DER WorkSheet: New dwelling design stage

(86)m=	1	0.99	0.94	0.82	0.63	0.45	0.33	0.39	0.64	0.92	0.99	1	(86)

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

(87)m=	19.35	19.73	20.21	20.68	20.91	20.98	21	20.99	20.93	20.51	19.8	19.29	(87)

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

(88)m=	19.7	19.7	19.7	19.71	19.72	19.73	19.73	19.73	19.72	19.72	19.71	19.71	(88)

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

(89)m=	1	0.98	0.92	0.77	0.56	0.37	0.24	0.28	0.54	0.89	0.99	1	(89)

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

(90)m=	17.53	18.08	18.76	19.38	19.64	19.72	19.73	19.73	19.68	19.19	18.2	17.44	(90)

fLA = Living area ÷ (4) = 0.09 (91)

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

(92)m=	17.7	18.23	18.9	19.5	19.76	19.83	19.84	19.84	19.79	19.31	18.35	17.61	(92)

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

(93)m=	17.7	18.23	18.9	19.5	19.76	19.83	19.84	19.84	19.79	19.31	18.35	17.61	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.91	0.76	0.56	0.37	0.24	0.29	0.55	0.88	0.98	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	3286.57	5019.81	6491.31	7040.72	6013.07	4024.94	2514.77	2660.39	4242.54	4910.74	3671.01	2900.45	(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=	10682.1	10605.79	9841.59	8329.2	6321.04	4067.3	2519.9	2671.06	4439.48	6832.77	8855.87	10603.68	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	5502.27	3753.78	2492.61	927.71	229.13	0	0	0	0	1429.99	3733.1	5731.21	

Total per year (kWh/year) = Sum(98)$_{1,5,12}$ = 23799.79 (98)

Space heating requirement in kWh/m²/year 44.34 (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	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	7305.01	5750.75	5896.18	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.95	0.97	0.96	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	6946.88	5600.67	5654.45	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	12283.97	11746.14	10483.82	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	3842.71	4572.23	3593.05	0	0	0	0	

Total = Sum(104) = 12007.99 (104)

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Cooled fraction	f C = cooled area ÷ (4) =	0.75	(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	715.86	851.76	669.35	0	0	0	0

	Total = Sum(107) =	2236.96	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	4.17	(108)

9b. Energy requirements – Community heating scheme

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

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

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

Fraction of heat from Community CHP		0.87	(303a)
Fraction of community heat from heat source 2		0.13	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.87	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.13	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		23799.79	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	21741.11	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	3248.67	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2863.87	
If DHW from community scheme:			
Water heat from Community CHP	(64) x (303a) x (305) x (306) =	2616.14	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	390.92	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	279.97	(313)
Cooling System Energy Efficiency Ratio		4.32	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	517.81	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		0	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	0	(331)

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Energy for lighting (calculated in Appendix L)						992.09	(332)
12b. CO2 Emissions – Community heating scheme							
Electrical efficiency of CHP unit						27.2	(361)
Heat efficiency of CHP unit						66.8	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	32546.57	x	0.22		7030.06	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	8852.67	x	0.52		-4594.53	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	3916.38	x	0.22		845.94	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	1065.26	x	0.52		-552.87	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					90	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	873.5	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	145.3	(372)
Total CO2 associated with community systems	(363)...(366) + (368)...(372)				=	3747.4	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					3747.4	(376)
CO2 associated with space cooling	(315) x			0.52	=	268.75	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	514.9	(379)
Total CO2, kg/year	sum of (376)...(382) =					4531.04	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					8.44	(384)
EI rating (section 14)						89.56	(385)

APPENDIX (iv)

SAP L1A 2010 REGULATIONS COMPLIANCE REPORT
(SAP PROPOSED HOUSE CHECKLIST)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.1.21
Printed on 29 May 2015 at 18:11:03

Project Information

Assessed By: Ondrej Gajdos (STRO006629) **Building Type:** Detached House

Dwelling Details

NEW DWELLING DESIGN STAGE Total Floor Area: 536.8m²
Site Reference : 17 Branch Hill **Plot Reference:** Proposed House
Address : 17, Branch Hill, LONDON, NW3 7NA

Client Details

Name:
Address :

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

1a TER and DER

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

Target Carbon Dioxide Emission Rate (TER)	13.58 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	8.44 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	62.2 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	52.7 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.16 (max. 0.30)	0.16 (max. 0.70)	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.15 (max. 0.20)	0.15 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (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:	Community heating schemes - CommCHP
Secondary heating system:	None

5 Cylinder insulation

Hot water Storage:	Nominal cylinder loss: 3.50 kWh/day Permitted by DBSCG: 3.92 kWh/day	
Primary pipework insulated:	Yes	OK

6 Controls

Space heating controls	Charging system linked to use of community heating, programmer and at least two room thermostats	OK
Hot water controls:	Cylinderstat	OK

Regulations Compliance Report

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 (Thames valley):	Medium	OK
Based on:		
Overshading:	Average or unknown	
Windows facing: North East	4.67m²,	
Windows facing: North East	2.25m²,	
Windows facing: North East	3.36m²,	
Windows facing: North West	1m²,	
Windows facing: South East	1m²,	
Windows facing: North West	0.4m²,	
Windows facing: North West	13.33m²,	
Windows facing: North West	3.2m²,	
Windows facing: South West	7.97m²,	
Windows facing: South West	7.56m²,	
Windows facing: South West	4.32m²,	
Windows facing: South West	20.66m²,	
Windows facing: South West	9.8m²,	
Windows facing: South West	9.87m²,	
Windows facing: South West	10.12m²,	
Windows facing: South East	30.15m²,	
Windows facing: North West	2.35m²,	
Windows facing: South East	6.63m²,	
Windows facing: South East	2.65m²,	
Windows facing: South East	4.9m²,	
Windows facing: South East	2.24m²,	
Windows facing: South East	0.36m²,	
Windows facing: South East	1.92m²,	
Windows facing: South East	2.21m²,	
Windows facing: South East	0.32m²,	
Windows facing: South West	11.61m²,	
Windows facing: South West	12.37m²,	
Windows facing: South West	12.1m²,	
Windows facing: South West	4.51m²,	
Roof windows facing: Horizontal	24m²	
Roof windows facing: Horizontal	3.49m²	
Roof windows facing: Horizontal	5.22m²	
Roof windows facing: Horizontal	2.58m²	
Roof windows facing: Horizontal	1.4m²	
Ventilation rate:	4.00	
Blinds/curtains:	Closed 100% of daylight hours	
10 Key features		
Doors U-value	1 W/m²K	

Regulations Compliance Report

Community heating, heat from CHP

Fixed cooling system

APPENDIX (v)

SAP L1A 2010 REGULATIONS COMPLIANCE REPORT
(PROPOSED HOUSE SAP WORKSHEETS)

SAP WorkSheet: New dwelling design stage

User Details

Assessor Name:	Ondrej Gajdos	**Stroma Number:**	STRO006629
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.21

Property Address: Proposed House

Address : 17, Branch Hill, LONDON, NW3 7NA

1. Overall dwelling dimensions

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	230	(1a) x	2.7	(2a) =	621	(3a)
Ground floor	164.6	(1b) x	3.6	(2b) =	592.56	(3b)
First floor	142.2	(1c) x	3.1	(2c) =	440.82	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	536.8	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		1654.38	(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	+	3	+	0	=	3	x 20 =	60	(6b)
Number of intermittent fans							10	x 10 =	100	(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) =	160	÷ (5) =	0.1 (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)			0.35 (18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered			1 (19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.92 (20)
Infiltration rate incorporating shelter factor		(21) = (18) x (20) =	0.32 (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

0.41	0.4	0.39	0.35	0.34	0.3	0.3	0.3	0.32	0.34	0.36	0.38

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

(24a)

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

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

(24b)

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

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

(24c)

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

(24d)m=	0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.57	0.57

(24d)

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

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

(25)

3. Heat losses and heat loss parameter

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x 1	= 2			(26)
Windows Type 1			4.67	x1/[1/(1.3)+ 0.04]	= 5.77			(27)
Windows Type 2			2.25	x1/[1/(1.3)+ 0.04]	= 2.78			(27)
Windows Type 3			1.68	x1/[1/(1.3)+ 0.04]	= 2.08			(27)
Windows Type 4			1	x1/[1/(1.3)+ 0.04]	= 1.24			(27)
Windows Type 5			1	x1/[1/(1.3)+ 0.04]	= 1.24			(27)
Windows Type 6			0.4	x1/[1/(1.3)+ 0.04]	= 0.49			(27)
Windows Type 7			13.33	x1/[1/(1.3)+ 0.04]	= 16.47			(27)
Windows Type 8			0.64	x1/[1/(1.3)+ 0.04]	= 0.79			(27)
Windows Type 9			7.97	x1/[1/(1.3)+ 0.04]	= 9.85			(27)
Windows Type 10			7.56	x1/[1/(1.3)+ 0.04]	= 9.34			(27)
Windows Type 11			4.32	x1/[1/(1.3)+ 0.04]	= 5.34			(27)
Windows Type 12			10.33	x1/[1/(1.3)+ 0.04]	= 12.77			(27)
Windows Type 13			9.8	x1/[1/(1.3)+ 0.04]	= 12.11			(27)
Windows Type 14			9.87	x1/[1/(1.3)+ 0.04]	= 12.2			(27)
Windows Type 15			10.12	x1/[1/(1.3)+ 0.04]	= 12.51			(27)
Windows Type 16			30.15	x1/[1/(1.3)+ 0.04]	= 37.26			(27)

