

APPENDIX (A)

PART L1B COMPLIANCE CHECKLIST

**ME7 Ltd**
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9 Templewood Avenue
London NW3 7UY

Part L1B Compliance Checklist
-2010 PART L1B BUILDING REGULATIONS-

Paragraph	Requirement	Comments	Pass/ Fail
4.1 a (5.3-5.4)	Newly constructed and replacement thermal elements: Area weighted average U-value: Walls: 0.28 W/m ² K Pitched roof, insulation at rafter level: 0.18 W/m ² K Pitched roof, insulation at ceiling level: 0.16 W/m ² K Flat roof: 0.18 W/m ² K Floor: 0.22 W/m ² K	- Newly constructed walls will achieve U-value of 0.28 W/m²K - Newly constructed Ground floor will achieve U-value of 0.22 W/m²K - Newly constructed roof will achieve U-value of 0.18 W/m²K	Pass
4.1 b (4.19)	Controlled fittings performance (applies to new or replacement fittings): Area weighted average U-value: Window, roof window or rooflight: 1.6 W/m ² K Glazed doors: 1.8 W/m ² K Solid doors: 1.8 W/m ² K	- New windows will achieve U-value of 1.6 W/m²K and new solid doors will achieve U-value 1.8 W/m²K	Pass
4.2	Area of windows, roof windows and doors Maximum area of openings in extension: 25% of the extension floor area + area of openings which, as a result of the extension works, no longer exist.	- Area of openings in the extension: 98.3 m² - Floor area of the proposed extension: 211.51 m² - Area of existing openings: 27.47 m² - Area of openings in notional extension: 70.04 m²	Pass (par. 4.6)

4.3 (4.24)	Minimum efficiencies and controls of heating and hot water system: - Efficiency of appliances not less than that recommended for its type in the Domestic Heating Compliance Guide (Minimum gas boiler SEDBUK 2009 efficiency 88%, minimum heat pump CoP of 2.2) - Controls that meet the minimum requirements as given in the Domestic Heating Compliance Guide	- Newly installed condensing boiler will achieve SEDBUK 2009 efficiency of at least 88% - Time and temperature zone control	Pass
4.3 (4.24 a)	Insulation of pipes and ducts Insulated to standards that are not worse than those set out in the Domestic Heating Compliance Guide	- All relevant pipework in new extension will be insulated to standards that are not worse than those set out in the Domestic Heating Compliance Guide	Pass
4.3 (4.24 c)	Mechanical cooling Energy efficiency ratio EER > 2.4	- Newly installed mechanical cooling will achieve EER of 2.4 or higher	Pass
4.3 (4.24 d)	Fixed internal lighting - Provide fixed energy efficient light fittings that number not less than three per four fixed light fittings. - Low energy light fittings should have lamps with luminous efficacy greater than 45 lamp lumens per circuit-watt and total output greater than 400 lamp lumens	- At least 75% of newly installed light fittings will be low energy	Pass
4.3 (4.24 e)	Fixed external lighting - Lamp capacity does not exceed 100 W per fitting and the lamp automatically switches off when there is enough daylight and when it is not required OR - Only low energy light fittings are provided	Builder's submission	N/A
4.3 (4.30)	Commissioning of controlled services	Builder's submission	N/A
4.15 b (5.5-5.6)	Continuity of insulation and airtightness: - Avoid thermal bridges in insulation caused by gaps, at the joints between elements and edges of elements - Reduce unwanted air leakage through the new envelope parts - Adopt Accredited Construction Details where practical	Builder's submission	N/A

4.6	More design flexibility using SAP2009 Demonstrate that CO ₂ emissions from all the dwellings in the building as it will become are no greater than if each dwelling had been improved following the guidance set out in paragraphs 4.1 to 4.3	CO ₂ emissions from building built to the standards set out in paragraphs 4.1 to 4.3: 34,037.37 kgCO ₂ / year CO ₂ emissions from building as proposed: 33,914.18 kgCO ₂ / year (Supporting SAP worksheets attached)	Pass
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Ondrej Gajdos

ME7 Ltd



APPENDIX (B)

SAP WORKSHEET - EXISTING DWELLING

SAP WorkSheet: New dwelling as built

User Details:			
Assessor Name:	Ondrej Gajdos	Stroma Number:	STRO006629
Software Name:	Stroma FSAP 2009	Software Version:	Version: 1.4.0.86
Property Address: Existing			
Address :	Existing House, 9 Templewood Avenue, London, NW3 7UY		

1. Overall dwelling dimensions

	Area(m ²)		Ave Height(m)		Volume(m ³)
Basement	120	(1a) x	2.6	(2a) =	312
Ground floor	285	(1b) x	3.2	(2b) =	912
First floor	248	(1c) x	2.9	(2c) =	719.2
Second floor	150	(1d) x	2.9	(2d) =	435
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	803	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	2378.2

2. Ventilation rate

	main heating	Secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	4	4	160
Number of open flues	0	0	0	0	0
Number of intermittent fans				10	100
Number of passive vents				0	0
Number of flueless gas fires				0	0

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =		260	+ (5) =	0.11	(8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>					
Number of storeys in the dwelling (ns)				0	(9)
Additional infiltration				0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction				0	(11)
<i>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</i>					
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				15	(17)
If based on air permeability value, then (18) = [(17) + 20] x (8), otherwise (18) = (16)				0.86	(18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>					
Number of sides on which sheltered				2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =			0.73	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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SAP WorkSheet: New dwelling as built

Monthly average wind speed from Table 7

(22)m=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.99	0.93	0.93	0.82	0.75	0.71	0.68	0.68	0.77	0.82	0.88	0.93
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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
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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
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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
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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 × 0.5]

(24d)m=	0.99	0.93	0.93	0.84	0.78	0.75	0.73	0.73	0.79	0.84	0.88	0.93
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.99	0.93	0.93	0.84	0.78	0.75	0.73	0.73	0.79	0.84	0.88	0.93
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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			2.15	x 3	= 6.45		(26)
Doors Type 2			5.5	x 3.9	= 21.45		(26)
Doors Type 3			2.15	x 3	= 6.45		(26)
Windows Type 1			1.86	x 1/1/ (4.8) + 0.04	= 7.49		(27)
Windows Type 2			1.86	x 1/1/ (4.8) + 0.04	= 7.49		(27)
Windows Type 3			1.86	x 1/1/ (4.8) + 0.04	= 7.49		(27)
Windows Type 4			1.86	x 1/1/ (4.8) + 0.04	= 7.49		(27)
Windows Type 5			3.5	x 1/1/ (4.8) + 0.04	= 14.09		(27)
Windows Type 6			1.87	x 1/1/ (4.8) + 0.04	= 7.53		(27)
Windows Type 7			2.53	x 1/1/ (4.8) + 0.04	= 10.19		(27)
Windows Type 8			2.04	x 1/1/ (4.8) + 0.04	= 8.21		(27)
Windows Type 9			2.56	x 1/1/ (4.8) + 0.04	= 10.31		(27)
Windows Type 10			4.18	x 1/1/ (4.8) + 0.04	= 16.83		(27)
Windows Type 11			2.49	x 1/1/ (4.8) + 0.04	= 10.03		(27)

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Windows Type 12			1.86	$\times 1/(1/(4.8) + 0.04) =$	7.49			(27)
Windows Type 13			1.87	$\times 1/(1/(4.8) + 0.04) =$	7.53			(27)
Windows Type 14			1.44	$\times 1/(1/(4.8) + 0.04) =$	5.8			(27)
Windows Type 15			0.76	$\times 1/(1/(4.8) + 0.04) =$	3.06			(27)
Windows Type 16			1.2	$\times 1/(1/(4.8) + 0.04) =$	4.83			(27)
Windows Type 17			3.36	$\times 1/(1/(4.8) + 0.04) =$	13.53			(27)
Windows Type 18			1.26	$\times 1/(1/(4.8) + 0.04) =$	5.07			(27)
Windows Type 19			1.86	$\times 1/(1/(4.8) + 0.04) =$	7.49			(27)
Windows Type 20			2.55	$\times 1/(1/(4.8) + 0.04) =$	10.27			(27)
Windows Type 21			2.55	$\times 1/(1/(4.8) + 0.04) =$	10.27			(27)
Windows Type 22			2.55	$\times 1/(1/(4.8) + 0.04) =$	10.27			(27)
Windows Type 23			3.42	$\times 1/(1/(4.8) + 0.04) =$	13.77			(27)
Windows Type 24			1.44	$\times 1/(1/(4.8) + 0.04) =$	5.8			(27)
Windows Type 25			2.55	$\times 1/(1/(4.8) + 0.04) =$	10.27			(27)
Floor Type 1			145	$\times$	0.22	=	31.9	(28)
Floor Type 2			177.13	$\times$	0.22	=	38.9686	(28)
Floor Type 3			38.58	$\times$	0.5	=	19.29	(28)
Walls Type1	498.25	52.87	445.38	$\times$	2.1	=	935.3	(29)
Walls Type2	106.6	0	106.6	$\times$	2.1	=	223.86	(29)
Walls Type3	25	77.14	-52.14	$\times$	2.1	=	-109.49	(29)
Roof Type1	46.96	0	46.96	$\times$	0.18	=	8.45	(30)
Roof Type2	27.3	0	27.3	$\times$	2.3	=	62.79	(30)
Roof Type3	290	0	290	$\times$	2.3	=	667	(30)
Roof Type4	25.6	0	25.6	$\times$	2.3	=	58.88	(30)
Total area of elements, m ²			1380.42					(31)

* for windows and roof windows, use effective window U-value calculated using formula $1/(1/U\text{-value}) + 0.04$ as given in paragraph 3.2

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

Fabric heat loss, W/K = $S (A \times U)$ (26)...(30) + (32) = 2453.15 (33)

Heat capacity $C_m = S(A \times k)$ ((28)...(30) + (32) + (32a)...(32e) = 37105.25 (34)

Thermal mass parameter (TMP = $C_m + TFA$) 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 : $S (L \times Y)$ calculated using Appendix K 207.06 (36)

if details of thermal bridging are not known (36) = $0.15 \times (31)$

Total fabric heat loss (33) + (36) = 2660.22 (37)

Ventilation heat loss calculated monthly (38)m = $0.33 \times (25)m \times (5)$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	773.96	732.74	732.74	657.37	612.36	591.42	571.53	571.53	623.22	657.37	693.88	732.74	(38)

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

(39)m=	3434.17	3392.96	3392.96	3317.59	3272.58	3251.64	3231.75	3231.75	3283.44	3317.59	3354.09	3392.96	
Average = Sum(39) / 12 =												3322.79	(39)

