Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.6
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Project Information:

Assessed By: Chloe Hewitt (STRO029693) **Building Type:** Detached House

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 185.52m²
Site Reference : Wardentree Lane **Plot Reference:** Plot 3
Address : Plot 3, Land off Wardentree Lane, Spalding

Client Details:

Name: Allison Homes
Address :

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

1a TER and DER

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

Target Carbon Dioxide Emission Rate (TER)	14.92 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	13.15 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	55.7 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	53.5 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	**OK**
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	**OK**
Roof	0.09 (max. 0.20)	0.09 (max. 0.35)	**OK**
Openings	1.20 (max. 2.00)	1.20 (max. 3.30)	**OK**

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	**OK**

4 Heating efficiency

Main Heating system: Database: (rev 408, product index 010320):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Vaillant
Model: Ecotec Plus
Model qualifier: 612
(Regular)
Efficiency 89.0 % SEDBUK2009
Minimum 88.0 % **OK**

Secondary heating system: None

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5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.08 kWh/day	
	Permitted by DBSCG: 2.30 kWh/day	OK
Primary pipework insulated:	Yes	OK

6 Controls

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

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (East Pennines):	Not significant	OK

Based on:

Overshading:	Average or unknown
Windows facing: South East	2.39m²
Windows facing: South East	0.84m²
Windows facing: South East	0.84m²
Windows facing: South East	2.39m²
Windows facing: North West	1.86m²
Windows facing: North East	0.96m²
Windows facing: North East	1.44m²
Windows facing: South East	2.12m²
Windows facing: South East	1.61m²
Windows facing: South East	2.12m²
Windows facing: North East	2.12m²
Windows facing: North West	1.26m²
Windows facing: North West	2.12m²
Windows facing: North West	0.66m²
Windows facing: North West	3.15m²
Windows facing: North West	3.78m²
Ventilation rate:	3.00
Blinds/curtains:	
	Closed 100% of daylight hours

10 Key features

Roofs U-value	0.09 W/m²K
Floors U-value	0.12 W/m²K
Photovoltaic array	

SAP Input

Property Details: Plot 3

Address:	Plot 3, Land off Wardentree Lane, Spalding
Located in:	England
Region:	East Pennines
UPRN:	
Date of assessment:	Tuesday, February 14, 2017
Date of certificate:	Friday, March 3, 2017
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:	408

Property description:

Dwelling type:	House
Detachment:	Detached
Year Completed:	2016

Floor Location:	Floor area:	Storey height:
Basement floor	92.76 m²	2.38 m
Floor 1	92.76 m²	2.62 m

Living area:	25.54 m² (fraction 0.15)
Front of dwelling faces:	South East

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Front Door	Manufacturer	Half glazed	low-E, En = 0.05, soft coat	Yes	PVC-U
Rear Door	Manufacturer	Half glazed	low-E, En = 0.05, soft coat	Yes	PVC-U
W1	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
W2	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
W3	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
W4	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
W5	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
W6	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
W7	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
W8	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
W9	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
W10	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
W11	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
W12	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
W13	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
W14	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
D3	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
D4	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Front Door	16mm or more mm	0.7	0.63	1.2	2.12	1
Rear Door	16mm or more mm	0.7	0.63	1.2	1.97	1
W1	16mm or more	0.7	0.63	1.2	2.39	1
W2	16mm or more	0.7	0.63	1.2	0.84	1
W3	16mm or more	0.7	0.63	1.2	0.84	1
W4	16mm or more	0.7	0.63	1.2	2.39	1
W5	16mm or more	0.7	0.63	1.2	1.86	1
W6	16mm or more	0.7	0.63	1.2	0.96	1

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W7	16mm or more	0.7	0.63	1.2	1.44	1
W8	16mm or more	0.7	0.63	1.2	2.12	1
W9	16mm or more	0.7	0.63	1.2	1.61	1
W10	16mm or more	0.7	0.63	1.2	2.12	1
W11	16mm or more	0.7	0.63	1.2	2.12	1
W12	16mm or more	0.7	0.63	1.2	1.26	1
W13	16mm or more	0.7	0.63	1.2	2.12	1
W14	16mm or more	0.7	0.63	1.2	0.66	1
D3	16mm or more	0.7	0.63	1.2	3.15	1
D4	16mm or more	0.7	0.63	1.2	3.78	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Front Door		External Wall	South East	1.01	2.1
Rear Door		External Wall	North West	0.94	2.1
W1		External Wall	South East	1.77	1.35
W2		External Wall	South East	0.4	2.1
W3		External Wall	South East	0.4	2.1
W4		External Wall	South East	1.77	1.35
W5		External Wall	North West	1.77	1.05
W6		External Wall	North East	0.915	1.05
W7		External Wall	North East	1.2	1.2
W8		External Wall	South East	1.77	1.2
W9		External Wall	South East	1.342	1.2
W10		External Wall	South East	1.77	1.2
W11		External Wall	North East	1.77	1.2
W12		External Wall	North West	1.2	1.05
W13		External Wall	North West	1.77	1.2
W14		External Wall	North West	0.63	1.05
D3		External Wall	North West	1.5	2.1
D4		External Wall	North West	1.8	2.1

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
External Wall	196.95	33.75	163.2	0.24	0	False	N/A
Main Roof	92.76	0	92.76	0.09	0		N/A
Ground Floor	92.76			0.12			N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0837

	Length	Psi-value		
[Approved]	23.73	0.5	E1	Steel lintel with perforated steel base plate
[Approved]	18.48	0.04	E3	Sill
[Approved]	53.4	0.05	E4	Jamb
[Approved]	39.39	0.16	E5	Ground floor (normal)
[Approved]	19.03	0.06	E10	Eaves (insulation at ceiling level)
[Approved]	19.7	0.24	E12	Gable (insulation at ceiling level)
[Approved]	30	0.09	E16	Corner (normal)
[Approved]	39.39	0.07	E6	Intermediate floor within a dwelling
[Approved]	10	-0.09	E17	Corner (inverted internal area greater than external area)

Ventilation:

Pressure test: Yes (As designed)

SAP Input

Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	6
Number of passive stacks:	0
Number of sides sheltered:	0
Pressure test:	5

Main heating system:

Main heating system:	Boiler systems with radiators or underfloor heating Gas boilers and oil boilers Fuel: mains gas Info Source: Boiler Database Database: (rev 408, product index 010320) Efficiency: Winter 79.3 % Summer: 90.0 Brand name: Vaillant Model: Ecotec Plus Model qualifier: 612 (Regular boiler) Systems with radiators Central heating pump : 2013 or later Design flow temperature: Unknown Boiler interlock: Yes Delayed start

Main heating Control:

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

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas Hot water cylinder Cylinder volume: 210 litres Cylinder insulation: Factory 75 mm Primary pipework insulation: True Cylinderstat: True Cylinder in heated space: True Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	No
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 1.5 Tilt of collector: 45° Overshading: None or very little Collector Orientation: South East
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

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User Details:

Assessor Name:	Chloe Hewitt	**Stroma Number:**	STRO029693
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.6

Property Address: Plot 3

Address : Plot 3, Land off Wardentree Lane, Spalding

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	92.76	(1a) x	2.38	(2a) =	220.77	(3a)
Ground floor	92.76	(1b) x	2.62	(2b) =	243.03	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	185.52	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		463.8	(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							6	x 10 =	60	(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) =	60	÷ (5) =	0.13 (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)			0.38 (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) =			0.38 (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

0.48	0.47	0.46	0.42	0.41	0.36	0.36	0.35	0.38	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	0.61	0.61	0.59	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.6

(24d)

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

(25)m=	0.62	0.61	0.61	0.59	0.58	0.56	0.56	0.56	0.57	0.58	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	
Doors Type 1			2.12	x	1.2	=	2.544			(26)
Doors Type 2			1.97	x	1.2	=	2.364			(26)
Windows Type 1			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 2			0.84	x1/[1/(1.2)+ 0.04]		=	0.96			(27)
Windows Type 3			0.84	x1/[1/(1.2)+ 0.04]		=	0.96			(27)
Windows Type 4			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 5			1.86	x1/[1/(1.2)+ 0.04]		=	2.13			(27)
Windows Type 6			0.96	x1/[1/(1.2)+ 0.04]		=	1.1			(27)
Windows Type 7			1.44	x1/[1/(1.2)+ 0.04]		=	1.65			(27)
Windows Type 8			2.12	x1/[1/(1.2)+ 0.04]		=	2.43			(27)
Windows Type 9			1.61	x1/[1/(1.2)+ 0.04]		=	1.84			(27)
Windows Type 10			2.12	x1/[1/(1.2)+ 0.04]		=	2.43			(27)
Windows Type 11			2.12	x1/[1/(1.2)+ 0.04]		=	2.43			(27)
Windows Type 12			1.26	x1/[1/(1.2)+ 0.04]		=	1.44			(27)
Windows Type 13			2.12	x1/[1/(1.2)+ 0.04]		=	2.43			(27)
Windows Type 14			0.66	x1/[1/(1.2)+ 0.04]		=	0.76			(27)
Windows Type 15			3.15	x1/[1/(1.2)+ 0.04]		=	3.61			(27)

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Windows Type 16			3.78	x1/[1/(1.2)+ 0.04] =	4.33			(27)
Floor			92.76	x 0.12 =	11.1312			(28)
Walls	196.95	33.75	163.2	x 0.24 =	39.17			(29)
Roof	92.76	0	92.76	x 0.09 =	8.35			(30)
Total area of elements, m²			382.47					(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) = 97.52 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17583.84 (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 32 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 129.52 (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=	94.43	93.74	93.05	89.85	89.25	86.47	86.47	85.95	87.54	89.25	90.47	91.73	(38)

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

(39)m=	223.95	223.26	222.58	219.37	218.78	215.99	215.99	215.47	217.06	218.78	219.99	221.25	

Average = Sum(39)$_{1...12}$ /12= 219.37 (39)

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

(40)m=	1.21	1.2	1.2	1.18	1.18	1.16	1.16	1.16	1.17	1.18	1.19	1.19	

Average = Sum(40)$_{1...12}$ /12= 1.18 (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 2.98 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 105.05 (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	
(44)m=	115.55	111.35	107.15	102.95	98.74	94.54	94.54	98.74	102.95	107.15	111.35	115.55	

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

Total = Sum(44)$_{1...12}$ = 1260.57 (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=	171.36	149.87	154.66	134.83	129.37	111.64	103.45	118.71	120.13	140	152.82	165.95	

Total = Sum(45)$_{1...12}$ = 1652.8 (45)

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

(46)m=	25.7	22.48	23.2	20.22	19.41	16.75	15.52	17.81	18.02	21	22.92	24.89	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

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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) =	210	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.01	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0.83	(52)
Temperature factor from Table 2b		0.54	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.13	(54)
Enter (50) or (54) in (55)		1.13	(55)

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

(56)m=	34.9	31.52	34.9	33.77	34.9	33.77	34.9	34.9	33.77	34.9	33.77	34.9

(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=	34.9	31.52	34.9	33.77	34.9	33.77	34.9	34.9	33.77	34.9	33.77	34.9

(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=	229.52	202.4	212.81	191.11	187.53	167.92	161.61	176.87	176.41	198.16	209.1	224.11

(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=	229.52	202.4	212.81	191.11	187.53	167.92	161.61	176.87	176.41	198.16	209.1	224.11

Output from water heater (annual)$_{1...12}$ 2337.56 (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=	103.5	91.86	97.95	89.86	89.54	82.15	80.92	86	84.97	93.08	95.84	101.71

(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=	178.98	178.98	178.98	178.98	178.98	178.98	178.98	178.98	178.98	178.98	178.98	178.98

(66)

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

(67)m=	81.15	72.07	58.61	44.37	33.17	28	30.26	39.33	52.79	67.03	78.23	83.4

(67)

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

(68)m=	532.94	538.47	524.53	494.86	457.41	422.21	398.7	393.17	407.1	436.77	474.22	509.42

(68)

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

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(69)m=	55.88	55.88	55.88	55.88	55.88	55.88	55.88	55.88	55.88	55.88	55.88	55.88	(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=	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	(71)

Water heating gains (Table 5)

(72)m=	139.12	136.69	131.65	124.8	120.35	114.09	108.77	115.59	118.01	125.1	133.11	136.7	(72)

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

(73)m=	871.74	865.77	833.34	782.58	729.48	682.85	656.27	666.63	696.45	747.45	804.11	848.07	(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)	
Northeast 0.9x	0.77	x	0.96	x	11.28	x	0.63	x	0.7	=	3.31	(75)
Northeast 0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(75)
Northeast 0.9x	0.77	x	2.12	x	11.28	x	0.63	x	0.7	=	7.31	(75)
Northeast 0.9x	0.77	x	0.96	x	22.97	x	0.63	x	0.7	=	6.74	(75)
Northeast 0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(75)
Northeast 0.9x	0.77	x	2.12	x	22.97	x	0.63	x	0.7	=	14.88	(75)
Northeast 0.9x	0.77	x	0.96	x	41.38	x	0.63	x	0.7	=	12.14	(75)
Northeast 0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(75)
Northeast 0.9x	0.77	x	2.12	x	41.38	x	0.63	x	0.7	=	26.81	(75)
Northeast 0.9x	0.77	x	0.96	x	67.96	x	0.63	x	0.7	=	19.94	(75)
Northeast 0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(75)
Northeast 0.9x	0.77	x	2.12	x	67.96	x	0.63	x	0.7	=	44.03	(75)
Northeast 0.9x	0.77	x	0.96	x	91.35	x	0.63	x	0.7	=	26.8	(75)
Northeast 0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(75)
Northeast 0.9x	0.77	x	2.12	x	91.35	x	0.63	x	0.7	=	59.18	(75)
Northeast 0.9x	0.77	x	0.96	x	97.38	x	0.63	x	0.7	=	28.57	(75)
Northeast 0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(75)
Northeast 0.9x	0.77	x	2.12	x	97.38	x	0.63	x	0.7	=	63.1	(75)
Northeast 0.9x	0.77	x	0.96	x	91.1	x	0.63	x	0.7	=	26.73	(75)
Northeast 0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(75)
Northeast 0.9x	0.77	x	2.12	x	91.1	x	0.63	x	0.7	=	59.02	(75)
Northeast 0.9x	0.77	x	0.96	x	72.63	x	0.63	x	0.7	=	21.31	(75)
Northeast 0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(75)
Northeast 0.9x	0.77	x	2.12	x	72.63	x	0.63	x	0.7	=	47.05	(75)
Northeast 0.9x	0.77	x	0.96	x	50.42	x	0.63	x	0.7	=	14.79	(75)
Northeast 0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(75)
Northeast 0.9x	0.77	x	2.12	x	50.42	x	0.63	x	0.7	=	32.67	(75)
Northeast 0.9x	0.77	x	0.96	x	28.07	x	0.63	x	0.7	=	8.23	(75)

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Northeast	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(75)
Northeast	0.9x	0.77	x	2.12	x	28.07	x	0.63	x	0.7	=	18.18	(75)
Northeast	0.9x	0.77	x	0.96	x	14.2	x	0.63	x	0.7	=	4.17	(75)
Northeast	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(75)
Northeast	0.9x	0.77	x	2.12	x	14.2	x	0.63	x	0.7	=	9.2	(75)
Northeast	0.9x	0.77	x	0.96	x	9.21	x	0.63	x	0.7	=	2.7	(75)
Northeast	0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(75)
Northeast	0.9x	0.77	x	2.12	x	9.21	x	0.63	x	0.7	=	5.97	(75)
Southeast	0.9x	0.77	x	2.39	x	36.79	x	0.63	x	0.7	=	26.87	(77)
Southeast	0.9x	0.77	x	0.84	x	36.79	x	0.63	x	0.7	=	9.45	(77)
Southeast	0.9x	0.77	x	0.84	x	36.79	x	0.63	x	0.7	=	9.45	(77)
Southeast	0.9x	0.77	x	2.39	x	36.79	x	0.63	x	0.7	=	26.87	(77)
Southeast	0.9x	0.77	x	2.12	x	36.79	x	0.63	x	0.7	=	23.84	(77)
Southeast	0.9x	0.77	x	1.61	x	36.79	x	0.63	x	0.7	=	18.1	(77)
Southeast	0.9x	0.77	x	2.12	x	36.79	x	0.63	x	0.7	=	23.84	(77)
Southeast	0.9x	0.77	x	2.39	x	62.67	x	0.63	x	0.7	=	45.78	(77)
Southeast	0.9x	0.77	x	0.84	x	62.67	x	0.63	x	0.7	=	16.09	(77)
Southeast	0.9x	0.77	x	0.84	x	62.67	x	0.63	x	0.7	=	16.09	(77)
Southeast	0.9x	0.77	x	2.39	x	62.67	x	0.63	x	0.7	=	45.78	(77)
Southeast	0.9x	0.77	x	2.12	x	62.67	x	0.63	x	0.7	=	40.61	(77)
Southeast	0.9x	0.77	x	1.61	x	62.67	x	0.63	x	0.7	=	30.84	(77)
Southeast	0.9x	0.77	x	2.12	x	62.67	x	0.63	x	0.7	=	40.61	(77)
Southeast	0.9x	0.77	x	2.39	x	85.75	x	0.63	x	0.7	=	62.63	(77)
Southeast	0.9x	0.77	x	0.84	x	85.75	x	0.63	x	0.7	=	22.01	(77)
Southeast	0.9x	0.77	x	0.84	x	85.75	x	0.63	x	0.7	=	22.01	(77)
Southeast	0.9x	0.77	x	2.39	x	85.75	x	0.63	x	0.7	=	62.63	(77)
Southeast	0.9x	0.77	x	2.12	x	85.75	x	0.63	x	0.7	=	55.56	(77)
Southeast	0.9x	0.77	x	1.61	x	85.75	x	0.63	x	0.7	=	42.19	(77)
Southeast	0.9x	0.77	x	2.12	x	85.75	x	0.63	x	0.7	=	55.56	(77)
Southeast	0.9x	0.77	x	2.39	x	106.25	x	0.63	x	0.7	=	77.61	(77)
Southeast	0.9x	0.77	x	0.84	x	106.25	x	0.63	x	0.7	=	27.28	(77)
Southeast	0.9x	0.77	x	0.84	x	106.25	x	0.63	x	0.7	=	27.28	(77)
Southeast	0.9x	0.77	x	2.39	x	106.25	x	0.63	x	0.7	=	77.61	(77)
Southeast	0.9x	0.77	x	2.12	x	106.25	x	0.63	x	0.7	=	68.84	(77)
Southeast	0.9x	0.77	x	1.61	x	106.25	x	0.63	x	0.7	=	52.28	(77)
Southeast	0.9x	0.77	x	2.12	x	106.25	x	0.63	x	0.7	=	68.84	(77)
Southeast	0.9x	0.77	x	2.39	x	119.01	x	0.63	x	0.7	=	86.93	(77)
Southeast	0.9x	0.77	x	0.84	x	119.01	x	0.63	x	0.7	=	30.55	(77)
Southeast	0.9x	0.77	x	0.84	x	119.01	x	0.63	x	0.7	=	30.55	(77)
Southeast	0.9x	0.77	x	2.39	x	119.01	x	0.63	x	0.7	=	86.93	(77)
Southeast	0.9x	0.77	x	2.12	x	119.01	x	0.63	x	0.7	=	77.11	(77)

