Regulations Compliance Report

Approved Document L1A 2014 Edition, Wales assessed by Stroma FSAP 2012 program, 1.0.5.49
Printed on 22 September 2021 at 10:21:15

Project Information:

Assessed By: John Ashe (STRO031268) **Building Type:** Detached House

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 137.44m²

Site Reference : Derwyddfa, Cemaes Bay, Anglesey **Plot Reference:** Derwyddfa, Cemaes Bay, Angles

Address :

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1 TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	14.86 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	14.80 kg/m²	**OK**

2 Fabric U-values

Element	Average	Highest	
External wall	0.19 (max. 0.21)	0.19 (max. 0.70)	**OK**
Floor	0.15 (max. 0.18)	0.15 (max. 0.70)	**OK**
Roof	0.13 (max. 0.15)	0.16 (max. 0.35)	**OK**
Openings	1.60 (max. 1.60)	1.60 (max. 3.30)	**OK**

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.50 (design value)	
Maximum	10.0	**OK**

4 Heating efficiency

Main Heating system:	Boiler systems with radiators or underfloor heating - mains gas Data from manufacturer Combi boiler Efficiency 89.0 % SEDBUK2009 Minimum 88.0 %	**OK**
Secondary heating system:	None	

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**

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7 Low energy lights		
Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**
8 Mechanical ventilation		
Not applicable		
9 Summertime temperature		
Overheating risk (Wales):	Not assessed	**?**
10 Key features		
Air permeablility	4.5 m^3/m^2h	
Roofs U-value	0.11 W/m^2K	

Thermal Bridge Report

Property Details: Derwyddfa, Cemaes Bay, Anglesey - SAP

Address:
Located in: Wales
Region: Wales

Thermal bridges:

Thermal bridges: User-defined = UD
Default = D
Approved = A
User-defined (individual PSI-values) Y-Value = 0.0661

External Junctions Details:

Junction Type	PSI-Value	Length	Reference	Type
Other lintels (including other steel lintels)	0.3	15.6	E2	[A]
Sill	0.04	12.6	E3	[A]
Jamb	0.05	29.27	E4	[A]
Ground floor (normal)	0.16	33.41	E5	[A]
Intermediate floor within a dwelling	0.07	33.41	E6	[A]
Eaves (insulation at rafter level)	0.04	18.75	E11	[A]
Gable (insulation at ceiling level)	0.24	8.4	E12	[A]
Gable (insulation at rafter level)	0.04	8.17	E13	[A]
Corner (normal)	0.09	14.64	E16	[A]

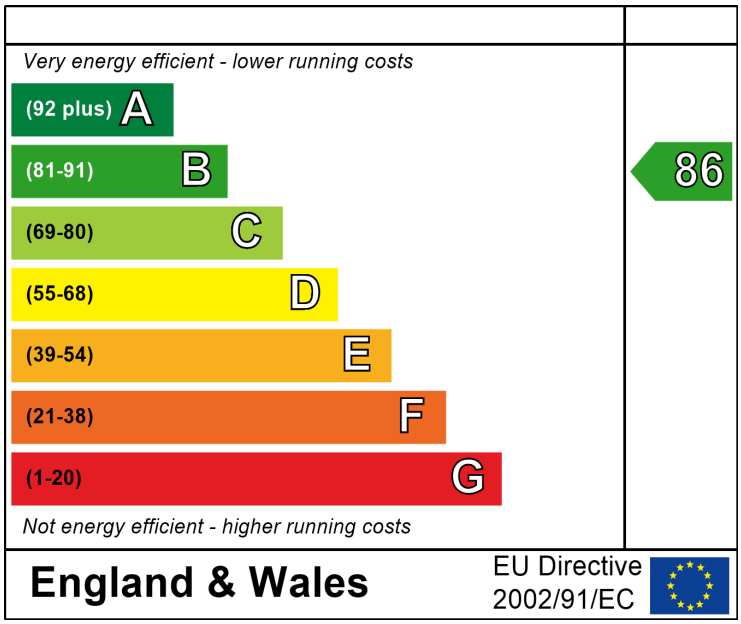
Predicted Energy Assessment

Dwelling type:	Detached House
Date of assessment:	22 September 2021
Produced by:	John Ashe
Total floor area:	137.44 m²

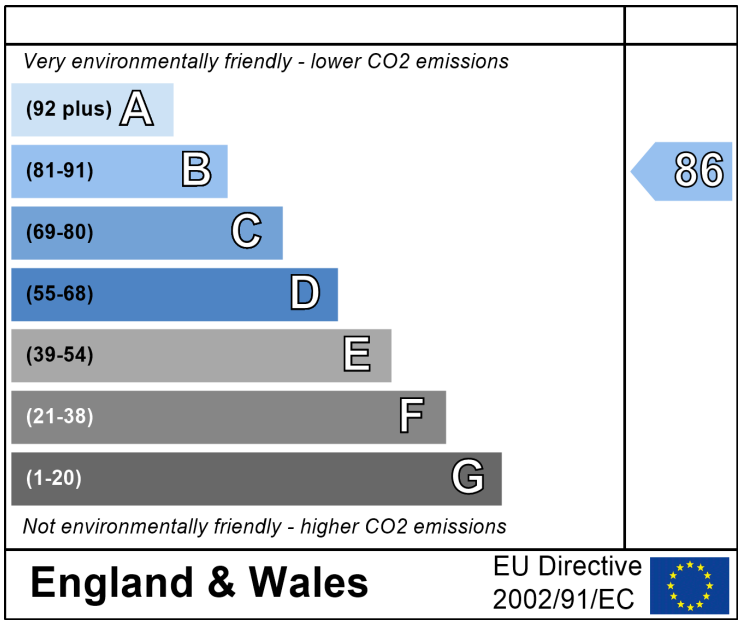
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about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

