67 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

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

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

Water heating

Output from water heater (calculated above)

195.59	172.4	181.06	162.33	159.08	142.16	136.54	149.81	149.54	168.32	177.97	190.89

Efficiency of water heater 79.8 (216)

(217)m=	87.76	87.46	86.85	85.48	83.06	79.8	79.8	79.8	79.8	85.52	87.19	87.87	(217)

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

(219)m=	222.86	197.11	208.48	189.9	191.53	178.15	171.11	187.73	187.4	196.81	204.11	217.25

Total = Sum(219a)$_{1...12}$ = 2352.43 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3375.67
Water heating fuel used		2352.43
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			336.08	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			6139.18	(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	=	729.14	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	508.13	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1237.27	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	174.42	(268)
Total CO2, kg/year		sum of (265)…(271) =		1450.62	(272)

TER = 27.64 (273)