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Southeast	0.9x	0.77	x	1.61	x	119.01	x	0.63	x	0.7	=	58.56	(77)
Southeast	0.9x	0.77	x	2.12	x	119.01	x	0.63	x	0.7	=	77.11	(77)
Southeast	0.9x	0.77	x	2.39	x	118.15	x	0.63	x	0.7	=	86.3	(77)
Southeast	0.9x	0.77	x	0.84	x	118.15	x	0.63	x	0.7	=	30.33	(77)
Southeast	0.9x	0.77	x	0.84	x	118.15	x	0.63	x	0.7	=	30.33	(77)
Southeast	0.9x	0.77	x	2.39	x	118.15	x	0.63	x	0.7	=	86.3	(77)
Southeast	0.9x	0.77	x	2.12	x	118.15	x	0.63	x	0.7	=	76.55	(77)
Southeast	0.9x	0.77	x	1.61	x	118.15	x	0.63	x	0.7	=	58.13	(77)
Southeast	0.9x	0.77	x	2.12	x	118.15	x	0.63	x	0.7	=	76.55	(77)
Southeast	0.9x	0.77	x	2.39	x	113.91	x	0.63	x	0.7	=	83.2	(77)
Southeast	0.9x	0.77	x	0.84	x	113.91	x	0.63	x	0.7	=	29.24	(77)
Southeast	0.9x	0.77	x	0.84	x	113.91	x	0.63	x	0.7	=	29.24	(77)
Southeast	0.9x	0.77	x	2.39	x	113.91	x	0.63	x	0.7	=	83.2	(77)
Southeast	0.9x	0.77	x	2.12	x	113.91	x	0.63	x	0.7	=	73.8	(77)
Southeast	0.9x	0.77	x	1.61	x	113.91	x	0.63	x	0.7	=	56.05	(77)
Southeast	0.9x	0.77	x	2.12	x	113.91	x	0.63	x	0.7	=	73.8	(77)
Southeast	0.9x	0.77	x	2.39	x	104.39	x	0.63	x	0.7	=	76.25	(77)
Southeast	0.9x	0.77	x	0.84	x	104.39	x	0.63	x	0.7	=	26.8	(77)
Southeast	0.9x	0.77	x	0.84	x	104.39	x	0.63	x	0.7	=	26.8	(77)
Southeast	0.9x	0.77	x	2.39	x	104.39	x	0.63	x	0.7	=	76.25	(77)
Southeast	0.9x	0.77	x	2.12	x	104.39	x	0.63	x	0.7	=	67.63	(77)
Southeast	0.9x	0.77	x	1.61	x	104.39	x	0.63	x	0.7	=	51.36	(77)
Southeast	0.9x	0.77	x	2.12	x	104.39	x	0.63	x	0.7	=	67.63	(77)
Southeast	0.9x	0.77	x	2.39	x	92.85	x	0.63	x	0.7	=	67.82	(77)
Southeast	0.9x	0.77	x	0.84	x	92.85	x	0.63	x	0.7	=	23.84	(77)
Southeast	0.9x	0.77	x	0.84	x	92.85	x	0.63	x	0.7	=	23.84	(77)
Southeast	0.9x	0.77	x	2.39	x	92.85	x	0.63	x	0.7	=	67.82	(77)
Southeast	0.9x	0.77	x	2.12	x	92.85	x	0.63	x	0.7	=	60.16	(77)
Southeast	0.9x	0.77	x	1.61	x	92.85	x	0.63	x	0.7	=	45.69	(77)
Southeast	0.9x	0.77	x	2.12	x	92.85	x	0.63	x	0.7	=	60.16	(77)
Southeast	0.9x	0.77	x	2.39	x	69.27	x	0.63	x	0.7	=	50.59	(77)
Southeast	0.9x	0.77	x	0.84	x	69.27	x	0.63	x	0.7	=	17.78	(77)
Southeast	0.9x	0.77	x	0.84	x	69.27	x	0.63	x	0.7	=	17.78	(77)
Southeast	0.9x	0.77	x	2.39	x	69.27	x	0.63	x	0.7	=	50.59	(77)
Southeast	0.9x	0.77	x	2.12	x	69.27	x	0.63	x	0.7	=	44.88	(77)
Southeast	0.9x	0.77	x	1.61	x	69.27	x	0.63	x	0.7	=	34.08	(77)
Southeast	0.9x	0.77	x	2.12	x	69.27	x	0.63	x	0.7	=	44.88	(77)
Southeast	0.9x	0.77	x	2.39	x	44.07	x	0.63	x	0.7	=	32.19	(77)
Southeast	0.9x	0.77	x	0.84	x	44.07	x	0.63	x	0.7	=	11.31	(77)
Southeast	0.9x	0.77	x	0.84	x	44.07	x	0.63	x	0.7	=	11.31	(77)
Southeast	0.9x	0.77	x	2.39	x	44.07	x	0.63	x	0.7	=	32.19	(77)

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Southeast	0.9x	0.77	x	2.12	x	44.07	x	0.63	x	0.7	=	28.55	(77)
Southeast	0.9x	0.77	x	1.61	x	44.07	x	0.63	x	0.7	=	21.68	(77)
Southeast	0.9x	0.77	x	2.12	x	44.07	x	0.63	x	0.7	=	28.55	(77)
Southeast	0.9x	0.77	x	2.39	x	31.49	x	0.63	x	0.7	=	23	(77)
Southeast	0.9x	0.77	x	0.84	x	31.49	x	0.63	x	0.7	=	8.08	(77)
Southeast	0.9x	0.77	x	0.84	x	31.49	x	0.63	x	0.7	=	8.08	(77)
Southeast	0.9x	0.77	x	2.39	x	31.49	x	0.63	x	0.7	=	23	(77)
Southeast	0.9x	0.77	x	2.12	x	31.49	x	0.63	x	0.7	=	20.4	(77)
Southeast	0.9x	0.77	x	1.61	x	31.49	x	0.63	x	0.7	=	15.49	(77)
Southeast	0.9x	0.77	x	2.12	x	31.49	x	0.63	x	0.7	=	20.4	(77)
Northwest	0.9x	0.77	x	1.86	x	11.28	x	0.63	x	0.7	=	6.41	(81)
Northwest	0.9x	0.77	x	1.26	x	11.28	x	0.63	x	0.7	=	4.34	(81)
Northwest	0.9x	0.77	x	2.12	x	11.28	x	0.63	x	0.7	=	7.31	(81)
Northwest	0.9x	0.77	x	0.66	x	11.28	x	0.63	x	0.7	=	2.28	(81)
Northwest	0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	10.86	(81)
Northwest	0.9x	0.77	x	3.78	x	11.28	x	0.63	x	0.7	=	13.03	(81)
Northwest	0.9x	0.77	x	1.86	x	22.97	x	0.63	x	0.7	=	13.06	(81)
Northwest	0.9x	0.77	x	1.26	x	22.97	x	0.63	x	0.7	=	8.84	(81)
Northwest	0.9x	0.77	x	2.12	x	22.97	x	0.63	x	0.7	=	14.88	(81)
Northwest	0.9x	0.77	x	0.66	x	22.97	x	0.63	x	0.7	=	4.63	(81)
Northwest	0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	22.11	(81)
Northwest	0.9x	0.77	x	3.78	x	22.97	x	0.63	x	0.7	=	26.53	(81)
Northwest	0.9x	0.77	x	1.86	x	41.38	x	0.63	x	0.7	=	23.52	(81)
Northwest	0.9x	0.77	x	1.26	x	41.38	x	0.63	x	0.7	=	15.93	(81)
Northwest	0.9x	0.77	x	2.12	x	41.38	x	0.63	x	0.7	=	26.81	(81)
Northwest	0.9x	0.77	x	0.66	x	41.38	x	0.63	x	0.7	=	8.35	(81)
Northwest	0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	39.83	(81)
Northwest	0.9x	0.77	x	3.78	x	41.38	x	0.63	x	0.7	=	47.8	(81)
Northwest	0.9x	0.77	x	1.86	x	67.96	x	0.63	x	0.7	=	38.63	(81)
Northwest	0.9x	0.77	x	1.26	x	67.96	x	0.63	x	0.7	=	26.17	(81)
Northwest	0.9x	0.77	x	2.12	x	67.96	x	0.63	x	0.7	=	44.03	(81)
Northwest	0.9x	0.77	x	0.66	x	67.96	x	0.63	x	0.7	=	13.71	(81)
Northwest	0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	65.42	(81)
Northwest	0.9x	0.77	x	3.78	x	67.96	x	0.63	x	0.7	=	78.5	(81)
Northwest	0.9x	0.77	x	1.86	x	91.35	x	0.63	x	0.7	=	51.92	(81)
Northwest	0.9x	0.77	x	1.26	x	91.35	x	0.63	x	0.7	=	35.17	(81)
Northwest	0.9x	0.77	x	2.12	x	91.35	x	0.63	x	0.7	=	59.18	(81)
Northwest	0.9x	0.77	x	0.66	x	91.35	x	0.63	x	0.7	=	18.42	(81)
Northwest	0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	87.94	(81)
Northwest	0.9x	0.77	x	3.78	x	91.35	x	0.63	x	0.7	=	105.52	(81)
Northwest	0.9x	0.77	x	1.86	x	97.38	x	0.63	x	0.7	=	55.36	(81)

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Northwest	0.9x	0.77	x	1.26	x	97.38	x	0.63	x	0.7	=	37.5	(81)
Northwest	0.9x	0.77	x	2.12	x	97.38	x	0.63	x	0.7	=	63.1	(81)
Northwest	0.9x	0.77	x	0.66	x	97.38	x	0.63	x	0.7	=	19.64	(81)
Northwest	0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	93.75	(81)
Northwest	0.9x	0.77	x	3.78	x	97.38	x	0.63	x	0.7	=	112.5	(81)
Northwest	0.9x	0.77	x	1.86	x	91.1	x	0.63	x	0.7	=	51.79	(81)
Northwest	0.9x	0.77	x	1.26	x	91.1	x	0.63	x	0.7	=	35.08	(81)
Northwest	0.9x	0.77	x	2.12	x	91.1	x	0.63	x	0.7	=	59.02	(81)
Northwest	0.9x	0.77	x	0.66	x	91.1	x	0.63	x	0.7	=	18.38	(81)
Northwest	0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	87.7	(81)
Northwest	0.9x	0.77	x	3.78	x	91.1	x	0.63	x	0.7	=	105.24	(81)
Northwest	0.9x	0.77	x	1.86	x	72.63	x	0.63	x	0.7	=	41.28	(81)
Northwest	0.9x	0.77	x	1.26	x	72.63	x	0.63	x	0.7	=	27.97	(81)
Northwest	0.9x	0.77	x	2.12	x	72.63	x	0.63	x	0.7	=	47.05	(81)
Northwest	0.9x	0.77	x	0.66	x	72.63	x	0.63	x	0.7	=	14.65	(81)
Northwest	0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	69.92	(81)
Northwest	0.9x	0.77	x	3.78	x	72.63	x	0.63	x	0.7	=	83.9	(81)
Northwest	0.9x	0.77	x	1.86	x	50.42	x	0.63	x	0.7	=	28.66	(81)
Northwest	0.9x	0.77	x	1.26	x	50.42	x	0.63	x	0.7	=	19.42	(81)
Northwest	0.9x	0.77	x	2.12	x	50.42	x	0.63	x	0.7	=	32.67	(81)
Northwest	0.9x	0.77	x	0.66	x	50.42	x	0.63	x	0.7	=	10.17	(81)
Northwest	0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	48.54	(81)
Northwest	0.9x	0.77	x	3.78	x	50.42	x	0.63	x	0.7	=	58.25	(81)
Northwest	0.9x	0.77	x	1.86	x	28.07	x	0.63	x	0.7	=	15.95	(81)
Northwest	0.9x	0.77	x	1.26	x	28.07	x	0.63	x	0.7	=	10.81	(81)
Northwest	0.9x	0.77	x	2.12	x	28.07	x	0.63	x	0.7	=	18.18	(81)
Northwest	0.9x	0.77	x	0.66	x	28.07	x	0.63	x	0.7	=	5.66	(81)
Northwest	0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	27.02	(81)
Northwest	0.9x	0.77	x	3.78	x	28.07	x	0.63	x	0.7	=	32.42	(81)
Northwest	0.9x	0.77	x	1.86	x	14.2	x	0.63	x	0.7	=	8.07	(81)
Northwest	0.9x	0.77	x	1.26	x	14.2	x	0.63	x	0.7	=	5.47	(81)
Northwest	0.9x	0.77	x	2.12	x	14.2	x	0.63	x	0.7	=	9.2	(81)
Northwest	0.9x	0.77	x	0.66	x	14.2	x	0.63	x	0.7	=	2.86	(81)
Northwest	0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	13.67	(81)
Northwest	0.9x	0.77	x	3.78	x	14.2	x	0.63	x	0.7	=	16.4	(81)
Northwest	0.9x	0.77	x	1.86	x	9.21	x	0.63	x	0.7	=	5.24	(81)
Northwest	0.9x	0.77	x	1.26	x	9.21	x	0.63	x	0.7	=	3.55	(81)
Northwest	0.9x	0.77	x	2.12	x	9.21	x	0.63	x	0.7	=	5.97	(81)
Northwest	0.9x	0.77	x	0.66	x	9.21	x	0.63	x	0.7	=	1.86	(81)
Northwest	0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	8.87	(81)
Northwest	0.9x	0.77	x	3.78	x	9.21	x	0.63	x	0.7	=	10.64	(81)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m=	198.25	357.56	542.02	760.06	932.08	960.86	911.59	777.82	616.67	409.41	241.07	167.32	(83)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(84)m=	1069.99	1223.33	1375.35	1542.64	1661.56	1643.71	1567.86	1444.45	1313.12	1156.86	1045.18	1015.38	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.75	0.59	0.65	0.88	0.98	1	1	(86)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(87)m=	19.66	19.81	20.06	20.42	20.73	20.93	20.98	20.97	20.83	20.43	19.99	19.64	(87)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(88)m=	19.91	19.92	19.92	19.93	19.94	19.95	19.95	19.95	19.94	19.94	19.93	19.93	(88)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(89)m=	1	1	0.99	0.96	0.86	0.66	0.46	0.52	0.82	0.97	1	1	(89)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(90)m=	18.13	18.35	18.72	19.24	19.67	19.9	19.94	19.94	19.8	19.26	18.62	18.11	(90)

fLA = Living area ÷ (4) = 0.14 (91)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(92)m=	18.34	18.55	18.91	19.4	19.81	20.04	20.09	20.08	19.94	19.42	18.81	18.32	(92)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(93)m=	18.19	18.4	18.76	19.25	19.66	19.89	19.94	19.93	19.79	19.27	18.66	18.17	(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:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m=	1	0.99	0.98	0.95	0.85	0.66	0.45	0.52	0.81	0.96	0.99	1	(94)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(95)m=	1065.95	1214.1	1350.45	1460.3	1412.74	1078.29	712.3	745.93	1058.07	1115.14	1037.27	1012.41	(95)

Monthly average external temperature from Table 8

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(97)m=	3111.2	3014.04	2728.31	2270.69	1741.9	1142.65	720.5	761	1235.41	1896.93	2542.29	3091.45	(97)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m=	1521.66	1209.56	1025.13	583.48	244.89	0	0	0	0	581.65	1083.61	1546.81	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 7796.79 (98)

Space heating requirement in kWh/m²/year 42.03 (99)

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

Space heating:

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

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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		90 (206)
Efficiency of secondary/supplementary heating system, %		0 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement (calculated above)													kWh/year
	1521.66	1209.56	1025.13	583.48	244.89	0	0	0	0	581.65	1083.61	1546.81	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1690.73	1343.95	1139.03	648.31	272.1	0	0	0	0	646.28	1204.01	1718.68	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 8663.1 (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)													
	229.52	202.4	212.81	191.11	187.53	167.92	161.61	176.87	176.41	198.16	209.1	224.11	

Efficiency of water heater 79.3 (216)

(217)m=	88.44	88.29	87.96	87.1	85.02	79.3	79.3	79.3	79.3	87.02	88.08	88.49	(217)

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

(219)m=	259.53	229.24	241.94	219.42	220.56	211.76	203.79	223.04	222.46	227.72	237.41	253.26	

Total = Sum(219a)$_{1...12}$ = 2750.14 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		8663.1	
Water heating fuel used		2750.14	
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		573.22	(232)
Electricity generated by PVs		-1204.8	(233)

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 =	301.48		(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 =	95.7		(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89		(249)

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(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 =	75.61	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-158.91	(252)

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

Total energy cost	(245)...(247) + (250)…(254) =	443.77	(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] =	0.81	(257)
SAP rating (Section 12)		88.72	(258)

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

		Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	1871.23	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	594.03	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2465.26	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	297.5	(268)
Energy saving/generation technologies Item 1			0.519	=	-625.29	(269)
Total CO2, kg/year	sum of (265)…(271) =				2176.4	(272)
CO2 emissions per m²	(272) ÷ (4) =				11.73	(273)
EI rating (section 14)					87	(274)

13a. Primary Energy

		Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x		1.22	=	10568.99	(261)
Space heating (secondary)	(215) x		3.07	=	0	(263)
Energy for water heating	(219) x		1.22	=	3355.17	(264)
Space and water heating	(261) + (262) + (263) + (264) =				13924.16	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		3.07	=	230.25	(267)
Electricity for lighting	(232) x		0	=	1759.8	(268)
Energy saving/generation technologies Item 1			3.07	=	-3698.72	(269)
'Total Primary Energy	sum of (265)…(271) =				12215.48	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =				65.84	(273)

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User Details:

Assessor Name:	Chloe Hewitt	**Stroma Number:**	STRO029693
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.6

Property Address: Plot 3

Address : Plot 3, Land off Wardentree Lane, Spalding

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	92.76	(1a) x	2.38	(2a) =	220.77	(3a)
Ground floor	92.76	(1b) x	2.62	(2b) =	243.03	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	185.52	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		463.8	(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) =	0.09 (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)	0.34 (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) =	0.34 (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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4

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	0.59	0.58	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58

(24d)

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

(25)m=	0.59	0.59	0.58	0.57	0.57	0.55	0.55	0.55	0.56	0.57	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 Type 1			2.12	x	1.2	=	2.544			(26)
Doors Type 2			1.97	x	1.2	=	2.364			(26)
Windows Type 1			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 2			0.84	x1/[1/(1.4)+ 0.04]		=	1.11			(27)
Windows Type 3			0.84	x1/[1/(1.4)+ 0.04]		=	1.11			(27)
Windows Type 4			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 5			1.86	x1/[1/(1.4)+ 0.04]		=	2.47			(27)
Windows Type 6			0.96	x1/[1/(1.4)+ 0.04]		=	1.27			(27)
Windows Type 7			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 8			2.12	x1/[1/(1.4)+ 0.04]		=	2.81			(27)
Windows Type 9			1.61	x1/[1/(1.4)+ 0.04]		=	2.13			(27)
Windows Type 10			2.12	x1/[1/(1.4)+ 0.04]		=	2.81			(27)
Windows Type 11			2.12	x1/[1/(1.4)+ 0.04]		=	2.81			(27)
Windows Type 12			1.26	x1/[1/(1.4)+ 0.04]		=	1.67			(27)
Windows Type 13			2.12	x1/[1/(1.4)+ 0.04]		=	2.81			(27)
Windows Type 14			0.66	x1/[1/(1.4)+ 0.04]		=	0.88			(27)
Windows Type 15			3.15	x1/[1/(1.4)+ 0.04]		=	4.18			(27)