Developer Confirmation Report

Property Details: Derwyddfa, Cemaes Bay, Anglesey - SAP

Address:
Located in: Wales
Region: Wales
UPRN:
Date of assessment: 22 September 2021
Date of certificate: 22 September 2021
Assessment type: New dwelling design stage
Transaction type: None of the above
Thermal Mass Parameter: Indicative Value Low
Comments:

Property description:

Dwelling type: House
Detachment: Detached
Year Completed: 2021
Front of dwelling faces: North
Comments:

Opening types:

Name:	Type:	Frame Factor:	g-value:	U-Value:	Area:
Front Windows	Windows	0.7	0.63	1.6	8.98
Rear Windows	Windows	0.7	0.63	1.6	7.44
Left Windows	Windows	0.7	0.63	1.6	5.86

Overshading: Average or unknown
Comments:

Opaque Elements:

Type:	U-Value:		Kappa:
External Elements			
Walls	0.19	Please provide the U-Value calculation to justify the U-Value entered into the assessment.	N/A

Materials Used:

Type:	Name:	Thickness:	Conductivity:	R-Value:
Walls	Internal Surface Resistance	0	0	0.13

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Walls	Plaster (Lightweight) (0 mm)	13	0.18	0.07
Walls	Concrete Block (Low Density) (100 mm)	100	0.18	0.56
Walls	Kooltherm K8 Cavity Board (70 mm)	70	0.02	3.5
Walls	Unventilated Cavity - (Wall - Low Emissivity) (0 mm)	50	0	0.44
Walls	Concrete Block (Low Density) (100 mm)	100	0.18	0.56
Walls	Render - Gypsum and Sand (0 mm)	22	0.8	0.03
Walls	External Surface Resistance	0	0	0.04

Comments:

Roof - Slope	0.16	Please provide the U-Value calculation to justify the U-Value entered into the assessment.	N/A
Ceiling	0.11	Please provide the U-Value calculation to justify the U-Value entered into the assessment.	N/A

Materials Used:

Type:	Name:	Thickness:	Conductivity:	R-Value:
Ceiling	Internal Surface Resistance	0	0	0.1
Ceiling	Plaster (Lightweight) (0 mm)	3	0.18	0.02
Ceiling	Plasterboard Standard (0 mm)	12.5	0.21	0.06
Ceiling	Mineral Wool Quilt (0 mm)	200	0.042	4.76
Ceiling	Mineral Wool Quilt (0 mm)	200	0.042	4.76
Ceiling	Roof space (mm)	0	0	0.2
Ceiling	External Surface Resistance	0	0	0.04

Comments:

GF	0.15	Please provide the U-Value calculation to justify the U-Value entered into the assessment.	N/A

Materials Used:

Type:	Name:	Thickness:	Conductivity:	R-Value:
GF	Internal Surface Resistance	0	0	0.17
GF	Screed (1200) (0 mm)	75	0.41	0.18
GF	Kooltherm K3 Floorboard (100 mm)	100	0.02	5
GF	Concrete Medium Density (0 mm)	100	1.35	0.07
GF	External Surface Resistance	0	0	0.04

Comments:

Internal Elements (Area, Kappa)
Party Elements (Area, Kappa)

Thermal bridges:

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Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0661

	Length	Psi-value		
[Approved]	15.6	0.3	E2	Other lintels (including other steel lintels)
[Approved]	12.6	0.04	E3	Sill
[Approved]	29.27	0.05	E4	Jamb
[Approved]	33.41	0.16	E5	Ground floor (normal)
[Approved]	33.41	0.07	E6	Intermediate floor within a dwelling
[Approved]	18.75	0.04	E11	Eaves (insulation at rafter level)
[Approved]	8.4	0.24	E12	Gable (insulation at ceiling level)
[Approved]	8.17	0.04	E13	Gable (insulation at rafter level)
[Approved]	14.64	0.09	E16	Corner (normal)

Comments:

If specific construction details have been adopted then please provide the associated checklists; signed and dated.

Ventilation:

Pressure test: Yes (As designed)
Ventilation: Natural ventilation (extract fans)
Pressure test: 4.5
Comments:

Please provide the pressure test certificate, or certificates if the result is based on an average; signed and dated.

Main heating system:

Main heating system:

Boiler systems with radiators or underfloor heating
Gas boilers and oil boilers
Fuel: mains gas
Info Source: Manufacturer Declaration
Manufacturer's data
Efficiency: 89.0% (SEDBUK2009)
Condensing combi with automatic ignition
Fuel Burning Type:
Systems with radiators
Central heating pump : 2013 or later
Boiler interlock: Yes
Delayed start

Comments:

Main heating Control:

Main heating Control:

Time and temperature zone control by suitable arrangement of plumbing and

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electrical services

Comments:

Secondary heating system:

Secondary heating system: None

Comments:

Water heating:

Water heating: No hot water cylinder

Comments:

Solar panel: False

Others:

Electricity tariff: Standard Tariff
Low energy lights: 100%
Terrain type: Low rise urban / suburban
Wind turbine: No
Photovoltaics: None

Comments:

Please provide the MCS certificate or data sheet equivalent confirming the size of the array on the roof. This should include any calculations to support a proportioned amount included in the assessment.

Declaration :

I confirm that the property has been built to the above specification.

Signed:

.....

Date:

.....