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

(40)m=	4.28	4.23	4.23	4.13	4.08	4.05	4.02	4.02	4.09	4.13	4.18	4.23	
Average = Sum(40) / 12 =												4.14	(40)

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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 3.79 (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) + 36 130.65 (43)

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

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

(44)m=	143.71	138.48	133.26	128.03	122.81	117.58	117.58	122.81	128.03	133.26	138.48	143.71	
Total = Sum(44),... =												1567.75	(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=	213.63	186.84	192.8	168.09	161.29	139.18	128.97	147.99	149.76	174.53	190.52	206.89	
Total = Sum(45),... =												2060.48	(45)

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

(46)m=	32.04	28.03	28.92	25.21	24.19	20.88	19.35	22.2	22.46	26.18	28.58	31.03	(46)
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Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.86 (47)

Temperature factor from Table 2b 0.54 (48)

Energy lost from water storage, kWh/year (47) x (48) = 1.54 (49)

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

Cylinder volume (litres) including any solar storage within same 0 (50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

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

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year ((50) x (51) x (52) x (53) = 0 (54)

Enter (49) or (54) in (55) 1.54 (55)

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

(56)m=	47.88	43.24	47.88	46.33	47.88	46.33	47.88	47.88	46.33	47.88	46.33	47.88	(56)
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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=	47.88	43.24	47.88	46.33	47.88	46.33	47.88	47.88	46.33	47.88	46.33	47.88	(57)
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Primary circuit loss (annual) from Table 3 360 (58)

Primary circuit loss calculated for each month (59)m = (58) + 365 x (41)m

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

(59)m=	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(59)
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Combi loss calculated for each month (61)m = (60) + 365 x (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	292.08	257.7	271.25	244.01	239.74	215.1	207.42	226.45	225.68	252.98	266.44	285.34	(62)
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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
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 (63)

Output from water heater

(64)m=

292.08	257.7	271.25	244.01	239.74	215.1	207.42	226.45	225.68	252.98	266.44	285.34
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Output from water heater (annual) (64) 2984.19

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=

133.79	118.81	126.87	116.63	116.39	107.01	105.64	111.97	110.53	120.79	124.08	131.55
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 (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

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
227.15	227.15	227.15	227.15	227.15	227.15	227.15	227.15	227.15	227.15	227.15	227.15

 (66)

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

(67)m=

319.61	283.88	230.86	174.78	130.65	110.3	119.18	154.92	207.93	264.01	308.14	328.49
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 (67)

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

(68)m=

1189.68	1202.02	1170.91	1104.68	1021.08	942.51	890.02	877.67	908.78	975.01	1058.61	1137.18
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 (68)

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

(69)m=

61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5
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 (69)

Pumps and fans gains (Table 5a)

(70)m=

10	10	10	10	10	10	10	10	10	10	10	10
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 (70)

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

(71)m=

-151.43	-151.43	-151.43	-151.43	-151.43	-151.43	-151.43	-151.43	-151.43	-151.43	-151.43	-151.43
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 (71)

Water heating gains (Table 5)

(72)m=

179.83	176.8	170.52	161.98	156.44	148.63	141.99	150.5	153.52	162.36	172.34	176.82
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 (72)

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

(73)m=

1836.33	1809.92	1719.51	1588.66	1455.39	1348.66	1298.41	1330.3	1417.45	1548.6	1686.31	1789.71
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 (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 m ²		Flux Table 6a		g _s Table 6b		FF Table 6c		Gains (W)
North	0.9x	0.77	x	2.55	x	10.73	x	0.85	x	0.7	= 11.28 (74)
North	0.9x	0.77	x	2.55	x	20.36	x	0.85	x	0.7	= 21.41 (74)
North	0.9x	0.77	x	2.55	x	33.31	x	0.85	x	0.7	= 35.02 (74)
North	0.9x	0.77	x	2.55	x	54.64	x	0.85	x	0.7	= 57.45 (74)
North	0.9x	0.77	x	2.55	x	75.22	x	0.85	x	0.7	= 79.09 (74)
North	0.9x	0.77	x	2.55	x	84.09	x	0.85	x	0.7	= 88.42 (74)
North	0.9x	0.77	x	2.55	x	79.12	x	0.85	x	0.7	= 83.19 (74)
North	0.9x	0.77	x	2.55	x	61.56	x	0.85	x	0.7	= 64.73 (74)
North	0.9x	0.77	x	2.55	x	41.09	x	0.85	x	0.7	= 43.2 (74)
North	0.9x	0.77	x	2.55	x	24.81	x	0.85	x	0.7	= 26.09 (74)

SAP WorkSheet: New dwelling as built

North	0.9x	0.77	x	2.55	x	13.22	x	0.85	x	0.7	=	13.9	(74)
North	0.9x	0.77	x	2.55	x	8.94	x	0.85	x	0.7	=	9.4	(74)
Northeast	0.9x	0.77	x	1.86	x	11.51	x	0.85	x	0.7	=	35.31	(75)
Northeast	0.9x	0.77	x	1.87	x	11.51	x	0.85	x	0.7	=	17.75	(75)
Northeast	0.9x	0.77	x	2.55	x	11.51	x	0.85	x	0.7	=	24.2	(75)
Northeast	0.9x	0.77	x	1.86	x	23.55	x	0.85	x	0.7	=	72.26	(75)
Northeast	0.9x	0.77	x	1.87	x	23.55	x	0.85	x	0.7	=	36.32	(75)
Northeast	0.9x	0.77	x	2.55	x	23.55	x	0.85	x	0.7	=	49.53	(75)
Northeast	0.9x	0.77	x	1.86	x	41.13	x	0.85	x	0.7	=	126.17	(75)
Northeast	0.9x	0.77	x	1.87	x	41.13	x	0.85	x	0.7	=	63.42	(75)
Northeast	0.9x	0.77	x	2.55	x	41.13	x	0.85	x	0.7	=	86.49	(75)
Northeast	0.9x	0.77	x	1.86	x	67.8	x	0.85	x	0.7	=	207.99	(75)
Northeast	0.9x	0.77	x	1.87	x	67.8	x	0.85	x	0.7	=	104.55	(75)
Northeast	0.9x	0.77	x	2.55	x	67.8	x	0.85	x	0.7	=	142.57	(75)
Northeast	0.9x	0.77	x	1.86	x	89.77	x	0.85	x	0.7	=	275.38	(75)
Northeast	0.9x	0.77	x	1.87	x	89.77	x	0.85	x	0.7	=	138.43	(75)
Northeast	0.9x	0.77	x	2.55	x	89.77	x	0.85	x	0.7	=	188.77	(75)
Northeast	0.9x	0.77	x	1.86	x	97.5	x	0.85	x	0.7	=	299.11	(75)
Northeast	0.9x	0.77	x	1.87	x	97.5	x	0.85	x	0.7	=	150.36	(75)
Northeast	0.9x	0.77	x	2.55	x	97.5	x	0.85	x	0.7	=	205.04	(75)
Northeast	0.9x	0.77	x	1.86	x	92.98	x	0.85	x	0.7	=	285.24	(75)
Northeast	0.9x	0.77	x	1.87	x	92.98	x	0.85	x	0.7	=	143.39	(75)
Northeast	0.9x	0.77	x	2.55	x	92.98	x	0.85	x	0.7	=	195.53	(75)
Northeast	0.9x	0.77	x	1.86	x	75.42	x	0.85	x	0.7	=	231.36	(75)
Northeast	0.9x	0.77	x	1.87	x	75.42	x	0.85	x	0.7	=	116.3	(75)
Northeast	0.9x	0.77	x	2.55	x	75.42	x	0.85	x	0.7	=	158.6	(75)
Northeast	0.9x	0.77	x	1.86	x	51.24	x	0.85	x	0.7	=	157.21	(75)
Northeast	0.9x	0.77	x	1.87	x	51.24	x	0.85	x	0.7	=	79.03	(75)
Northeast	0.9x	0.77	x	2.55	x	51.24	x	0.85	x	0.7	=	107.76	(75)
Northeast	0.9x	0.77	x	1.86	x	29.6	x	0.85	x	0.7	=	90.8	(75)
Northeast	0.9x	0.77	x	1.87	x	29.6	x	0.85	x	0.7	=	45.65	(75)
Northeast	0.9x	0.77	x	2.55	x	29.6	x	0.85	x	0.7	=	62.24	(75)
Northeast	0.9x	0.77	x	1.86	x	14.52	x	0.85	x	0.7	=	44.56	(75)
Northeast	0.9x	0.77	x	1.87	x	14.52	x	0.85	x	0.7	=	22.4	(75)
Northeast	0.9x	0.77	x	2.55	x	14.52	x	0.85	x	0.7	=	30.54	(75)
Northeast	0.9x	0.77	x	1.86	x	9.36	x	0.85	x	0.7	=	28.72	(75)
Northeast	0.9x	0.77	x	1.87	x	9.36	x	0.85	x	0.7	=	14.44	(75)
Northeast	0.9x	0.77	x	2.55	x	9.36	x	0.85	x	0.7	=	19.68	(75)
Southeast	0.9x	0.77	x	1.86	x	37.39	x	0.85	x	0.7	=	172.05	(77)
Southeast	0.9x	0.77	x	2.04	x	37.39	x	0.85	x	0.7	=	31.45	(77)
Southeast	0.9x	0.77	x	2.56	x	37.39	x	0.85	x	0.7	=	78.93	(77)