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Windows Type 16			3.78	x1/[1/(1.4)+ 0.04]	=	5.01			(27)
Floor			92.76	x	0.13	=	12.0588			(28)
Walls	196.95	33.75	163.2	x	0.18	=	29.38			(29)
Roof	92.76	0	92.76	x	0.13	=	12.06			(30)
Total area of elements, m²			382.47							(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) = 97.72 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17583.84 (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 15.21 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 112.93 (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=	90.59	90.05	89.51	87	86.53	84.34	84.34	83.93	85.18	86.53	87.48	88.47	(38)

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

(39)m=	203.52	202.98	202.44	199.93	199.46	197.27	197.27	196.86	198.11	199.46	200.41	201.4	

Average = Sum(39)$_{1...12}$ /12= 199.92 (39)

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

(40)m=	1.1	1.09	1.09	1.08	1.08	1.06	1.06	1.06	1.07	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 2.98 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 105.05 (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	
(44)m=	115.55	111.35	107.15	102.95	98.74	94.54	94.54	98.74	102.95	107.15	111.35	115.55	

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

Total = Sum(44)$_{1...12}$ = 1260.57 (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=	171.36	149.87	154.66	134.83	129.37	111.64	103.45	118.71	120.13	140	152.82	165.95	

Total = Sum(45)$_{1...12}$ = 1652.8 (45)

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

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

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

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

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

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

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

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

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

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

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

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

(62)m=	145.66	127.39	131.46	114.61	109.97	94.89	87.93	100.91	102.11	119	129.9	141.06	(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=	145.66	127.39	131.46	114.61	109.97	94.89	87.93	100.91	102.11	119	129.9	141.06	

Output from water heater (annual)$_{1...12}$ 1404.88 (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=	36.41	31.85	32.86	28.65	27.49	23.72	21.98	25.23	25.53	29.75	32.47	35.27	(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=	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	(66)

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

(67)m=	32.46	28.83	23.45	17.75	13.27	11.2	12.1	15.73	21.12	26.81	31.29	33.36	(67)

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

(68)m=	357.07	360.77	351.44	331.56	306.47	282.88	267.13	263.42	272.76	292.64	317.73	341.31	(68)

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

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(69)m=	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	(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=	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	(71)

Water heating gains (Table 5)

(72)m=	48.94	47.39	44.17	39.79	36.95	32.95	29.55	33.91	35.45	39.99	45.1	47.4	(72)

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

(73)m=	506.21	504.74	486.8	456.85	424.43	394.78	376.53	380.81	397.08	427.18	461.87	489.82	(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)	
Northeast 0.9x	0.77	x	0.96	x	11.28	x	0.63	x	0.7	=	3.31	(75)
Northeast 0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(75)
Northeast 0.9x	0.77	x	2.12	x	11.28	x	0.63	x	0.7	=	7.31	(75)
Northeast 0.9x	0.77	x	0.96	x	22.97	x	0.63	x	0.7	=	6.74	(75)
Northeast 0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(75)
Northeast 0.9x	0.77	x	2.12	x	22.97	x	0.63	x	0.7	=	14.88	(75)
Northeast 0.9x	0.77	x	0.96	x	41.38	x	0.63	x	0.7	=	12.14	(75)
Northeast 0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(75)
Northeast 0.9x	0.77	x	2.12	x	41.38	x	0.63	x	0.7	=	26.81	(75)
Northeast 0.9x	0.77	x	0.96	x	67.96	x	0.63	x	0.7	=	19.94	(75)
Northeast 0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(75)
Northeast 0.9x	0.77	x	2.12	x	67.96	x	0.63	x	0.7	=	44.03	(75)
Northeast 0.9x	0.77	x	0.96	x	91.35	x	0.63	x	0.7	=	26.8	(75)
Northeast 0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(75)
Northeast 0.9x	0.77	x	2.12	x	91.35	x	0.63	x	0.7	=	59.18	(75)
Northeast 0.9x	0.77	x	0.96	x	97.38	x	0.63	x	0.7	=	28.57	(75)
Northeast 0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(75)
Northeast 0.9x	0.77	x	2.12	x	97.38	x	0.63	x	0.7	=	63.1	(75)
Northeast 0.9x	0.77	x	0.96	x	91.1	x	0.63	x	0.7	=	26.73	(75)
Northeast 0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(75)
Northeast 0.9x	0.77	x	2.12	x	91.1	x	0.63	x	0.7	=	59.02	(75)
Northeast 0.9x	0.77	x	0.96	x	72.63	x	0.63	x	0.7	=	21.31	(75)
Northeast 0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(75)
Northeast 0.9x	0.77	x	2.12	x	72.63	x	0.63	x	0.7	=	47.05	(75)
Northeast 0.9x	0.77	x	0.96	x	50.42	x	0.63	x	0.7	=	14.79	(75)
Northeast 0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(75)
Northeast 0.9x	0.77	x	2.12	x	50.42	x	0.63	x	0.7	=	32.67	(75)
Northeast 0.9x	0.77	x	0.96	x	28.07	x	0.63	x	0.7	=	8.23	(75)

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Northeast	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(75)
Northeast	0.9x	0.77	x	2.12	x	28.07	x	0.63	x	0.7	=	18.18	(75)
Northeast	0.9x	0.77	x	0.96	x	14.2	x	0.63	x	0.7	=	4.17	(75)
Northeast	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(75)
Northeast	0.9x	0.77	x	2.12	x	14.2	x	0.63	x	0.7	=	9.2	(75)
Northeast	0.9x	0.77	x	0.96	x	9.21	x	0.63	x	0.7	=	2.7	(75)
Northeast	0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(75)
Northeast	0.9x	0.77	x	2.12	x	9.21	x	0.63	x	0.7	=	5.97	(75)
Southeast	0.9x	0.77	x	2.39	x	36.79	x	0.63	x	0.7	=	26.87	(77)
Southeast	0.9x	0.77	x	0.84	x	36.79	x	0.63	x	0.7	=	9.45	(77)
Southeast	0.9x	0.77	x	0.84	x	36.79	x	0.63	x	0.7	=	9.45	(77)
Southeast	0.9x	0.77	x	2.39	x	36.79	x	0.63	x	0.7	=	26.87	(77)
Southeast	0.9x	0.77	x	2.12	x	36.79	x	0.63	x	0.7	=	23.84	(77)
Southeast	0.9x	0.77	x	1.61	x	36.79	x	0.63	x	0.7	=	18.1	(77)
Southeast	0.9x	0.77	x	2.12	x	36.79	x	0.63	x	0.7	=	23.84	(77)
Southeast	0.9x	0.77	x	2.39	x	62.67	x	0.63	x	0.7	=	45.78	(77)
Southeast	0.9x	0.77	x	0.84	x	62.67	x	0.63	x	0.7	=	16.09	(77)
Southeast	0.9x	0.77	x	0.84	x	62.67	x	0.63	x	0.7	=	16.09	(77)
Southeast	0.9x	0.77	x	2.39	x	62.67	x	0.63	x	0.7	=	45.78	(77)
Southeast	0.9x	0.77	x	2.12	x	62.67	x	0.63	x	0.7	=	40.61	(77)
Southeast	0.9x	0.77	x	1.61	x	62.67	x	0.63	x	0.7	=	30.84	(77)
Southeast	0.9x	0.77	x	2.12	x	62.67	x	0.63	x	0.7	=	40.61	(77)
Southeast	0.9x	0.77	x	2.39	x	85.75	x	0.63	x	0.7	=	62.63	(77)
Southeast	0.9x	0.77	x	0.84	x	85.75	x	0.63	x	0.7	=	22.01	(77)
Southeast	0.9x	0.77	x	0.84	x	85.75	x	0.63	x	0.7	=	22.01	(77)
Southeast	0.9x	0.77	x	2.39	x	85.75	x	0.63	x	0.7	=	62.63	(77)
Southeast	0.9x	0.77	x	2.12	x	85.75	x	0.63	x	0.7	=	55.56	(77)
Southeast	0.9x	0.77	x	1.61	x	85.75	x	0.63	x	0.7	=	42.19	(77)
Southeast	0.9x	0.77	x	2.12	x	85.75	x	0.63	x	0.7	=	55.56	(77)
Southeast	0.9x	0.77	x	2.39	x	106.25	x	0.63	x	0.7	=	77.61	(77)
Southeast	0.9x	0.77	x	0.84	x	106.25	x	0.63	x	0.7	=	27.28	(77)
Southeast	0.9x	0.77	x	0.84	x	106.25	x	0.63	x	0.7	=	27.28	(77)
Southeast	0.9x	0.77	x	2.39	x	106.25	x	0.63	x	0.7	=	77.61	(77)
Southeast	0.9x	0.77	x	2.12	x	106.25	x	0.63	x	0.7	=	68.84	(77)
Southeast	0.9x	0.77	x	1.61	x	106.25	x	0.63	x	0.7	=	52.28	(77)
Southeast	0.9x	0.77	x	2.12	x	106.25	x	0.63	x	0.7	=	68.84	(77)
Southeast	0.9x	0.77	x	2.39	x	119.01	x	0.63	x	0.7	=	86.93	(77)
Southeast	0.9x	0.77	x	0.84	x	119.01	x	0.63	x	0.7	=	30.55	(77)
Southeast	0.9x	0.77	x	0.84	x	119.01	x	0.63	x	0.7	=	30.55	(77)
Southeast	0.9x	0.77	x	2.39	x	119.01	x	0.63	x	0.7	=	86.93	(77)
Southeast	0.9x	0.77	x	2.12	x	119.01	x	0.63	x	0.7	=	77.11	(77)

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Southeast	0.9x	0.77	x	1.61	x	119.01	x	0.63	x	0.7	=	58.56		(77)
Southeast	0.9x	0.77	x	2.12	x	119.01	x	0.63	x	0.7	=	77.11		(77)
Southeast	0.9x	0.77	x	2.39	x	118.15	x	0.63	x	0.7	=	86.3		(77)
Southeast	0.9x	0.77	x	0.84	x	118.15	x	0.63	x	0.7	=	30.33		(77)
Southeast	0.9x	0.77	x	0.84	x	118.15	x	0.63	x	0.7	=	30.33		(77)
Southeast	0.9x	0.77	x	2.39	x	118.15	x	0.63	x	0.7	=	86.3		(77)
Southeast	0.9x	0.77	x	2.12	x	118.15	x	0.63	x	0.7	=	76.55		(77)
Southeast	0.9x	0.77	x	1.61	x	118.15	x	0.63	x	0.7	=	58.13		(77)
Southeast	0.9x	0.77	x	2.12	x	118.15	x	0.63	x	0.7	=	76.55		(77)
Southeast	0.9x	0.77	x	2.39	x	113.91	x	0.63	x	0.7	=	83.2		(77)
Southeast	0.9x	0.77	x	0.84	x	113.91	x	0.63	x	0.7	=	29.24		(77)
Southeast	0.9x	0.77	x	0.84	x	113.91	x	0.63	x	0.7	=	29.24		(77)
Southeast	0.9x	0.77	x	2.39	x	113.91	x	0.63	x	0.7	=	83.2		(77)
Southeast	0.9x	0.77	x	2.12	x	113.91	x	0.63	x	0.7	=	73.8		(77)
Southeast	0.9x	0.77	x	1.61	x	113.91	x	0.63	x	0.7	=	56.05		(77)
Southeast	0.9x	0.77	x	2.12	x	113.91	x	0.63	x	0.7	=	73.8		(77)
Southeast	0.9x	0.77	x	2.39	x	104.39	x	0.63	x	0.7	=	76.25		(77)
Southeast	0.9x	0.77	x	0.84	x	104.39	x	0.63	x	0.7	=	26.8		(77)
Southeast	0.9x	0.77	x	0.84	x	104.39	x	0.63	x	0.7	=	26.8		(77)
Southeast	0.9x	0.77	x	2.39	x	104.39	x	0.63	x	0.7	=	76.25		(77)
Southeast	0.9x	0.77	x	2.12	x	104.39	x	0.63	x	0.7	=	67.63		(77)
Southeast	0.9x	0.77	x	1.61	x	104.39	x	0.63	x	0.7	=	51.36		(77)
Southeast	0.9x	0.77	x	2.12	x	104.39	x	0.63	x	0.7	=	67.63		(77)
Southeast	0.9x	0.77	x	2.39	x	92.85	x	0.63	x	0.7	=	67.82		(77)
Southeast	0.9x	0.77	x	0.84	x	92.85	x	0.63	x	0.7	=	23.84		(77)
Southeast	0.9x	0.77	x	0.84	x	92.85	x	0.63	x	0.7	=	23.84		(77)
Southeast	0.9x	0.77	x	2.39	x	92.85	x	0.63	x	0.7	=	67.82		(77)
Southeast	0.9x	0.77	x	2.12	x	92.85	x	0.63	x	0.7	=	60.16		(77)
Southeast	0.9x	0.77	x	1.61	x	92.85	x	0.63	x	0.7	=	45.69		(77)
Southeast	0.9x	0.77	x	2.12	x	92.85	x	0.63	x	0.7	=	60.16		(77)
Southeast	0.9x	0.77	x	2.39	x	69.27	x	0.63	x	0.7	=	50.59		(77)
Southeast	0.9x	0.77	x	0.84	x	69.27	x	0.63	x	0.7	=	17.78		(77)
Southeast	0.9x	0.77	x	0.84	x	69.27	x	0.63	x	0.7	=	17.78		(77)
Southeast	0.9x	0.77	x	2.39	x	69.27	x	0.63	x	0.7	=	50.59		(77)
Southeast	0.9x	0.77	x	2.12	x	69.27	x	0.63	x	0.7	=	44.88		(77)
Southeast	0.9x	0.77	x	1.61	x	69.27	x	0.63	x	0.7	=	34.08		(77)
Southeast	0.9x	0.77	x	2.12	x	69.27	x	0.63	x	0.7	=	44.88		(77)
Southeast	0.9x	0.77	x	2.39	x	44.07	x	0.63	x	0.7	=	32.19		(77)
Southeast	0.9x	0.77	x	0.84	x	44.07	x	0.63	x	0.7	=	11.31		(77)
Southeast	0.9x	0.77	x	0.84	x	44.07	x	0.63	x	0.7	=	11.31		(77)
Southeast	0.9x	0.77	x	2.39	x	44.07	x	0.63	x	0.7	=	32.19		(77)

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Southeast	0.9x	0.77	x	2.12	x	44.07	x	0.63	x	0.7	=	28.55	(77)
Southeast	0.9x	0.77	x	1.61	x	44.07	x	0.63	x	0.7	=	21.68	(77)
Southeast	0.9x	0.77	x	2.12	x	44.07	x	0.63	x	0.7	=	28.55	(77)
Southeast	0.9x	0.77	x	2.39	x	31.49	x	0.63	x	0.7	=	23	(77)
Southeast	0.9x	0.77	x	0.84	x	31.49	x	0.63	x	0.7	=	8.08	(77)
Southeast	0.9x	0.77	x	0.84	x	31.49	x	0.63	x	0.7	=	8.08	(77)
Southeast	0.9x	0.77	x	2.39	x	31.49	x	0.63	x	0.7	=	23	(77)
Southeast	0.9x	0.77	x	2.12	x	31.49	x	0.63	x	0.7	=	20.4	(77)
Southeast	0.9x	0.77	x	1.61	x	31.49	x	0.63	x	0.7	=	15.49	(77)
Southeast	0.9x	0.77	x	2.12	x	31.49	x	0.63	x	0.7	=	20.4	(77)
Northwest	0.9x	0.77	x	1.86	x	11.28	x	0.63	x	0.7	=	6.41	(81)
Northwest	0.9x	0.77	x	1.26	x	11.28	x	0.63	x	0.7	=	4.34	(81)
Northwest	0.9x	0.77	x	2.12	x	11.28	x	0.63	x	0.7	=	7.31	(81)
Northwest	0.9x	0.77	x	0.66	x	11.28	x	0.63	x	0.7	=	2.28	(81)
Northwest	0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	10.86	(81)
Northwest	0.9x	0.77	x	3.78	x	11.28	x	0.63	x	0.7	=	13.03	(81)
Northwest	0.9x	0.77	x	1.86	x	22.97	x	0.63	x	0.7	=	13.06	(81)
Northwest	0.9x	0.77	x	1.26	x	22.97	x	0.63	x	0.7	=	8.84	(81)
Northwest	0.9x	0.77	x	2.12	x	22.97	x	0.63	x	0.7	=	14.88	(81)
Northwest	0.9x	0.77	x	0.66	x	22.97	x	0.63	x	0.7	=	4.63	(81)
Northwest	0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	22.11	(81)
Northwest	0.9x	0.77	x	3.78	x	22.97	x	0.63	x	0.7	=	26.53	(81)
Northwest	0.9x	0.77	x	1.86	x	41.38	x	0.63	x	0.7	=	23.52	(81)
Northwest	0.9x	0.77	x	1.26	x	41.38	x	0.63	x	0.7	=	15.93	(81)
Northwest	0.9x	0.77	x	2.12	x	41.38	x	0.63	x	0.7	=	26.81	(81)
Northwest	0.9x	0.77	x	0.66	x	41.38	x	0.63	x	0.7	=	8.35	(81)
Northwest	0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	39.83	(81)
Northwest	0.9x	0.77	x	3.78	x	41.38	x	0.63	x	0.7	=	47.8	(81)
Northwest	0.9x	0.77	x	1.86	x	67.96	x	0.63	x	0.7	=	38.63	(81)
Northwest	0.9x	0.77	x	1.26	x	67.96	x	0.63	x	0.7	=	26.17	(81)
Northwest	0.9x	0.77	x	2.12	x	67.96	x	0.63	x	0.7	=	44.03	(81)
Northwest	0.9x	0.77	x	0.66	x	67.96	x	0.63	x	0.7	=	13.71	(81)
Northwest	0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	65.42	(81)
Northwest	0.9x	0.77	x	3.78	x	67.96	x	0.63	x	0.7	=	78.5	(81)
Northwest	0.9x	0.77	x	1.86	x	91.35	x	0.63	x	0.7	=	51.92	(81)
Northwest	0.9x	0.77	x	1.26	x	91.35	x	0.63	x	0.7	=	35.17	(81)
Northwest	0.9x	0.77	x	2.12	x	91.35	x	0.63	x	0.7	=	59.18	(81)
Northwest	0.9x	0.77	x	0.66	x	91.35	x	0.63	x	0.7	=	18.42	(81)
Northwest	0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	87.94	(81)
Northwest	0.9x	0.77	x	3.78	x	91.35	x	0.63	x	0.7	=	105.52	(81)
Northwest	0.9x	0.77	x	1.86	x	97.38	x	0.63	x	0.7	=	55.36	(81)