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	John Ashe	**Stroma Number:**	STRO031268
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.49

Property Address: Derwyddfa, Cemaes Bay, Anglesey - SAP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	68.72 (1a)	x	2.36 (2a)	=	162.18	(3a)
First floor	68.72 (1b)	x	1.95 (2b)	=	134	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	137.44 (4)					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		296.18	(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							2	x 10 =	20	(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) =	20	÷ (5) =	0.07	(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			4.5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.29	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.29	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.37	0.37	0.36	0.32	0.31	0.28	0.28	0.27	0.29	0.31	0.33	0.34

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=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56

(24d)

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

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

(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	
Windows Type 1			8.98	x1/[1/(1.6)+ 0.04] =	13.5			(27)
Windows Type 2			7.44	x1/[1/(1.6)+ 0.04] =	11.19			(27)
Windows Type 3			5.86	x1/[1/(1.6)+ 0.04] =	8.81			(27)
Floor			68.72	x 0.15 =	10.308			(28)
Walls	137.38	22.28	115.1	x 0.19 =	21.87			(29)
Roof Type1	38.27	0	38.27	x 0.16 =	6.12			(30)
Roof Type2	39.37	0	39.37	x 0.11 =	4.33			(30)
Total area of elements, m²			283.74					(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) = 76.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 15163.96 (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 18.74 (36)

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

Total fabric heat loss (33) + (36) = 94.88 (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=	55.67	55.4	55.15	53.93	53.7	52.64	52.64	52.45	53.05	53.7	54.16	54.64	(38)

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

(39)m=	150.55	150.28	150.02	148.81	148.58	147.52	147.52	147.33	147.93	148.58	149.04	149.52	

Average = Sum(39)$_{1...12}$ /12= 148.81 (39)

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

(40)m=	1.1	1.09	1.09	1.08	1.08	1.07	1.07	1.07	1.08	1.08	1.08	1.09	

Average = Sum(40)$_{1...12}$ /12= 1.08 (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 2.91 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 103.36 (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=	113.7	109.56	105.43	101.29	97.16	93.02	93.02	97.16	101.29	105.43	109.56	113.7	

Total = Sum(44)$_{1...12}$ = 1240.33 (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=	168.61	147.47	152.17	132.67	127.3	109.85	101.79	116.81	118.2	137.75	150.37	163.29	

Total = Sum(45)$_{1...12}$ = 1626.27 (45)

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

(46)m=	25.29	22.12	22.83	19.9	19.09	16.48	15.27	17.52	17.73	20.66	22.56	24.49	(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=	50.96	46.03	50.96	49.32	49.51	45.88	47.4	49.51	49.32	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=	219.57	193.49	203.13	181.98	176.81	155.72	149.2	166.32	167.52	188.71	199.68	214.25	(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=	219.57	193.49	203.13	181.98	176.81	155.72	149.2	166.32	167.52	188.71	199.68	214.25	

Output from water heater (annual)$_{1...12}$ | 2216.38 | (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=	68.8	60.54	63.34	56.44	54.7	47.99	45.7	51.22	51.63	58.54	62.33	67.03	(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=	174.72	174.72	174.72	174.72	174.72	174.72	174.72	174.72	174.72	174.72	174.72	174.72	(66)

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

(67)m=	71.08	63.13	51.34	38.87	29.06	24.53	26.51	34.45	46.24	58.72	68.53	73.06	(67)

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

(68)m=	457.44	462.18	450.22	424.76	392.61	362.4	342.22	337.47	349.43	374.9	407.04	437.25	(68)

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

(69)m=	55.38	55.38	55.38	55.38	55.38	55.38	55.38	55.38	55.38	55.38	55.38	55.38	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	(71)

Water heating gains (Table 5)

(72)m=	92.48	90.09	85.13	78.39	73.53	66.66	61.42	68.84	71.71	78.69	86.56	90.1	(72)

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

(73)m=	737.62	732.03	703.32	658.64	611.82	570.21	546.77	557.39	584.01	628.92	678.76	717.03	(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)	
North	0.9x 0.77	x	8.98	x	10.63	x	0.63	x	0.7	=	29.18	(74)
North	0.9x 0.77	x	8.98	x	20.32	x	0.63	x	0.7	=	55.77	(74)