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Southeast 0.9x	0.77	x	4.18	x	37.39	x	0.85	x	0.7	=	64.44	(77)
Southeast 0.9x	0.77	x	2.49	x	37.39	x	0.85	x	0.7	=	153.55	(77)
Southeast 0.9x	0.77	x	1.86	x	37.39	x	0.85	x	0.7	=	28.67	(77)
Southeast 0.9x	0.77	x	1.86	x	63.74	x	0.85	x	0.7	=	293.29	(77)
Southeast 0.9x	0.77	x	2.04	x	63.74	x	0.85	x	0.7	=	53.61	(77)
Southeast 0.9x	0.77	x	2.56	x	63.74	x	0.85	x	0.7	=	134.56	(77)
Southeast 0.9x	0.77	x	4.18	x	63.74	x	0.85	x	0.7	=	109.85	(77)
Southeast 0.9x	0.77	x	2.49	x	63.74	x	0.85	x	0.7	=	261.75	(77)
Southeast 0.9x	0.77	x	1.86	x	63.74	x	0.85	x	0.7	=	48.88	(77)
Southeast 0.9x	0.77	x	1.86	x	84.22	x	0.85	x	0.7	=	387.53	(77)
Southeast 0.9x	0.77	x	2.04	x	84.22	x	0.85	x	0.7	=	70.84	(77)
Southeast 0.9x	0.77	x	2.56	x	84.22	x	0.85	x	0.7	=	177.79	(77)
Southeast 0.9x	0.77	x	4.18	x	84.22	x	0.85	x	0.7	=	145.15	(77)
Southeast 0.9x	0.77	x	2.49	x	84.22	x	0.85	x	0.7	=	345.86	(77)
Southeast 0.9x	0.77	x	1.86	x	84.22	x	0.85	x	0.7	=	64.59	(77)
Southeast 0.9x	0.77	x	1.86	x	103.49	x	0.85	x	0.7	=	476.22	(77)
Southeast 0.9x	0.77	x	2.04	x	103.49	x	0.85	x	0.7	=	87.05	(77)
Southeast 0.9x	0.77	x	2.56	x	103.49	x	0.85	x	0.7	=	218.48	(77)
Southeast 0.9x	0.77	x	4.18	x	103.49	x	0.85	x	0.7	=	178.37	(77)
Southeast 0.9x	0.77	x	2.49	x	103.49	x	0.85	x	0.7	=	425.01	(77)
Southeast 0.9x	0.77	x	1.86	x	103.49	x	0.85	x	0.7	=	79.37	(77)
Southeast 0.9x	0.77	x	1.86	x	113.34	x	0.85	x	0.7	=	521.54	(77)
Southeast 0.9x	0.77	x	2.04	x	113.34	x	0.85	x	0.7	=	95.33	(77)
Southeast 0.9x	0.77	x	2.56	x	113.34	x	0.85	x	0.7	=	239.27	(77)
Southeast 0.9x	0.77	x	4.18	x	113.34	x	0.85	x	0.7	=	195.34	(77)
Southeast 0.9x	0.77	x	2.49	x	113.34	x	0.85	x	0.7	=	465.46	(77)
Southeast 0.9x	0.77	x	1.86	x	113.34	x	0.85	x	0.7	=	86.92	(77)
Southeast 0.9x	0.77	x	1.86	x	115.04	x	0.85	x	0.7	=	529.39	(77)
Southeast 0.9x	0.77	x	2.04	x	115.04	x	0.85	x	0.7	=	96.77	(77)
Southeast 0.9x	0.77	x	2.56	x	115.04	x	0.85	x	0.7	=	242.88	(77)
Southeast 0.9x	0.77	x	4.18	x	115.04	x	0.85	x	0.7	=	198.29	(77)
Southeast 0.9x	0.77	x	2.49	x	115.04	x	0.85	x	0.7	=	472.47	(77)
Southeast 0.9x	0.77	x	1.86	x	115.04	x	0.85	x	0.7	=	88.23	(77)
Southeast 0.9x	0.77	x	1.86	x	112.79	x	0.85	x	0.7	=	519.03	(77)
Southeast 0.9x	0.77	x	2.04	x	112.79	x	0.85	x	0.7	=	94.88	(77)
Southeast 0.9x	0.77	x	2.56	x	112.79	x	0.85	x	0.7	=	238.12	(77)
Southeast 0.9x	0.77	x	4.18	x	112.79	x	0.85	x	0.7	=	194.4	(77)
Southeast 0.9x	0.77	x	2.49	x	112.79	x	0.85	x	0.7	=	463.22	(77)
Southeast 0.9x	0.77	x	1.86	x	112.79	x	0.85	x	0.7	=	86.5	(77)
Southeast 0.9x	0.77	x	1.86	x	105.34	x	0.85	x	0.7	=	484.74	(77)
Southeast 0.9x	0.77	x	2.04	x	105.34	x	0.85	x	0.7	=	88.61	(77)

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Southeast 0.9x	0.77	x	2.56	x	105.34	x	0.85	x	0.7	=	222.39	(77)
Southeast 0.9x	0.77	x	4.18	x	105.34	x	0.85	x	0.7	=	181.56	(77)
Southeast 0.9x	0.77	x	2.49	x	105.34	x	0.85	x	0.7	=	432.62	(77)
Southeast 0.9x	0.77	x	1.86	x	105.34	x	0.85	x	0.7	=	80.79	(77)
Southeast 0.9x	0.77	x	1.86	x	92.9	x	0.85	x	0.7	=	427.48	(77)
Southeast 0.9x	0.77	x	2.04	x	92.9	x	0.85	x	0.7	=	78.14	(77)
Southeast 0.9x	0.77	x	2.56	x	92.9	x	0.85	x	0.7	=	196.12	(77)
Southeast 0.9x	0.77	x	4.18	x	92.9	x	0.85	x	0.7	=	160.11	(77)
Southeast 0.9x	0.77	x	2.49	x	92.9	x	0.85	x	0.7	=	381.52	(77)
Southeast 0.9x	0.77	x	1.86	x	92.9	x	0.85	x	0.7	=	71.25	(77)
Southeast 0.9x	0.77	x	1.86	x	72.36	x	0.85	x	0.7	=	332.99	(77)
Southeast 0.9x	0.77	x	2.04	x	72.36	x	0.85	x	0.7	=	60.87	(77)
Southeast 0.9x	0.77	x	2.56	x	72.36	x	0.85	x	0.7	=	152.77	(77)
Southeast 0.9x	0.77	x	4.18	x	72.36	x	0.85	x	0.7	=	124.72	(77)
Southeast 0.9x	0.77	x	2.49	x	72.36	x	0.85	x	0.7	=	297.18	(77)
Southeast 0.9x	0.77	x	1.86	x	72.36	x	0.85	x	0.7	=	55.5	(77)
Southeast 0.9x	0.77	x	1.86	x	44.83	x	0.85	x	0.7	=	206.27	(77)
Southeast 0.9x	0.77	x	2.04	x	44.83	x	0.85	x	0.7	=	37.71	(77)
Southeast 0.9x	0.77	x	2.56	x	44.83	x	0.85	x	0.7	=	94.63	(77)
Southeast 0.9x	0.77	x	4.18	x	44.83	x	0.85	x	0.7	=	77.26	(77)
Southeast 0.9x	0.77	x	2.49	x	44.83	x	0.85	x	0.7	=	184.09	(77)
Southeast 0.9x	0.77	x	1.86	x	44.83	x	0.85	x	0.7	=	34.38	(77)
Southeast 0.9x	0.77	x	1.86	x	31.95	x	0.85	x	0.7	=	147.02	(77)
Southeast 0.9x	0.77	x	2.04	x	31.95	x	0.85	x	0.7	=	26.87	(77)
Southeast 0.9x	0.77	x	2.56	x	31.95	x	0.85	x	0.7	=	67.45	(77)
Southeast 0.9x	0.77	x	4.18	x	31.95	x	0.85	x	0.7	=	55.07	(77)
Southeast 0.9x	0.77	x	2.49	x	31.95	x	0.85	x	0.7	=	131.21	(77)
Southeast 0.9x	0.77	x	1.86	x	31.95	x	0.85	x	0.7	=	24.5	(77)
Southwest 0.9x	0.77	x	1.86	x	37.39		0.85	x	0.7	=	143.37	(79)
Southwest 0.9x	0.77	x	2.53	x	37.39		0.85	x	0.7	=	78.01	(79)
Southwest 0.9x	0.77	x	1.87	x	37.39		0.85	x	0.7	=	28.83	(79)
Southwest 0.9x	0.77	x	1.44	x	37.39		0.85	x	0.7	=	22.2	(79)
Southwest 0.9x	0.77	x	0.76	x	37.39		0.85	x	0.7	=	11.72	(79)
Southwest 0.9x	0.77	x	1.2	x	37.39		0.85	x	0.7	=	18.5	(79)
Southwest 0.9x	0.77	x	3.36	x	37.39		0.85	x	0.7	=	51.8	(79)
Southwest 0.9x	0.77	x	1.26	x	37.39		0.85	x	0.7	=	19.42	(79)
Southwest 0.9x	0.77	x	1.86	x	63.74		0.85	x	0.7	=	244.41	(79)
Southwest 0.9x	0.77	x	2.53	x	63.74		0.85	x	0.7	=	132.98	(79)
Southwest 0.9x	0.77	x	1.87	x	63.74		0.85	x	0.7	=	49.14	(79)
Southwest 0.9x	0.77	x	1.44	x	63.74		0.85	x	0.7	=	37.84	(79)
Southwest 0.9x	0.77	x	0.76	x	63.74		0.85	x	0.7	=	19.97	(79)

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Southwest0.9x	0.77	x	1.2	x	63.74	0.85	x	0.7	=	31.54	(79)
Southwest0.9x	0.77	x	3.36	x	63.74	0.85	x	0.7	=	88.3	(79)
Southwest0.9x	0.77	x	1.26	x	63.74	0.85	x	0.7	=	33.11	(79)
Southwest0.9x	0.77	x	1.86	x	84.22	0.85	x	0.7	=	322.94	(79)
Southwest0.9x	0.77	x	2.53	x	84.22	0.85	x	0.7	=	175.71	(79)
Southwest0.9x	0.77	x	1.87	x	84.22	0.85	x	0.7	=	64.94	(79)
Southwest0.9x	0.77	x	1.44	x	84.22	0.85	x	0.7	=	50	(79)
Southwest0.9x	0.77	x	0.76	x	84.22	0.85	x	0.7	=	26.39	(79)
Southwest0.9x	0.77	x	1.2	x	84.22	0.85	x	0.7	=	41.67	(79)
Southwest0.9x	0.77	x	3.36	x	84.22	0.85	x	0.7	=	116.68	(79)
Southwest0.9x	0.77	x	1.26	x	84.22	0.85	x	0.7	=	43.75	(79)
Southwest0.9x	0.77	x	1.86	x	103.49	0.85	x	0.7	=	396.85	(79)
Southwest0.9x	0.77	x	2.53	x	103.49	0.85	x	0.7	=	215.92	(79)
Southwest0.9x	0.77	x	1.87	x	103.49	0.85	x	0.7	=	79.8	(79)
Southwest0.9x	0.77	x	1.44	x	103.49	0.85	x	0.7	=	61.45	(79)
Southwest0.9x	0.77	x	0.76	x	103.49	0.85	x	0.7	=	32.43	(79)
Southwest0.9x	0.77	x	1.2	x	103.49	0.85	x	0.7	=	51.21	(79)
Southwest0.9x	0.77	x	3.36	x	103.49	0.85	x	0.7	=	143.38	(79)
Southwest0.9x	0.77	x	1.26	x	103.49	0.85	x	0.7	=	53.77	(79)
Southwest0.9x	0.77	x	1.86	x	113.34	0.85	x	0.7	=	434.61	(79)
Southwest0.9x	0.77	x	2.53	x	113.34	0.85	x	0.7	=	236.47	(79)
Southwest0.9x	0.77	x	1.87	x	113.34	0.85	x	0.7	=	87.39	(79)
Southwest0.9x	0.77	x	1.44	x	113.34	0.85	x	0.7	=	67.3	(79)
Southwest0.9x	0.77	x	0.76	x	113.34	0.85	x	0.7	=	35.52	(79)
Southwest0.9x	0.77	x	1.2	x	113.34	0.85	x	0.7	=	56.08	(79)
Southwest0.9x	0.77	x	3.36	x	113.34	0.85	x	0.7	=	157.02	(79)
Southwest0.9x	0.77	x	1.26	x	113.34	0.85	x	0.7	=	58.88	(79)
Southwest0.9x	0.77	x	1.86	x	115.04	0.85	x	0.7	=	441.16	(79)
Southwest0.9x	0.77	x	2.53	x	115.04	0.85	x	0.7	=	240.03	(79)
Southwest0.9x	0.77	x	1.87	x	115.04	0.85	x	0.7	=	88.71	(79)
Southwest0.9x	0.77	x	1.44	x	115.04	0.85	x	0.7	=	68.31	(79)
Southwest0.9x	0.77	x	0.76	x	115.04	0.85	x	0.7	=	36.05	(79)
Southwest0.9x	0.77	x	1.2	x	115.04	0.85	x	0.7	=	56.92	(79)
Southwest0.9x	0.77	x	3.36	x	115.04	0.85	x	0.7	=	159.39	(79)
Southwest0.9x	0.77	x	1.26	x	115.04	0.85	x	0.7	=	59.77	(79)
Southwest0.9x	0.77	x	1.86	x	112.79	0.85	x	0.7	=	432.52	(79)
Southwest0.9x	0.77	x	2.53	x	112.79	0.85	x	0.7	=	235.33	(79)
Southwest0.9x	0.77	x	1.87	x	112.79	0.85	x	0.7	=	86.97	(79)
Southwest0.9x	0.77	x	1.44	x	112.79	0.85	x	0.7	=	66.97	(79)
Southwest0.9x	0.77	x	0.76	x	112.79	0.85	x	0.7	=	35.35	(79)
Southwest0.9x	0.77	x	1.2	x	112.79	0.85	x	0.7	=	55.81	(79)