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Northwest	0.9x	0.77	x	1.26	x	97.38	x	0.63	x	0.7	=	37.5	(81)
Northwest	0.9x	0.77	x	2.12	x	97.38	x	0.63	x	0.7	=	63.1	(81)
Northwest	0.9x	0.77	x	0.66	x	97.38	x	0.63	x	0.7	=	19.64	(81)
Northwest	0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	93.75	(81)
Northwest	0.9x	0.77	x	3.78	x	97.38	x	0.63	x	0.7	=	112.5	(81)
Northwest	0.9x	0.77	x	1.86	x	91.1	x	0.63	x	0.7	=	51.79	(81)
Northwest	0.9x	0.77	x	1.26	x	91.1	x	0.63	x	0.7	=	35.08	(81)
Northwest	0.9x	0.77	x	2.12	x	91.1	x	0.63	x	0.7	=	59.02	(81)
Northwest	0.9x	0.77	x	0.66	x	91.1	x	0.63	x	0.7	=	18.38	(81)
Northwest	0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	87.7	(81)
Northwest	0.9x	0.77	x	3.78	x	91.1	x	0.63	x	0.7	=	105.24	(81)
Northwest	0.9x	0.77	x	1.86	x	72.63	x	0.63	x	0.7	=	41.28	(81)
Northwest	0.9x	0.77	x	1.26	x	72.63	x	0.63	x	0.7	=	27.97	(81)
Northwest	0.9x	0.77	x	2.12	x	72.63	x	0.63	x	0.7	=	47.05	(81)
Northwest	0.9x	0.77	x	0.66	x	72.63	x	0.63	x	0.7	=	14.65	(81)
Northwest	0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	69.92	(81)
Northwest	0.9x	0.77	x	3.78	x	72.63	x	0.63	x	0.7	=	83.9	(81)
Northwest	0.9x	0.77	x	1.86	x	50.42	x	0.63	x	0.7	=	28.66	(81)
Northwest	0.9x	0.77	x	1.26	x	50.42	x	0.63	x	0.7	=	19.42	(81)
Northwest	0.9x	0.77	x	2.12	x	50.42	x	0.63	x	0.7	=	32.67	(81)
Northwest	0.9x	0.77	x	0.66	x	50.42	x	0.63	x	0.7	=	10.17	(81)
Northwest	0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	48.54	(81)
Northwest	0.9x	0.77	x	3.78	x	50.42	x	0.63	x	0.7	=	58.25	(81)
Northwest	0.9x	0.77	x	1.86	x	28.07	x	0.63	x	0.7	=	15.95	(81)
Northwest	0.9x	0.77	x	1.26	x	28.07	x	0.63	x	0.7	=	10.81	(81)
Northwest	0.9x	0.77	x	2.12	x	28.07	x	0.63	x	0.7	=	18.18	(81)
Northwest	0.9x	0.77	x	0.66	x	28.07	x	0.63	x	0.7	=	5.66	(81)
Northwest	0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	27.02	(81)
Northwest	0.9x	0.77	x	3.78	x	28.07	x	0.63	x	0.7	=	32.42	(81)
Northwest	0.9x	0.77	x	1.86	x	14.2	x	0.63	x	0.7	=	8.07	(81)
Northwest	0.9x	0.77	x	1.26	x	14.2	x	0.63	x	0.7	=	5.47	(81)
Northwest	0.9x	0.77	x	2.12	x	14.2	x	0.63	x	0.7	=	9.2	(81)
Northwest	0.9x	0.77	x	0.66	x	14.2	x	0.63	x	0.7	=	2.86	(81)
Northwest	0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	13.67	(81)
Northwest	0.9x	0.77	x	3.78	x	14.2	x	0.63	x	0.7	=	16.4	(81)
Northwest	0.9x	0.77	x	1.86	x	9.21	x	0.63	x	0.7	=	5.24	(81)
Northwest	0.9x	0.77	x	1.26	x	9.21	x	0.63	x	0.7	=	3.55	(81)
Northwest	0.9x	0.77	x	2.12	x	9.21	x	0.63	x	0.7	=	5.97	(81)
Northwest	0.9x	0.77	x	0.66	x	9.21	x	0.63	x	0.7	=	1.86	(81)
Northwest	0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	8.87	(81)
Northwest	0.9x	0.77	x	3.78	x	9.21	x	0.63	x	0.7	=	10.64	(81)

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

(83)m=	198.25	357.56	542.02	760.06	932.08	960.86	911.59	777.82	616.67	409.41	241.07	167.32	(83)

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

(84)m=	704.46	862.3	1028.81	1216.9	1356.51	1355.64	1288.12	1158.63	1013.74	836.6	702.95	657.14	(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	
(86)m=	1	1	1	0.99	0.94	0.81	0.64	0.72	0.94	1	1	1	(86)

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

(87)m=	19.62	19.77	20.02	20.38	20.7	20.92	20.98	20.97	20.79	20.36	19.93	19.6	(87)

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

(88)m=	20	20.01	20.01	20.02	20.02	20.03	20.03	20.03	20.03	20.02	20.02	20.01	(88)

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

(89)m=	1	1	1	0.98	0.91	0.73	0.52	0.6	0.9	0.99	1	1	(89)

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

(90)m=	18.73	18.88	19.13	19.49	19.81	19.99	20.03	20.02	19.89	19.48	19.05	18.72	(90)

fLA = Living area ÷ (4) = 0.14 (91)

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

(92)m=	18.85	19	19.26	19.61	19.93	20.12	20.16	20.15	20.01	19.6	19.17	18.84	(92)

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

(93)m=	18.85	19	19.26	19.61	19.93	20.12	20.16	20.15	20.01	19.6	19.17	18.84	(93)

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	1	1	1	0.98	0.91	0.74	0.53	0.62	0.9	0.99	1	1	(94)

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

(95)m=	704.16	861.17	1023.83	1189.81	1234.06	1000.22	689.06	713.16	908.63	828.77	702.22	656.95	(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=	2961.77	2862.13	2582.28	2141.77	1641.25	1088.19	701.69	738.54	1171.68	1795.9	2419.17	2948.48	(97)

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

(98)m=	1679.66	1344.65	1159.48	685.41	302.94	0	0	0	0	719.54	1236.21	1704.9	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 8832.79 (98)

Space heating requirement in kWh/m²/year 47.61 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

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

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Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	1854.3	1459.77	1496.14	0	0	0	0	(100)

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.81	0.89	0.84	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	1501.59	1295.08	1258.87	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	1721.79	1639.54	1491.09	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	158.55	256.28	172.77	0	0	0	0	

Total = Sum(104) = 587.6 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	

Total = Sum(104) = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	39.64	64.07	43.19	0	0	0	0	

Total = Sum(107) = 146.9 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0.79 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 48.4 (109)

Target Fabric Energy Efficiency (TFEE) 55.66 (109)

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

STUDIO11 architecture

User Details:

Assessor Name:	Chloe Hewitt	**Stroma Number:**	STRO029693
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.6

Property Address: Plot 3

Address : Plot 3, Land off Wardentree Lane, Spalding

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	92.76	(1a) x	2.38	(2a) =	220.77	(3a)
Ground floor	92.76	(1b) x	2.62	(2b) =	243.03	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	185.52	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		463.8	(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) =	0.09 (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)	0.34 (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) =	0.34 (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

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design sta

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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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4

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	0.59	0.58	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58

(24d)

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

(25)m=	0.59	0.59	0.58	0.57	0.57	0.55	0.55	0.55	0.56	0.57	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 Type 1			2.12	x	1.2	=	2.544			(26)
Doors Type 2			1.97	x	1.2	=	2.364			(26)
Windows Type 1			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 2			0.84	x1/[1/(1.2)+ 0.04]		=	0.96			(27)
Windows Type 3			0.84	x1/[1/(1.2)+ 0.04]		=	0.96			(27)
Windows Type 4			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 5			1.86	x1/[1/(1.2)+ 0.04]		=	2.13			(27)
Windows Type 6			0.96	x1/[1/(1.2)+ 0.04]		=	1.1			(27)
Windows Type 7			1.44	x1/[1/(1.2)+ 0.04]		=	1.65			(27)
Windows Type 8			2.12	x1/[1/(1.2)+ 0.04]		=	2.43			(27)
Windows Type 9			1.61	x1/[1/(1.2)+ 0.04]		=	1.84			(27)
Windows Type 10			2.12	x1/[1/(1.2)+ 0.04]		=	2.43			(27)
Windows Type 11			2.12	x1/[1/(1.2)+ 0.04]		=	2.43			(27)
Windows Type 12			1.26	x1/[1/(1.2)+ 0.04]		=	1.44			(27)
Windows Type 13			2.12	x1/[1/(1.2)+ 0.04]		=	2.43			(27)
Windows Type 14			0.66	x1/[1/(1.2)+ 0.04]		=	0.76			(27)
Windows Type 15			3.15	x1/[1/(1.2)+ 0.04]		=	3.61			(27)

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Windows Type 16			3.78	x1/[1/(1.2)+ 0.04] =	4.33			(27)
Floor			92.76	x 0.12 =	11.1312			(28)
Walls	196.95	33.75	163.2	x 0.24 =	39.17			(29)
Roof	92.76	0	92.76	x 0.09 =	8.35			(30)
Total area of elements, m²			382.47					(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) = 97.52 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17583.84 (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 32 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 129.52 (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=	90.59	90.05	89.51	87	86.53	84.34	84.34	83.93	85.18	86.53	87.48	88.47	(38)

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

(39)m=	220.11	219.57	219.03	216.52	216.05	213.86	213.86	213.45	214.7	216.05	217	217.99	

Average = Sum(39)$_{1...12}$ /12= 216.51 (39)

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

(40)m=	1.19	1.18	1.18	1.17	1.16	1.15	1.15	1.15	1.16	1.16	1.17	1.18	

Average = Sum(40)$_{1...12}$ /12= 1.17 (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 2.98 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 105.05 (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	
(44)m=	115.55	111.35	107.15	102.95	98.74	94.54	94.54	98.74	102.95	107.15	111.35	115.55	

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

Total = Sum(44)$_{1...12}$ = 1260.57 (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=	171.36	149.87	154.66	134.83	129.37	111.64	103.45	118.71	120.13	140	152.82	165.95	

Total = Sum(45)$_{1...12}$ = 1652.8 (45)

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

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

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

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

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

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

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

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

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

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

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

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

(62)m=	145.66	127.39	131.46	114.61	109.97	94.89	87.93	100.91	102.11	119	129.9	141.06	(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=	145.66	127.39	131.46	114.61	109.97	94.89	87.93	100.91	102.11	119	129.9	141.06	

Output from water heater (annual)$_{1...12}$ 1404.88 (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=	36.41	31.85	32.86	28.65	27.49	23.72	21.98	25.23	25.53	29.75	32.47	35.27	(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=	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	(66)

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

(67)m=	32.46	28.83	23.45	17.75	13.27	11.2	12.1	15.73	21.12	26.81	31.29	33.36	(67)

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

(68)m=	357.07	360.77	351.44	331.56	306.47	282.88	267.13	263.42	272.76	292.64	317.73	341.31	(68)

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

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(69)m=	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	(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=	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	(71)

Water heating gains (Table 5)

(72)m=	48.94	47.39	44.17	39.79	36.95	32.95	29.55	33.91	35.45	39.99	45.1	47.4	(72)

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

(73)m=	506.21	504.74	486.8	456.85	424.43	394.78	376.53	380.81	397.08	427.18	461.87	489.82	(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)	
Northeast 0.9x	0.77	x	0.96	x	11.28	x	0.63	x	0.7	=	3.31	(75)
Northeast 0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(75)
Northeast 0.9x	0.77	x	2.12	x	11.28	x	0.63	x	0.7	=	7.31	(75)
Northeast 0.9x	0.77	x	0.96	x	22.97	x	0.63	x	0.7	=	6.74	(75)
Northeast 0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(75)
Northeast 0.9x	0.77	x	2.12	x	22.97	x	0.63	x	0.7	=	14.88	(75)
Northeast 0.9x	0.77	x	0.96	x	41.38	x	0.63	x	0.7	=	12.14	(75)
Northeast 0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(75)
Northeast 0.9x	0.77	x	2.12	x	41.38	x	0.63	x	0.7	=	26.81	(75)
Northeast 0.9x	0.77	x	0.96	x	67.96	x	0.63	x	0.7	=	19.94	(75)
Northeast 0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(75)
Northeast 0.9x	0.77	x	2.12	x	67.96	x	0.63	x	0.7	=	44.03	(75)
Northeast 0.9x	0.77	x	0.96	x	91.35	x	0.63	x	0.7	=	26.8	(75)
Northeast 0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(75)
Northeast 0.9x	0.77	x	2.12	x	91.35	x	0.63	x	0.7	=	59.18	(75)
Northeast 0.9x	0.77	x	0.96	x	97.38	x	0.63	x	0.7	=	28.57	(75)
Northeast 0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(75)
Northeast 0.9x	0.77	x	2.12	x	97.38	x	0.63	x	0.7	=	63.1	(75)
Northeast 0.9x	0.77	x	0.96	x	91.1	x	0.63	x	0.7	=	26.73	(75)
Northeast 0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(75)
Northeast 0.9x	0.77	x	2.12	x	91.1	x	0.63	x	0.7	=	59.02	(75)
Northeast 0.9x	0.77	x	0.96	x	72.63	x	0.63	x	0.7	=	21.31	(75)
Northeast 0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(75)
Northeast 0.9x	0.77	x	2.12	x	72.63	x	0.63	x	0.7	=	47.05	(75)
Northeast 0.9x	0.77	x	0.96	x	50.42	x	0.63	x	0.7	=	14.79	(75)
Northeast 0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(75)
Northeast 0.9x	0.77	x	2.12	x	50.42	x	0.63	x	0.7	=	32.67	(75)
Northeast 0.9x	0.77	x	0.96	x	28.07	x	0.63	x	0.7	=	8.23	(75)

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Northeast	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(75)
Northeast	0.9x	0.77	x	2.12	x	28.07	x	0.63	x	0.7	=	18.18	(75)
Northeast	0.9x	0.77	x	0.96	x	14.2	x	0.63	x	0.7	=	4.17	(75)
Northeast	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(75)
Northeast	0.9x	0.77	x	2.12	x	14.2	x	0.63	x	0.7	=	9.2	(75)
Northeast	0.9x	0.77	x	0.96	x	9.21	x	0.63	x	0.7	=	2.7	(75)
Northeast	0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(75)
Northeast	0.9x	0.77	x	2.12	x	9.21	x	0.63	x	0.7	=	5.97	(75)
Southeast	0.9x	0.77	x	2.39	x	36.79	x	0.63	x	0.7	=	26.87	(77)
Southeast	0.9x	0.77	x	0.84	x	36.79	x	0.63	x	0.7	=	9.45	(77)
Southeast	0.9x	0.77	x	0.84	x	36.79	x	0.63	x	0.7	=	9.45	(77)
Southeast	0.9x	0.77	x	2.39	x	36.79	x	0.63	x	0.7	=	26.87	(77)
Southeast	0.9x	0.77	x	2.12	x	36.79	x	0.63	x	0.7	=	23.84	(77)
Southeast	0.9x	0.77	x	1.61	x	36.79	x	0.63	x	0.7	=	18.1	(77)
Southeast	0.9x	0.77	x	2.12	x	36.79	x	0.63	x	0.7	=	23.84	(77)
Southeast	0.9x	0.77	x	2.39	x	62.67	x	0.63	x	0.7	=	45.78	(77)
Southeast	0.9x	0.77	x	0.84	x	62.67	x	0.63	x	0.7	=	16.09	(77)
Southeast	0.9x	0.77	x	0.84	x	62.67	x	0.63	x	0.7	=	16.09	(77)
Southeast	0.9x	0.77	x	2.39	x	62.67	x	0.63	x	0.7	=	45.78	(77)
Southeast	0.9x	0.77	x	2.12	x	62.67	x	0.63	x	0.7	=	40.61	(77)
Southeast	0.9x	0.77	x	1.61	x	62.67	x	0.63	x	0.7	=	30.84	(77)
Southeast	0.9x	0.77	x	2.12	x	62.67	x	0.63	x	0.7	=	40.61	(77)
Southeast	0.9x	0.77	x	2.39	x	85.75	x	0.63	x	0.7	=	62.63	(77)
Southeast	0.9x	0.77	x	0.84	x	85.75	x	0.63	x	0.7	=	22.01	(77)
Southeast	0.9x	0.77	x	0.84	x	85.75	x	0.63	x	0.7	=	22.01	(77)
Southeast	0.9x	0.77	x	2.39	x	85.75	x	0.63	x	0.7	=	62.63	(77)
Southeast	0.9x	0.77	x	2.12	x	85.75	x	0.63	x	0.7	=	55.56	(77)
Southeast	0.9x	0.77	x	1.61	x	85.75	x	0.63	x	0.7	=	42.19	(77)
Southeast	0.9x	0.77	x	2.12	x	85.75	x	0.63	x	0.7	=	55.56	(77)
Southeast	0.9x	0.77	x	2.39	x	106.25	x	0.63	x	0.7	=	77.61	(77)
Southeast	0.9x	0.77	x	0.84	x	106.25	x	0.63	x	0.7	=	27.28	(77)
Southeast	0.9x	0.77	x	0.84	x	106.25	x	0.63	x	0.7	=	27.28	(77)
Southeast	0.9x	0.77	x	2.39	x	106.25	x	0.63	x	0.7	=	77.61	(77)
Southeast	0.9x	0.77	x	2.12	x	106.25	x	0.63	x	0.7	=	68.84	(77)
Southeast	0.9x	0.77	x	1.61	x	106.25	x	0.63	x	0.7	=	52.28	(77)
Southeast	0.9x	0.77	x	2.12	x	106.25	x	0.63	x	0.7	=	68.84	(77)
Southeast	0.9x	0.77	x	2.39	x	119.01	x	0.63	x	0.7	=	86.93	(77)
Southeast	0.9x	0.77	x	0.84	x	119.01	x	0.63	x	0.7	=	30.55	(77)
Southeast	0.9x	0.77	x	0.84	x	119.01	x	0.63	x	0.7	=	30.55	(77)
Southeast	0.9x	0.77	x	2.39	x	119.01	x	0.63	x	0.7	=	86.93	(77)
Southeast	0.9x	0.77	x	2.12	x	119.01	x	0.63	x	0.7	=	77.11	(77)