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Windows Type 17			2.35	x1/[1/(1.3)+ 0.04] =	2.9					(27)
Windows Type 18			6.63	x1/[1/(1.3)+ 0.04] =	8.19					(27)
Windows Type 19			2.65	x1/[1/(1.3)+ 0.04] =	3.27					(27)
Windows Type 20			4.9	x1/[1/(1.3)+ 0.04] =	6.06					(27)
Windows Type 21			2.24	x1/[1/(1.3)+ 0.04] =	2.77					(27)
Windows Type 22			0.36	x1/[1/(1.3)+ 0.04] =	0.44					(27)
Windows Type 23			0.64	x1/[1/(1.3)+ 0.04] =	0.79					(27)
Windows Type 24			2.21	x1/[1/(1.3)+ 0.04] =	2.73					(27)
Windows Type 25			0.32	x1/[1/(1.3)+ 0.04] =	0.4					(27)
Windows Type 26			11.61	x1/[1/(1.3)+ 0.04] =	14.35					(27)
Windows Type 27			12.37	x1/[1/(1.3)+ 0.04] =	15.29					(27)
Windows Type 28			12.1	x1/[1/(1.3)+ 0.04] =	14.95					(27)
Windows Type 29			4.51	x1/[1/(1.3)+ 0.04] =	5.57					(27)
Rooflights Type 1			24	x1/[1/(1.3) + 0.04] =	31.2					(27b)
Rooflights Type 2			3.49	x1/[1/(1.3) + 0.04] =	4.537					(27b)
Rooflights Type 3			5.22	x1/[1/(1.3) + 0.04] =	6.785999					(27b)
Rooflights Type 4			2.58	x1/[1/(1.3) + 0.04] =	3.354					(27b)
Rooflights Type 5			0.7	x1/[1/(1.3) + 0.04] =	0.91					(27b)
Floor Type 1			230	x 0.13 =	29.9					(28)
Floor Type 2			1.1	x 0.13 =	0.143					(28)
Walls Type1	100.34	2	98.34	x 0.16 =	15.73					(29)
Walls Type2	503.39	193.83	309.56	x 0.16 =	49.53					(29)
Roof Type1	61.1	8.71	52.39	x 0.15 =	7.86					(30)
Roof Type2	21.9	0	21.9	x 0.15 =	3.29					(30)
Roof Type3	142.2	27.98	114.22	x 0.15 =	17.13					(30)
Total area of elements, m²			1060.03							(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) =	410.45 (33)
Heat capacity Cm = S(A x k)	((28)...(30) + (32) + (32a)...(32e) =	0 (34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K	68.37 (36)

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

Total fabric heat loss	(33) + (36) =	478.82 (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=	318.61	316.84	315.1	306.95	305.42	298.31	298.31	297	301.05	305.42	308.51	311.74	(38)

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

(39)m=	797.43	795.66	793.92	785.76	784.24	777.13	777.13	775.81	779.87	784.24	787.32	790.55	

Average = Sum(39)$_{1\ldots12}$ /12= 785.75 (39)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.49	1.48	1.48	1.46	1.46	1.45	1.45	1.45	1.45	1.46	1.47	1.47	

Average = Sum(40)$_{1..12}$ /12= 1.46 (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 3.44 (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) + 36 115.89 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	127.48	122.85	118.21	113.58	108.94	104.31	104.31	108.94	113.58	118.21	122.85	127.48	

Total = Sum(44)$_{1..12}$ = 1390.73 (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=	189.06	165.35	170.63	148.76	142.73	123.17	114.13	130.97	132.53	154.46	168.6	183.09	

Total = Sum(45)$_{1..12}$ = 1823.47 (45)

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

(46)m=	28.36	24.8	25.59	22.31	21.41	18.48	17.12	19.65	19.88	23.17	25.29	27.46	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 500 (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): 3.5 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 2.1 (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) 2.1 (55)

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

(56)m=	65.1	58.8	65.1	63	65.1	63	65.1	65.1	63	65.1	63	65.1	(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=	65.1	58.8	65.1	63	65.1	63	65.1	65.1	63	65.1	63	65.1	(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)

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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=	277.42	245.16	258.99	234.27	231.1	208.68	202.5	219.33	218.05	242.82	254.11	271.45	(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=	277.42	245.16	258.99	234.27	231.1	208.68	202.5	219.33	218.05	242.82	254.11	271.45	

Output from water heater (annual)$_{112}$ 2863.87 (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=	133.55	118.83	127.42	117.87	118.15	109.36	108.64	114.24	112.48	122.05	124.47	131.57	(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=	206.39	206.39	206.39	206.39	206.39	206.39	206.39	206.39	206.39	206.39	206.39	206.39	(66)

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

(67)m=	140.44	124.74	101.44	76.8	57.41	48.47	52.37	68.07	91.37	116.01	135.4	144.34	(67)

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

(68)m=	940.49	950.25	925.66	873.3	807.21	745.09	703.6	693.84	718.43	770.79	836.88	898.99	(68)

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

(69)m=	59.08	59.08	59.08	59.08	59.08	59.08	59.08	59.08	59.08	59.08	59.08	59.08	(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=	-137.59	-137.59	-137.59	-137.59	-137.59	-137.59	-137.59	-137.59	-137.59	-137.59	-137.59	-137.59	(71)

Water heating gains (Table 5)

(72)m=	179.5	176.83	171.27	163.71	158.8	151.89	146.02	153.55	156.22	164.04	172.87	176.84	(72)

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

(73)m=	1388.31	1379.69	1326.24	1241.68	1151.29	1073.33	1029.86	1043.33	1093.89	1178.71	1273.03	1348.05	(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	0.54	x	4.67	x	11.28	x	0.63	x	0.7	=	11.29	(75)
Northeast 0.9x	0.54	x	2.25	x	11.28	x	0.63	x	0.7	=	5.44	(75)
Northeast 0.9x	0.77	x	1.68	x	11.28	x	0.63	x	0.7	=	11.59	(75)
Northeast 0.9x	0.54	x	4.67	x	22.97	x	0.63	x	0.7	=	22.99	(75)
Northeast 0.9x	0.54	x	2.25	x	22.97	x	0.63	x	0.7	=	11.08	(75)

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Northeast	0.9x	0.77	x	1.68	x	22.97	x	0.63	x	0.7	=	23.58	(75)
Northeast	0.9x	0.54	x	4.67	x	41.38	x	0.63	x	0.7	=	41.42	(75)
Northeast	0.9x	0.54	x	2.25	x	41.38	x	0.63	x	0.7	=	19.95	(75)
Northeast	0.9x	0.77	x	1.68	x	41.38	x	0.63	x	0.7	=	42.49	(75)
Northeast	0.9x	0.54	x	4.67	x	67.96	x	0.63	x	0.7	=	68.02	(75)
Northeast	0.9x	0.54	x	2.25	x	67.96	x	0.63	x	0.7	=	32.77	(75)
Northeast	0.9x	0.77	x	1.68	x	67.96	x	0.63	x	0.7	=	69.78	(75)
Northeast	0.9x	0.54	x	4.67	x	91.35	x	0.63	x	0.7	=	91.43	(75)
Northeast	0.9x	0.54	x	2.25	x	91.35	x	0.63	x	0.7	=	44.05	(75)
Northeast	0.9x	0.77	x	1.68	x	91.35	x	0.63	x	0.7	=	93.8	(75)
Northeast	0.9x	0.54	x	4.67	x	97.38	x	0.63	x	0.7	=	97.47	(75)
Northeast	0.9x	0.54	x	2.25	x	97.38	x	0.63	x	0.7	=	46.96	(75)
Northeast	0.9x	0.77	x	1.68	x	97.38	x	0.63	x	0.7	=	100	(75)
Northeast	0.9x	0.54	x	4.67	x	91.1	x	0.63	x	0.7	=	91.18	(75)
Northeast	0.9x	0.54	x	2.25	x	91.1	x	0.63	x	0.7	=	43.93	(75)
Northeast	0.9x	0.77	x	1.68	x	91.1	x	0.63	x	0.7	=	93.55	(75)
Northeast	0.9x	0.54	x	4.67	x	72.63	x	0.63	x	0.7	=	72.69	(75)
Northeast	0.9x	0.54	x	2.25	x	72.63	x	0.63	x	0.7	=	35.02	(75)
Northeast	0.9x	0.77	x	1.68	x	72.63	x	0.63	x	0.7	=	74.58	(75)
Northeast	0.9x	0.54	x	4.67	x	50.42	x	0.63	x	0.7	=	50.47	(75)
Northeast	0.9x	0.54	x	2.25	x	50.42	x	0.63	x	0.7	=	24.31	(75)
Northeast	0.9x	0.77	x	1.68	x	50.42	x	0.63	x	0.7	=	51.77	(75)
Northeast	0.9x	0.54	x	4.67	x	28.07	x	0.63	x	0.7	=	28.09	(75)
Northeast	0.9x	0.54	x	2.25	x	28.07	x	0.63	x	0.7	=	13.53	(75)
Northeast	0.9x	0.77	x	1.68	x	28.07	x	0.63	x	0.7	=	28.82	(75)
Northeast	0.9x	0.54	x	4.67	x	14.2	x	0.63	x	0.7	=	14.21	(75)
Northeast	0.9x	0.54	x	2.25	x	14.2	x	0.63	x	0.7	=	6.85	(75)
Northeast	0.9x	0.77	x	1.68	x	14.2	x	0.63	x	0.7	=	14.58	(75)
Northeast	0.9x	0.54	x	4.67	x	9.21	x	0.63	x	0.7	=	9.22	(75)
Northeast	0.9x	0.54	x	2.25	x	9.21	x	0.63	x	0.7	=	4.44	(75)
Northeast	0.9x	0.77	x	1.68	x	9.21	x	0.63	x	0.7	=	9.46	(75)
Southeast	0.9x	0.77	x	1	x	36.79	x	0.63	x	0.7	=	11.24	(77)
Southeast	0.9x	0.77	x	30.15	x	36.79	x	0.63	x	0.7	=	339.03	(77)
Southeast	0.9x	0.77	x	6.63	x	36.79	x	0.63	x	0.7	=	74.55	(77)
Southeast	0.9x	0.77	x	2.65	x	36.79	x	0.63	x	0.7	=	29.8	(77)
Southeast	0.9x	0.77	x	4.9	x	36.79	x	0.63	x	0.7	=	55.1	(77)
Southeast	0.9x	0.77	x	2.24	x	36.79	x	0.63	x	0.7	=	25.19	(77)
Southeast	0.9x	0.77	x	0.36	x	36.79	x	0.63	x	0.7	=	4.05	(77)
Southeast	0.9x	0.77	x	0.64	x	36.79	x	0.63	x	0.7	=	21.59	(77)
Southeast	0.9x	0.77	x	2.21	x	36.79	x	0.63	x	0.7	=	24.85	(77)
Southeast	0.9x	0.77	x	0.32	x	36.79	x	0.63	x	0.7	=	3.6	(77)