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Southwest0.9x	0.77	x	3.36	x	112.79	0.85	x	0.7	=	156.27	(79)
Southwest0.9x	0.77	x	1.26	x	112.79	0.85	x	0.7	=	58.6	(79)
Southwest0.9x	0.77	x	1.86	x	105.34	0.85	x	0.7	=	403.95	(79)
Southwest0.9x	0.77	x	2.53	x	105.34	0.85	x	0.7	=	219.78	(79)
Southwest0.9x	0.77	x	1.87	x	105.34	0.85	x	0.7	=	81.22	(79)
Southwest0.9x	0.77	x	1.44	x	105.34	0.85	x	0.7	=	62.55	(79)
Southwest0.9x	0.77	x	0.76	x	105.34	0.85	x	0.7	=	33.01	(79)
Southwest0.9x	0.77	x	1.2	x	105.34	0.85	x	0.7	=	52.12	(79)
Southwest0.9x	0.77	x	3.36	x	105.34	0.85	x	0.7	=	145.94	(79)
Southwest0.9x	0.77	x	1.26	x	105.34	0.85	x	0.7	=	54.73	(79)
Southwest0.9x	0.77	x	1.86	x	92.9	0.85	x	0.7	=	356.23	(79)
Southwest0.9x	0.77	x	2.53	x	92.9	0.85	x	0.7	=	193.82	(79)
Southwest0.9x	0.77	x	1.87	x	92.9	0.85	x	0.7	=	71.63	(79)
Southwest0.9x	0.77	x	1.44	x	92.9	0.85	x	0.7	=	55.16	(79)
Southwest0.9x	0.77	x	0.76	x	92.9	0.85	x	0.7	=	29.11	(79)
Southwest0.9x	0.77	x	1.2	x	92.9	0.85	x	0.7	=	45.97	(79)
Southwest0.9x	0.77	x	3.36	x	92.9	0.85	x	0.7	=	128.7	(79)
Southwest0.9x	0.77	x	1.26	x	92.9	0.85	x	0.7	=	48.26	(79)
Southwest0.9x	0.77	x	1.86	x	72.36	0.85	x	0.7	=	277.49	(79)
Southwest0.9x	0.77	x	2.53	x	72.36	0.85	x	0.7	=	150.98	(79)
Southwest0.9x	0.77	x	1.87	x	72.36	0.85	x	0.7	=	55.8	(79)
Southwest0.9x	0.77	x	1.44	x	72.36	0.85	x	0.7	=	42.97	(79)
Southwest0.9x	0.77	x	0.76	x	72.36	0.85	x	0.7	=	22.68	(79)
Southwest0.9x	0.77	x	1.2	x	72.36	0.85	x	0.7	=	35.81	(79)
Southwest0.9x	0.77	x	3.36	x	72.36	0.85	x	0.7	=	100.25	(79)
Southwest0.9x	0.77	x	1.26	x	72.36	0.85	x	0.7	=	37.6	(79)
Southwest0.9x	0.77	x	1.86	x	44.83	0.85	x	0.7	=	171.89	(79)
Southwest0.9x	0.77	x	2.53	x	44.83	0.85	x	0.7	=	93.52	(79)
Southwest0.9x	0.77	x	1.87	x	44.83	0.85	x	0.7	=	34.56	(79)
Southwest0.9x	0.77	x	1.44	x	44.83	0.85	x	0.7	=	26.62	(79)
Southwest0.9x	0.77	x	0.76	x	44.83	0.85	x	0.7	=	14.05	(79)
Southwest0.9x	0.77	x	1.2	x	44.83	0.85	x	0.7	=	22.18	(79)
Southwest0.9x	0.77	x	3.36	x	44.83	0.85	x	0.7	=	62.1	(79)
Southwest0.9x	0.77	x	1.26	x	44.83	0.85	x	0.7	=	23.29	(79)
Southwest0.9x	0.77	x	1.86	x	31.95	0.85	x	0.7	=	122.52	(79)
Southwest0.9x	0.77	x	2.53	x	31.95	0.85	x	0.7	=	66.66	(79)
Southwest0.9x	0.77	x	1.87	x	31.95	0.85	x	0.7	=	24.64	(79)
Southwest0.9x	0.77	x	1.44	x	31.95	0.85	x	0.7	=	18.97	(79)
Southwest0.9x	0.77	x	0.76	x	31.95	0.85	x	0.7	=	10.01	(79)
Southwest0.9x	0.77	x	1.2	x	31.95	0.85	x	0.7	=	15.81	(79)
Southwest0.9x	0.77	x	3.36	x	31.95	0.85	x	0.7	=	44.26	(79)

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Southwest	0.9x	0.77	x	1.26	x	31.95	0.85	x	0.7	=	16.6	(79)
West	0.9x	0.77	x	2.55	x	19.87	0.85	x	0.7	=	20.9	(80)
West	0.9x	0.77	x	2.55	x	38.52	0.85	x	0.7	=	40.5	(80)
West	0.9x	0.77	x	2.55	x	61.57	0.85	x	0.7	=	64.73	(80)
West	0.9x	0.77	x	2.55	x	91.41	0.85	x	0.7	=	96.11	(80)
West	0.9x	0.77	x	2.55	x	111.22	0.85	x	0.7	=	116.94	(80)
West	0.9x	0.77	x	2.55	x	116.05	0.85	x	0.7	=	122.02	(80)
West	0.9x	0.77	x	2.55	x	112.64	0.85	x	0.7	=	118.44	(80)
West	0.9x	0.77	x	2.55	x	98.03	0.85	x	0.7	=	103.08	(80)
West	0.9x	0.77	x	2.55	x	73.6	0.85	x	0.7	=	77.39	(80)
West	0.9x	0.77	x	2.55	x	46.91	0.85	x	0.7	=	49.32	(80)
West	0.9x	0.77	x	2.55	x	24.71	0.85	x	0.7	=	25.98	(80)
West	0.9x	0.77	x	2.55	x	16.39	0.85	x	0.7	=	17.24	(80)
Northwest	0.9x	0.77	x	1.86	x	11.51	0.85	x	0.7	=	61.79	(81)
Northwest	0.9x	0.77	x	3.5	x	11.51	0.85	x	0.7	=	33.22	(81)
Northwest	0.9x	0.77	x	1.86	x	11.51	0.85	x	0.7	=	26.48	(81)
Northwest	0.9x	0.77	x	2.55	x	11.51	0.85	x	0.7	=	36.31	(81)
Northwest	0.9x	0.77	x	3.42	x	11.51	0.85	x	0.7	=	16.23	(81)
Northwest	0.9x	0.77	x	1.44	x	11.51	0.85	x	0.7	=	6.83	(81)
Northwest	0.9x	0.77	x	1.86	x	23.55	0.85	x	0.7	=	126.45	(81)
Northwest	0.9x	0.77	x	3.5	x	23.55	0.85	x	0.7	=	67.99	(81)
Northwest	0.9x	0.77	x	1.86	x	23.55	0.85	x	0.7	=	54.19	(81)
Northwest	0.9x	0.77	x	2.55	x	23.55	0.85	x	0.7	=	74.3	(81)
Northwest	0.9x	0.77	x	3.42	x	23.55	0.85	x	0.7	=	33.22	(81)
Northwest	0.9x	0.77	x	1.44	x	23.55	0.85	x	0.7	=	13.99	(81)
Northwest	0.9x	0.77	x	1.86	x	41.13	0.85	x	0.7	=	220.79	(81)
Northwest	0.9x	0.77	x	3.5	x	41.13	0.85	x	0.7	=	118.71	(81)
Northwest	0.9x	0.77	x	1.86	x	41.13	0.85	x	0.7	=	94.63	(81)
Northwest	0.9x	0.77	x	2.55	x	41.13	0.85	x	0.7	=	129.73	(81)
Northwest	0.9x	0.77	x	3.42	x	41.13	0.85	x	0.7	=	58	(81)
Northwest	0.9x	0.77	x	1.44	x	41.13	0.85	x	0.7	=	24.42	(81)
Northwest	0.9x	0.77	x	1.86	x	67.8	0.85	x	0.7	=	363.98	(81)
Northwest	0.9x	0.77	x	3.5	x	67.8	0.85	x	0.7	=	195.69	(81)
Northwest	0.9x	0.77	x	1.86	x	67.8	0.85	x	0.7	=	155.99	(81)
Northwest	0.9x	0.77	x	2.55	x	67.8	0.85	x	0.7	=	213.86	(81)
Northwest	0.9x	0.77	x	3.42	x	67.8	0.85	x	0.7	=	95.61	(81)
Northwest	0.9x	0.77	x	1.44	x	67.8	0.85	x	0.7	=	40.26	(81)
Northwest	0.9x	0.77	x	1.86	x	89.77	0.85	x	0.7	=	481.92	(81)
Northwest	0.9x	0.77	x	3.5	x	89.77	0.85	x	0.7	=	259.1	(81)
Northwest	0.9x	0.77	x	1.86	x	89.77	0.85	x	0.7	=	206.54	(81)
Northwest	0.9x	0.77	x	2.55	x	89.77	0.85	x	0.7	=	283.15	(81)