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Southeast	0.9x	0.77	x	1.61	x	119.01	x	0.63	x	0.7	=	58.56	(77)
Southeast	0.9x	0.77	x	2.12	x	119.01	x	0.63	x	0.7	=	77.11	(77)
Southeast	0.9x	0.77	x	2.39	x	118.15	x	0.63	x	0.7	=	86.3	(77)
Southeast	0.9x	0.77	x	0.84	x	118.15	x	0.63	x	0.7	=	30.33	(77)
Southeast	0.9x	0.77	x	0.84	x	118.15	x	0.63	x	0.7	=	30.33	(77)
Southeast	0.9x	0.77	x	2.39	x	118.15	x	0.63	x	0.7	=	86.3	(77)
Southeast	0.9x	0.77	x	2.12	x	118.15	x	0.63	x	0.7	=	76.55	(77)
Southeast	0.9x	0.77	x	1.61	x	118.15	x	0.63	x	0.7	=	58.13	(77)
Southeast	0.9x	0.77	x	2.12	x	118.15	x	0.63	x	0.7	=	76.55	(77)
Southeast	0.9x	0.77	x	2.39	x	113.91	x	0.63	x	0.7	=	83.2	(77)
Southeast	0.9x	0.77	x	0.84	x	113.91	x	0.63	x	0.7	=	29.24	(77)
Southeast	0.9x	0.77	x	0.84	x	113.91	x	0.63	x	0.7	=	29.24	(77)
Southeast	0.9x	0.77	x	2.39	x	113.91	x	0.63	x	0.7	=	83.2	(77)
Southeast	0.9x	0.77	x	2.12	x	113.91	x	0.63	x	0.7	=	73.8	(77)
Southeast	0.9x	0.77	x	1.61	x	113.91	x	0.63	x	0.7	=	56.05	(77)
Southeast	0.9x	0.77	x	2.12	x	113.91	x	0.63	x	0.7	=	73.8	(77)
Southeast	0.9x	0.77	x	2.39	x	104.39	x	0.63	x	0.7	=	76.25	(77)
Southeast	0.9x	0.77	x	0.84	x	104.39	x	0.63	x	0.7	=	26.8	(77)
Southeast	0.9x	0.77	x	0.84	x	104.39	x	0.63	x	0.7	=	26.8	(77)
Southeast	0.9x	0.77	x	2.39	x	104.39	x	0.63	x	0.7	=	76.25	(77)
Southeast	0.9x	0.77	x	2.12	x	104.39	x	0.63	x	0.7	=	67.63	(77)
Southeast	0.9x	0.77	x	1.61	x	104.39	x	0.63	x	0.7	=	51.36	(77)
Southeast	0.9x	0.77	x	2.12	x	104.39	x	0.63	x	0.7	=	67.63	(77)
Southeast	0.9x	0.77	x	2.39	x	92.85	x	0.63	x	0.7	=	67.82	(77)
Southeast	0.9x	0.77	x	0.84	x	92.85	x	0.63	x	0.7	=	23.84	(77)
Southeast	0.9x	0.77	x	0.84	x	92.85	x	0.63	x	0.7	=	23.84	(77)
Southeast	0.9x	0.77	x	2.39	x	92.85	x	0.63	x	0.7	=	67.82	(77)
Southeast	0.9x	0.77	x	2.12	x	92.85	x	0.63	x	0.7	=	60.16	(77)
Southeast	0.9x	0.77	x	1.61	x	92.85	x	0.63	x	0.7	=	45.69	(77)
Southeast	0.9x	0.77	x	2.12	x	92.85	x	0.63	x	0.7	=	60.16	(77)
Southeast	0.9x	0.77	x	2.39	x	69.27	x	0.63	x	0.7	=	50.59	(77)
Southeast	0.9x	0.77	x	0.84	x	69.27	x	0.63	x	0.7	=	17.78	(77)
Southeast	0.9x	0.77	x	0.84	x	69.27	x	0.63	x	0.7	=	17.78	(77)
Southeast	0.9x	0.77	x	2.39	x	69.27	x	0.63	x	0.7	=	50.59	(77)
Southeast	0.9x	0.77	x	2.12	x	69.27	x	0.63	x	0.7	=	44.88	(77)
Southeast	0.9x	0.77	x	1.61	x	69.27	x	0.63	x	0.7	=	34.08	(77)
Southeast	0.9x	0.77	x	2.12	x	69.27	x	0.63	x	0.7	=	44.88	(77)
Southeast	0.9x	0.77	x	2.39	x	44.07	x	0.63	x	0.7	=	32.19	(77)
Southeast	0.9x	0.77	x	0.84	x	44.07	x	0.63	x	0.7	=	11.31	(77)
Southeast	0.9x	0.77	x	0.84	x	44.07	x	0.63	x	0.7	=	11.31	(77)
Southeast	0.9x	0.77	x	2.39	x	44.07	x	0.63	x	0.7	=	32.19	(77)

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design sta

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Southeast	0.9x	0.77	x	2.12	x	44.07	x	0.63	x	0.7	=	28.55	(77)
Southeast	0.9x	0.77	x	1.61	x	44.07	x	0.63	x	0.7	=	21.68	(77)
Southeast	0.9x	0.77	x	2.12	x	44.07	x	0.63	x	0.7	=	28.55	(77)
Southeast	0.9x	0.77	x	2.39	x	31.49	x	0.63	x	0.7	=	23	(77)
Southeast	0.9x	0.77	x	0.84	x	31.49	x	0.63	x	0.7	=	8.08	(77)
Southeast	0.9x	0.77	x	0.84	x	31.49	x	0.63	x	0.7	=	8.08	(77)
Southeast	0.9x	0.77	x	2.39	x	31.49	x	0.63	x	0.7	=	23	(77)
Southeast	0.9x	0.77	x	2.12	x	31.49	x	0.63	x	0.7	=	20.4	(77)
Southeast	0.9x	0.77	x	1.61	x	31.49	x	0.63	x	0.7	=	15.49	(77)
Southeast	0.9x	0.77	x	2.12	x	31.49	x	0.63	x	0.7	=	20.4	(77)
Northwest	0.9x	0.77	x	1.86	x	11.28	x	0.63	x	0.7	=	6.41	(81)
Northwest	0.9x	0.77	x	1.26	x	11.28	x	0.63	x	0.7	=	4.34	(81)
Northwest	0.9x	0.77	x	2.12	x	11.28	x	0.63	x	0.7	=	7.31	(81)
Northwest	0.9x	0.77	x	0.66	x	11.28	x	0.63	x	0.7	=	2.28	(81)
Northwest	0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	10.86	(81)
Northwest	0.9x	0.77	x	3.78	x	11.28	x	0.63	x	0.7	=	13.03	(81)
Northwest	0.9x	0.77	x	1.86	x	22.97	x	0.63	x	0.7	=	13.06	(81)
Northwest	0.9x	0.77	x	1.26	x	22.97	x	0.63	x	0.7	=	8.84	(81)
Northwest	0.9x	0.77	x	2.12	x	22.97	x	0.63	x	0.7	=	14.88	(81)
Northwest	0.9x	0.77	x	0.66	x	22.97	x	0.63	x	0.7	=	4.63	(81)
Northwest	0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	22.11	(81)
Northwest	0.9x	0.77	x	3.78	x	22.97	x	0.63	x	0.7	=	26.53	(81)
Northwest	0.9x	0.77	x	1.86	x	41.38	x	0.63	x	0.7	=	23.52	(81)
Northwest	0.9x	0.77	x	1.26	x	41.38	x	0.63	x	0.7	=	15.93	(81)
Northwest	0.9x	0.77	x	2.12	x	41.38	x	0.63	x	0.7	=	26.81	(81)
Northwest	0.9x	0.77	x	0.66	x	41.38	x	0.63	x	0.7	=	8.35	(81)
Northwest	0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	39.83	(81)
Northwest	0.9x	0.77	x	3.78	x	41.38	x	0.63	x	0.7	=	47.8	(81)
Northwest	0.9x	0.77	x	1.86	x	67.96	x	0.63	x	0.7	=	38.63	(81)
Northwest	0.9x	0.77	x	1.26	x	67.96	x	0.63	x	0.7	=	26.17	(81)
Northwest	0.9x	0.77	x	2.12	x	67.96	x	0.63	x	0.7	=	44.03	(81)
Northwest	0.9x	0.77	x	0.66	x	67.96	x	0.63	x	0.7	=	13.71	(81)
Northwest	0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	65.42	(81)
Northwest	0.9x	0.77	x	3.78	x	67.96	x	0.63	x	0.7	=	78.5	(81)
Northwest	0.9x	0.77	x	1.86	x	91.35	x	0.63	x	0.7	=	51.92	(81)
Northwest	0.9x	0.77	x	1.26	x	91.35	x	0.63	x	0.7	=	35.17	(81)
Northwest	0.9x	0.77	x	2.12	x	91.35	x	0.63	x	0.7	=	59.18	(81)
Northwest	0.9x	0.77	x	0.66	x	91.35	x	0.63	x	0.7	=	18.42	(81)
Northwest	0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	87.94	(81)
Northwest	0.9x	0.77	x	3.78	x	91.35	x	0.63	x	0.7	=	105.52	(81)
Northwest	0.9x	0.77	x	1.86	x	97.38	x	0.63	x	0.7	=	55.36	(81)

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Northwest	0.9x	0.77	x	1.26	x	97.38	x	0.63	x	0.7	=	37.5	(81)
Northwest	0.9x	0.77	x	2.12	x	97.38	x	0.63	x	0.7	=	63.1	(81)
Northwest	0.9x	0.77	x	0.66	x	97.38	x	0.63	x	0.7	=	19.64	(81)
Northwest	0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	93.75	(81)
Northwest	0.9x	0.77	x	3.78	x	97.38	x	0.63	x	0.7	=	112.5	(81)
Northwest	0.9x	0.77	x	1.86	x	91.1	x	0.63	x	0.7	=	51.79	(81)
Northwest	0.9x	0.77	x	1.26	x	91.1	x	0.63	x	0.7	=	35.08	(81)
Northwest	0.9x	0.77	x	2.12	x	91.1	x	0.63	x	0.7	=	59.02	(81)
Northwest	0.9x	0.77	x	0.66	x	91.1	x	0.63	x	0.7	=	18.38	(81)
Northwest	0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	87.7	(81)
Northwest	0.9x	0.77	x	3.78	x	91.1	x	0.63	x	0.7	=	105.24	(81)
Northwest	0.9x	0.77	x	1.86	x	72.63	x	0.63	x	0.7	=	41.28	(81)
Northwest	0.9x	0.77	x	1.26	x	72.63	x	0.63	x	0.7	=	27.97	(81)
Northwest	0.9x	0.77	x	2.12	x	72.63	x	0.63	x	0.7	=	47.05	(81)
Northwest	0.9x	0.77	x	0.66	x	72.63	x	0.63	x	0.7	=	14.65	(81)
Northwest	0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	69.92	(81)
Northwest	0.9x	0.77	x	3.78	x	72.63	x	0.63	x	0.7	=	83.9	(81)
Northwest	0.9x	0.77	x	1.86	x	50.42	x	0.63	x	0.7	=	28.66	(81)
Northwest	0.9x	0.77	x	1.26	x	50.42	x	0.63	x	0.7	=	19.42	(81)
Northwest	0.9x	0.77	x	2.12	x	50.42	x	0.63	x	0.7	=	32.67	(81)
Northwest	0.9x	0.77	x	0.66	x	50.42	x	0.63	x	0.7	=	10.17	(81)
Northwest	0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	48.54	(81)
Northwest	0.9x	0.77	x	3.78	x	50.42	x	0.63	x	0.7	=	58.25	(81)
Northwest	0.9x	0.77	x	1.86	x	28.07	x	0.63	x	0.7	=	15.95	(81)
Northwest	0.9x	0.77	x	1.26	x	28.07	x	0.63	x	0.7	=	10.81	(81)
Northwest	0.9x	0.77	x	2.12	x	28.07	x	0.63	x	0.7	=	18.18	(81)
Northwest	0.9x	0.77	x	0.66	x	28.07	x	0.63	x	0.7	=	5.66	(81)
Northwest	0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	27.02	(81)
Northwest	0.9x	0.77	x	3.78	x	28.07	x	0.63	x	0.7	=	32.42	(81)
Northwest	0.9x	0.77	x	1.86	x	14.2	x	0.63	x	0.7	=	8.07	(81)
Northwest	0.9x	0.77	x	1.26	x	14.2	x	0.63	x	0.7	=	5.47	(81)
Northwest	0.9x	0.77	x	2.12	x	14.2	x	0.63	x	0.7	=	9.2	(81)
Northwest	0.9x	0.77	x	0.66	x	14.2	x	0.63	x	0.7	=	2.86	(81)
Northwest	0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	13.67	(81)
Northwest	0.9x	0.77	x	3.78	x	14.2	x	0.63	x	0.7	=	16.4	(81)
Northwest	0.9x	0.77	x	1.86	x	9.21	x	0.63	x	0.7	=	5.24	(81)
Northwest	0.9x	0.77	x	1.26	x	9.21	x	0.63	x	0.7	=	3.55	(81)
Northwest	0.9x	0.77	x	2.12	x	9.21	x	0.63	x	0.7	=	5.97	(81)
Northwest	0.9x	0.77	x	0.66	x	9.21	x	0.63	x	0.7	=	1.86	(81)
Northwest	0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	8.87	(81)
Northwest	0.9x	0.77	x	3.78	x	9.21	x	0.63	x	0.7	=	10.64	(81)

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design sta

STUDIO11 architecture

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

(83)m=	198.25	357.56	542.02	760.06	932.08	960.86	911.59	777.82	616.67	409.41	241.07	167.32	(83)

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

(84)m=	704.46	862.3	1028.81	1216.9	1356.51	1355.64	1288.12	1158.63	1013.74	836.6	702.95	657.14	(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	
(86)m=	1	1	1	0.99	0.95	0.84	0.68	0.76	0.95	1	1	1	(86)

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

(87)m=	19.51	19.65	19.92	20.28	20.64	20.88	20.97	20.95	20.74	20.29	19.83	19.49	(87)

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

(88)m=	19.93	19.93	19.94	19.95	19.95	19.96	19.96	19.96	19.95	19.95	19.94	19.94	(88)

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

(89)m=	1	1	1	0.98	0.92	0.76	0.54	0.63	0.91	0.99	1	1	(89)

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

(90)m=	18.55	18.71	18.97	19.34	19.68	19.9	19.95	19.94	19.78	19.35	18.89	18.54	(90)

fLA = Living area ÷ (4) = 0.14 (91)

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

(92)m=	18.69	18.84	19.1	19.47	19.81	20.03	20.09	20.08	19.92	19.48	19.02	18.67	(92)

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

(93)m=	18.69	18.84	19.1	19.47	19.81	20.03	20.09	20.08	19.92	19.48	19.02	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=	1	1	1	0.98	0.92	0.76	0.56	0.64	0.91	0.99	1	1	(94)

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

(95)m=	704.12	861.07	1023.78	1191.61	1247.18	1035.16	725.16	745.93	919.49	828.94	702.15	656.91	(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=	3166.48	3059.99	2759.91	2289.12	1752.71	1161.86	746.26	785.69	1248.64	1917.88	2587.09	3154.78	(97)

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

(98)m=	1832	1477.67	1291.68	790.21	376.12	0	0	0	0	810.17	1357.16	1858.41	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 9793.42 (98)

Space heating requirement in kWh/m²/year 52.79 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

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

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design sta

Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	2010.25	1582.54	1622.23	0	0	0	0	(100)

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.76	0.85	0.8	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	1534.39	1342.27	1292.87	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	1721.79	1639.54	1491.09	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	134.93	221.17	147.48	0	0	0	0	

Total = Sum(104) = 503.57 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	

Total = Sum(104) = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	33.73	55.29	36.87	0	0	0	0	

Total = Sum(107) = 125.89 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0.68 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 53.47 (109)

DER WorkSheet: New dwelling design stage

STUDIO11 architecture

User Details:

Assessor Name:	Chloe Hewitt	**Stroma Number:**	STRO029693
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.6

Property Address: Plot 3

Address : Plot 3, Land off Wardentree Lane, Spalding

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	92.76	(1a) x	2.38	(2a) =	220.77	(3a)
Ground floor	92.76	(1b) x	2.62	(2b) =	243.03	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	185.52	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		463.8	(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							6	x 10 =	60	(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) =	60	÷ (5) =	0.13 (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)		0.38 (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) =		0.38 (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

DER WorkSheet: New dwelling design stage

STUDIO11 architecture

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

0.48	0.47	0.46	0.42	0.41	0.36	0.36	0.35	0.38	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	0.61	0.61	0.59	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.6

(24d)

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

(25)m=	0.62	0.61	0.61	0.59	0.58	0.56	0.56	0.56	0.57	0.58	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	
Doors Type 1			2.12	x	1.2	=	2.544			(26)
Doors Type 2			1.97	x	1.2	=	2.364			(26)
Windows Type 1			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 2			0.84	x1/[1/(1.2)+ 0.04]		=	0.96			(27)
Windows Type 3			0.84	x1/[1/(1.2)+ 0.04]		=	0.96			(27)
Windows Type 4			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 5			1.86	x1/[1/(1.2)+ 0.04]		=	2.13			(27)
Windows Type 6			0.96	x1/[1/(1.2)+ 0.04]		=	1.1			(27)
Windows Type 7			1.44	x1/[1/(1.2)+ 0.04]		=	1.65			(27)
Windows Type 8			2.12	x1/[1/(1.2)+ 0.04]		=	2.43			(27)
Windows Type 9			1.61	x1/[1/(1.2)+ 0.04]		=	1.84			(27)
Windows Type 10			2.12	x1/[1/(1.2)+ 0.04]		=	2.43			(27)
Windows Type 11			2.12	x1/[1/(1.2)+ 0.04]		=	2.43			(27)
Windows Type 12			1.26	x1/[1/(1.2)+ 0.04]		=	1.44			(27)
Windows Type 13			2.12	x1/[1/(1.2)+ 0.04]		=	2.43			(27)
Windows Type 14			0.66	x1/[1/(1.2)+ 0.04]		=	0.76			(27)
Windows Type 15			3.15	x1/[1/(1.2)+ 0.04]		=	3.61			(27)

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Windows Type 16			3.78	x1/[1/(1.2)+ 0.04] =	4.33			(27)
Floor			92.76	x	0.12	=	11.1312			(28)
Walls	196.95	33.75	163.2	x	0.24	=	39.17			(29)
Roof	92.76	0	92.76	x	0.09	=	8.35			(30)
Total area of elements, m²			382.47							(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) = 97.52 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17583.84 (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 32 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 129.52 (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=	94.43	93.74	93.05	89.85	89.25	86.47	86.47	85.95	87.54	89.25	90.47	91.73	(38)

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

(39)m=	223.95	223.26	222.58	219.37	218.78	215.99	215.99	215.47	217.06	218.78	219.99	221.25	

Average = Sum(39)$_{1...12}$ /12= 219.37 (39)

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

(40)m=	1.21	1.2	1.2	1.18	1.18	1.16	1.16	1.16	1.17	1.18	1.19	1.19	

Average = Sum(40)$_{1...12}$ /12= 1.18 (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 2.98 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 105.05 (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	
(44)m=	115.55	111.35	107.15	102.95	98.74	94.54	94.54	98.74	102.95	107.15	111.35	115.55	

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

Total = Sum(44)$_{1...12}$ = 1260.57 (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=	171.36	149.87	154.66	134.83	129.37	111.64	103.45	118.71	120.13	140	152.82	165.95	

Total = Sum(45)$_{1...12}$ = 1652.8 (45)

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

(46)m=	25.7	22.48	23.2	20.22	19.41	16.75	15.52	17.81	18.02	21	22.92	24.89	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

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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) =	210	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.01	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0.83	(52)
Temperature factor from Table 2b		0.54	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.13	(54)
Enter (50) or (54) in (55)		1.13	(55)