Southeast 0.9x	0.77	x	1	x	62.67	x	0.63	x	0.7	=	19.15	(77)
Southeast 0.9x	0.77	x	30.15	x	62.67	x	0.63	x	0.7	=	577.49	(77)
Southeast 0.9x	0.77	x	6.63	x	62.67	x	0.63	x	0.7	=	126.99	(77)
Southeast 0.9x	0.77	x	2.65	x	62.67	x	0.63	x	0.7	=	50.76	(77)
Southeast 0.9x	0.77	x	4.9	x	62.67	x	0.63	x	0.7	=	93.85	(77)
Southeast 0.9x	0.77	x	2.24	x	62.67	x	0.63	x	0.7	=	42.9	(77)
Southeast 0.9x	0.77	x	0.36	x	62.67	x	0.63	x	0.7	=	6.9	(77)
Southeast 0.9x	0.77	x	0.64	x	62.67	x	0.63	x	0.7	=	36.78	(77)
Southeast 0.9x	0.77	x	2.21	x	62.67	x	0.63	x	0.7	=	42.33	(77)
Southeast 0.9x	0.77	x	0.32	x	62.67	x	0.63	x	0.7	=	6.13	(77)
Southeast 0.9x	0.77	x	1	x	85.75	x	0.63	x	0.7	=	26.21	(77)
Southeast 0.9x	0.77	x	30.15	x	85.75	x	0.63	x	0.7	=	790.14	(77)
Southeast 0.9x	0.77	x	6.63	x	85.75	x	0.63	x	0.7	=	173.75	(77)
Southeast 0.9x	0.77	x	2.65	x	85.75	x	0.63	x	0.7	=	69.45	(77)
Southeast 0.9x	0.77	x	4.9	x	85.75	x	0.63	x	0.7	=	128.41	(77)
Southeast 0.9x	0.77	x	2.24	x	85.75	x	0.63	x	0.7	=	58.7	(77)
Southeast 0.9x	0.77	x	0.36	x	85.75	x	0.63	x	0.7	=	9.43	(77)
Southeast 0.9x	0.77	x	0.64	x	85.75	x	0.63	x	0.7	=	50.32	(77)
Southeast 0.9x	0.77	x	2.21	x	85.75	x	0.63	x	0.7	=	57.92	(77)
Southeast 0.9x	0.77	x	0.32	x	85.75	x	0.63	x	0.7	=	8.39	(77)
Southeast 0.9x	0.77	x	1	x	106.25	x	0.63	x	0.7	=	32.47	(77)
Southeast 0.9x	0.77	x	30.15	x	106.25	x	0.63	x	0.7	=	979.03	(77)
Southeast 0.9x	0.77	x	6.63	x	106.25	x	0.63	x	0.7	=	215.29	(77)
Southeast 0.9x	0.77	x	2.65	x	106.25	x	0.63	x	0.7	=	86.05	(77)
Southeast 0.9x	0.77	x	4.9	x	106.25	x	0.63	x	0.7	=	159.11	(77)
Southeast 0.9x	0.77	x	2.24	x	106.25	x	0.63	x	0.7	=	72.74	(77)
Southeast 0.9x	0.77	x	0.36	x	106.25	x	0.63	x	0.7	=	11.69	(77)
Southeast 0.9x	0.77	x	0.64	x	106.25	x	0.63	x	0.7	=	62.35	(77)
Southeast 0.9x	0.77	x	2.21	x	106.25	x	0.63	x	0.7	=	71.76	(77)
Southeast 0.9x	0.77	x	0.32	x	106.25	x	0.63	x	0.7	=	10.39	(77)
Southeast 0.9x	0.77	x	1	x	119.01	x	0.63	x	0.7	=	36.37	(77)
Southeast 0.9x	0.77	x	30.15	x	119.01	x	0.63	x	0.7	=	1096.59	(77)
Southeast 0.9x	0.77	x	6.63	x	119.01	x	0.63	x	0.7	=	241.14	(77)
Southeast 0.9x	0.77	x	2.65	x	119.01	x	0.63	x	0.7	=	96.38	(77)
Southeast 0.9x	0.77	x	4.9	x	119.01	x	0.63	x	0.7	=	178.22	(77)
Southeast 0.9x	0.77	x	2.24	x	119.01	x	0.63	x	0.7	=	81.47	(77)
Southeast 0.9x	0.77	x	0.36	x	119.01	x	0.63	x	0.7	=	13.09	(77)
Southeast 0.9x	0.77	x	0.64	x	119.01	x	0.63	x	0.7	=	69.83	(77)
Southeast 0.9x	0.77	x	2.21	x	119.01	x	0.63	x	0.7	=	80.38	(77)
Southeast 0.9x	0.77	x	0.32	x	119.01	x	0.63	x	0.7	=	11.64	(77)
Southeast 0.9x	0.77	x	1	x	118.15	x	0.63	x	0.7	=	36.11	(77)

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Southeast	0.9x	0.77	x	30.15	x	118.15	x	0.63	x	0.7	=	1088.66	(77)
Southeast	0.9x	0.77	x	6.63	x	118.15	x	0.63	x	0.7	=	239.4	(77)
Southeast	0.9x	0.77	x	2.65	x	118.15	x	0.63	x	0.7	=	95.69	(77)
Southeast	0.9x	0.77	x	4.9	x	118.15	x	0.63	x	0.7	=	176.93	(77)
Southeast	0.9x	0.77	x	2.24	x	118.15	x	0.63	x	0.7	=	80.88	(77)
Southeast	0.9x	0.77	x	0.36	x	118.15	x	0.63	x	0.7	=	13	(77)
Southeast	0.9x	0.77	x	0.64	x	118.15	x	0.63	x	0.7	=	69.33	(77)
Southeast	0.9x	0.77	x	2.21	x	118.15	x	0.63	x	0.7	=	79.8	(77)
Southeast	0.9x	0.77	x	0.32	x	118.15	x	0.63	x	0.7	=	11.55	(77)
Southeast	0.9x	0.77	x	1	x	113.91	x	0.63	x	0.7	=	34.81	(77)
Southeast	0.9x	0.77	x	30.15	x	113.91	x	0.63	x	0.7	=	1049.59	(77)
Southeast	0.9x	0.77	x	6.63	x	113.91	x	0.63	x	0.7	=	230.8	(77)
Southeast	0.9x	0.77	x	2.65	x	113.91	x	0.63	x	0.7	=	92.25	(77)
Southeast	0.9x	0.77	x	4.9	x	113.91	x	0.63	x	0.7	=	170.58	(77)
Southeast	0.9x	0.77	x	2.24	x	113.91	x	0.63	x	0.7	=	77.98	(77)
Southeast	0.9x	0.77	x	0.36	x	113.91	x	0.63	x	0.7	=	12.53	(77)
Southeast	0.9x	0.77	x	0.64	x	113.91	x	0.63	x	0.7	=	66.84	(77)
Southeast	0.9x	0.77	x	2.21	x	113.91	x	0.63	x	0.7	=	76.93	(77)
Southeast	0.9x	0.77	x	0.32	x	113.91	x	0.63	x	0.7	=	11.14	(77)
Southeast	0.9x	0.77	x	1	x	104.39	x	0.63	x	0.7	=	31.9	(77)
Southeast	0.9x	0.77	x	30.15	x	104.39	x	0.63	x	0.7	=	961.88	(77)
Southeast	0.9x	0.77	x	6.63	x	104.39	x	0.63	x	0.7	=	211.52	(77)
Southeast	0.9x	0.77	x	2.65	x	104.39	x	0.63	x	0.7	=	84.54	(77)
Southeast	0.9x	0.77	x	4.9	x	104.39	x	0.63	x	0.7	=	156.33	(77)
Southeast	0.9x	0.77	x	2.24	x	104.39	x	0.63	x	0.7	=	71.46	(77)
Southeast	0.9x	0.77	x	0.36	x	104.39	x	0.63	x	0.7	=	11.49	(77)
Southeast	0.9x	0.77	x	0.64	x	104.39	x	0.63	x	0.7	=	61.25	(77)
Southeast	0.9x	0.77	x	2.21	x	104.39	x	0.63	x	0.7	=	70.51	(77)
Southeast	0.9x	0.77	x	0.32	x	104.39	x	0.63	x	0.7	=	10.21	(77)
Southeast	0.9x	0.77	x	1	x	92.85	x	0.63	x	0.7	=	28.38	(77)
Southeast	0.9x	0.77	x	30.15	x	92.85	x	0.63	x	0.7	=	855.56	(77)
Southeast	0.9x	0.77	x	6.63	x	92.85	x	0.63	x	0.7	=	188.14	(77)
Southeast	0.9x	0.77	x	2.65	x	92.85	x	0.63	x	0.7	=	75.2	(77)
Southeast	0.9x	0.77	x	4.9	x	92.85	x	0.63	x	0.7	=	139.05	(77)
Southeast	0.9x	0.77	x	2.24	x	92.85	x	0.63	x	0.7	=	63.56	(77)
Southeast	0.9x	0.77	x	0.36	x	92.85	x	0.63	x	0.7	=	10.22	(77)
Southeast	0.9x	0.77	x	0.64	x	92.85	x	0.63	x	0.7	=	54.48	(77)
Southeast	0.9x	0.77	x	2.21	x	92.85	x	0.63	x	0.7	=	62.71	(77)
Southeast	0.9x	0.77	x	0.32	x	92.85	x	0.63	x	0.7	=	9.08	(77)
Southeast	0.9x	0.77	x	1	x	69.27	x	0.63	x	0.7	=	21.17	(77)
Southeast	0.9x	0.77	x	30.15	x	69.27	x	0.63	x	0.7	=	638.25	(77)