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North	0.9x	0.77	x	8.98	x	34.53	x	0.63	x	0.7	=	94.77	(74)
North	0.9x	0.77	x	8.98	x	55.46	x	0.63	x	0.7	=	152.22	(74)
North	0.9x	0.77	x	8.98	x	74.72	x	0.63	x	0.7	=	205.05	(74)
North	0.9x	0.77	x	8.98	x	79.99	x	0.63	x	0.7	=	219.51	(74)
North	0.9x	0.77	x	8.98	x	74.68	x	0.63	x	0.7	=	204.94	(74)
North	0.9x	0.77	x	8.98	x	59.25	x	0.63	x	0.7	=	162.6	(74)
North	0.9x	0.77	x	8.98	x	41.52	x	0.63	x	0.7	=	113.94	(74)
North	0.9x	0.77	x	8.98	x	24.19	x	0.63	x	0.7	=	66.39	(74)
North	0.9x	0.77	x	8.98	x	13.12	x	0.63	x	0.7	=	36	(74)
North	0.9x	0.77	x	8.98	x	8.86	x	0.63	x	0.7	=	24.33	(74)
East	0.9x	0.77	x	5.86	x	19.64	x	0.63	x	0.7	=	35.17	(76)
East	0.9x	0.77	x	5.86	x	38.42	x	0.63	x	0.7	=	68.81	(76)
East	0.9x	0.77	x	5.86	x	63.27	x	0.63	x	0.7	=	113.32	(76)
East	0.9x	0.77	x	5.86	x	92.28	x	0.63	x	0.7	=	165.26	(76)
East	0.9x	0.77	x	5.86	x	113.09	x	0.63	x	0.7	=	202.54	(76)
East	0.9x	0.77	x	5.86	x	115.77	x	0.63	x	0.7	=	207.33	(76)
East	0.9x	0.77	x	5.86	x	110.22	x	0.63	x	0.7	=	197.39	(76)
East	0.9x	0.77	x	5.86	x	94.68	x	0.63	x	0.7	=	169.55	(76)
East	0.9x	0.77	x	5.86	x	73.59	x	0.63	x	0.7	=	131.79	(76)
East	0.9x	0.77	x	5.86	x	45.59	x	0.63	x	0.7	=	81.65	(76)
East	0.9x	0.77	x	5.86	x	24.49	x	0.63	x	0.7	=	43.86	(76)
East	0.9x	0.77	x	5.86	x	16.15	x	0.63	x	0.7	=	28.93	(76)
South	0.9x	0.77	x	7.44	x	46.75	x	0.63	x	0.7	=	106.3	(78)
South	0.9x	0.77	x	7.44	x	76.57	x	0.63	x	0.7	=	174.1	(78)
South	0.9x	0.77	x	7.44	x	97.53	x	0.63	x	0.7	=	221.77	(78)
South	0.9x	0.77	x	7.44	x	110.23	x	0.63	x	0.7	=	250.65	(78)
South	0.9x	0.77	x	7.44	x	114.87	x	0.63	x	0.7	=	261.19	(78)
South	0.9x	0.77	x	7.44	x	110.55	x	0.63	x	0.7	=	251.36	(78)
South	0.9x	0.77	x	7.44	x	108.01	x	0.63	x	0.7	=	245.59	(78)
South	0.9x	0.77	x	7.44	x	104.89	x	0.63	x	0.7	=	238.51	(78)
South	0.9x	0.77	x	7.44	x	101.89	x	0.63	x	0.7	=	231.66	(78)
South	0.9x	0.77	x	7.44	x	82.59	x	0.63	x	0.7	=	187.78	(78)
South	0.9x	0.77	x	7.44	x	55.42	x	0.63	x	0.7	=	126.01	(78)
South	0.9x	0.77	x	7.44	x	40.4	x	0.63	x	0.7	=	91.86	(78)

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

(83)m=	170.66	298.67	429.85	568.13	668.78	678.2	647.92	570.66	477.39	335.81	205.86	145.11

(83)

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

(84)m=	908.28	1030.7	1133.17	1226.77	1280.6	1248.42	1194.69	1128.04	1061.4	964.74	884.62	862.14

(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

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(86)m=	0.96	0.94	0.91	0.85	0.76	0.62	0.49	0.53	0.72	0.87	0.94	0.96	(86)

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

(87)m=	18.82	19.08	19.48	19.99	20.45	20.78	20.92	20.89	20.65	20.06	19.35	18.77	(87)

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

(88)m=	20	20.01	20.01	20.01	20.02	20.02	20.02	20.02	20.02	20.02	20.01	20.01	(88)

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

(89)m=	0.95	0.93	0.9	0.83	0.72	0.56	0.4	0.44	0.66	0.85	0.93	0.96	(89)

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

(90)m=	17.09	17.46	18.04	18.77	19.4	19.82	19.97	19.95	19.67	18.88	17.87	17.02	(90)

fLA = Living area ÷ (4) = 0.13 (91)

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

(92)m=	17.33	17.68	18.24	18.94	19.54	19.95	20.09	20.07	19.8	19.04	18.07	17.25	(92)

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

(93)m=	17.18	17.53	18.09	18.79	19.39	19.8	19.94	19.92	19.65	18.89	17.92	17.1	(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=	0.93	0.9	0.86	0.79	0.69	0.54	0.39	0.43	0.63	0.81	0.9	0.93	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	841.42	929.08	976.49	972.75	880.75	672.93	466.21	483.49	671.09	784.09	796.48	805.15	(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=	1938.31	1897.72	1738.06	1471.07	1142.51	766.38	493.19	519.23	821.65	1232.09	1612.01	1928.99	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	816.09	650.93	566.6	358.79	194.75	0	0	0	0	333.32	587.18	836.14	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4343.8 (98)

Space heating requirement in kWh/m²/year 31.61 (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 89.8 (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)													
	816.09	650.93	566.6	358.79	194.75	0	0	0	0	333.32	587.18	836.14	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	908.79	724.86	630.96	399.54	216.87	0	0	0	0	371.18	653.87	931.11	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 4837.19 (211)

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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)

	219.57	193.49	203.13	181.98	176.81	155.72	149.2	166.32	167.52	188.71	199.68	214.25

Efficiency of water heater 80.5 (216)

(217)m=	87.65	87.48	87.14	86.44	85.12	80.5	80.5	80.5	80.5	86.2	87.24	87.73

(217)

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

(219)m=	250.5	221.18	233.1	210.53	207.72	193.45	185.34	206.61	208.1	218.92	228.88	244.21

Total = Sum(219a)$_{1...12}$ = 2608.52 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		4837.19
Water heating fuel used		2608.52
Electricity for pumps, fans and electric keep-hot		
central heating pump:	30	(230c)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		30 (231)
Electricity for lighting		502.13 (232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		7977.84 (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 =	168.33 (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 =	90.78 (247)
Pumps, fans and electric keep-hot	(231)	13.19 x 0.01 =	3.96 (249)

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

Energy for lighting	(232)	13.19 x 0.01 =	66.23 (250)
Additional standing charges (Table 12)			120 (251)

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

Total energy cost (245)...(247) + (250)…(254) = 449.3 (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] =	1.03 (257)
SAP rating (Section 12)		85.57 (258)