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

(56)m=	34.9	31.52	34.9	33.77	34.9	33.77	34.9	34.9	33.77	34.9	33.77	34.9

(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=	34.9	31.52	34.9	33.77	34.9	33.77	34.9	34.9	33.77	34.9	33.77	34.9

(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=	229.52	202.4	212.81	191.11	187.53	167.92	161.61	176.87	176.41	198.16	209.1	224.11

(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=	229.52	202.4	212.81	191.11	187.53	167.92	161.61	176.87	176.41	198.16	209.1	224.11

Output from water heater (annual)$_{1...12}$: 2337.56 (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=	103.5	91.86	97.95	89.86	89.54	82.15	80.92	86	84.97	93.08	95.84	101.71

(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=	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15

(66)

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

(67)m=	32.46	28.83	23.45	17.75	13.27	11.2	12.1	15.73	21.12	26.81	31.29	33.36

(67)

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

(68)m=	357.07	360.77	351.44	331.56	306.47	282.88	267.13	263.42	272.76	292.64	317.73	341.31

(68)

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

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(69)m=	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	(71)

Water heating gains (Table 5)

(72)m=	139.12	136.69	131.65	124.8	120.35	114.09	108.77	115.59	118.01	125.1	133.11	136.7	(72)

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

(73)m=	599.39	597.04	577.28	544.85	510.83	478.92	458.75	465.49	482.63	515.3	552.88	582.12	(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)	
Northeast 0.9x	0.77	x	0.96	x	11.28	x	0.63	x	0.7	=	3.31	(75)
Northeast 0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(75)
Northeast 0.9x	0.77	x	2.12	x	11.28	x	0.63	x	0.7	=	7.31	(75)
Northeast 0.9x	0.77	x	0.96	x	22.97	x	0.63	x	0.7	=	6.74	(75)
Northeast 0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(75)
Northeast 0.9x	0.77	x	2.12	x	22.97	x	0.63	x	0.7	=	14.88	(75)
Northeast 0.9x	0.77	x	0.96	x	41.38	x	0.63	x	0.7	=	12.14	(75)
Northeast 0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(75)
Northeast 0.9x	0.77	x	2.12	x	41.38	x	0.63	x	0.7	=	26.81	(75)
Northeast 0.9x	0.77	x	0.96	x	67.96	x	0.63	x	0.7	=	19.94	(75)
Northeast 0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(75)
Northeast 0.9x	0.77	x	2.12	x	67.96	x	0.63	x	0.7	=	44.03	(75)
Northeast 0.9x	0.77	x	0.96	x	91.35	x	0.63	x	0.7	=	26.8	(75)
Northeast 0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(75)
Northeast 0.9x	0.77	x	2.12	x	91.35	x	0.63	x	0.7	=	59.18	(75)
Northeast 0.9x	0.77	x	0.96	x	97.38	x	0.63	x	0.7	=	28.57	(75)
Northeast 0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(75)
Northeast 0.9x	0.77	x	2.12	x	97.38	x	0.63	x	0.7	=	63.1	(75)
Northeast 0.9x	0.77	x	0.96	x	91.1	x	0.63	x	0.7	=	26.73	(75)
Northeast 0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(75)
Northeast 0.9x	0.77	x	2.12	x	91.1	x	0.63	x	0.7	=	59.02	(75)
Northeast 0.9x	0.77	x	0.96	x	72.63	x	0.63	x	0.7	=	21.31	(75)
Northeast 0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(75)
Northeast 0.9x	0.77	x	2.12	x	72.63	x	0.63	x	0.7	=	47.05	(75)
Northeast 0.9x	0.77	x	0.96	x	50.42	x	0.63	x	0.7	=	14.79	(75)
Northeast 0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(75)
Northeast 0.9x	0.77	x	2.12	x	50.42	x	0.63	x	0.7	=	32.67	(75)
Northeast 0.9x	0.77	x	0.96	x	28.07	x	0.63	x	0.7	=	8.23	(75)

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Northeast	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(75)
Northeast	0.9x	0.77	x	2.12	x	28.07	x	0.63	x	0.7	=	18.18	(75)
Northeast	0.9x	0.77	x	0.96	x	14.2	x	0.63	x	0.7	=	4.17	(75)
Northeast	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(75)
Northeast	0.9x	0.77	x	2.12	x	14.2	x	0.63	x	0.7	=	9.2	(75)
Northeast	0.9x	0.77	x	0.96	x	9.21	x	0.63	x	0.7	=	2.7	(75)
Northeast	0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(75)
Northeast	0.9x	0.77	x	2.12	x	9.21	x	0.63	x	0.7	=	5.97	(75)
Southeast	0.9x	0.77	x	2.39	x	36.79	x	0.63	x	0.7	=	26.87	(77)
Southeast	0.9x	0.77	x	0.84	x	36.79	x	0.63	x	0.7	=	9.45	(77)
Southeast	0.9x	0.77	x	0.84	x	36.79	x	0.63	x	0.7	=	9.45	(77)
Southeast	0.9x	0.77	x	2.39	x	36.79	x	0.63	x	0.7	=	26.87	(77)
Southeast	0.9x	0.77	x	2.12	x	36.79	x	0.63	x	0.7	=	23.84	(77)
Southeast	0.9x	0.77	x	1.61	x	36.79	x	0.63	x	0.7	=	18.1	(77)
Southeast	0.9x	0.77	x	2.12	x	36.79	x	0.63	x	0.7	=	23.84	(77)
Southeast	0.9x	0.77	x	2.39	x	62.67	x	0.63	x	0.7	=	45.78	(77)
Southeast	0.9x	0.77	x	0.84	x	62.67	x	0.63	x	0.7	=	16.09	(77)
Southeast	0.9x	0.77	x	0.84	x	62.67	x	0.63	x	0.7	=	16.09	(77)
Southeast	0.9x	0.77	x	2.39	x	62.67	x	0.63	x	0.7	=	45.78	(77)
Southeast	0.9x	0.77	x	2.12	x	62.67	x	0.63	x	0.7	=	40.61	(77)
Southeast	0.9x	0.77	x	1.61	x	62.67	x	0.63	x	0.7	=	30.84	(77)
Southeast	0.9x	0.77	x	2.12	x	62.67	x	0.63	x	0.7	=	40.61	(77)
Southeast	0.9x	0.77	x	2.39	x	85.75	x	0.63	x	0.7	=	62.63	(77)
Southeast	0.9x	0.77	x	0.84	x	85.75	x	0.63	x	0.7	=	22.01	(77)
Southeast	0.9x	0.77	x	0.84	x	85.75	x	0.63	x	0.7	=	22.01	(77)
Southeast	0.9x	0.77	x	2.39	x	85.75	x	0.63	x	0.7	=	62.63	(77)
Southeast	0.9x	0.77	x	2.12	x	85.75	x	0.63	x	0.7	=	55.56	(77)
Southeast	0.9x	0.77	x	1.61	x	85.75	x	0.63	x	0.7	=	42.19	(77)
Southeast	0.9x	0.77	x	2.12	x	85.75	x	0.63	x	0.7	=	55.56	(77)
Southeast	0.9x	0.77	x	2.39	x	106.25	x	0.63	x	0.7	=	77.61	(77)
Southeast	0.9x	0.77	x	0.84	x	106.25	x	0.63	x	0.7	=	27.28	(77)
Southeast	0.9x	0.77	x	0.84	x	106.25	x	0.63	x	0.7	=	27.28	(77)
Southeast	0.9x	0.77	x	2.39	x	106.25	x	0.63	x	0.7	=	77.61	(77)
Southeast	0.9x	0.77	x	2.12	x	106.25	x	0.63	x	0.7	=	68.84	(77)
Southeast	0.9x	0.77	x	1.61	x	106.25	x	0.63	x	0.7	=	52.28	(77)
Southeast	0.9x	0.77	x	2.12	x	106.25	x	0.63	x	0.7	=	68.84	(77)
Southeast	0.9x	0.77	x	2.39	x	119.01	x	0.63	x	0.7	=	86.93	(77)
Southeast	0.9x	0.77	x	0.84	x	119.01	x	0.63	x	0.7	=	30.55	(77)
Southeast	0.9x	0.77	x	0.84	x	119.01	x	0.63	x	0.7	=	30.55	(77)
Southeast	0.9x	0.77	x	2.39	x	119.01	x	0.63	x	0.7	=	86.93	(77)
Southeast	0.9x	0.77	x	2.12	x	119.01	x	0.63	x	0.7	=	77.11	(77)

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Southeast	0.9x	0.77	x	1.61	x	119.01	x	0.63	x	0.7	=	58.56	(77)
Southeast	0.9x	0.77	x	2.12	x	119.01	x	0.63	x	0.7	=	77.11	(77)
Southeast	0.9x	0.77	x	2.39	x	118.15	x	0.63	x	0.7	=	86.3	(77)
Southeast	0.9x	0.77	x	0.84	x	118.15	x	0.63	x	0.7	=	30.33	(77)
Southeast	0.9x	0.77	x	0.84	x	118.15	x	0.63	x	0.7	=	30.33	(77)
Southeast	0.9x	0.77	x	2.39	x	118.15	x	0.63	x	0.7	=	86.3	(77)
Southeast	0.9x	0.77	x	2.12	x	118.15	x	0.63	x	0.7	=	76.55	(77)
Southeast	0.9x	0.77	x	1.61	x	118.15	x	0.63	x	0.7	=	58.13	(77)
Southeast	0.9x	0.77	x	2.12	x	118.15	x	0.63	x	0.7	=	76.55	(77)
Southeast	0.9x	0.77	x	2.39	x	113.91	x	0.63	x	0.7	=	83.2	(77)
Southeast	0.9x	0.77	x	0.84	x	113.91	x	0.63	x	0.7	=	29.24	(77)
Southeast	0.9x	0.77	x	0.84	x	113.91	x	0.63	x	0.7	=	29.24	(77)
Southeast	0.9x	0.77	x	2.39	x	113.91	x	0.63	x	0.7	=	83.2	(77)
Southeast	0.9x	0.77	x	2.12	x	113.91	x	0.63	x	0.7	=	73.8	(77)
Southeast	0.9x	0.77	x	1.61	x	113.91	x	0.63	x	0.7	=	56.05	(77)
Southeast	0.9x	0.77	x	2.12	x	113.91	x	0.63	x	0.7	=	73.8	(77)
Southeast	0.9x	0.77	x	2.39	x	104.39	x	0.63	x	0.7	=	76.25	(77)
Southeast	0.9x	0.77	x	0.84	x	104.39	x	0.63	x	0.7	=	26.8	(77)
Southeast	0.9x	0.77	x	0.84	x	104.39	x	0.63	x	0.7	=	26.8	(77)
Southeast	0.9x	0.77	x	2.39	x	104.39	x	0.63	x	0.7	=	76.25	(77)
Southeast	0.9x	0.77	x	2.12	x	104.39	x	0.63	x	0.7	=	67.63	(77)
Southeast	0.9x	0.77	x	1.61	x	104.39	x	0.63	x	0.7	=	51.36	(77)
Southeast	0.9x	0.77	x	2.12	x	104.39	x	0.63	x	0.7	=	67.63	(77)
Southeast	0.9x	0.77	x	2.39	x	92.85	x	0.63	x	0.7	=	67.82	(77)
Southeast	0.9x	0.77	x	0.84	x	92.85	x	0.63	x	0.7	=	23.84	(77)
Southeast	0.9x	0.77	x	0.84	x	92.85	x	0.63	x	0.7	=	23.84	(77)
Southeast	0.9x	0.77	x	2.39	x	92.85	x	0.63	x	0.7	=	67.82	(77)
Southeast	0.9x	0.77	x	2.12	x	92.85	x	0.63	x	0.7	=	60.16	(77)
Southeast	0.9x	0.77	x	1.61	x	92.85	x	0.63	x	0.7	=	45.69	(77)
Southeast	0.9x	0.77	x	2.12	x	92.85	x	0.63	x	0.7	=	60.16	(77)
Southeast	0.9x	0.77	x	2.39	x	69.27	x	0.63	x	0.7	=	50.59	(77)
Southeast	0.9x	0.77	x	0.84	x	69.27	x	0.63	x	0.7	=	17.78	(77)
Southeast	0.9x	0.77	x	0.84	x	69.27	x	0.63	x	0.7	=	17.78	(77)
Southeast	0.9x	0.77	x	2.39	x	69.27	x	0.63	x	0.7	=	50.59	(77)
Southeast	0.9x	0.77	x	2.12	x	69.27	x	0.63	x	0.7	=	44.88	(77)
Southeast	0.9x	0.77	x	1.61	x	69.27	x	0.63	x	0.7	=	34.08	(77)
Southeast	0.9x	0.77	x	2.12	x	69.27	x	0.63	x	0.7	=	44.88	(77)
Southeast	0.9x	0.77	x	2.39	x	44.07	x	0.63	x	0.7	=	32.19	(77)
Southeast	0.9x	0.77	x	0.84	x	44.07	x	0.63	x	0.7	=	11.31	(77)
Southeast	0.9x	0.77	x	0.84	x	44.07	x	0.63	x	0.7	=	11.31	(77)
Southeast	0.9x	0.77	x	2.39	x	44.07	x	0.63	x	0.7	=	32.19	(77)

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Southeast	0.9x	0.77	x	2.12	x	44.07	x	0.63	x	0.7	=	28.55	(77)
Southeast	0.9x	0.77	x	1.61	x	44.07	x	0.63	x	0.7	=	21.68	(77)
Southeast	0.9x	0.77	x	2.12	x	44.07	x	0.63	x	0.7	=	28.55	(77)
Southeast	0.9x	0.77	x	2.39	x	31.49	x	0.63	x	0.7	=	23	(77)
Southeast	0.9x	0.77	x	0.84	x	31.49	x	0.63	x	0.7	=	8.08	(77)
Southeast	0.9x	0.77	x	0.84	x	31.49	x	0.63	x	0.7	=	8.08	(77)
Southeast	0.9x	0.77	x	2.39	x	31.49	x	0.63	x	0.7	=	23	(77)
Southeast	0.9x	0.77	x	2.12	x	31.49	x	0.63	x	0.7	=	20.4	(77)
Southeast	0.9x	0.77	x	1.61	x	31.49	x	0.63	x	0.7	=	15.49	(77)
Southeast	0.9x	0.77	x	2.12	x	31.49	x	0.63	x	0.7	=	20.4	(77)
Northwest	0.9x	0.77	x	1.86	x	11.28	x	0.63	x	0.7	=	6.41	(81)
Northwest	0.9x	0.77	x	1.26	x	11.28	x	0.63	x	0.7	=	4.34	(81)
Northwest	0.9x	0.77	x	2.12	x	11.28	x	0.63	x	0.7	=	7.31	(81)
Northwest	0.9x	0.77	x	0.66	x	11.28	x	0.63	x	0.7	=	2.28	(81)
Northwest	0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	10.86	(81)
Northwest	0.9x	0.77	x	3.78	x	11.28	x	0.63	x	0.7	=	13.03	(81)
Northwest	0.9x	0.77	x	1.86	x	22.97	x	0.63	x	0.7	=	13.06	(81)
Northwest	0.9x	0.77	x	1.26	x	22.97	x	0.63	x	0.7	=	8.84	(81)
Northwest	0.9x	0.77	x	2.12	x	22.97	x	0.63	x	0.7	=	14.88	(81)
Northwest	0.9x	0.77	x	0.66	x	22.97	x	0.63	x	0.7	=	4.63	(81)
Northwest	0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	22.11	(81)
Northwest	0.9x	0.77	x	3.78	x	22.97	x	0.63	x	0.7	=	26.53	(81)
Northwest	0.9x	0.77	x	1.86	x	41.38	x	0.63	x	0.7	=	23.52	(81)
Northwest	0.9x	0.77	x	1.26	x	41.38	x	0.63	x	0.7	=	15.93	(81)
Northwest	0.9x	0.77	x	2.12	x	41.38	x	0.63	x	0.7	=	26.81	(81)
Northwest	0.9x	0.77	x	0.66	x	41.38	x	0.63	x	0.7	=	8.35	(81)
Northwest	0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	39.83	(81)
Northwest	0.9x	0.77	x	3.78	x	41.38	x	0.63	x	0.7	=	47.8	(81)
Northwest	0.9x	0.77	x	1.86	x	67.96	x	0.63	x	0.7	=	38.63	(81)
Northwest	0.9x	0.77	x	1.26	x	67.96	x	0.63	x	0.7	=	26.17	(81)
Northwest	0.9x	0.77	x	2.12	x	67.96	x	0.63	x	0.7	=	44.03	(81)
Northwest	0.9x	0.77	x	0.66	x	67.96	x	0.63	x	0.7	=	13.71	(81)
Northwest	0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	65.42	(81)
Northwest	0.9x	0.77	x	3.78	x	67.96	x	0.63	x	0.7	=	78.5	(81)
Northwest	0.9x	0.77	x	1.86	x	91.35	x	0.63	x	0.7	=	51.92	(81)
Northwest	0.9x	0.77	x	1.26	x	91.35	x	0.63	x	0.7	=	35.17	(81)
Northwest	0.9x	0.77	x	2.12	x	91.35	x	0.63	x	0.7	=	59.18	(81)
Northwest	0.9x	0.77	x	0.66	x	91.35	x	0.63	x	0.7	=	18.42	(81)
Northwest	0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	87.94	(81)
Northwest	0.9x	0.77	x	3.78	x	91.35	x	0.63	x	0.7	=	105.52	(81)
Northwest	0.9x	0.77	x	1.86	x	97.38	x	0.63	x	0.7	=	55.36	(81)