SAP WorkSheet: New dwelling as built

Northwest 0.9x	0.77	x	3.42	x	89.77	x	0.85	x	0.7	=	126.59	(81)
Northwest 0.9x	0.77	x	1.44	x	89.77	x	0.85	x	0.7	=	53.3	(81)
Northwest 0.9x	0.77	x	1.86	x	97.5	x	0.85	x	0.7	=	523.45	(81)
Northwest 0.9x	0.77	x	3.5	x	97.5	x	0.85	x	0.7	=	281.42	(81)
Northwest 0.9x	0.77	x	1.86	x	97.5	x	0.85	x	0.7	=	224.33	(81)
Northwest 0.9x	0.77	x	2.55	x	97.5	x	0.85	x	0.7	=	307.56	(81)
Northwest 0.9x	0.77	x	3.42	x	97.5	x	0.85	x	0.7	=	137.5	(81)
Northwest 0.9x	0.77	x	1.44	x	97.5	x	0.85	x	0.7	=	57.89	(81)
Northwest 0.9x	0.77	x	1.86	x	92.98	x	0.85	x	0.7	=	499.17	(81)
Northwest 0.9x	0.77	x	3.5	x	92.98	x	0.85	x	0.7	=	268.37	(81)
Northwest 0.9x	0.77	x	1.86	x	92.98	x	0.85	x	0.7	=	213.93	(81)
Northwest 0.9x	0.77	x	2.55	x	92.98	x	0.85	x	0.7	=	293.29	(81)
Northwest 0.9x	0.77	x	3.42	x	92.98	x	0.85	x	0.7	=	131.12	(81)
Northwest 0.9x	0.77	x	1.44	x	92.98	x	0.85	x	0.7	=	55.21	(81)
Northwest 0.9x	0.77	x	1.86	x	75.42	x	0.85	x	0.7	=	404.89	(81)
Northwest 0.9x	0.77	x	3.5	x	75.42	x	0.85	x	0.7	=	217.68	(81)
Northwest 0.9x	0.77	x	1.86	x	75.42	x	0.85	x	0.7	=	173.52	(81)
Northwest 0.9x	0.77	x	2.55	x	75.42	x	0.85	x	0.7	=	237.89	(81)
Northwest 0.9x	0.77	x	3.42	x	75.42	x	0.85	x	0.7	=	106.35	(81)
Northwest 0.9x	0.77	x	1.44	x	75.42	x	0.85	x	0.7	=	44.78	(81)
Northwest 0.9x	0.77	x	1.86	x	51.24	x	0.85	x	0.7	=	275.11	(81)
Northwest 0.9x	0.77	x	3.5	x	51.24	x	0.85	x	0.7	=	147.91	(81)
Northwest 0.9x	0.77	x	1.86	x	51.24	x	0.85	x	0.7	=	117.9	(81)
Northwest 0.9x	0.77	x	2.55	x	51.24	x	0.85	x	0.7	=	161.64	(81)
Northwest 0.9x	0.77	x	3.42	x	51.24	x	0.85	x	0.7	=	72.26	(81)
Northwest 0.9x	0.77	x	1.44	x	51.24	x	0.85	x	0.7	=	30.43	(81)
Northwest 0.9x	0.77	x	1.86	x	29.6	x	0.85	x	0.7	=	158.9	(81)
Northwest 0.9x	0.77	x	3.5	x	29.6	x	0.85	x	0.7	=	85.43	(81)
Northwest 0.9x	0.77	x	1.86	x	29.6	x	0.85	x	0.7	=	68.1	(81)
Northwest 0.9x	0.77	x	2.55	x	29.6	x	0.85	x	0.7	=	93.37	(81)
Northwest 0.9x	0.77	x	3.42	x	29.6	x	0.85	x	0.7	=	41.74	(81)
Northwest 0.9x	0.77	x	1.44	x	29.6	x	0.85	x	0.7	=	17.57	(81)
Northwest 0.9x	0.77	x	1.86	x	14.52	x	0.85	x	0.7	=	77.98	(81)
Northwest 0.9x	0.77	x	3.5	x	14.52	x	0.85	x	0.7	=	41.92	(81)
Northwest 0.9x	0.77	x	1.86	x	14.52	x	0.85	x	0.7	=	33.42	(81)
Northwest 0.9x	0.77	x	2.55	x	14.52	x	0.85	x	0.7	=	45.82	(81)
Northwest 0.9x	0.77	x	3.42	x	14.52	x	0.85	x	0.7	=	20.48	(81)
Northwest 0.9x	0.77	x	1.44	x	14.52	x	0.85	x	0.7	=	8.62	(81)
Northwest 0.9x	0.77	x	1.86	x	9.36	x	0.85	x	0.7	=	50.25	(81)
Northwest 0.9x	0.77	x	3.5	x	9.36	x	0.85	x	0.7	=	27.02	(81)
Northwest 0.9x	0.77	x	1.86	x	9.36	x	0.85	x	0.7	=	21.54	(81)

SAP WorkSheet: New dwelling as built

Northwest 0.9x	0.77	x	2.55	x	9.36	x	0.85	x	0.7	=	29.53	(81)
Northwest 0.9x	0.77	x	3.42	x	9.36	x	0.85	x	0.7	=	13.2	(81)
Northwest 0.9x	0.77	x	1.44	x	9.36	x	0.85	x	0.7	=	5.56	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	1193.23	2129.4	3055.95	4173.36	4946.33	5175.46	5010.82	4403.22	3513.36	2486.82	1448.18	1008.17	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m, watts

(84)m=	3029.56	3939.31	4775.47	5762.03	6401.72	6524.12	6309.23	5733.53	4930.81	4035.42	3134.49	2797.88	(84)
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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	0.99	0.97	0.94	0.88	0.9	0.97	0.99	1	1	(86)

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

(87)m=	17	17.22	17.74	18.34	19.15	19.88	20.41	20.38	19.69	18.74	17.7	17.11	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	18.28	18.29	18.29	18.32	18.34	18.34	18.35	18.35	18.33	18.32	18.31	18.29	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.98	0.95	0.86	0.58	0.61	0.92	0.98	1	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	14.98	15.2	15.72	16.33	17.14	17.84	18.27	18.26	17.67	16.73	15.68	15.1	(90)
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fLA = Living area ÷ (4) = 0.05 (91)

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

(92)m=	15.08	15.31	15.82	16.43	17.24	17.94	18.38	18.37	17.77	16.83	15.78	15.2	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	15.08	15.31	15.82	16.43	17.24	17.94	18.38	18.37	17.77	16.83	15.78	15.2	(93)
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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	
(94)m=	0.99	0.99	0.98	0.97	0.93	0.83	0.58	0.62	0.9	0.97	0.99	1	(94)

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

(95)m=	3013.82	3903.27	4693.12	5571.75	5936.02	5430.92	3684.37	3530.28	4425.14	3926.58	3109.59	2784.91	(95)
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Monthly average external temperature from Table 8

(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)
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Heat loss rate for mean internal temperature, Lm, W = [(39)m x ((93)m – (96)m)]

(97)m=	36326.77	34966.35	30617.69	25637.8	18136.45	10868.54	4777.06	4740.34	11392.72	20002.11	29457.52	34932.55	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	24784.83	20874.39	19287.88	14447.56	9077.12	0	0	0	0	11960.19	18970.51	23917.84	(98)
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Total per year (kWh/year) = Sum(98) = 143320.32 (98)

Space heating requirement in kWh/m²/year

178.48 (99)

SAP WorkSheet: New dwelling as built

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

Space heating:

Fraction of space heat from secondary/supplementary system		0.1	(201)
Fraction of space heat from main system(s)	$(202) = 1 - (201) =$	0.9	(202)
Fraction of total heating from main system 1	$(204) = (202) \times [1 - (203)] =$	0.9	(204)
Efficiency of main space heating system 1		84	(206)
Efficiency of secondary/supplementary heating system, %		100	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	24784.83	20874.39	19287.88	14447.56	9077.12	0	0	0	0	11960.19	18970.51	23917.84		
$(211)m = \{[(98)m \times (204)] + (210)m\} \times 100 + (206)$	26555.18	22365.42	20665.58	15479.52	9725.49	0	0	0	0	12814.49	20325.54	25626.26		(211)
Total (kWh/year) = Sum(211), $_{(1,12)} =$													153557.48	(211)

Space heating fuel (secondary), kWh/month													
$= \{[(98)m \times (201)] + (214)m\} \times 100 + (208)$													
(215)m=	2478.48	2087.44	1928.79	1444.76	907.71	0	0	0	0	1196.02	1897.05	2391.78	
Total (kWh/year) =Sum(215), _{(1,12) =}												14332.03	(215)

Water heating

Output from water heater (calculated above)														
292.08	257.7	271.25	244.01	239.74	215.1	207.42	226.45	225.68	252.98	266.44	285.34			
Efficiency of water heater												74	(216)	
(217)m=	83.85	83.85	83.83	83.79	83.68	74	74	74	74	83.74	83.83	83.85	(217)	
Fuel for water heating, kWh/month														
(219)m = (64)m x 100 + (217)m														
(219)m=	348.32	307.35	323.59	291.21	286.5	290.67	280.3	306.01	304.98	302.11	317.84	340.29		
												Total = Sum(219a) _(1,12) =	3699.17	(219)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1	153557.48	
Space heating fuel used, secondary	14332.03	
Water heating fuel used	3699.17	
Electricity for pumps, fans and electric keep-hot		
central heating pump:	130	(230c)
boiler with a fan-assisted flue	45	(230e)
Total electricity for the above, kWh/year	175	(231)
Electricity for lighting	2257.77	(232)

10a Fuel costs - individual heating systems

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	3.1 x 0.01 =	4760.28 (240)
Space heating - main system 2	(213) x	0 x 0.01 =	0 (241)
Space heating - secondary	(215) x	11.46 x 0.01 =	1642.45 (242)

SAP WorkSheet: New dwelling as built

Water heating cost (other fuel)	(219)	3.1	x 0.01 =	114.67	(247)
Pumps, fans and electric keep-hot	(231)	11.46	x 0.01 =	20.06	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	11.46	x 0.01 =	258.74	(250)
Additional standing charges (Table 12)				106	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)...(254) =			6902.2	(255)