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

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	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	1044.83	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	563.44	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1608.27	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	15.57	(267)
Electricity for lighting	(232) x		0.519	=	260.61	(268)
Total CO2, kg/year		sum of (265)…(271) =			1884.45	(272)
CO2 emissions per m²		(272) ÷ (4) =			13.71	(273)
EI rating (section 14)					86	(274)

13a. Primary Energy

	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x		1.22	=	5901.37	(261)
Space heating (secondary)	(215) x		3.07	=	0	(263)
Energy for water heating	(219) x		1.22	=	3182.39	(264)
Space and water heating	(261) + (262) + (263) + (264) =				9083.76	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		3.07	=	92.1	(267)
Electricity for lighting	(232) x		0	=	1541.54	(268)
‘Total Primary Energy		sum of (265)…(271) =			10717.41	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =			77.98	(273)

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User Details:

Assessor Name:	John Ashe	**Stroma Number:**	STRO031268
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.49

Property Address: Derwyddfa, Cemaes Bay, Anglesey - SAP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	68.72 (1a)	x	2.36 (2a)	=	162.18	(3a)
First floor	68.72 (1b)	x	1.95 (2b)	=	134	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	137.44 (4)					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		296.18	(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							2	x 10 =	20	(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) =	20	÷ (5) =	0.07 (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			4.5 (17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.29 (18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered			0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.29 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.37	0.37	0.36	0.32	0.31	0.28	0.28	0.27	0.29	0.31	0.33	0.34

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=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56

(24d)

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

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

(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	
Windows Type 1			8.98	x1/[1/(1.6)+ 0.04] =	13.5			(27)
Windows Type 2			7.44	x1/[1/(1.6)+ 0.04] =	11.19			(27)
Windows Type 3			5.86	x1/[1/(1.6)+ 0.04] =	8.81			(27)
Floor			68.72	x 0.15 =	10.308			(28)
Walls	137.38	22.28	115.1	x 0.19 =	21.87			(29)
Roof Type1	38.27	0	38.27	x 0.16 =	6.12			(30)
Roof Type2	39.37	0	39.37	x 0.11 =	4.33			(30)
Total area of elements, m²			283.74					(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) = 76.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 15163.96 (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 18.74 (36)

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

Total fabric heat loss (33) + (36) = 94.88 (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=	55.67	55.4	55.15	53.93	53.7	52.64	52.64	52.45	53.05	53.7	54.16	54.64	(38)

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

(39)m=	150.55	150.28	150.02	148.81	148.58	147.52	147.52	147.33	147.93	148.58	149.04	149.52	

Average = Sum(39)$_{1...12}$ /12= 148.81 (39)

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

(40)m=	1.1	1.09	1.09	1.08	1.08	1.07	1.07	1.07	1.08	1.08	1.08	1.09	

Average = Sum(40)$_{1...12}$ /12= 1.08 (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 2.91 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 103.36 (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=	113.7	109.56	105.43	101.29	97.16	93.02	93.02	97.16	101.29	105.43	109.56	113.7	

Total = Sum(44)$_{1...12}$ = 1240.33 (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=	168.61	147.47	152.17	132.67	127.3	109.85	101.79	116.81	118.2	137.75	150.37	163.29	

Total = Sum(45)$_{1...12}$ = 1626.27 (45)

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

(46)m=	25.29	22.12	22.83	19.9	19.09	16.48	15.27	17.52	17.73	20.66	22.56	24.49	(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=	50.96	46.03	50.96	49.32	49.51	45.88	47.4	49.51	49.32	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=	219.57	193.49	203.13	181.98	176.81	155.72	149.2	166.32	167.52	188.71	199.68	214.25	(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=	219.57	193.49	203.13	181.98	176.81	155.72	149.2	166.32	167.52	188.71	199.68	214.25	

Output from water heater (annual)$_{1...12}$ | 2216.38 | (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=	68.8	60.54	63.34	56.44	54.7	47.99	45.7	51.22	51.63	58.54	62.33	67.03	(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=	145.6	145.6	145.6	145.6	145.6	145.6	145.6	145.6	145.6	145.6	145.6	145.6	(66)

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

(67)m=	28.43	25.25	20.54	15.55	11.62	9.81	10.6	13.78	18.5	23.49	27.41	29.22	(67)

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

(68)m=	306.48	309.66	301.65	284.59	263.05	242.81	229.28	226.1	234.12	251.18	272.72	292.96	(68)

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

(69)m=	37.56	37.56	37.56	37.56	37.56	37.56	37.56	37.56	37.56	37.56	37.56	37.56	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	(71)

Water heating gains (Table 5)

(72)m=	92.48	90.09	85.13	78.39	73.53	66.66	61.42	68.84	71.71	78.69	86.56	90.1	(72)

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

(73)m=	497.07	494.69	477	448.21	417.88	388.96	370.99	378.41	394.01	423.03	456.37	481.96	(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)	
North	0.9x 0.77	x	8.98	x	10.63	x	0.63	x	0.7	=	29.18	(74)
North	0.9x 0.77	x	8.98	x	20.32	x	0.63	x	0.7	=	55.77	(74)