Southeast	0.9x	0.77	x	6.63	x	69.27	x	0.63	x	0.7	=	140.35	(77)
Southeast	0.9x	0.77	x	2.65	x	69.27	x	0.63	x	0.7	=	56.1	(77)
Southeast	0.9x	0.77	x	4.9	x	69.27	x	0.63	x	0.7	=	103.73	(77)
Southeast	0.9x	0.77	x	2.24	x	69.27	x	0.63	x	0.7	=	47.42	(77)
Southeast	0.9x	0.77	x	0.36	x	69.27	x	0.63	x	0.7	=	7.62	(77)
Southeast	0.9x	0.77	x	0.64	x	69.27	x	0.63	x	0.7	=	40.64	(77)
Southeast	0.9x	0.77	x	2.21	x	69.27	x	0.63	x	0.7	=	46.78	(77)
Southeast	0.9x	0.77	x	0.32	x	69.27	x	0.63	x	0.7	=	6.77	(77)
Southeast	0.9x	0.77	x	1	x	44.07	x	0.63	x	0.7	=	13.47	(77)
Southeast	0.9x	0.77	x	30.15	x	44.07	x	0.63	x	0.7	=	406.08	(77)
Southeast	0.9x	0.77	x	6.63	x	44.07	x	0.63	x	0.7	=	89.3	(77)
Southeast	0.9x	0.77	x	2.65	x	44.07	x	0.63	x	0.7	=	35.69	(77)
Southeast	0.9x	0.77	x	4.9	x	44.07	x	0.63	x	0.7	=	66	(77)
Southeast	0.9x	0.77	x	2.24	x	44.07	x	0.63	x	0.7	=	30.17	(77)
Southeast	0.9x	0.77	x	0.36	x	44.07	x	0.63	x	0.7	=	4.85	(77)
Southeast	0.9x	0.77	x	0.64	x	44.07	x	0.63	x	0.7	=	25.86	(77)
Southeast	0.9x	0.77	x	2.21	x	44.07	x	0.63	x	0.7	=	29.77	(77)
Southeast	0.9x	0.77	x	0.32	x	44.07	x	0.63	x	0.7	=	4.31	(77)
Southeast	0.9x	0.77	x	1	x	31.49	x	0.63	x	0.7	=	9.62	(77)
Southeast	0.9x	0.77	x	30.15	x	31.49	x	0.63	x	0.7	=	290.14	(77)
Southeast	0.9x	0.77	x	6.63	x	31.49	x	0.63	x	0.7	=	63.8	(77)
Southeast	0.9x	0.77	x	2.65	x	31.49	x	0.63	x	0.7	=	25.5	(77)
Southeast	0.9x	0.77	x	4.9	x	31.49	x	0.63	x	0.7	=	47.15	(77)
Southeast	0.9x	0.77	x	2.24	x	31.49	x	0.63	x	0.7	=	21.56	(77)
Southeast	0.9x	0.77	x	0.36	x	31.49	x	0.63	x	0.7	=	3.46	(77)
Southeast	0.9x	0.77	x	0.64	x	31.49	x	0.63	x	0.7	=	18.48	(77)
Southeast	0.9x	0.77	x	2.21	x	31.49	x	0.63	x	0.7	=	21.27	(77)
Southeast	0.9x	0.77	x	0.32	x	31.49	x	0.63	x	0.7	=	3.08	(77)
Southwest	0.9x	0.77	x	7.97	x	36.79		0.63	x	0.7	=	89.62	(79)
Southwest	0.9x	0.77	x	7.56	x	36.79		0.63	x	0.7	=	85.01	(79)
Southwest	0.9x	0.77	x	4.32	x	36.79		0.63	x	0.7	=	48.58	(79)
Southwest	0.9x	0.77	x	10.33	x	36.79		0.63	x	0.7	=	232.31	(79)
Southwest	0.9x	0.77	x	9.8	x	36.79		0.63	x	0.7	=	110.2	(79)
Southwest	0.9x	0.77	x	9.87	x	36.79		0.63	x	0.7	=	110.98	(79)
Southwest	0.9x	0.77	x	10.12	x	36.79		0.63	x	0.7	=	113.8	(79)
Southwest	0.9x	0.77	x	11.61	x	36.79		0.63	x	0.7	=	130.55	(79)
Southwest	0.9x	0.77	x	12.37	x	36.79		0.63	x	0.7	=	139.1	(79)
Southwest	0.9x	0.77	x	12.1	x	36.79		0.63	x	0.7	=	136.06	(79)
Southwest	0.9x	1	x	4.51	x	36.79		0.63	x	0.7	=	65.86	(79)
Southwest	0.9x	0.77	x	7.97	x	62.67		0.63	x	0.7	=	152.66	(79)
Southwest	0.9x	0.77	x	7.56	x	62.67		0.63	x	0.7	=	144.8	(79)

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Southwest 0.9x	0.77	x	4.32	x	62.67		0.63	x	0.7	=	82.74	(79)
Southwest 0.9x	0.77	x	10.33	x	62.67		0.63	x	0.7	=	395.72	(79)
Southwest 0.9x	0.77	x	9.8	x	62.67		0.63	x	0.7	=	187.71	(79)
Southwest 0.9x	0.77	x	9.87	x	62.67		0.63	x	0.7	=	189.05	(79)
Southwest 0.9x	0.77	x	10.12	x	62.67		0.63	x	0.7	=	193.84	(79)
Southwest 0.9x	0.77	x	11.61	x	62.67		0.63	x	0.7	=	222.38	(79)
Southwest 0.9x	0.77	x	12.37	x	62.67		0.63	x	0.7	=	236.93	(79)
Southwest 0.9x	0.77	x	12.1	x	62.67		0.63	x	0.7	=	231.76	(79)
Southwest 0.9x	1	x	4.51	x	62.67		0.63	x	0.7	=	112.19	(79)
Southwest 0.9x	0.77	x	7.97	x	85.75		0.63	x	0.7	=	208.87	(79)
Southwest 0.9x	0.77	x	7.56	x	85.75		0.63	x	0.7	=	198.13	(79)
Southwest 0.9x	0.77	x	4.32	x	85.75		0.63	x	0.7	=	113.21	(79)
Southwest 0.9x	0.77	x	10.33	x	85.75		0.63	x	0.7	=	541.44	(79)
Southwest 0.9x	0.77	x	9.8	x	85.75		0.63	x	0.7	=	256.83	(79)
Southwest 0.9x	0.77	x	9.87	x	85.75		0.63	x	0.7	=	258.66	(79)
Southwest 0.9x	0.77	x	10.12	x	85.75		0.63	x	0.7	=	265.22	(79)
Southwest 0.9x	0.77	x	11.61	x	85.75		0.63	x	0.7	=	304.26	(79)
Southwest 0.9x	0.77	x	12.37	x	85.75		0.63	x	0.7	=	324.18	(79)
Southwest 0.9x	0.77	x	12.1	x	85.75		0.63	x	0.7	=	317.11	(79)
Southwest 0.9x	1	x	4.51	x	85.75		0.63	x	0.7	=	153.5	(79)
Southwest 0.9x	0.77	x	7.97	x	106.25		0.63	x	0.7	=	258.8	(79)
Southwest 0.9x	0.77	x	7.56	x	106.25		0.63	x	0.7	=	245.49	(79)
Southwest 0.9x	0.77	x	4.32	x	106.25		0.63	x	0.7	=	140.28	(79)
Southwest 0.9x	0.77	x	10.33	x	106.25		0.63	x	0.7	=	670.87	(79)
Southwest 0.9x	0.77	x	9.8	x	106.25		0.63	x	0.7	=	318.22	(79)
Southwest 0.9x	0.77	x	9.87	x	106.25		0.63	x	0.7	=	320.5	(79)
Southwest 0.9x	0.77	x	10.12	x	106.25		0.63	x	0.7	=	328.62	(79)
Southwest 0.9x	0.77	x	11.61	x	106.25		0.63	x	0.7	=	377	(79)
Southwest 0.9x	0.77	x	12.37	x	106.25		0.63	x	0.7	=	401.68	(79)
Southwest 0.9x	0.77	x	12.1	x	106.25		0.63	x	0.7	=	392.91	(79)
Southwest 0.9x	1	x	4.51	x	106.25		0.63	x	0.7	=	190.19	(79)
Southwest 0.9x	0.77	x	7.97	x	119.01		0.63	x	0.7	=	289.88	(79)
Southwest 0.9x	0.77	x	7.56	x	119.01		0.63	x	0.7	=	274.97	(79)
Southwest 0.9x	0.77	x	4.32	x	119.01		0.63	x	0.7	=	157.12	(79)
Southwest 0.9x	0.77	x	10.33	x	119.01		0.63	x	0.7	=	751.43	(79)
Southwest 0.9x	0.77	x	9.8	x	119.01		0.63	x	0.7	=	356.44	(79)
Southwest 0.9x	0.77	x	9.87	x	119.01		0.63	x	0.7	=	358.98	(79)
Southwest 0.9x	0.77	x	10.12	x	119.01		0.63	x	0.7	=	368.08	(79)
Southwest 0.9x	0.77	x	11.61	x	119.01		0.63	x	0.7	=	422.27	(79)
Southwest 0.9x	0.77	x	12.37	x	119.01		0.63	x	0.7	=	449.91	(79)
Southwest 0.9x	0.77	x	12.1	x	119.01		0.63	x	0.7	=	440.09	(79)