11a SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	3.83	(257)
SAP rating (Section 12)		46.49	(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	0.198	= 30404.38 (261)
Space heating (secondary)	(215) x	0.517	= 7409.66 (263)
Water heating	(219) x	0.198	= 732.44 (264)
Space and water heating	(261) + (262) + (263) + (264) =		38546.48 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517	= 90.48 (267)
Electricity for lighting	(232) x	0.517	= 1167.27 (268)
Total CO2, kg/year		sum of (265)...(271) =	39804.22 (272)
CO2 emissions per m²		(272) ÷ (4) =	49.57 (273)
EI rating (section 14)			41 (274)

13a Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) x	1.02	= 156628.63 (261)
Space heating (secondary)	(215) x	2.92	= 41849.53 (263)
Energy for water heating	(219) x	1.02	= 3773.16 (264)
Space and water heating	(261) + (262) + (263) + (264) =		202251.32 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92	= 511 (267)
Electricity for lighting	(232) x	0	= 6592.69 (268)
Total Primary Energy		sum of (265)...(271) =	209355.01 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =	260.72 (273)

APPENDIX (C)

EXISTING PEA - PREDICTED ENERGY ASSESSMENT (OUTLINE EPC)

Predicted Energy Assessment

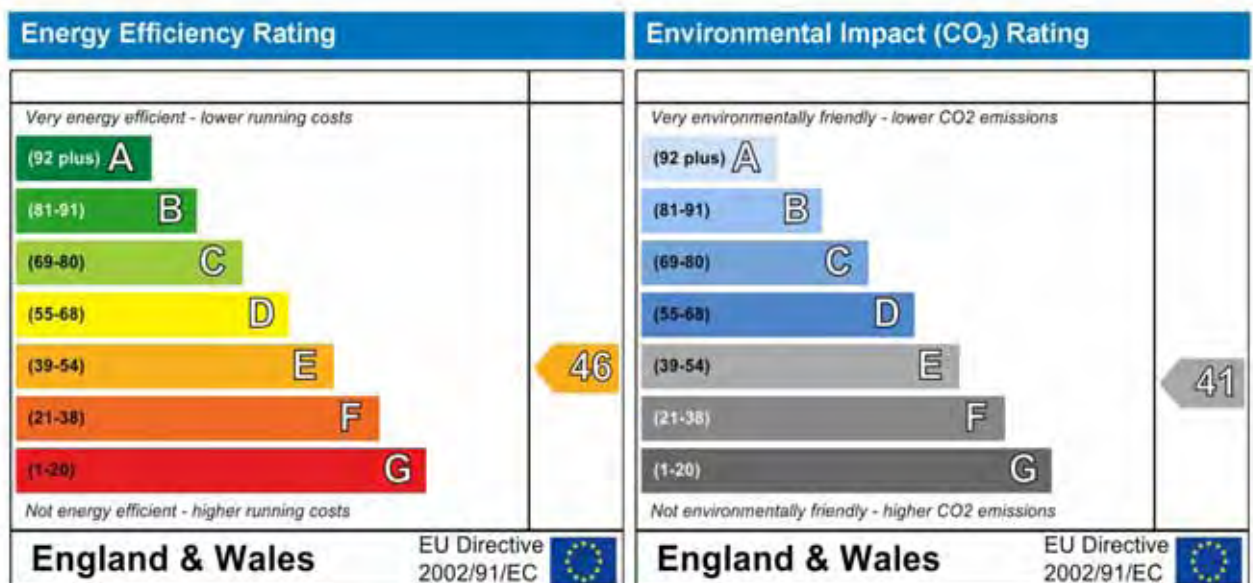
Existing House
9 Templewood Avenue
London
NW3 7UY

Dwelling type:
Date of assessment:
Produced by:
Total floor area:

Detached House
29 August 2012
Ondrej Gajdos
803 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 2009 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.



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

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

APPENDIX (D)

SAP WORKSHEET - PROPOSED DWELLING

*(For modelling)

SAP WorkSheet: New dwelling as built

User Details:

Assessor Name: Ondrej Gajdos **Stroma Number:** STRO006629
Software Name: Stroma FSAP 2009 **Software Version:** Version: 1.5.0.18

Property Address: Proposed

Address : 9 Templewood Avenue, London, NW3 7UY

1 Overall dwelling dimensions:

	Area(m ²)		Ave Height(m)		Volume(m ³)
Basement	322.13 (1a)	x	2.6 (2a)	=	837.54 (3a)
Ground floor	325 (1b)	x	3.2 (2b)	=	1040 (3b)
First floor	248 (1c)	x	2.9 (2c)	=	719.2 (3c)
Second floor	150 (1d)	x	2.9 (2d)	=	435 (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	1045.13 (4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		3031.74 (5)

2 Ventilation rate:

	main heating	Secondary heating	other	total		m ³ per hour
Number of chimneys	0	0	4	4	x 40 =	160 (6a)
Number of open flues	0	0	0	0	x 20 =	0 (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 = $(6a)+(6b)+(7a)+(7b)+(7c) =$											260	$+ (5) =$	0.09	(8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>														
Number of storeys in the dwelling (ns)													0	(9)
Additional infiltration												$[(9)-1] \times 0.1 =$	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction													0	(11)
<i>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</i>														
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											$0.25 - [0.2 \times (14) + 100] =$		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													15	(17)
If based on air permeability value, then $(18) = [(17) + 20] \times (8)$, otherwise $(18) = (16)$													0.84	(18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>														
Number of sides on which sheltered													2	(19)
Shelter factor											$(20) = 1 - [0.075 \times (19)] =$		0.85	(20)
Infiltration rate incorporating shelter factor											$(21) = (18) \times (20) =$		0.71	(21)
Infiltration rate modified for monthly wind speed														
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			

SAP WorkSheet: New dwelling as built

Monthly average wind speed from Table 7

(22)m=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1
--------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27
---------	------	------	------	------	------	------	------	------	------	------	-----	------

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

	0.96	0.91	0.91	0.8	0.73	0.69	0.66	0.66	0.75	0.8	0.85	0.91
--	------	------	------	-----	------	------	------	------	------	-----	------	------

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 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 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 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 × 0.5]

(24d)m= 0.96 0.91 0.91 0.82 0.77 0.74 0.72 0.72 0.72 0.78 0.82 0.86 0.91 (24d)

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

(25)m= 0.96 0.91 0.91 0.82 0.77 0.74 0.72 0.72 0.78 0.82 0.86 0.91 (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			2.15	x 3	= 6.45		(26)
Doors Type 2			5.5	x 3.9	= 21.45		(26)
Doors Type 3			2.15	x 3	= 6.45		(26)
Windows Type 1			3.83	x 1/1/ (4.8)+ 0.04]	= 15.42		(27)
Windows Type 2			2.49	x 1/1/ (4.8)+ 0.04]	= 10.03		(27)
Windows Type 3			1.86	x 1/1/ (4.8)+ 0.04]	= 7.49		(27)
Windows Type 4			2.48	x 1/1/ (4.8)+ 0.04]	= 9.99		(27)
Windows Type 5			1.36	x 1/1/ (4.8)+ 0.04]	= 5.48		(27)
Windows Type 6			1.95	x 1/1/ (1.6)+ 0.04]	= 2.93		(27)
Windows Type 7			12.59	x 1/1/ (1.6)+ 0.04]	= 18.93		(27)
Windows Type 8			12.92	x 1/1/ (1.6)+ 0.04]	= 19.43		(27)
Windows Type 9			5.46	x 1/1/ (1.6)+ 0.04]	= 8.21		(27)
Windows Type 10			13.52	x 1/1/ (1.6)+ 0.04]	= 20.33		(27)
Windows Type 11			14.94	x 1/1/ (1.6)+ 0.04]	= 22.47		(27)

SAP WorkSheet: New dwelling as built

Windows Type 12			4.14	$\times 1/[1/(1.6) + 0.04] =$	6.23			(27)	
Windows Type 13			7.14	$\times 1/[1/(1.6) + 0.04] =$	10.74			(27)	
Windows Type 14			6.22	$\times 1/[1/(1.6) + 0.04] =$	9.35			(27)	
Windows Type 15			6.22	$\times 1/[1/(1.6) + 0.04] =$	9.35			(27)	
Windows Type 16			1.86	$\times 1/[1/(4.8) + 0.04] =$	7.49			(27)	
Windows Type 17			1.86	$\times 1/[1/(4.8) + 0.04] =$	7.49			(27)	
Windows Type 18			1.86	$\times 1/[1/(4.8) + 0.04] =$	7.49			(27)	
Windows Type 19			1.86	$\times 1/[1/(4.8) + 0.04] =$	7.49			(27)	
Windows Type 20			3.5	$\times 1/[1/(4.8) + 0.04] =$	14.09			(27)	
Windows Type 21			1.87	$\times 1/[1/(4.8) + 0.04] =$	7.53			(27)	
Windows Type 22			2.53	$\times 1/[1/(4.8) + 0.04] =$	10.19			(27)	
Windows Type 23			2.04	$\times 1/[1/(4.8) + 0.04] =$	8.21			(27)	
Rooflights			1.13	$\times 1/[1/(1.6) + 0.04] =$	1.808			(27b)	
Floor Type 1			145	$\times$	0.22	=	31.9		(28)
Floor Type 2			177.13	$\times$	0.22	=	38.9686		(28)
Floor Type 3			38.56	$\times$	0.5	=	19.29		(28)
Walls Type1	316.83	74.84	241.99	$\times$	2.1	=	508.18		(29)
Walls Type2	82.16	0	82.16	$\times$	2.1	=	172.54		(29)
Walls Type3	173.99	103.54	70.45	$\times$	0.28	=	19.73		(29)
Walls Type4	52.81	0	52.81	$\times$	0.28	=	14.79		(29)
Walls Type5	25	17.84	7.16	$\times$	2.1	=	15.04		(29)
Roof Type1	46.96	1.13	45.83	$\times$	0.18	=	8.25		(30)
Roof Type2	27.3	0	27.3	$\times$	2.3	=	62.79		(30)
Roof Type3	290	0	290	$\times$	2.3	=	667		(30)
Roof Type4	25.6	0	25.6	$\times$	2.3	=	58.88		(30)
Total area of elements, m ²			1401.36						(31)

* for windows and roof windows, use effective window U-value calculated using formula $1/(1/U\text{-value} + 0.04)$ as given in paragraph 3.2

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

Fabric heat loss, W/K = $S(A \times U)$ (28)...(30) + (32) = 2140.63 (33)

Heat capacity $C_m = S(A \times k)$ ((28)...(30) + (32) + (32a)...(32e) = 35317.32 (34)