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North	0.9x	0.77	x	8.98	x	34.53	x	0.63	x	0.7	=	94.77	(74)
North	0.9x	0.77	x	8.98	x	55.46	x	0.63	x	0.7	=	152.22	(74)
North	0.9x	0.77	x	8.98	x	74.72	x	0.63	x	0.7	=	205.05	(74)
North	0.9x	0.77	x	8.98	x	79.99	x	0.63	x	0.7	=	219.51	(74)
North	0.9x	0.77	x	8.98	x	74.68	x	0.63	x	0.7	=	204.94	(74)
North	0.9x	0.77	x	8.98	x	59.25	x	0.63	x	0.7	=	162.6	(74)
North	0.9x	0.77	x	8.98	x	41.52	x	0.63	x	0.7	=	113.94	(74)
North	0.9x	0.77	x	8.98	x	24.19	x	0.63	x	0.7	=	66.39	(74)
North	0.9x	0.77	x	8.98	x	13.12	x	0.63	x	0.7	=	36	(74)
North	0.9x	0.77	x	8.98	x	8.86	x	0.63	x	0.7	=	24.33	(74)
East	0.9x	0.77	x	5.86	x	19.64	x	0.63	x	0.7	=	35.17	(76)
East	0.9x	0.77	x	5.86	x	38.42	x	0.63	x	0.7	=	68.81	(76)
East	0.9x	0.77	x	5.86	x	63.27	x	0.63	x	0.7	=	113.32	(76)
East	0.9x	0.77	x	5.86	x	92.28	x	0.63	x	0.7	=	165.26	(76)
East	0.9x	0.77	x	5.86	x	113.09	x	0.63	x	0.7	=	202.54	(76)
East	0.9x	0.77	x	5.86	x	115.77	x	0.63	x	0.7	=	207.33	(76)
East	0.9x	0.77	x	5.86	x	110.22	x	0.63	x	0.7	=	197.39	(76)
East	0.9x	0.77	x	5.86	x	94.68	x	0.63	x	0.7	=	169.55	(76)
East	0.9x	0.77	x	5.86	x	73.59	x	0.63	x	0.7	=	131.79	(76)
East	0.9x	0.77	x	5.86	x	45.59	x	0.63	x	0.7	=	81.65	(76)
East	0.9x	0.77	x	5.86	x	24.49	x	0.63	x	0.7	=	43.86	(76)
East	0.9x	0.77	x	5.86	x	16.15	x	0.63	x	0.7	=	28.93	(76)
South	0.9x	0.77	x	7.44	x	46.75	x	0.63	x	0.7	=	106.3	(78)
South	0.9x	0.77	x	7.44	x	76.57	x	0.63	x	0.7	=	174.1	(78)
South	0.9x	0.77	x	7.44	x	97.53	x	0.63	x	0.7	=	221.77	(78)
South	0.9x	0.77	x	7.44	x	110.23	x	0.63	x	0.7	=	250.65	(78)
South	0.9x	0.77	x	7.44	x	114.87	x	0.63	x	0.7	=	261.19	(78)
South	0.9x	0.77	x	7.44	x	110.55	x	0.63	x	0.7	=	251.36	(78)
South	0.9x	0.77	x	7.44	x	108.01	x	0.63	x	0.7	=	245.59	(78)
South	0.9x	0.77	x	7.44	x	104.89	x	0.63	x	0.7	=	238.51	(78)
South	0.9x	0.77	x	7.44	x	101.89	x	0.63	x	0.7	=	231.66	(78)
South	0.9x	0.77	x	7.44	x	82.59	x	0.63	x	0.7	=	187.78	(78)
South	0.9x	0.77	x	7.44	x	55.42	x	0.63	x	0.7	=	126.01	(78)
South	0.9x	0.77	x	7.44	x	40.4	x	0.63	x	0.7	=	91.86	(78)

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

(83)m=	170.66	298.67	429.85	568.13	668.78	678.2	647.92	570.66	477.39	335.81	205.86	145.11

(83)

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

(84)m=	667.73	793.36	906.85	1016.33	1086.66	1067.16	1018.91	949.06	871.4	758.84	662.24	627.07

(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

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(86)m=	0.98	0.97	0.94	0.89	0.81	0.69	0.55	0.6	0.79	0.92	0.97	0.98	(86)

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

(87)m=	18.54	18.81	19.25	19.81	20.33	20.72	20.89	20.86	20.55	19.87	19.1	18.48	(87)

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

(88)m=	20	20.01	20.01	20.01	20.02	20.02	20.02	20.02	20.02	20.02	20.01	20.01	(88)

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

(89)m=	0.98	0.96	0.93	0.88	0.78	0.62	0.46	0.5	0.73	0.9	0.96	0.98	(89)

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

(90)m=	16.68	17.08	17.71	18.53	19.25	19.75	19.94	19.92	19.56	18.62	17.51	16.61	(90)

fLA = Living area ÷ (4) = 0.13 (91)

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

(92)m=	16.93	17.31	17.92	18.7	19.4	19.88	20.07	20.04	19.69	18.79	17.72	16.86	(92)

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

(93)m=	16.78	17.16	17.77	18.55	19.25	19.73	19.92	19.89	19.54	18.64	17.57	16.71	(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=	0.96	0.94	0.9	0.84	0.74	0.6	0.44	0.49	0.7	0.87	0.94	0.96	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	640.52	744.49	819.77	855.28	806.28	637.35	452.78	465.07	611.32	659.64	623.17	604.93	(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=	1878.71	1842.42	1690.76	1436.01	1121.12	756.86	489.73	514.44	804.8	1194.75	1560.35	1870.08	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	921.21	737.8	648.02	418.13	234.24	0	0	0	0	398.12	674.77	941.28	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4973.58 (98)

Space heating requirement in kWh/m²/year 36.19 (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 89.8 (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)													
	921.21	737.8	648.02	418.13	234.24	0	0	0	0	398.12	674.77	941.28	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1025.85	821.61	721.63	465.62	260.85	0	0	0	0	443.34	751.41	1048.19	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 5538.51 (211)

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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)

	219.57	193.49	203.13	181.98	176.81	155.72	149.2	166.32	167.52	188.71	199.68	214.25

Efficiency of water heater 80.5 (216)

(217)m=	87.85	87.7	87.39	86.76	85.55	80.5	80.5	80.5	80.5	86.58	87.49	87.92

(217)