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Southwest	0.9x	1	x	4.51	x	119.01		0.63	x	0.7	=	213.03	(79)
Southwest	0.9x	0.77	x	7.97	x	118.15		0.63	x	0.7	=	287.78	(79)
Southwest	0.9x	0.77	x	7.56	x	118.15		0.63	x	0.7	=	272.98	(79)
Southwest	0.9x	0.77	x	4.32	x	118.15		0.63	x	0.7	=	155.99	(79)
Southwest	0.9x	0.77	x	10.33	x	118.15		0.63	x	0.7	=	746	(79)
Southwest	0.9x	0.77	x	9.8	x	118.15		0.63	x	0.7	=	353.86	(79)
Southwest	0.9x	0.77	x	9.87	x	118.15		0.63	x	0.7	=	356.39	(79)
Southwest	0.9x	0.77	x	10.12	x	118.15		0.63	x	0.7	=	365.41	(79)
Southwest	0.9x	0.77	x	11.61	x	118.15		0.63	x	0.7	=	419.22	(79)
Southwest	0.9x	0.77	x	12.37	x	118.15		0.63	x	0.7	=	446.66	(79)
Southwest	0.9x	0.77	x	12.1	x	118.15		0.63	x	0.7	=	436.91	(79)
Southwest	0.9x	1	x	4.51	x	118.15		0.63	x	0.7	=	211.49	(79)
Southwest	0.9x	0.77	x	7.97	x	113.91		0.63	x	0.7	=	277.45	(79)
Southwest	0.9x	0.77	x	7.56	x	113.91		0.63	x	0.7	=	263.18	(79)
Southwest	0.9x	0.77	x	4.32	x	113.91		0.63	x	0.7	=	150.39	(79)
Southwest	0.9x	0.77	x	10.33	x	113.91		0.63	x	0.7	=	719.22	(79)
Southwest	0.9x	0.77	x	9.8	x	113.91		0.63	x	0.7	=	341.16	(79)
Southwest	0.9x	0.77	x	9.87	x	113.91		0.63	x	0.7	=	343.6	(79)
Southwest	0.9x	0.77	x	10.12	x	113.91		0.63	x	0.7	=	352.3	(79)
Southwest	0.9x	0.77	x	11.61	x	113.91		0.63	x	0.7	=	404.17	(79)
Southwest	0.9x	0.77	x	12.37	x	113.91		0.63	x	0.7	=	430.63	(79)
Southwest	0.9x	0.77	x	12.1	x	113.91		0.63	x	0.7	=	421.23	(79)
Southwest	0.9x	1	x	4.51	x	113.91		0.63	x	0.7	=	203.9	(79)
Southwest	0.9x	0.77	x	7.97	x	104.39		0.63	x	0.7	=	254.27	(79)
Southwest	0.9x	0.77	x	7.56	x	104.39		0.63	x	0.7	=	241.19	(79)
Southwest	0.9x	0.77	x	4.32	x	104.39		0.63	x	0.7	=	137.82	(79)
Southwest	0.9x	0.77	x	10.33	x	104.39		0.63	x	0.7	=	659.12	(79)
Southwest	0.9x	0.77	x	9.8	x	104.39		0.63	x	0.7	=	312.65	(79)
Southwest	0.9x	0.77	x	9.87	x	104.39		0.63	x	0.7	=	314.88	(79)
Southwest	0.9x	0.77	x	10.12	x	104.39		0.63	x	0.7	=	322.86	(79)
Southwest	0.9x	0.77	x	11.61	x	104.39		0.63	x	0.7	=	370.39	(79)
Southwest	0.9x	0.77	x	12.37	x	104.39		0.63	x	0.7	=	394.64	(79)
Southwest	0.9x	0.77	x	12.1	x	104.39		0.63	x	0.7	=	386.03	(79)
Southwest	0.9x	1	x	4.51	x	104.39		0.63	x	0.7	=	186.86	(79)
Southwest	0.9x	0.77	x	7.97	x	92.85		0.63	x	0.7	=	226.16	(79)
Southwest	0.9x	0.77	x	7.56	x	92.85		0.63	x	0.7	=	214.53	(79)
Southwest	0.9x	0.77	x	4.32	x	92.85		0.63	x	0.7	=	122.59	(79)
Southwest	0.9x	0.77	x	10.33	x	92.85		0.63	x	0.7	=	586.26	(79)
Southwest	0.9x	0.77	x	9.8	x	92.85		0.63	x	0.7	=	278.09	(79)
Southwest	0.9x	0.77	x	9.87	x	92.85		0.63	x	0.7	=	280.08	(79)
Southwest	0.9x	0.77	x	10.12	x	92.85		0.63	x	0.7	=	287.17	(79)

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Southwest	0.9x	0.77	x	11.61	x	92.85		0.63	x	0.7	=	329.45	(79)
Southwest	0.9x	0.77	x	12.37	x	92.85		0.63	x	0.7	=	351.02	(79)
Southwest	0.9x	0.77	x	12.1	x	92.85		0.63	x	0.7	=	343.36	(79)
Southwest	0.9x	1	x	4.51	x	92.85		0.63	x	0.7	=	166.21	(79)
Southwest	0.9x	0.77	x	7.97	x	69.27		0.63	x	0.7	=	168.72	(79)
Southwest	0.9x	0.77	x	7.56	x	69.27		0.63	x	0.7	=	160.04	(79)
Southwest	0.9x	0.77	x	4.32	x	69.27		0.63	x	0.7	=	91.45	(79)
Southwest	0.9x	0.77	x	10.33	x	69.27		0.63	x	0.7	=	437.35	(79)
Southwest	0.9x	0.77	x	9.8	x	69.27		0.63	x	0.7	=	207.46	(79)
Southwest	0.9x	0.77	x	9.87	x	69.27		0.63	x	0.7	=	208.94	(79)
Southwest	0.9x	0.77	x	10.12	x	69.27		0.63	x	0.7	=	214.23	(79)
Southwest	0.9x	0.77	x	11.61	x	69.27		0.63	x	0.7	=	245.77	(79)
Southwest	0.9x	0.77	x	12.37	x	69.27		0.63	x	0.7	=	261.86	(79)
Southwest	0.9x	0.77	x	12.1	x	69.27		0.63	x	0.7	=	256.15	(79)
Southwest	0.9x	1	x	4.51	x	69.27		0.63	x	0.7	=	123.99	(79)
Southwest	0.9x	0.77	x	7.97	x	44.07		0.63	x	0.7	=	107.34	(79)
Southwest	0.9x	0.77	x	7.56	x	44.07		0.63	x	0.7	=	101.82	(79)
Southwest	0.9x	0.77	x	4.32	x	44.07		0.63	x	0.7	=	58.18	(79)
Southwest	0.9x	0.77	x	10.33	x	44.07		0.63	x	0.7	=	278.26	(79)
Southwest	0.9x	0.77	x	9.8	x	44.07		0.63	x	0.7	=	131.99	(79)
Southwest	0.9x	0.77	x	9.87	x	44.07		0.63	x	0.7	=	132.93	(79)
Southwest	0.9x	0.77	x	10.12	x	44.07		0.63	x	0.7	=	136.3	(79)
Southwest	0.9x	0.77	x	11.61	x	44.07		0.63	x	0.7	=	156.37	(79)
Southwest	0.9x	0.77	x	12.37	x	44.07		0.63	x	0.7	=	166.61	(79)
Southwest	0.9x	0.77	x	12.1	x	44.07		0.63	x	0.7	=	162.97	(79)
Southwest	0.9x	1	x	4.51	x	44.07		0.63	x	0.7	=	78.89	(79)
Southwest	0.9x	0.77	x	7.97	x	31.49		0.63	x	0.7	=	76.7	(79)
Southwest	0.9x	0.77	x	7.56	x	31.49		0.63	x	0.7	=	72.75	(79)
Southwest	0.9x	0.77	x	4.32	x	31.49		0.63	x	0.7	=	41.57	(79)
Southwest	0.9x	0.77	x	10.33	x	31.49		0.63	x	0.7	=	198.81	(79)
Southwest	0.9x	0.77	x	9.8	x	31.49		0.63	x	0.7	=	94.31	(79)
Southwest	0.9x	0.77	x	9.87	x	31.49		0.63	x	0.7	=	94.98	(79)
Southwest	0.9x	0.77	x	10.12	x	31.49		0.63	x	0.7	=	97.39	(79)
Southwest	0.9x	0.77	x	11.61	x	31.49		0.63	x	0.7	=	111.72	(79)
Southwest	0.9x	0.77	x	12.37	x	31.49		0.63	x	0.7	=	119.04	(79)
Southwest	0.9x	0.77	x	12.1	x	31.49		0.63	x	0.7	=	116.44	(79)
Southwest	0.9x	1	x	4.51	x	31.49		0.63	x	0.7	=	56.36	(79)
Northwest	0.9x	0.77	x	1	x	11.28	x	0.63	x	0.7	=	3.45	(81)
Northwest	0.9x	0.77	x	0.4	x	11.28	x	0.63	x	0.7	=	1.38	(81)
Northwest	0.9x	0.77	x	13.33	x	11.28	x	0.63	x	0.7	=	45.96	(81)
Northwest	0.9x	0.77	x	0.64	x	11.28	x	0.63	x	0.7	=	11.03	(81)