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Northwest	0.9x	0.77	x	1.26	x	97.38	x	0.63	x	0.7	=	37.5	(81)
Northwest	0.9x	0.77	x	2.12	x	97.38	x	0.63	x	0.7	=	63.1	(81)
Northwest	0.9x	0.77	x	0.66	x	97.38	x	0.63	x	0.7	=	19.64	(81)
Northwest	0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	93.75	(81)
Northwest	0.9x	0.77	x	3.78	x	97.38	x	0.63	x	0.7	=	112.5	(81)
Northwest	0.9x	0.77	x	1.86	x	91.1	x	0.63	x	0.7	=	51.79	(81)
Northwest	0.9x	0.77	x	1.26	x	91.1	x	0.63	x	0.7	=	35.08	(81)
Northwest	0.9x	0.77	x	2.12	x	91.1	x	0.63	x	0.7	=	59.02	(81)
Northwest	0.9x	0.77	x	0.66	x	91.1	x	0.63	x	0.7	=	18.38	(81)
Northwest	0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	87.7	(81)
Northwest	0.9x	0.77	x	3.78	x	91.1	x	0.63	x	0.7	=	105.24	(81)
Northwest	0.9x	0.77	x	1.86	x	72.63	x	0.63	x	0.7	=	41.28	(81)
Northwest	0.9x	0.77	x	1.26	x	72.63	x	0.63	x	0.7	=	27.97	(81)
Northwest	0.9x	0.77	x	2.12	x	72.63	x	0.63	x	0.7	=	47.05	(81)
Northwest	0.9x	0.77	x	0.66	x	72.63	x	0.63	x	0.7	=	14.65	(81)
Northwest	0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	69.92	(81)
Northwest	0.9x	0.77	x	3.78	x	72.63	x	0.63	x	0.7	=	83.9	(81)
Northwest	0.9x	0.77	x	1.86	x	50.42	x	0.63	x	0.7	=	28.66	(81)
Northwest	0.9x	0.77	x	1.26	x	50.42	x	0.63	x	0.7	=	19.42	(81)
Northwest	0.9x	0.77	x	2.12	x	50.42	x	0.63	x	0.7	=	32.67	(81)
Northwest	0.9x	0.77	x	0.66	x	50.42	x	0.63	x	0.7	=	10.17	(81)
Northwest	0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	48.54	(81)
Northwest	0.9x	0.77	x	3.78	x	50.42	x	0.63	x	0.7	=	58.25	(81)
Northwest	0.9x	0.77	x	1.86	x	28.07	x	0.63	x	0.7	=	15.95	(81)
Northwest	0.9x	0.77	x	1.26	x	28.07	x	0.63	x	0.7	=	10.81	(81)
Northwest	0.9x	0.77	x	2.12	x	28.07	x	0.63	x	0.7	=	18.18	(81)
Northwest	0.9x	0.77	x	0.66	x	28.07	x	0.63	x	0.7	=	5.66	(81)
Northwest	0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	27.02	(81)
Northwest	0.9x	0.77	x	3.78	x	28.07	x	0.63	x	0.7	=	32.42	(81)
Northwest	0.9x	0.77	x	1.86	x	14.2	x	0.63	x	0.7	=	8.07	(81)
Northwest	0.9x	0.77	x	1.26	x	14.2	x	0.63	x	0.7	=	5.47	(81)
Northwest	0.9x	0.77	x	2.12	x	14.2	x	0.63	x	0.7	=	9.2	(81)
Northwest	0.9x	0.77	x	0.66	x	14.2	x	0.63	x	0.7	=	2.86	(81)
Northwest	0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	13.67	(81)
Northwest	0.9x	0.77	x	3.78	x	14.2	x	0.63	x	0.7	=	16.4	(81)
Northwest	0.9x	0.77	x	1.86	x	9.21	x	0.63	x	0.7	=	5.24	(81)
Northwest	0.9x	0.77	x	1.26	x	9.21	x	0.63	x	0.7	=	3.55	(81)
Northwest	0.9x	0.77	x	2.12	x	9.21	x	0.63	x	0.7	=	5.97	(81)
Northwest	0.9x	0.77	x	0.66	x	9.21	x	0.63	x	0.7	=	1.86	(81)
Northwest	0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	8.87	(81)
Northwest	0.9x	0.77	x	3.78	x	9.21	x	0.63	x	0.7	=	10.64	(81)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m=	198.25	357.56	542.02	760.06	932.08	960.86	911.59	777.82	616.67	409.41	241.07	167.32	(83)

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

(84)m=	797.64	954.6	1119.29	1304.91	1442.91	1439.78	1370.34	1243.31	1099.3	924.71	793.95	749.44	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.98	0.94	0.82	0.65	0.73	0.93	0.99	1	1	(86)

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

(87)m=	19.53	19.68	19.94	20.31	20.66	20.89	20.97	20.96	20.76	20.32	19.86	19.51	(87)

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

(88)m=	19.91	19.92	19.92	19.93	19.94	19.95	19.95	19.95	19.94	19.94	19.93	19.93	(88)

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

(89)m=	1	1	0.99	0.98	0.91	0.73	0.52	0.59	0.89	0.99	1	1	(89)

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

(90)m=	17.93	18.16	18.54	19.09	19.57	19.87	19.94	19.93	19.73	19.1	18.44	17.92	(90)

fLA = Living area ÷ (4) = 0.14 (91)

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

(92)m=	18.15	18.36	18.74	19.26	19.72	20.01	20.08	20.07	19.87	19.27	18.63	18.14	(92)

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

(93)m=	18	18.21	18.59	19.11	19.57	19.86	19.93	19.92	19.72	19.12	18.48	17.99	(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	0.97	0.9	0.72	0.51	0.59	0.87	0.98	1	1	(94)

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

(95)m=	796.76	951.96	1110.01	1264.97	1292.33	1039.1	705.22	732.22	958.82	909.74	792.01	748.84	(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=	3068.69	2972.56	2689.99	2239.35	1722.62	1136.62	719.35	758.82	1219.6	1864.28	2503.94	3050.27	(97)

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

(98)m=	1690.32	1357.84	1175.5	701.55	320.13	0	0	0	0	710.18	1232.59	1712.26	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 8900.38 (98)

Space heating requirement in kWh/m²/year 47.98 (99)

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

Space heating:

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

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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		90	(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)	1690.32	1357.84	1175.5	701.55	320.13	0	0	0	0	710.18	1232.59	1712.26	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1878.13	1508.72	1306.11	779.5	355.7	0	0	0	0	789.09	1369.55	1902.52	(211)

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 9889.31 (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)

	229.52	202.4	212.81	191.11	187.53	167.92	161.61	176.87	176.41	198.16	209.1	224.11

Efficiency of water heater 79.3 (216)

(217)m=	88.57	88.45	88.18	87.47	85.73	79.3	79.3	79.3	79.3	87.43	88.27	88.62	(217)

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

(219)m=	259.13	228.83	241.35	218.48	218.76	211.76	203.79	223.04	222.46	226.66	236.88	252.9	

Total = Sum(219a)$_{1...12}$ = 2744.04 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			9889.31	
Water heating fuel used			2744.04	
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			573.22	(232)
Electricity generated by PVs			-1204.8	(233)

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	=	2136.09	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	592.71	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2728.8	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)

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Electricity for lighting	(232)	x	0.519	=	297.5	(268)
Energy saving/generation technologies Item 1			0.519	=	-625.29	(269)
Total CO2, kg/year			sum of (265)…(271) =		2439.94	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		13.15	(273)
EI rating (section 14)					86	(274)

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STUDIO11 architecture

User Details:

Assessor Name:	Chloe Hewitt	**Stroma Number:**	STRO029693
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.6

Property Address: Plot 3

Address : Plot 3, Land off Wardentree Lane, Spalding

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	92.76	(1a) x	2.38	(2a) =	220.77	(3a)
Ground floor	92.76	(1b) x	2.62	(2b) =	243.03	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	185.52	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		463.8	(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) =	0.09 (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)		0.34 (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) =		0.34 (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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4

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

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

(25)m=	0.59	0.59	0.58	0.57	0.57	0.55	0.55	0.55	0.56	0.57	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 Type 1			2.12	x	1.2	=	2.544			(26)
Doors Type 2			1.97	x	1.2	=	2.364			(26)
Windows Type 1			2.39	x	1/[1/(1.4)+ 0.04]	=	3.17			(27)
Windows Type 2			0.84	x	1/[1/(1.4)+ 0.04]	=	1.11			(27)
Windows Type 3			0.84	x	1/[1/(1.4)+ 0.04]	=	1.11			(27)
Windows Type 4			2.39	x	1/[1/(1.4)+ 0.04]	=	3.17			(27)
Windows Type 5			1.86	x	1/[1/(1.4)+ 0.04]	=	2.47			(27)
Windows Type 6			0.96	x	1/[1/(1.4)+ 0.04]	=	1.27			(27)
Windows Type 7			1.44	x	1/[1/(1.4)+ 0.04]	=	1.91			(27)
Windows Type 8			2.12	x	1/[1/(1.4)+ 0.04]	=	2.81			(27)
Windows Type 9			1.61	x	1/[1/(1.4)+ 0.04]	=	2.13			(27)
Windows Type 10			2.12	x	1/[1/(1.4)+ 0.04]	=	2.81			(27)
Windows Type 11			2.12	x	1/[1/(1.4)+ 0.04]	=	2.81			(27)
Windows Type 12			1.26	x	1/[1/(1.4)+ 0.04]	=	1.67			(27)
Windows Type 13			2.12	x	1/[1/(1.4)+ 0.04]	=	2.81			(27)
Windows Type 14			0.66	x	1/[1/(1.4)+ 0.04]	=	0.88			(27)
Windows Type 15			3.15	x	1/[1/(1.4)+ 0.04]	=	4.18			(27)

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Windows Type 16			3.78	x1/[1/(1.4)+ 0.04]	=	5.01			(27)
Floor			92.76	x	0.13	=	12.0588			(28)
Walls	196.95	33.75	163.2	x	0.18	=	29.38			(29)
Roof	92.76	0	92.76	x	0.13	=	12.06			(30)
Total area of elements, m²			382.47							(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) = 97.72 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17583.84 (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 15.21 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 112.93 (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=	90.59	90.05	89.51	87	86.53	84.34	84.34	83.93	85.18	86.53	87.48	88.47	(38)

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

(39)m=	203.52	202.98	202.44	199.93	199.46	197.27	197.27	196.86	198.11	199.46	200.41	201.4	

Average = Sum(39)$_{1...12}$ /12= 199.92 (39)

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

(40)m=	1.1	1.09	1.09	1.08	1.08	1.06	1.06	1.06	1.07	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 2.98 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 105.05 (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	
(44)m=	115.55	111.35	107.15	102.95	98.74	94.54	94.54	98.74	102.95	107.15	111.35	115.55	

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

Total = Sum(44)$_{1...12}$ = 1260.57 (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=	171.36	149.87	154.66	134.83	129.37	111.64	103.45	118.71	120.13	140	152.82	165.95	

Total = Sum(45)$_{1...12}$ = 1652.8 (45)

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

(46)m=	25.7	22.48	23.2	20.22	19.41	16.75	15.52	17.81	18.02	21	22.92	24.89	(46)

Water storage loss:

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

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If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):		1.7	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0.92	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0.92	(55)

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

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

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

(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48 (57)

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=	223.11	196.61	206.4	184.91	181.12	161.72	155.2	170.46	170.21	191.75	202.9	217.7 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)
(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	223.11	196.61	206.4	184.91	181.12	161.72	155.2	170.46	170.21	191.75	202.9	217.7

Output from water heater (annual)$_{1...12}$: 2262.08 (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=	98.37	87.22	92.82	84.89	84.41	77.18	75.79	80.87	80.01	87.95	90.87	96.58 (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=	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15 (66)

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

(67)m=	32.46	28.83	23.45	17.75	13.27	11.2	12.1	15.73	21.12	26.81	31.29	33.36 (67)

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

(68)m=	357.07	360.77	351.44	331.56	306.47	282.88	267.13	263.42	272.76	292.64	317.73	341.31 (68)

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

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(69)m=	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	37.92	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	-119.32	(71)

Water heating gains (Table 5)

(72)m=	132.22	129.8	124.76	117.91	113.46	107.2	101.87	108.69	111.12	118.21	126.21	129.81	(72)

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

(73)m=	592.49	590.14	570.38	537.96	503.94	472.03	451.85	458.6	475.74	508.4	545.98	575.23	(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)	
Northeast 0.9x	0.77	x	0.96	x	11.28	x	0.63	x	0.7	=	3.31	(75)
Northeast 0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	4.97	(75)
Northeast 0.9x	0.77	x	2.12	x	11.28	x	0.63	x	0.7	=	7.31	(75)
Northeast 0.9x	0.77	x	0.96	x	22.97	x	0.63	x	0.7	=	6.74	(75)
Northeast 0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	10.11	(75)
Northeast 0.9x	0.77	x	2.12	x	22.97	x	0.63	x	0.7	=	14.88	(75)
Northeast 0.9x	0.77	x	0.96	x	41.38	x	0.63	x	0.7	=	12.14	(75)
Northeast 0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	18.21	(75)
Northeast 0.9x	0.77	x	2.12	x	41.38	x	0.63	x	0.7	=	26.81	(75)
Northeast 0.9x	0.77	x	0.96	x	67.96	x	0.63	x	0.7	=	19.94	(75)
Northeast 0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	29.91	(75)
Northeast 0.9x	0.77	x	2.12	x	67.96	x	0.63	x	0.7	=	44.03	(75)
Northeast 0.9x	0.77	x	0.96	x	91.35	x	0.63	x	0.7	=	26.8	(75)
Northeast 0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	40.2	(75)
Northeast 0.9x	0.77	x	2.12	x	91.35	x	0.63	x	0.7	=	59.18	(75)
Northeast 0.9x	0.77	x	0.96	x	97.38	x	0.63	x	0.7	=	28.57	(75)
Northeast 0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	42.86	(75)
Northeast 0.9x	0.77	x	2.12	x	97.38	x	0.63	x	0.7	=	63.1	(75)
Northeast 0.9x	0.77	x	0.96	x	91.1	x	0.63	x	0.7	=	26.73	(75)
Northeast 0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	40.09	(75)
Northeast 0.9x	0.77	x	2.12	x	91.1	x	0.63	x	0.7	=	59.02	(75)
Northeast 0.9x	0.77	x	0.96	x	72.63	x	0.63	x	0.7	=	21.31	(75)
Northeast 0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	31.96	(75)
Northeast 0.9x	0.77	x	2.12	x	72.63	x	0.63	x	0.7	=	47.05	(75)
Northeast 0.9x	0.77	x	0.96	x	50.42	x	0.63	x	0.7	=	14.79	(75)
Northeast 0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	22.19	(75)
Northeast 0.9x	0.77	x	2.12	x	50.42	x	0.63	x	0.7	=	32.67	(75)
Northeast 0.9x	0.77	x	0.96	x	28.07	x	0.63	x	0.7	=	8.23	(75)

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Northeast	0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	12.35	(75)
Northeast	0.9x	0.77	x	2.12	x	28.07	x	0.63	x	0.7	=	18.18	(75)
Northeast	0.9x	0.77	x	0.96	x	14.2	x	0.63	x	0.7	=	4.17	(75)
Northeast	0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	6.25	(75)
Northeast	0.9x	0.77	x	2.12	x	14.2	x	0.63	x	0.7	=	9.2	(75)
Northeast	0.9x	0.77	x	0.96	x	9.21	x	0.63	x	0.7	=	2.7	(75)
Northeast	0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	4.06	(75)
Northeast	0.9x	0.77	x	2.12	x	9.21	x	0.63	x	0.7	=	5.97	(75)
Southeast	0.9x	0.77	x	2.39	x	36.79	x	0.63	x	0.7	=	26.87	(77)
Southeast	0.9x	0.77	x	0.84	x	36.79	x	0.63	x	0.7	=	9.45	(77)
Southeast	0.9x	0.77	x	0.84	x	36.79	x	0.63	x	0.7	=	9.45	(77)
Southeast	0.9x	0.77	x	2.39	x	36.79	x	0.63	x	0.7	=	26.87	(77)
Southeast	0.9x	0.77	x	2.12	x	36.79	x	0.63	x	0.7	=	23.84	(77)
Southeast	0.9x	0.77	x	1.61	x	36.79	x	0.63	x	0.7	=	18.1	(77)
Southeast	0.9x	0.77	x	2.12	x	36.79	x	0.63	x	0.7	=	23.84	(77)
Southeast	0.9x	0.77	x	2.39	x	62.67	x	0.63	x	0.7	=	45.78	(77)
Southeast	0.9x	0.77	x	0.84	x	62.67	x	0.63	x	0.7	=	16.09	(77)
Southeast	0.9x	0.77	x	0.84	x	62.67	x	0.63	x	0.7	=	16.09	(77)
Southeast	0.9x	0.77	x	2.39	x	62.67	x	0.63	x	0.7	=	45.78	(77)
Southeast	0.9x	0.77	x	2.12	x	62.67	x	0.63	x	0.7	=	40.61	(77)
Southeast	0.9x	0.77	x	1.61	x	62.67	x	0.63	x	0.7	=	30.84	(77)
Southeast	0.9x	0.77	x	2.12	x	62.67	x	0.63	x	0.7	=	40.61	(77)
Southeast	0.9x	0.77	x	2.39	x	85.75	x	0.63	x	0.7	=	62.63	(77)
Southeast	0.9x	0.77	x	0.84	x	85.75	x	0.63	x	0.7	=	22.01	(77)
Southeast	0.9x	0.77	x	0.84	x	85.75	x	0.63	x	0.7	=	22.01	(77)
Southeast	0.9x	0.77	x	2.39	x	85.75	x	0.63	x	0.7	=	62.63	(77)
Southeast	0.9x	0.77	x	2.12	x	85.75	x	0.63	x	0.7	=	55.56	(77)
Southeast	0.9x	0.77	x	1.61	x	85.75	x	0.63	x	0.7	=	42.19	(77)
Southeast	0.9x	0.77	x	2.12	x	85.75	x	0.63	x	0.7	=	55.56	(77)
Southeast	0.9x	0.77	x	2.39	x	106.25	x	0.63	x	0.7	=	77.61	(77)
Southeast	0.9x	0.77	x	0.84	x	106.25	x	0.63	x	0.7	=	27.28	(77)
Southeast	0.9x	0.77	x	0.84	x	106.25	x	0.63	x	0.7	=	27.28	(77)
Southeast	0.9x	0.77	x	2.39	x	106.25	x	0.63	x	0.7	=	77.61	(77)
Southeast	0.9x	0.77	x	2.12	x	106.25	x	0.63	x	0.7	=	68.84	(77)
Southeast	0.9x	0.77	x	1.61	x	106.25	x	0.63	x	0.7	=	52.28	(77)
Southeast	0.9x	0.77	x	2.12	x	106.25	x	0.63	x	0.7	=	68.84	(77)
Southeast	0.9x	0.77	x	2.39	x	119.01	x	0.63	x	0.7	=	86.93	(77)
Southeast	0.9x	0.77	x	0.84	x	119.01	x	0.63	x	0.7	=	30.55	(77)
Southeast	0.9x	0.77	x	0.84	x	119.01	x	0.63	x	0.7	=	30.55	(77)
Southeast	0.9x	0.77	x	2.39	x	119.01	x	0.63	x	0.7	=	86.93	(77)
Southeast	0.9x	0.77	x	2.12	x	119.01	x	0.63	x	0.7	=	77.11	(77)