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

(219)m=	249.95	220.64	232.44	209.75	206.68	193.45	185.34	206.61	208.1	217.95	228.23	243.69

Total = Sum(219a)$_{1...12}$ = 2602.82 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		5538.51	
Water heating fuel used		2602.82	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	30	(231)
Electricity for lighting		502.13	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		8673.46	(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	=	1196.32	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	562.21	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1758.53	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	15.57	(267)
Electricity for lighting	(232) x		0.519	=	260.61	(268)
Total CO2, kg/year		sum of (265)…(271) =			2034.7	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =			14.8	(273)
EI rating (section 14)					85	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	John Ashe	**Stroma Number:**	STRO031268
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.49

Property Address: Derwyddfa, Cemaes Bay, Anglesey - SAP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	68.72 (1a)	x	2.36 (2a)	=	162.18	(3a)
First floor	68.72 (1b)	x	1.95 (2b)	=	134	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	137.44 (4)					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		296.18	(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) =	0.14 (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			0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.39 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.49	0.48	0.47	0.42	0.41	0.37	0.37	0.36	0.39	0.41	0.43	0.45

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=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6

(24d)

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

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

(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	
Windows Type 1			8.98	x1/[1/(1.4)+ 0.04] =	11.91			(27)
Windows Type 2			7.44	x1/[1/(1.4)+ 0.04] =	9.86			(27)
Windows Type 3			5.86	x1/[1/(1.4)+ 0.04] =	7.77			(27)
Floor			68.72	x 0.13 =	8.933599			(28)
Walls	137.38	22.28	115.1	x 0.18 =	20.72			(29)
Roof Type1	38.27	0	38.27	x 0.13 =	4.98			(30)
Roof Type2	39.37	0	39.37	x 0.13 =	5.12			(30)
Total area of elements, m²			283.74					(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) = 69.28 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 15163.96 (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 11.44 (36)

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

Total fabric heat loss (33) + (36) = 80.73 (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=	60.65	60.19	59.74	57.64	57.24	55.41	55.41	55.07	56.12	57.24	58.04	58.87	(38)

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

(39)m=	141.38	140.92	140.47	138.36	137.97	136.14	136.14	135.8	136.84	137.97	138.77	139.6	

Average = Sum(39)$_{1...12}$ /12= 138.36 (39)

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

(40)m=	1.03	1.03	1.02	1.01	1	0.99	0.99	0.99	1	1	1.01	1.02	

Average = Sum(40)$_{1...12}$ /12= 1.01 (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 2.91 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 103.36 (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=	113.7	109.56	105.43	101.29	97.16	93.02	93.02	97.16	101.29	105.43	109.56	113.7	

Total = Sum(44)$_{1...12}$ = 1240.33 (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=	168.61	147.47	152.17	132.67	127.3	109.85	101.79	116.81	118.2	137.75	150.37	163.29	

Total = Sum(45)$_{1...12}$ = 1626.27 (45)

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

(46)m=	25.29	22.12	22.83	19.9	19.09	16.48	15.27	17.52	17.73	20.66	22.56	24.49	(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=	50.96	46.03	50.96	49.32	49.51	45.88	47.4	49.51	49.32	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=	219.57	193.49	203.13	181.98	176.81	155.72	149.2	166.32	167.52	188.71	199.68	214.25	(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=	219.57	193.49	203.13	181.98	176.81	155.72	149.2	166.32	167.52	188.71	199.68	214.25	

Output from water heater (annual)$_{1...12}$ | 2216.38 | (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=	68.8	60.54	63.34	56.44	54.7	47.99	45.7	51.22	51.63	58.54	62.33	67.03	(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=	145.6	145.6	145.6	145.6	145.6	145.6	145.6	145.6	145.6	145.6	145.6	145.6	(66)

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

(67)m=	28.43	25.25	20.54	15.55	11.62	9.81	10.6	13.78	18.5	23.49	27.41	29.22	(67)

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

(68)m=	306.48	309.66	301.65	284.59	263.05	242.81	229.28	226.1	234.12	251.18	272.72	292.96	(68)

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

(69)m=	37.56	37.56	37.56	37.56	37.56	37.56	37.56	37.56	37.56	37.56	37.56	37.56	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	-116.48	(71)

Water heating gains (Table 5)

(72)m=	92.48	90.09	85.13	78.39	73.53	66.66	61.42	68.84	71.71	78.69	86.56	90.1	(72)

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

(73)m=	497.07	494.69	477	448.21	417.88	388.96	370.99	378.41	394.01	423.03	456.37	481.96	(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)	
North	0.9x 0.77	x	8.98	x	10.63	x	0.63	x	0.7	=	29.18	(74)
North	0.9x 0.77	x	8.98	x	20.32	x	0.63	x	0.7	=	55.77	(74)