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Northwest	0.9x	0.54	x	2.35	x	11.28	x	0.63	x	0.7	=	5.68	(81)
Northwest	0.9x	0.77	x	1	x	22.97	x	0.63	x	0.7	=	7.02	(81)
Northwest	0.9x	0.77	x	0.4	x	22.97	x	0.63	x	0.7	=	2.81	(81)
Northwest	0.9x	0.77	x	13.33	x	22.97	x	0.63	x	0.7	=	93.56	(81)
Northwest	0.9x	0.77	x	0.64	x	22.97	x	0.63	x	0.7	=	22.46	(81)
Northwest	0.9x	0.54	x	2.35	x	22.97	x	0.63	x	0.7	=	11.57	(81)
Northwest	0.9x	0.77	x	1	x	41.38	x	0.63	x	0.7	=	12.65	(81)
Northwest	0.9x	0.77	x	0.4	x	41.38	x	0.63	x	0.7	=	5.06	(81)
Northwest	0.9x	0.77	x	13.33	x	41.38	x	0.63	x	0.7	=	168.57	(81)
Northwest	0.9x	0.77	x	0.64	x	41.38	x	0.63	x	0.7	=	40.47	(81)
Northwest	0.9x	0.54	x	2.35	x	41.38	x	0.63	x	0.7	=	20.84	(81)
Northwest	0.9x	0.77	x	1	x	67.96	x	0.63	x	0.7	=	20.77	(81)
Northwest	0.9x	0.77	x	0.4	x	67.96	x	0.63	x	0.7	=	8.31	(81)
Northwest	0.9x	0.77	x	13.33	x	67.96	x	0.63	x	0.7	=	276.84	(81)
Northwest	0.9x	0.77	x	0.64	x	67.96	x	0.63	x	0.7	=	66.46	(81)
Northwest	0.9x	0.54	x	2.35	x	67.96	x	0.63	x	0.7	=	34.23	(81)
Northwest	0.9x	0.77	x	1	x	91.35	x	0.63	x	0.7	=	27.92	(81)
Northwest	0.9x	0.77	x	0.4	x	91.35	x	0.63	x	0.7	=	11.17	(81)
Northwest	0.9x	0.77	x	13.33	x	91.35	x	0.63	x	0.7	=	372.13	(81)
Northwest	0.9x	0.77	x	0.64	x	91.35	x	0.63	x	0.7	=	89.33	(81)
Northwest	0.9x	0.54	x	2.35	x	91.35	x	0.63	x	0.7	=	46.01	(81)
Northwest	0.9x	0.77	x	1	x	97.38	x	0.63	x	0.7	=	29.76	(81)
Northwest	0.9x	0.77	x	0.4	x	97.38	x	0.63	x	0.7	=	11.9	(81)
Northwest	0.9x	0.77	x	13.33	x	97.38	x	0.63	x	0.7	=	396.73	(81)
Northwest	0.9x	0.77	x	0.64	x	97.38	x	0.63	x	0.7	=	95.24	(81)
Northwest	0.9x	0.54	x	2.35	x	97.38	x	0.63	x	0.7	=	49.05	(81)
Northwest	0.9x	0.77	x	1	x	91.1	x	0.63	x	0.7	=	27.84	(81)
Northwest	0.9x	0.77	x	0.4	x	91.1	x	0.63	x	0.7	=	11.14	(81)
Northwest	0.9x	0.77	x	13.33	x	91.1	x	0.63	x	0.7	=	371.13	(81)
Northwest	0.9x	0.77	x	0.64	x	91.1	x	0.63	x	0.7	=	89.09	(81)
Northwest	0.9x	0.54	x	2.35	x	91.1	x	0.63	x	0.7	=	45.88	(81)
Northwest	0.9x	0.77	x	1	x	72.63	x	0.63	x	0.7	=	22.2	(81)
Northwest	0.9x	0.77	x	0.4	x	72.63	x	0.63	x	0.7	=	8.88	(81)
Northwest	0.9x	0.77	x	13.33	x	72.63	x	0.63	x	0.7	=	295.87	(81)
Northwest	0.9x	0.77	x	0.64	x	72.63	x	0.63	x	0.7	=	71.03	(81)
Northwest	0.9x	0.54	x	2.35	x	72.63	x	0.63	x	0.7	=	36.58	(81)
Northwest	0.9x	0.77	x	1	x	50.42	x	0.63	x	0.7	=	15.41	(81)
Northwest	0.9x	0.77	x	0.4	x	50.42	x	0.63	x	0.7	=	6.16	(81)
Northwest	0.9x	0.77	x	13.33	x	50.42	x	0.63	x	0.7	=	205.4	(81)
Northwest	0.9x	0.77	x	0.64	x	50.42	x	0.63	x	0.7	=	49.31	(81)
Northwest	0.9x	0.54	x	2.35	x	50.42	x	0.63	x	0.7	=	25.4	(81)

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Northwest 0.9x	0.77	x	1	x	28.07	x	0.63	x	0.7	=	8.58	(81)
Northwest 0.9x	0.77	x	0.4	x	28.07	x	0.63	x	0.7	=	3.43	(81)
Northwest 0.9x	0.77	x	13.33	x	28.07	x	0.63	x	0.7	=	114.34	(81)
Northwest 0.9x	0.77	x	0.64	x	28.07	x	0.63	x	0.7	=	27.45	(81)
Northwest 0.9x	0.54	x	2.35	x	28.07	x	0.63	x	0.7	=	14.14	(81)
Northwest 0.9x	0.77	x	1	x	14.2	x	0.63	x	0.7	=	4.34	(81)
Northwest 0.9x	0.77	x	0.4	x	14.2	x	0.63	x	0.7	=	1.74	(81)
Northwest 0.9x	0.77	x	13.33	x	14.2	x	0.63	x	0.7	=	57.84	(81)
Northwest 0.9x	0.77	x	0.64	x	14.2	x	0.63	x	0.7	=	13.88	(81)
Northwest 0.9x	0.54	x	2.35	x	14.2	x	0.63	x	0.7	=	7.15	(81)
Northwest 0.9x	0.77	x	1	x	9.21	x	0.63	x	0.7	=	2.82	(81)
Northwest 0.9x	0.77	x	0.4	x	9.21	x	0.63	x	0.7	=	1.13	(81)
Northwest 0.9x	0.77	x	13.33	x	9.21	x	0.63	x	0.7	=	37.54	(81)
Northwest 0.9x	0.77	x	0.64	x	9.21	x	0.63	x	0.7	=	9.01	(81)
Northwest 0.9x	0.54	x	2.35	x	9.21	x	0.63	x	0.7	=	4.64	(81)
Rooflights 0.9x	1	x	24	x	26	x	0.63	x	0.8	=	283.05	(82)
Rooflights 0.9x	1	x	3.49	x	26	x	0.63	x	0.8	=	41.16	(82)
Rooflights 0.9x	1	x	5.22	x	26	x	0.63	x	0.8	=	61.56	(82)
Rooflights 0.9x	1	x	2.58	x	26	x	0.63	x	0.8	=	30.43	(82)
Rooflights 0.9x	1	x	0.7	x	26	x	0.63	x	0.8	=	16.51	(82)
Rooflights 0.9x	1	x	24	x	54	x	0.63	x	0.8	=	587.87	(82)
Rooflights 0.9x	1	x	3.49	x	54	x	0.63	x	0.8	=	85.49	(82)
Rooflights 0.9x	1	x	5.22	x	54	x	0.63	x	0.8	=	127.86	(82)
Rooflights 0.9x	1	x	2.58	x	54	x	0.63	x	0.8	=	63.2	(82)
Rooflights 0.9x	1	x	0.7	x	54	x	0.63	x	0.8	=	34.29	(82)
Rooflights 0.9x	1	x	24	x	96	x	0.63	x	0.8	=	1045.09	(82)
Rooflights 0.9x	1	x	3.49	x	96	x	0.63	x	0.8	=	151.97	(82)
Rooflights 0.9x	1	x	5.22	x	96	x	0.63	x	0.8	=	227.31	(82)
Rooflights 0.9x	1	x	2.58	x	96	x	0.63	x	0.8	=	112.35	(82)
Rooflights 0.9x	1	x	0.7	x	96	x	0.63	x	0.8	=	60.96	(82)
Rooflights 0.9x	1	x	24	x	150	x	0.63	x	0.8	=	1632.96	(82)
Rooflights 0.9x	1	x	3.49	x	150	x	0.63	x	0.8	=	237.46	(82)
Rooflights 0.9x	1	x	5.22	x	150	x	0.63	x	0.8	=	355.17	(82)
Rooflights 0.9x	1	x	2.58	x	150	x	0.63	x	0.8	=	175.54	(82)
Rooflights 0.9x	1	x	0.7	x	150	x	0.63	x	0.8	=	95.26	(82)
Rooflights 0.9x	1	x	24	x	192	x	0.63	x	0.8	=	2090.19	(82)
Rooflights 0.9x	1	x	3.49	x	192	x	0.63	x	0.8	=	303.95	(82)
Rooflights 0.9x	1	x	5.22	x	192	x	0.63	x	0.8	=	454.62	(82)
Rooflights 0.9x	1	x	2.58	x	192	x	0.63	x	0.8	=	224.7	(82)
Rooflights 0.9x	1	x	0.7	x	192	x	0.63	x	0.8	=	121.93	(82)
Rooflights 0.9x	1	x	24	x	200	x	0.63	x	0.8	=	2177.28	(82)