Thermal mass parameter (TMP = $C_m - TFA$) 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 : $S(L \times Y)$ calculated using Appendix K 210.2 (36)

details of thermal bridging are not known (36) = $0.15 \times (31)$

Total fabric heat loss (33) + (36) = 2350.83 (37)

Ventilation heat loss calculated monthly (38)m = $0.33 \times (25)m \times (5)$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	960.33	910.63	910.63	819.74	765.47	740.22	716.24	716.24	776.56	819.74	863.77	910.63

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

(39)m=	3311.18	3261.46	3261.46	3170.57	3116.3	3091.05	3067.07	3067.07	3129.39	3170.57	3214.6	3261.46
Average = $\text{Sum}(39) / 12 =$	3176.85											

SAP WorkSheet: New dwelling as built

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

(62)m=

304.95	268.95	282.87	254.14	249.45	223.48	215.19	235.36	234.7	263.5	277.91	297.8
--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	-------

 (62)

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

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63)

Output from water heater

(64)m=

304.95	268.95	282.87	254.14	249.45	223.48	215.19	235.36	234.7	263.5	277.91	297.8
--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	-------

Output from water heater (annual) = 3108.3 (64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=

138.07	122.55	130.73	119.99	119.62	109.8	108.23	114.93	113.53	124.29	127.9	135.69
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 (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

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
246.04	246.04	246.04	246.04	246.04	246.04	246.04	246.04	246.04	246.04	246.04	246.04

 (66)

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

(67)m=

263.94	234.43	190.65	144.34	107.89	91.09	98.42	127.93	171.71	218.03	254.47	271.28
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 (67)

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

(68)m=

1398.73	1413.24	1376.67	1298.8	1200.51	1108.13	1046.41	1031.9	1068.48	1146.34	1244.63	1337.01
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 (68)

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

(69)m=

63.7	63.7	63.7	63.7	63.7	63.7	63.7	63.7	63.7	63.7	63.7	63.7
------	------	------	------	------	------	------	------	------	------	------	------

 (69)

Pumps and fans gains (Table 5a)

(70)m=

10	10	10	10	10	10	10	10	10	10	10	10
----	----	----	----	----	----	----	----	----	----	----	----

 (70)

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

(71)m=

-164.02	-164.02	-164.02	-164.02	-164.02	-164.02	-164.02	-164.02	-164.02	-164.02	-164.02	-164.02
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

 (71)

Water heating gains (Table 5)

(72)m=

185.58	182.37	175.71	166.66	160.78	152.5	145.47	154.48	157.68	167.05	177.64	182.39
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 (72)

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

(73)m=

2003.97	1985.76	1898.75	1765.51	1624.9	1507.44	1446.02	1470.03	1553.59	1687.14	1832.46	1946.39
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 (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 m ²	Flux Table 6a	g Table 6b	FF Table 6c	Gains (W)	
Northeast 0.9x	0.77	x 1.36	x 11.51	x 0.85	x 0.7	= 6.45	(75)
Northeast 0.9x	0.77	x 1.95	x 11.51	x 0.76	x 0.7	= 33.1	(75)
Northeast 0.9x	0.77	x 6.22	x 11.51	x 0.76	x 0.7	= 26.39	(75)
Northeast 0.9x	0.77	x 1.86	x 11.51	x 0.85	x 0.7	= 35.31	(75)
Northeast 0.9x	0.77	x 1.87	x 11.51	x 0.85	x 0.7	= 17.75	(75)
Northeast 0.9x	0.77	x 1.36	x 23.55	x 0.85	x 0.7	= 13.21	(75)
Northeast 0.9x	0.77	x 1.95	x 23.55	x 0.76	x 0.7	= 67.73	(75)
Northeast 0.9x	0.77	x 6.22	x 23.55	x 0.76	x 0.7	= 54.01	(75)

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Northeast 0.9x	0.77	x	1.86	x	23.55	x	0.85	x	0.7	=	72.26	(75)
Northeast 0.9x	0.77	x	1.87	x	23.55	x	0.85	x	0.7	=	36.32	(75)
Northeast 0.9x	0.77	x	1.36	x	41.13	x	0.85	x	0.7	=	23.06	(75)
Northeast 0.9x	0.77	x	1.95	x	41.13	x	0.76	x	0.7	=	118.27	(75)
Northeast 0.9x	0.77	x	6.22	x	41.13	x	0.76	x	0.7	=	94.31	(75)
Northeast 0.9x	0.77	x	1.86	x	41.13	x	0.85	x	0.7	=	126.17	(75)
Northeast 0.9x	0.77	x	1.87	x	41.13	x	0.85	x	0.7	=	63.42	(75)
Northeast 0.9x	0.77	x	1.36	x	67.8	x	0.85	x	0.7	=	38.02	(75)
Northeast 0.9x	0.77	x	1.95	x	67.8	x	0.76	x	0.7	=	194.96	(75)
Northeast 0.9x	0.77	x	6.22	x	67.8	x	0.76	x	0.7	=	155.47	(75)
Northeast 0.9x	0.77	x	1.86	x	67.8	x	0.85	x	0.7	=	207.99	(75)
Northeast 0.9x	0.77	x	1.87	x	67.8	x	0.85	x	0.7	=	104.55	(75)
Northeast 0.9x	0.77	x	1.36	x	89.77	x	0.85	x	0.7	=	50.34	(75)
Northeast 0.9x	0.77	x	1.95	x	89.77	x	0.76	x	0.7	=	258.14	(75)
Northeast 0.9x	0.77	x	6.22	x	89.77	x	0.76	x	0.7	=	205.85	(75)
Northeast 0.9x	0.77	x	1.86	x	89.77	x	0.85	x	0.7	=	275.38	(75)
Northeast 0.9x	0.77	x	1.87	x	89.77	x	0.85	x	0.7	=	138.43	(75)
Northeast 0.9x	0.77	x	1.36	x	97.5	x	0.85	x	0.7	=	54.68	(75)
Northeast 0.9x	0.77	x	1.95	x	97.5	x	0.76	x	0.7	=	280.38	(75)
Northeast 0.9x	0.77	x	6.22	x	97.5	x	0.76	x	0.7	=	223.59	(75)
Northeast 0.9x	0.77	x	1.86	x	97.5	x	0.85	x	0.7	=	299.11	(75)
Northeast 0.9x	0.77	x	1.87	x	97.5	x	0.85	x	0.7	=	150.36	(75)
Northeast 0.9x	0.77	x	1.36	x	92.98	x	0.85	x	0.7	=	52.14	(75)
Northeast 0.9x	0.77	x	1.95	x	92.98	x	0.76	x	0.7	=	267.38	(75)
Northeast 0.9x	0.77	x	6.22	x	92.98	x	0.76	x	0.7	=	213.22	(75)
Northeast 0.9x	0.77	x	1.86	x	92.98	x	0.85	x	0.7	=	285.24	(75)
Northeast 0.9x	0.77	x	1.87	x	92.98	x	0.85	x	0.7	=	143.39	(75)
Northeast 0.9x	0.77	x	1.36	x	75.42	x	0.85	x	0.7	=	42.29	(75)
Northeast 0.9x	0.77	x	1.95	x	75.42	x	0.76	x	0.7	=	216.88	(75)
Northeast 0.9x	0.77	x	6.22	x	75.42	x	0.76	x	0.7	=	172.94	(75)
Northeast 0.9x	0.77	x	1.86	x	75.42	x	0.85	x	0.7	=	231.36	(75)
Northeast 0.9x	0.77	x	1.87	x	75.42	x	0.85	x	0.7	=	116.3	(75)
Northeast 0.9x	0.77	x	1.36	x	51.24	x	0.85	x	0.7	=	28.74	(75)
Northeast 0.9x	0.77	x	1.95	x	51.24	x	0.76	x	0.7	=	147.36	(75)
Northeast 0.9x	0.77	x	6.22	x	51.24	x	0.76	x	0.7	=	117.51	(75)
Northeast 0.9x	0.77	x	1.86	x	51.24	x	0.85	x	0.7	=	157.21	(75)
Northeast 0.9x	0.77	x	1.87	x	51.24	x	0.85	x	0.7	=	79.03	(75)
Northeast 0.9x	0.77	x	1.36	x	29.6	x	0.85	x	0.7	=	16.6	(75)
Northeast 0.9x	0.77	x	1.95	x	29.6	x	0.76	x	0.7	=	85.12	(75)
Northeast 0.9x	0.77	x	6.22	x	29.6	x	0.76	x	0.7	=	67.87	(75)
Northeast 0.9x	0.77	x	1.86	x	29.6	x	0.85	x	0.7	=	90.8	(75)