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North	0.9x	0.77	x	8.98	x	34.53	x	0.63	x	0.7	=	94.77	(74)
North	0.9x	0.77	x	8.98	x	55.46	x	0.63	x	0.7	=	152.22	(74)
North	0.9x	0.77	x	8.98	x	74.72	x	0.63	x	0.7	=	205.05	(74)
North	0.9x	0.77	x	8.98	x	79.99	x	0.63	x	0.7	=	219.51	(74)
North	0.9x	0.77	x	8.98	x	74.68	x	0.63	x	0.7	=	204.94	(74)
North	0.9x	0.77	x	8.98	x	59.25	x	0.63	x	0.7	=	162.6	(74)
North	0.9x	0.77	x	8.98	x	41.52	x	0.63	x	0.7	=	113.94	(74)
North	0.9x	0.77	x	8.98	x	24.19	x	0.63	x	0.7	=	66.39	(74)
North	0.9x	0.77	x	8.98	x	13.12	x	0.63	x	0.7	=	36	(74)
North	0.9x	0.77	x	8.98	x	8.86	x	0.63	x	0.7	=	24.33	(74)
East	0.9x	0.77	x	5.86	x	19.64	x	0.63	x	0.7	=	35.17	(76)
East	0.9x	0.77	x	5.86	x	38.42	x	0.63	x	0.7	=	68.81	(76)
East	0.9x	0.77	x	5.86	x	63.27	x	0.63	x	0.7	=	113.32	(76)
East	0.9x	0.77	x	5.86	x	92.28	x	0.63	x	0.7	=	165.26	(76)
East	0.9x	0.77	x	5.86	x	113.09	x	0.63	x	0.7	=	202.54	(76)
East	0.9x	0.77	x	5.86	x	115.77	x	0.63	x	0.7	=	207.33	(76)
East	0.9x	0.77	x	5.86	x	110.22	x	0.63	x	0.7	=	197.39	(76)
East	0.9x	0.77	x	5.86	x	94.68	x	0.63	x	0.7	=	169.55	(76)
East	0.9x	0.77	x	5.86	x	73.59	x	0.63	x	0.7	=	131.79	(76)
East	0.9x	0.77	x	5.86	x	45.59	x	0.63	x	0.7	=	81.65	(76)
East	0.9x	0.77	x	5.86	x	24.49	x	0.63	x	0.7	=	43.86	(76)
East	0.9x	0.77	x	5.86	x	16.15	x	0.63	x	0.7	=	28.93	(76)
South	0.9x	0.77	x	7.44	x	46.75	x	0.63	x	0.7	=	106.3	(78)
South	0.9x	0.77	x	7.44	x	76.57	x	0.63	x	0.7	=	174.1	(78)
South	0.9x	0.77	x	7.44	x	97.53	x	0.63	x	0.7	=	221.77	(78)
South	0.9x	0.77	x	7.44	x	110.23	x	0.63	x	0.7	=	250.65	(78)
South	0.9x	0.77	x	7.44	x	114.87	x	0.63	x	0.7	=	261.19	(78)
South	0.9x	0.77	x	7.44	x	110.55	x	0.63	x	0.7	=	251.36	(78)
South	0.9x	0.77	x	7.44	x	108.01	x	0.63	x	0.7	=	245.59	(78)
South	0.9x	0.77	x	7.44	x	104.89	x	0.63	x	0.7	=	238.51	(78)
South	0.9x	0.77	x	7.44	x	101.89	x	0.63	x	0.7	=	231.66	(78)
South	0.9x	0.77	x	7.44	x	82.59	x	0.63	x	0.7	=	187.78	(78)
South	0.9x	0.77	x	7.44	x	55.42	x	0.63	x	0.7	=	126.01	(78)
South	0.9x	0.77	x	7.44	x	40.4	x	0.63	x	0.7	=	91.86	(78)

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

(83)m=	170.66	298.67	429.85	568.13	668.78	678.2	647.92	570.66	477.39	335.81	205.86	145.11

(83)

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

(84)m=	667.73	793.36	906.85	1016.33	1086.66	1067.16	1018.91	949.06	871.4	758.84	662.24	627.07

(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

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(86)m=	1	1	0.99	0.98	0.91	0.75	0.58	0.64	0.88	0.99	1	1	(86)

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

(87)m=	19.82	19.97	20.21	20.52	20.79	20.95	20.99	20.99	20.88	20.52	20.11	19.8	(87)

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

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

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

(89)m=	1	1	0.99	0.97	0.87	0.67	0.46	0.52	0.82	0.98	1	1	(89)

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

(90)m=	18.46	18.68	19.03	19.5	19.87	20.06	20.09	20.09	19.98	19.5	18.9	18.44	(90)

fLA = Living area ÷ (4) =	0.13	(91)

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

(92)m=	18.64	18.86	19.19	19.63	19.99	20.18	20.21	20.21	20.1	19.64	19.07	18.62	(92)

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

(93)m=	18.64	18.86	19.19	19.63	19.99	20.18	20.21	20.21	20.1	19.64	19.07	18.62	(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	0.99	0.96	0.87	0.68	0.48	0.54	0.82	0.97	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	666.74	790.18	896.11	974.54	945.05	723.87	487.2	509.41	717.42	739.82	659.89	626.41	(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=	2027.82	1966.7	1782.65	1485.15	1143.99	759.27	491.29	516.99	821.19	1246.71	1660.51	2013.31	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1012.65	790.62	659.59	367.63	148.01	0	0	0	0	377.13	720.45	1031.85	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	5107.93	(98)
Space heating requirement in kWh/m²/year	37.16	(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	93.4	(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)													
	1012.65	790.62	659.59	367.63	148.01	0	0	0	0	377.13	720.45	1031.85	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1084.2	846.49	706.2	393.61	158.47	0	0	0	0	403.78	771.36	1104.77	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$=	5468.88	(211)

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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)

	219.57	193.49	203.13	181.98	176.81	155.72	149.2	166.32	167.52	188.71	199.68	214.25

Efficiency of water heater 80.3 (216)

(217)m=	88.42	88.22	87.8	86.79	84.61	80.3	80.3	80.3	80.3	86.76	88	88.49

(217)

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

(219)m=	248.33	219.34	231.36	209.69	208.98	193.93	185.8	207.12	208.61	217.51	226.92	242.13

Total = Sum(219a)$_{1...12}$ = 2599.7 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		5468.88	
Water heating fuel used		2599.7	
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		502.13	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		8645.71	(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	=	1181.28	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	561.54	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1742.81	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	260.61	(268)
Total CO2, kg/year		sum of (265)…(271) =			2042.34	(272)

TER = 14.86 (273)