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Rooflights 0.9x	1	x	3.49	x	200	x	0.63	x	0.8	=	316.61	(82)
Rooflights 0.9x	1	x	5.22	x	200	x	0.63	x	0.8	=	473.56	(82)
Rooflights 0.9x	1	x	2.58	x	200	x	0.63	x	0.8	=	234.06	(82)
Rooflights 0.9x	1	x	0.7	x	200	x	0.63	x	0.8	=	127.01	(82)
Rooflights 0.9x	1	x	24	x	189	x	0.63	x	0.8	=	2057.53	(82)
Rooflights 0.9x	1	x	3.49	x	189	x	0.63	x	0.8	=	299.2	(82)
Rooflights 0.9x	1	x	5.22	x	189	x	0.63	x	0.8	=	447.51	(82)
Rooflights 0.9x	1	x	2.58	x	189	x	0.63	x	0.8	=	221.18	(82)
Rooflights 0.9x	1	x	0.7	x	189	x	0.63	x	0.8	=	120.02	(82)
Rooflights 0.9x	1	x	24	x	157	x	0.63	x	0.8	=	1709.16	(82)
Rooflights 0.9x	1	x	3.49	x	157	x	0.63	x	0.8	=	248.54	(82)
Rooflights 0.9x	1	x	5.22	x	157	x	0.63	x	0.8	=	371.74	(82)
Rooflights 0.9x	1	x	2.58	x	157	x	0.63	x	0.8	=	183.74	(82)
Rooflights 0.9x	1	x	0.7	x	157	x	0.63	x	0.8	=	99.7	(82)
Rooflights 0.9x	1	x	24	x	115	x	0.63	x	0.8	=	1251.94	(82)
Rooflights 0.9x	1	x	3.49	x	115	x	0.63	x	0.8	=	182.05	(82)
Rooflights 0.9x	1	x	5.22	x	115	x	0.63	x	0.8	=	272.3	(82)
Rooflights 0.9x	1	x	2.58	x	115	x	0.63	x	0.8	=	134.58	(82)
Rooflights 0.9x	1	x	0.7	x	115	x	0.63	x	0.8	=	73.03	(82)
Rooflights 0.9x	1	x	24	x	66	x	0.63	x	0.8	=	718.5	(82)
Rooflights 0.9x	1	x	3.49	x	66	x	0.63	x	0.8	=	104.48	(82)
Rooflights 0.9x	1	x	5.22	x	66	x	0.63	x	0.8	=	156.27	(82)
Rooflights 0.9x	1	x	2.58	x	66	x	0.63	x	0.8	=	77.24	(82)
Rooflights 0.9x	1	x	0.7	x	66	x	0.63	x	0.8	=	41.91	(82)
Rooflights 0.9x	1	x	24	x	33	x	0.63	x	0.8	=	359.25	(82)
Rooflights 0.9x	1	x	3.49	x	33	x	0.63	x	0.8	=	52.24	(82)
Rooflights 0.9x	1	x	5.22	x	33	x	0.63	x	0.8	=	78.14	(82)
Rooflights 0.9x	1	x	2.58	x	33	x	0.63	x	0.8	=	38.62	(82)
Rooflights 0.9x	1	x	0.7	x	33	x	0.63	x	0.8	=	20.96	(82)
Rooflights 0.9x	1	x	24	x	21	x	0.63	x	0.8	=	228.61	(82)
Rooflights 0.9x	1	x	3.49	x	21	x	0.63	x	0.8	=	33.24	(82)
Rooflights 0.9x	1	x	5.22	x	21	x	0.63	x	0.8	=	49.72	(82)
Rooflights 0.9x	1	x	2.58	x	21	x	0.63	x	0.8	=	24.58	(82)
Rooflights 0.9x	1	x	0.7	x	21	x	0.63	x	0.8	=	13.34	(82)

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

(83)m=	2379.6	4246.81	6263.27	8418.98	9958.53	10099.66	9649.87	8481.52	7013.44	4821.58	2886.93	2011.88	(83)

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

(84)m=	3767.91	5626.5	7589.51	9660.67	11109.82	11172.99	10679.74	9524.85	8107.33	6000.3	4159.96	3359.93	(84)

7. Mean internal temperature (heating season)

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

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

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

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(86)m=	1	0.98	0.93	0.8	0.61	0.44	0.32	0.37	0.62	0.91	0.99	1	(86)

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

(87)m=	19.42	19.8	20.27	20.71	20.92	20.98	21	20.99	20.94	20.55	19.87	19.36	(87)

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

(88)m=	19.7	19.7	19.7	19.71	19.72	19.73	19.73	19.73	19.72	19.72	19.71	19.71	(88)

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

(89)m=	0.99	0.97	0.91	0.75	0.54	0.35	0.23	0.27	0.52	0.87	0.98	1	(89)

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

(90)m=	17.64	18.18	18.84	19.41	19.65	19.72	19.73	19.73	19.68	19.25	18.3	17.55	(90)

fLA = Living area ÷ (4) = 0.09 (91)

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

(92)m=	17.8	18.33	18.97	19.53	19.77	19.83	19.84	19.84	19.8	19.37	18.44	17.72	(92)

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

(93)m=	17.8	18.33	18.97	19.53	19.77	19.83	19.84	19.84	19.8	19.37	18.44	17.72	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.9	0.74	0.54	0.36	0.24	0.28	0.53	0.86	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	3735.25	5429.92	6795.5	7185.36	6051.79	4030.8	2515.54	2662.14	4275.1	5143.76	4065.29	3340.81	(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=	10766.95	10684.75	9900.28	8355.09	6327.38	4068.22	2520.03	2671.34	4444.75	6876.7	8930.62	10686.14	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	5231.59	3531.25	2309.95	842.21	205.04	0	0	0	0	1289.3	3503.04	5464.93	

Total per year (kWh/year) = Sum(98)$_{1,5,12}$ = 22377.3 (98)

Space heating requirement in kWh/m²/year 41.69 (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	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	7305.01	5750.75	5896.18	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.95	0.97	0.96	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	6948.79	5601.55	5655.82	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	12305.12	11766.53	10502.5	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	3856.56	4586.75	3605.93	0	0	0	0	

Total = Sum(104) = 12049.24 (104)

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Cooled fraction								f C = cooled area ÷ (4) =				0.75	(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	718.44	854.46	671.75	0	0	0	0	
								Total = Sum(107)			=	2244.64	(107)
Space cooling requirement in kWh/m²/year								(107) ÷ (4) =				4.18	(108)

9b. Energy requirements – Community heating scheme

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

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

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

Fraction of heat from Community CHP		0.87	(303a)
Fraction of community heat from heat source 2		0.13	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.87	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.13	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating		**kWh/year**	
Annual space heating requirement		22377.3	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	20441.66	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	3054.5	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating			
Annual water heating requirement		2863.87	
If DHW from community scheme:			
Water heat from Community CHP	(64) x (303a) x (305) x (306) =	2616.14	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	390.92	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	265.03	(313)
Cooling System Energy Efficiency Ratio		4.32	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	519.59	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		0	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	0	(331)

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Energy for lighting (calculated in Appendix L)					992.09	(332)

10b. Fuel costs – Community heating scheme

		Fuel kWh/year		Fuel Price (Table 12)		Fuel Cost £/year	
Space heating from CHP	(307a)	x		2.97	x 0.01 =	607.12	(340a)
Space heating from heat source 2	(307b)	x		4.24	x 0.01 =	129.51	(340b)
Water heating from CHP	(310a)	x		2.97	x 0.01 =	77.7	(342a)
Water heating from heat source 2	(310b)	x		4.24	x 0.01 =	16.57	(342b)
				Fuel Price			
Space cooling (community cooling system)	(315)			13.19	x 0.01 =	68.53	(348)
Pumps and fans	(331)			13.19	x 0.01 =	0	(349)
Energy for lighting	(332)			13.19	x 0.01 =	130.86	(350)
Additional standing charges (Table 12)						120	(351)
Total energy cost	= (340a)...(342e) + (345)...(354) =					1150.29	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	0.83	(357)
SAP rating (section12)		88.42	(358)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						27.2	(361)
Heat efficiency of CHP unit						66.8	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) x 100 ÷ (362) =	30601.29	x	0.22		6609.88	(363)
less credit emissions for electricity	–(307a) x (361) ÷ (362) =	8323.55	x	0.52		-4319.92	(364)
Water heated by CHP	(310a) x 100 ÷ (362) =	3916.38	x	0.22		845.94	(365)
less credit emissions for electricity	–(310a) x (361) ÷ (362) =	1065.26	x	0.52		-552.87	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					90	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	826.9	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	137.55	(372)
Total CO2 associated with community systems	(363)...(366) + (368)...(372)				=	3547.48	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					3547.48	(376)
CO2 associated with space cooling	(315) x			0.52	=	269.67	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	0	(378)

SAP WorkSheet: New dwelling design stage

CO2 associated with electricity for lighting	(332))) x		0.52	=	514.9	(379)
Total CO2, kg/year	sum of (376)...(382) =				4332.04	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				8.07	(384)
EI rating (section 14)					90.02	(385)
13b. Primary Energy – Community heating scheme						
Electrical efficiency of CHP unit					27.2	(361)
Heat efficiency of CHP unit					66.8	(362)
		Energy kWh/year		**Primary factor**		**P.Energy kWh/year**
Space heating from CHP)	(307a) × 100 ÷ (362) =	30601.29	x	1.22		37333.58 (363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	8323.55	x	3.07		-25553.3 (364)
Water heated by CHP	(310a) × 100 ÷ (362) =	3916.38	x	1.22		4777.99 (365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	1065.26	x	3.07		-3270.34 (366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					90 (367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	=	4670.46 (368)
Electrical energy for heat distribution	[(313) x				=	813.65 (372)
Total Energy associated with community systems	(363)...(366) + (368)...(372)				=	18772.03 (373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)						18772.03 (373)
Energy associated with space heating (secondary)	(309) x			0	=	0 (374)
Energy associated with water from immersion heater or instantaneous heater	(312) x			1.22	=	0 (375)
Total Energy associated with space and water heating	(373) + (374) + (375) =					18772.03 (376)
Energy associated with space cooling	(315) x			3.07	=	1595.15 (377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x			3.07	=	0 (378)
Energy associated with electricity for lighting	(332))) x			3.07	=	3045.73 (379)
Total Primary Energy, kWh/year	sum of (376)...(382) =					23412.91 (383)