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Southeast	0.9x	0.77	x	1.61	x	119.01	x	0.63	x	0.7	=	58.56	(77)
Southeast	0.9x	0.77	x	2.12	x	119.01	x	0.63	x	0.7	=	77.11	(77)
Southeast	0.9x	0.77	x	2.39	x	118.15	x	0.63	x	0.7	=	86.3	(77)
Southeast	0.9x	0.77	x	0.84	x	118.15	x	0.63	x	0.7	=	30.33	(77)
Southeast	0.9x	0.77	x	0.84	x	118.15	x	0.63	x	0.7	=	30.33	(77)
Southeast	0.9x	0.77	x	2.39	x	118.15	x	0.63	x	0.7	=	86.3	(77)
Southeast	0.9x	0.77	x	2.12	x	118.15	x	0.63	x	0.7	=	76.55	(77)
Southeast	0.9x	0.77	x	1.61	x	118.15	x	0.63	x	0.7	=	58.13	(77)
Southeast	0.9x	0.77	x	2.12	x	118.15	x	0.63	x	0.7	=	76.55	(77)
Southeast	0.9x	0.77	x	2.39	x	113.91	x	0.63	x	0.7	=	83.2	(77)
Southeast	0.9x	0.77	x	0.84	x	113.91	x	0.63	x	0.7	=	29.24	(77)
Southeast	0.9x	0.77	x	0.84	x	113.91	x	0.63	x	0.7	=	29.24	(77)
Southeast	0.9x	0.77	x	2.39	x	113.91	x	0.63	x	0.7	=	83.2	(77)
Southeast	0.9x	0.77	x	2.12	x	113.91	x	0.63	x	0.7	=	73.8	(77)
Southeast	0.9x	0.77	x	1.61	x	113.91	x	0.63	x	0.7	=	56.05	(77)
Southeast	0.9x	0.77	x	2.12	x	113.91	x	0.63	x	0.7	=	73.8	(77)
Southeast	0.9x	0.77	x	2.39	x	104.39	x	0.63	x	0.7	=	76.25	(77)
Southeast	0.9x	0.77	x	0.84	x	104.39	x	0.63	x	0.7	=	26.8	(77)
Southeast	0.9x	0.77	x	0.84	x	104.39	x	0.63	x	0.7	=	26.8	(77)
Southeast	0.9x	0.77	x	2.39	x	104.39	x	0.63	x	0.7	=	76.25	(77)
Southeast	0.9x	0.77	x	2.12	x	104.39	x	0.63	x	0.7	=	67.63	(77)
Southeast	0.9x	0.77	x	1.61	x	104.39	x	0.63	x	0.7	=	51.36	(77)
Southeast	0.9x	0.77	x	2.12	x	104.39	x	0.63	x	0.7	=	67.63	(77)
Southeast	0.9x	0.77	x	2.39	x	92.85	x	0.63	x	0.7	=	67.82	(77)
Southeast	0.9x	0.77	x	0.84	x	92.85	x	0.63	x	0.7	=	23.84	(77)
Southeast	0.9x	0.77	x	0.84	x	92.85	x	0.63	x	0.7	=	23.84	(77)
Southeast	0.9x	0.77	x	2.39	x	92.85	x	0.63	x	0.7	=	67.82	(77)
Southeast	0.9x	0.77	x	2.12	x	92.85	x	0.63	x	0.7	=	60.16	(77)
Southeast	0.9x	0.77	x	1.61	x	92.85	x	0.63	x	0.7	=	45.69	(77)
Southeast	0.9x	0.77	x	2.12	x	92.85	x	0.63	x	0.7	=	60.16	(77)
Southeast	0.9x	0.77	x	2.39	x	69.27	x	0.63	x	0.7	=	50.59	(77)
Southeast	0.9x	0.77	x	0.84	x	69.27	x	0.63	x	0.7	=	17.78	(77)
Southeast	0.9x	0.77	x	0.84	x	69.27	x	0.63	x	0.7	=	17.78	(77)
Southeast	0.9x	0.77	x	2.39	x	69.27	x	0.63	x	0.7	=	50.59	(77)
Southeast	0.9x	0.77	x	2.12	x	69.27	x	0.63	x	0.7	=	44.88	(77)
Southeast	0.9x	0.77	x	1.61	x	69.27	x	0.63	x	0.7	=	34.08	(77)
Southeast	0.9x	0.77	x	2.12	x	69.27	x	0.63	x	0.7	=	44.88	(77)
Southeast	0.9x	0.77	x	2.39	x	44.07	x	0.63	x	0.7	=	32.19	(77)
Southeast	0.9x	0.77	x	0.84	x	44.07	x	0.63	x	0.7	=	11.31	(77)
Southeast	0.9x	0.77	x	0.84	x	44.07	x	0.63	x	0.7	=	11.31	(77)
Southeast	0.9x	0.77	x	2.39	x	44.07	x	0.63	x	0.7	=	32.19	(77)

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Southeast	0.9x	0.77	x	2.12	x	44.07	x	0.63	x	0.7	=	28.55	(77)
Southeast	0.9x	0.77	x	1.61	x	44.07	x	0.63	x	0.7	=	21.68	(77)
Southeast	0.9x	0.77	x	2.12	x	44.07	x	0.63	x	0.7	=	28.55	(77)
Southeast	0.9x	0.77	x	2.39	x	31.49	x	0.63	x	0.7	=	23	(77)
Southeast	0.9x	0.77	x	0.84	x	31.49	x	0.63	x	0.7	=	8.08	(77)
Southeast	0.9x	0.77	x	0.84	x	31.49	x	0.63	x	0.7	=	8.08	(77)
Southeast	0.9x	0.77	x	2.39	x	31.49	x	0.63	x	0.7	=	23	(77)
Southeast	0.9x	0.77	x	2.12	x	31.49	x	0.63	x	0.7	=	20.4	(77)
Southeast	0.9x	0.77	x	1.61	x	31.49	x	0.63	x	0.7	=	15.49	(77)
Southeast	0.9x	0.77	x	2.12	x	31.49	x	0.63	x	0.7	=	20.4	(77)
Northwest	0.9x	0.77	x	1.86	x	11.28	x	0.63	x	0.7	=	6.41	(81)
Northwest	0.9x	0.77	x	1.26	x	11.28	x	0.63	x	0.7	=	4.34	(81)
Northwest	0.9x	0.77	x	2.12	x	11.28	x	0.63	x	0.7	=	7.31	(81)
Northwest	0.9x	0.77	x	0.66	x	11.28	x	0.63	x	0.7	=	2.28	(81)
Northwest	0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	10.86	(81)
Northwest	0.9x	0.77	x	3.78	x	11.28	x	0.63	x	0.7	=	13.03	(81)
Northwest	0.9x	0.77	x	1.86	x	22.97	x	0.63	x	0.7	=	13.06	(81)
Northwest	0.9x	0.77	x	1.26	x	22.97	x	0.63	x	0.7	=	8.84	(81)
Northwest	0.9x	0.77	x	2.12	x	22.97	x	0.63	x	0.7	=	14.88	(81)
Northwest	0.9x	0.77	x	0.66	x	22.97	x	0.63	x	0.7	=	4.63	(81)
Northwest	0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	22.11	(81)
Northwest	0.9x	0.77	x	3.78	x	22.97	x	0.63	x	0.7	=	26.53	(81)
Northwest	0.9x	0.77	x	1.86	x	41.38	x	0.63	x	0.7	=	23.52	(81)
Northwest	0.9x	0.77	x	1.26	x	41.38	x	0.63	x	0.7	=	15.93	(81)
Northwest	0.9x	0.77	x	2.12	x	41.38	x	0.63	x	0.7	=	26.81	(81)
Northwest	0.9x	0.77	x	0.66	x	41.38	x	0.63	x	0.7	=	8.35	(81)
Northwest	0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	39.83	(81)
Northwest	0.9x	0.77	x	3.78	x	41.38	x	0.63	x	0.7	=	47.8	(81)
Northwest	0.9x	0.77	x	1.86	x	67.96	x	0.63	x	0.7	=	38.63	(81)
Northwest	0.9x	0.77	x	1.26	x	67.96	x	0.63	x	0.7	=	26.17	(81)
Northwest	0.9x	0.77	x	2.12	x	67.96	x	0.63	x	0.7	=	44.03	(81)
Northwest	0.9x	0.77	x	0.66	x	67.96	x	0.63	x	0.7	=	13.71	(81)
Northwest	0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	65.42	(81)
Northwest	0.9x	0.77	x	3.78	x	67.96	x	0.63	x	0.7	=	78.5	(81)
Northwest	0.9x	0.77	x	1.86	x	91.35	x	0.63	x	0.7	=	51.92	(81)
Northwest	0.9x	0.77	x	1.26	x	91.35	x	0.63	x	0.7	=	35.17	(81)
Northwest	0.9x	0.77	x	2.12	x	91.35	x	0.63	x	0.7	=	59.18	(81)
Northwest	0.9x	0.77	x	0.66	x	91.35	x	0.63	x	0.7	=	18.42	(81)
Northwest	0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	87.94	(81)
Northwest	0.9x	0.77	x	3.78	x	91.35	x	0.63	x	0.7	=	105.52	(81)
Northwest	0.9x	0.77	x	1.86	x	97.38	x	0.63	x	0.7	=	55.36	(81)

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Northwest	0.9x	0.77	x	1.26	x	97.38	x	0.63	x	0.7	=	37.5	(81)
Northwest	0.9x	0.77	x	2.12	x	97.38	x	0.63	x	0.7	=	63.1	(81)
Northwest	0.9x	0.77	x	0.66	x	97.38	x	0.63	x	0.7	=	19.64	(81)
Northwest	0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	93.75	(81)
Northwest	0.9x	0.77	x	3.78	x	97.38	x	0.63	x	0.7	=	112.5	(81)
Northwest	0.9x	0.77	x	1.86	x	91.1	x	0.63	x	0.7	=	51.79	(81)
Northwest	0.9x	0.77	x	1.26	x	91.1	x	0.63	x	0.7	=	35.08	(81)
Northwest	0.9x	0.77	x	2.12	x	91.1	x	0.63	x	0.7	=	59.02	(81)
Northwest	0.9x	0.77	x	0.66	x	91.1	x	0.63	x	0.7	=	18.38	(81)
Northwest	0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	87.7	(81)
Northwest	0.9x	0.77	x	3.78	x	91.1	x	0.63	x	0.7	=	105.24	(81)
Northwest	0.9x	0.77	x	1.86	x	72.63	x	0.63	x	0.7	=	41.28	(81)
Northwest	0.9x	0.77	x	1.26	x	72.63	x	0.63	x	0.7	=	27.97	(81)
Northwest	0.9x	0.77	x	2.12	x	72.63	x	0.63	x	0.7	=	47.05	(81)
Northwest	0.9x	0.77	x	0.66	x	72.63	x	0.63	x	0.7	=	14.65	(81)
Northwest	0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	69.92	(81)
Northwest	0.9x	0.77	x	3.78	x	72.63	x	0.63	x	0.7	=	83.9	(81)
Northwest	0.9x	0.77	x	1.86	x	50.42	x	0.63	x	0.7	=	28.66	(81)
Northwest	0.9x	0.77	x	1.26	x	50.42	x	0.63	x	0.7	=	19.42	(81)
Northwest	0.9x	0.77	x	2.12	x	50.42	x	0.63	x	0.7	=	32.67	(81)
Northwest	0.9x	0.77	x	0.66	x	50.42	x	0.63	x	0.7	=	10.17	(81)
Northwest	0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	48.54	(81)
Northwest	0.9x	0.77	x	3.78	x	50.42	x	0.63	x	0.7	=	58.25	(81)
Northwest	0.9x	0.77	x	1.86	x	28.07	x	0.63	x	0.7	=	15.95	(81)
Northwest	0.9x	0.77	x	1.26	x	28.07	x	0.63	x	0.7	=	10.81	(81)
Northwest	0.9x	0.77	x	2.12	x	28.07	x	0.63	x	0.7	=	18.18	(81)
Northwest	0.9x	0.77	x	0.66	x	28.07	x	0.63	x	0.7	=	5.66	(81)
Northwest	0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	27.02	(81)
Northwest	0.9x	0.77	x	3.78	x	28.07	x	0.63	x	0.7	=	32.42	(81)
Northwest	0.9x	0.77	x	1.86	x	14.2	x	0.63	x	0.7	=	8.07	(81)
Northwest	0.9x	0.77	x	1.26	x	14.2	x	0.63	x	0.7	=	5.47	(81)
Northwest	0.9x	0.77	x	2.12	x	14.2	x	0.63	x	0.7	=	9.2	(81)
Northwest	0.9x	0.77	x	0.66	x	14.2	x	0.63	x	0.7	=	2.86	(81)
Northwest	0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	13.67	(81)
Northwest	0.9x	0.77	x	3.78	x	14.2	x	0.63	x	0.7	=	16.4	(81)
Northwest	0.9x	0.77	x	1.86	x	9.21	x	0.63	x	0.7	=	5.24	(81)
Northwest	0.9x	0.77	x	1.26	x	9.21	x	0.63	x	0.7	=	3.55	(81)
Northwest	0.9x	0.77	x	2.12	x	9.21	x	0.63	x	0.7	=	5.97	(81)
Northwest	0.9x	0.77	x	0.66	x	9.21	x	0.63	x	0.7	=	1.86	(81)
Northwest	0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	8.87	(81)
Northwest	0.9x	0.77	x	3.78	x	9.21	x	0.63	x	0.7	=	10.64	(81)

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

(83)m=	198.25	357.56	542.02	760.06	932.08	960.86	911.59	777.82	616.67	409.41	241.07	167.32	(83)

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

(84)m=	790.74	947.71	1112.4	1298.02	1436.02	1432.89	1363.44	1236.42	1092.41	917.82	787.06	742.54	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.98	0.93	0.78	0.61	0.69	0.92	0.99	1	1	(86)

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

(87)m=	19.67	19.81	20.06	20.41	20.73	20.93	20.98	20.97	20.81	20.4	19.97	19.65	(87)

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

(88)m=	20	20.01	20.01	20.02	20.02	20.03	20.03	20.03	20.03	20.02	20.02	20.01	(88)

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

(89)m=	1	1	0.99	0.98	0.9	0.7	0.49	0.57	0.87	0.99	1	1	(89)

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

(90)m=	18.2	18.42	18.79	19.3	19.74	19.98	20.02	20.02	19.86	19.29	18.66	18.18	(90)

fLA = Living area ÷ (4) = 0.14 (91)

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

(92)m=	18.4	18.61	18.96	19.45	19.88	20.11	20.16	20.15	19.99	19.44	18.84	18.38	(92)

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

(93)m=	18.4	18.61	18.96	19.45	19.88	20.11	20.16	20.15	19.99	19.44	18.84	18.38	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.89	0.71	0.51	0.58	0.87	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	790.06	945.47	1103.86	1258.02	1277.73	1014.77	691.8	719.02	948.87	903.84	785.45	742.09	(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=	2870.45	2782.77	2523.15	2109.84	1630.91	1087.05	701.66	738.5	1167.03	1763.94	2353.55	2856.32	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1547.81	1234.66	1055.95	613.32	262.77	0	0	0	0	639.91	1129.03	1572.99	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 8056.43 (98)

Space heating requirement in kWh/m²/year 43.43 (99)

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

Space heating:

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

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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)	1547.81	1234.66	1055.95	613.32	262.77	0	0	0	0	639.91	1129.03	1572.99	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1655.41	1320.5	1129.36	655.95	281.03	0	0	0	0	684.4	1207.52	1682.34	(211)

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 8616.51 (211)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

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

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Output from water heater (calculated above)	223.11	196.61	206.4	184.91	181.12	161.72	155.2	170.46	170.21	191.75	202.9	217.7	
Efficiency of water heater													79.8 (216)
(217)m=	89	88.86	88.56	87.77	85.81	79.8	79.8	79.8	79.8	87.79	88.69	89.05	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	250.69	221.25	233.07	210.67	211.08	202.65	194.48	213.61	213.29	218.42	228.78	244.47	

Total = Sum(219a)$_{1...12}$ = 2642.47 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		8616.51	
Water heating fuel used		2642.47	
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		573.22	(232)

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	=	1861.17	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	570.77	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2431.94	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	297.5	(268)

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Total CO2, kg/year	sum of (265)…(271) =	2768.37	(272)
TER =		14.92	(273)

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on Friday, March 3, 2017

STUDIO11 architecture

Property Details: Plot 3

Dwelling type:	Detached House
Located in:	England
Region:	East Pennines
Cross ventilation possible:	Yes
Number of storeys:	2
Front of dwelling faces:	South East
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	
Ventilation rate during hot weather (ach):	3 (Windows open half the time)

Overheating Details:

Summer ventilation heat loss coefficient:	459.16	**(P1)**
Transmission heat loss coefficient:	129.5	
Summer heat loss coefficient:	588.68	**(P2)**

Overhangs:

Orientation:	Ratio:	Z_overhangs:
South East (W1)	0	1
South East (W2)	0	1
South East (W3)	0	1
South East (W4)	0	1
North West (W5)	0	1
North East (W6)	0	1
North East (W7)	0	1
South East (W8)	0	1
South East (W9)	0	1
South East (W10)	0	1
North East (W11)	0	1
North West (W12)	0	1
North West (W13)	0	1
North West (W14)	0	1
North West (D3)	0	1
North West (D4)	0	1

Solar shading:

Orientation:	Z blinds:	Solar access:	Overhangs:	Z summer:	
South East (W1)	1	0.9	1	0.9	**(P8)**
South East (W2)	1	0.9	1	0.9	**(P8)**
South East (W3)	1	0.9	1	0.9	**(P8)**
South East (W4)	1	0.9	1	0.9	**(P8)**
North West (W5)	1	0.9	1	0.9	**(P8)**
North East (W6)	1	0.9	1	0.9	**(P8)**
North East (W7)	1	0.9	1	0.9	**(P8)**
South East (W8)	1	0.9	1	0.9	**(P8)**
South East (W9)	1	0.9	1	0.9	**(P8)**
South East (W10)	1	0.9	1	0.9	**(P8)**
North East (W11)	1	0.9	1	0.9	**(P8)**

SAP 2012 Overheating Assessment

North West (W12)	1	0.9	1	0.9	**(P8)**
North West (W13)	1	0.9	1	0.9	**(P8)**
North West (W14)	1	0.9	1	0.9	**(P8)**
North West (D3)	1	0.9	1	0.9	**(P8)**
North West (D4)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
South East (W1)	0.9 x	2.39	113.91	0.63	0.7	0.9	97.25	
South East (W2)	0.9 x	0.84	113.91	0.63	0.7	0.9	34.18	
South East (W3)	0.9 x	0.84	113.91	0.63	0.7	0.9	34.18	
South East (W4)	0.9 x	2.39	113.91	0.63	0.7	0.9	97.25	
North West (W5)	0.9 x	1.86	91.1	0.63	0.7	0.9	60.53	
North East (W6)	0.9 x	0.96	91.1	0.63	0.7	0.9	31.24	
North East (W7)	0.9 x	1.44	91.1	0.63	0.7	0.9	46.86	
South East (W8)	0.9 x	2.12	113.91	0.63	0.7	0.9	86.26	
South East (W9)	0.9 x	1.61	113.91	0.63	0.7	0.9	65.51	
South East (W10)	0.9 x	2.12	113.91	0.63	0.7	0.9	86.26	
North East (W11)	0.9 x	2.12	91.1	0.63	0.7	0.9	68.99	
North West (W12)	0.9 x	1.26	91.1	0.63	0.7	0.9	41	
North West (W13)	0.9 x	2.12	91.1	0.63	0.7	0.9	68.99	
North West (W14)	0.9 x	0.66	91.1	0.63	0.7	0.9	21.48	
North West (D3)	0.9 x	3.15	91.1	0.63	0.7	0.9	102.51	
North West (D4)	0.9 x	3.78	91.1	0.63	0.7	0.9	123.01	
						Total	1065.5	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	679.85	653.27	663.63	
Total summer gains	1802.94	1718.76	1572.77	**(P5)**
Summer gain/loss ratio	3.06	2.92	2.67	**(P6)**
Mean summer external temperature (East Pennines)	14.6	16.6	16.4	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	17.91	19.77	19.32	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Not significant**	**Not significant**	

Assessment of likelihood of high internal temperature: Not significant