APPENDIX (vi)

PEA – PREDICTED ENERGY ASSESSMENT (PRE-EPC)

Predicted Energy Assessment

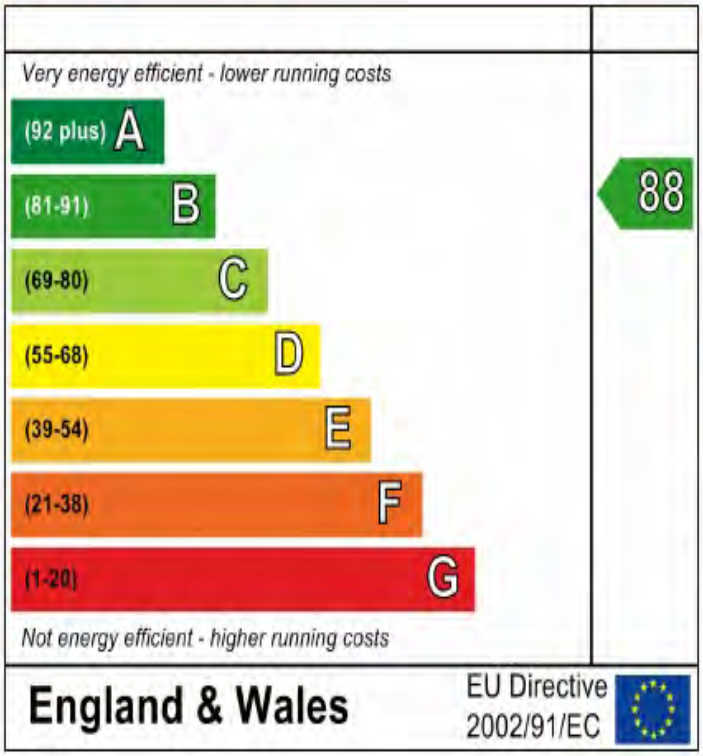
17, Branch Hill
LONDON
NW3 7NA

Dwelling type:	Detached House
Date of assessment:	28 May 2015
Produced by:	Ondrej Gajdos
Total floor area:	536.8 m²

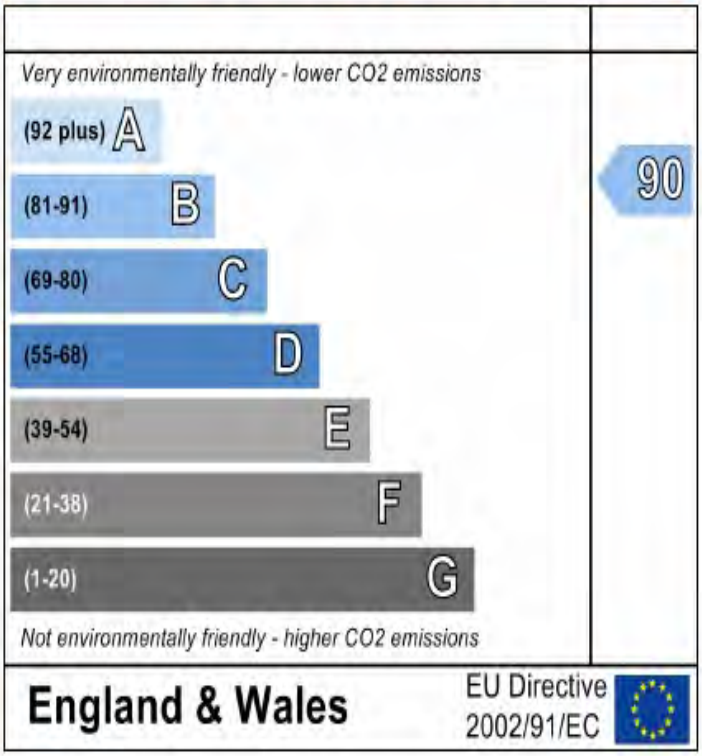
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about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

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

Energy Efficiency Rating



Environmental Impact (CO_2) Rating

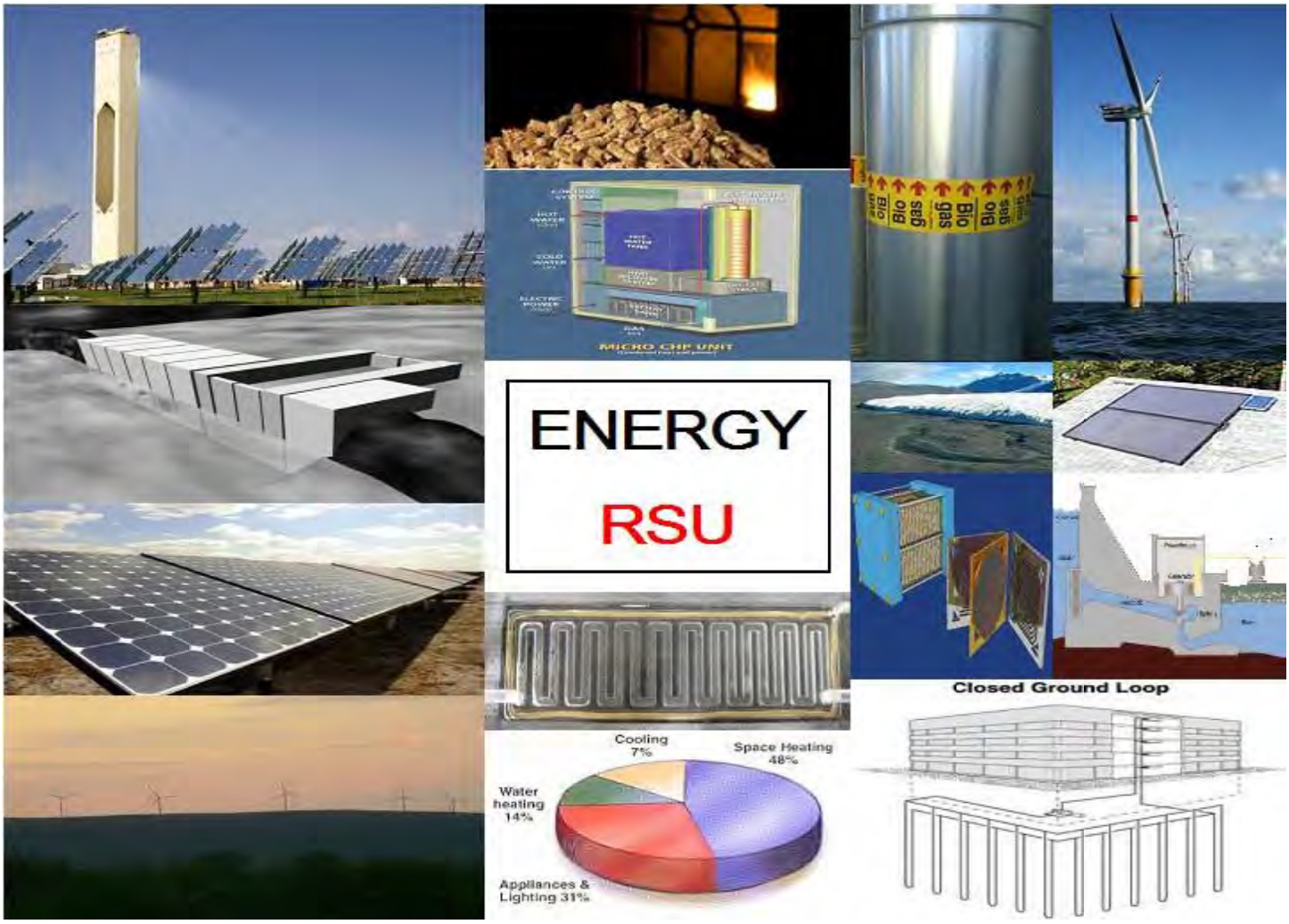


The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

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

APPENDIX (vii)

ENERGY RSU – RENEWABLES & SUSTAINABILITY UNIT



ENERGY RSU is an integrated energy sustainability unit able to provide the following:

- SAP Calculations & Certificates - L1A&B New/Existing Buildings (NHER certified)
- SBEM Calculations & Certificates - L2A&B New/Existing Buildings (BRE certified)
- EPC & DEC Certificates – New Build (CIBSE certified)
- Rd SAP Survey EPC Certificates – Existing Buildings (NHER certified)
- Commercial EPC Survey certificates – Existing Buildings (BRE certified) - Level 3, 4 & 5
- Energy Statements & Renewable Reports for Planning
- LEED/BREEAM assessments (USGBC/BRE certified)
- Low/Zero Carbon (LZC) and Sustainability Appraisals/designs (CIBSE Low Carbon Consultant)
- Renewable Energy Appraisals and Designs
- Carbon Rating assessments
- 2D/3D CFD and Dynamic Thermal Simulations
- EPBD Air Conditioning Inspections (Article 20) and EPBD Asset Ratings & Certificates
- Energy Usage (Running Costs)
- Utility/Bill Analysis and Recommendations
- Advice on Green and Environmental Issues Relating to M&E Building Services
- Code for Sustainable Homes New Build and Refurbishment (BRE certified)
- Solar Shading/Sun Studies

LOW CARBON ENERGY ASSESSORS CIBSE Certification Ltd. breglobal THE CODE FOR SUSTAINABLE HOMES ace member NHER Accreditation Scheme Registered Member

ME7 Ltd, Unit 2, Rays Farm Barns, Roman Road, Ingatestone, Essex, CM4 9EH
Tel: +44(0)1277 353225 MB: +44(0)7412 601472
Web: www.me7.eu Email: jb@me7.eu

M&E Consultants Energy Consultants

Section 5.0

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ME7 June 2015