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Northeast 0.9x	0.77	x	1.87	x	29.6	x	0.85	x	0.7	=	45.65	(75)
Northeast 0.9x	0.77	x	1.36	x	14.52	x	0.85	x	0.7	=	8.15	(75)
Northeast 0.9x	0.77	x	1.95	x	14.52	x	0.76	x	0.7	=	41.77	(75)
Northeast 0.9x	0.77	x	6.22	x	14.52	x	0.76	x	0.7	=	33.31	(75)
Northeast 0.9x	0.77	x	1.86	x	14.52	x	0.85	x	0.7	=	44.56	(75)
Northeast 0.9x	0.77	x	1.87	x	14.52	x	0.85	x	0.7	=	22.4	(75)
Northeast 0.9x	0.77	x	1.36	x	9.36	x	0.85	x	0.7	=	5.25	(75)
Northeast 0.9x	0.77	x	1.95	x	9.36	x	0.76	x	0.7	=	26.92	(75)
Northeast 0.9x	0.77	x	6.22	x	9.36	x	0.76	x	0.7	=	21.47	(75)
Northeast 0.9x	0.77	x	1.86	x	9.36	x	0.85	x	0.7	=	28.72	(75)
Northeast 0.9x	0.77	x	1.87	x	9.36	x	0.85	x	0.7	=	14.44	(75)
Southeast 0.9x	0.77	x	3.83	x	37.39	x	0.85	x	0.7	=	59.04	(77)
Southeast 0.9x	0.77	x	2.49	x	37.39	x	0.85	x	0.7	=	153.55	(77)
Southeast 0.9x	0.77	x	1.86	x	37.39	x	0.85	x	0.7	=	28.67	(77)
Southeast 0.9x	0.77	x	2.48	x	37.39	x	0.85	x	0.7	=	76.46	(77)
Southeast 0.9x	0.77	x	1.86	x	37.39	x	0.85	x	0.7	=	172.05	(77)
Southeast 0.9x	0.77	x	2.04	x	37.39	x	0.85	x	0.7	=	31.45	(77)
Southeast 0.9x	0.77	x	3.83	x	63.74	x	0.85	x	0.7	=	100.65	(77)
Southeast 0.9x	0.77	x	2.49	x	63.74	x	0.85	x	0.7	=	261.75	(77)
Southeast 0.9x	0.77	x	1.86	x	63.74	x	0.85	x	0.7	=	48.88	(77)
Southeast 0.9x	0.77	x	2.48	x	63.74	x	0.85	x	0.7	=	130.35	(77)
Southeast 0.9x	0.77	x	1.86	x	63.74	x	0.85	x	0.7	=	293.29	(77)
Southeast 0.9x	0.77	x	2.04	x	63.74	x	0.85	x	0.7	=	53.61	(77)
Southeast 0.9x	0.77	x	3.83	x	84.22	x	0.85	x	0.7	=	133	(77)
Southeast 0.9x	0.77	x	2.49	x	84.22	x	0.85	x	0.7	=	345.86	(77)
Southeast 0.9x	0.77	x	1.86	x	84.22	x	0.85	x	0.7	=	64.59	(77)
Southeast 0.9x	0.77	x	2.48	x	84.22	x	0.85	x	0.7	=	172.24	(77)
Southeast 0.9x	0.77	x	1.86	x	84.22	x	0.85	x	0.7	=	387.53	(77)
Southeast 0.9x	0.77	x	2.04	x	84.22	x	0.85	x	0.7	=	70.84	(77)
Southeast 0.9x	0.77	x	3.83	x	103.49	x	0.85	x	0.7	=	163.43	(77)
Southeast 0.9x	0.77	x	2.49	x	103.49	x	0.85	x	0.7	=	425.01	(77)
Southeast 0.9x	0.77	x	1.86	x	103.49	x	0.85	x	0.7	=	79.37	(77)
Southeast 0.9x	0.77	x	2.48	x	103.49	x	0.85	x	0.7	=	211.65	(77)
Southeast 0.9x	0.77	x	1.86	x	103.49	x	0.85	x	0.7	=	476.22	(77)
Southeast 0.9x	0.77	x	2.04	x	103.49	x	0.85	x	0.7	=	87.05	(77)
Southeast 0.9x	0.77	x	3.83	x	113.34	x	0.85	x	0.7	=	178.99	(77)
Southeast 0.9x	0.77	x	2.49	x	113.34	x	0.85	x	0.7	=	465.46	(77)
Southeast 0.9x	0.77	x	1.86	x	113.34	x	0.85	x	0.7	=	86.92	(77)
Southeast 0.9x	0.77	x	2.48	x	113.34	x	0.85	x	0.7	=	231.79	(77)
Southeast 0.9x	0.77	x	1.86	x	113.34	x	0.85	x	0.7	=	521.54	(77)
Southeast 0.9x	0.77	x	2.04	x	113.34	x	0.85	x	0.7	=	95.33	(77)

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Southeast 0.9x	0.77	x	3.83	x	115.04	x	0.85	x	0.7	=	181.68	(77)
Southeast 0.9x	0.77	x	2.49	x	115.04	x	0.85	x	0.7	=	472.47	(77)
Southeast 0.9x	0.77	x	1.86	x	115.04	x	0.85	x	0.7	=	88.23	(77)
Southeast 0.9x	0.77	x	2.48	x	115.04	x	0.85	x	0.7	=	235.29	(77)
Southeast 0.9x	0.77	x	1.86	x	115.04	x	0.85	x	0.7	=	529.39	(77)
Southeast 0.9x	0.77	x	2.04	x	115.04	x	0.85	x	0.7	=	96.77	(77)
Southeast 0.9x	0.77	x	3.83	x	112.79	x	0.85	x	0.7	=	178.12	(77)
Southeast 0.9x	0.77	x	2.49	x	112.79	x	0.85	x	0.7	=	463.22	(77)
Southeast 0.9x	0.77	x	1.86	x	112.79	x	0.85	x	0.7	=	86.5	(77)
Southeast 0.9x	0.77	x	2.48	x	112.79	x	0.85	x	0.7	=	230.68	(77)
Southeast 0.9x	0.77	x	1.86	x	112.79	x	0.85	x	0.7	=	519.03	(77)
Southeast 0.9x	0.77	x	2.04	x	112.79	x	0.85	x	0.7	=	94.88	(77)
Southeast 0.9x	0.77	x	3.83	x	105.34	x	0.85	x	0.7	=	166.36	(77)
Southeast 0.9x	0.77	x	2.49	x	105.34	x	0.85	x	0.7	=	432.62	(77)
Southeast 0.9x	0.77	x	1.86	x	105.34	x	0.85	x	0.7	=	80.79	(77)
Southeast 0.9x	0.77	x	2.48	x	105.34	x	0.85	x	0.7	=	215.44	(77)
Southeast 0.9x	0.77	x	1.86	x	105.34	x	0.85	x	0.7	=	484.74	(77)
Southeast 0.9x	0.77	x	2.04	x	105.34	x	0.85	x	0.7	=	88.61	(77)
Southeast 0.9x	0.77	x	3.83	x	92.9	x	0.85	x	0.7	=	146.71	(77)
Southeast 0.9x	0.77	x	2.49	x	92.9	x	0.85	x	0.7	=	381.52	(77)
Southeast 0.9x	0.77	x	1.86	x	92.9	x	0.85	x	0.7	=	71.25	(77)
Southeast 0.9x	0.77	x	2.48	x	92.9	x	0.85	x	0.7	=	189.99	(77)
Southeast 0.9x	0.77	x	1.86	x	92.9	x	0.85	x	0.7	=	427.48	(77)
Southeast 0.9x	0.77	x	2.04	x	92.9	x	0.85	x	0.7	=	78.14	(77)
Southeast 0.9x	0.77	x	3.83	x	72.36	x	0.85	x	0.7	=	114.28	(77)
Southeast 0.9x	0.77	x	2.49	x	72.36	x	0.85	x	0.7	=	297.18	(77)
Southeast 0.9x	0.77	x	1.86	x	72.36	x	0.85	x	0.7	=	55.5	(77)
Southeast 0.9x	0.77	x	2.48	x	72.36	x	0.85	x	0.7	=	148	(77)
Southeast 0.9x	0.77	x	1.86	x	72.36	x	0.85	x	0.7	=	332.99	(77)
Southeast 0.9x	0.77	x	2.04	x	72.36	x	0.85	x	0.7	=	60.67	(77)
Southeast 0.9x	0.77	x	3.83	x	44.83	x	0.85	x	0.7	=	70.79	(77)
Southeast 0.9x	0.77	x	2.49	x	44.83	x	0.85	x	0.7	=	184.09	(77)
Southeast 0.9x	0.77	x	1.86	x	44.83	x	0.85	x	0.7	=	34.38	(77)
Southeast 0.9x	0.77	x	2.48	x	44.83	x	0.85	x	0.7	=	91.68	(77)
Southeast 0.9x	0.77	x	1.86	x	44.83	x	0.85	x	0.7	=	206.27	(77)
Southeast 0.9x	0.77	x	2.04	x	44.83	x	0.85	x	0.7	=	37.71	(77)
Southeast 0.9x	0.77	x	3.83	x	31.95	x	0.85	x	0.7	=	50.46	(77)
Southeast 0.9x	0.77	x	2.49	x	31.95	x	0.85	x	0.7	=	131.21	(77)
Southeast 0.9x	0.77	x	1.86	x	31.95	x	0.85	x	0.7	=	24.5	(77)
Southeast 0.9x	0.77	x	2.48	x	31.95	x	0.85	x	0.7	=	65.34	(77)
Southeast 0.9x	0.77	x	1.86	x	31.95	x	0.85	x	0.7	=	147.02	(77)

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Southeast 0.9x	0.77	x	2.04	x	31.95	x	0.85	x	0.7	=	26.87	(77)
Southwest0.9x	0.77	x	4.14	x	37.39		0.76	x	0.7	=	57.07	(79)
Southwest0.9x	0.77	x	6.22	x	37.39		0.76	x	0.7	=	85.74	(79)
Southwest0.9x	0.77	x	1.86	x	37.39		0.85	x	0.7	=	143.37	(79)
Southwest0.9x	0.77	x	2.53	x	37.39		0.85	x	0.7	=	78.01	(79)
Southwest0.9x	0.77	x	4.14	x	63.74		0.76	x	0.7	=	97.28	(79)
Southwest0.9x	0.77	x	6.22	x	63.74		0.76	x	0.7	=	146.16	(79)
Southwest0.9x	0.77	x	1.86	x	63.74		0.85	x	0.7	=	244.41	(79)
Southwest0.9x	0.77	x	2.53	x	63.74		0.85	x	0.7	=	132.98	(79)
Southwest0.9x	0.77	x	4.14	x	84.22		0.76	x	0.7	=	128.54	(79)
Southwest0.9x	0.77	x	6.22	x	84.22		0.76	x	0.7	=	193.12	(79)
Southwest0.9x	0.77	x	1.86	x	84.22		0.85	x	0.7	=	322.94	(79)
Southwest0.9x	0.77	x	2.53	x	84.22		0.85	x	0.7	=	175.71	(79)
Southwest0.9x	0.77	x	4.14	x	103.49		0.76	x	0.7	=	157.96	(79)
Southwest0.9x	0.77	x	6.22	x	103.49		0.76	x	0.7	=	237.32	(79)
Southwest0.9x	0.77	x	1.86	x	103.49		0.85	x	0.7	=	396.85	(79)
Southwest0.9x	0.77	x	2.53	x	103.49		0.85	x	0.7	=	215.92	(79)
Southwest0.9x	0.77	x	4.14	x	113.34		0.76	x	0.7	=	172.99	(79)
Southwest0.9x	0.77	x	6.22	x	113.34		0.76	x	0.7	=	259.9	(79)
Southwest0.9x	0.77	x	1.86	x	113.34		0.85	x	0.7	=	434.61	(79)
Southwest0.9x	0.77	x	2.53	x	113.34		0.85	x	0.7	=	236.47	(79)
Southwest0.9x	0.77	x	4.14	x	115.04		0.76	x	0.7	=	175.59	(79)
Southwest0.9x	0.77	x	6.22	x	115.04		0.76	x	0.7	=	263.81	(79)
Southwest0.9x	0.77	x	1.86	x	115.04		0.85	x	0.7	=	441.16	(79)
Southwest0.9x	0.77	x	2.53	x	115.04		0.85	x	0.7	=	240.03	(79)
Southwest0.9x	0.77	x	4.14	x	112.79		0.76	x	0.7	=	172.15	(79)
Southwest0.9x	0.77	x	6.22	x	112.79		0.76	x	0.7	=	258.65	(79)
Southwest0.9x	0.77	x	1.86	x	112.79		0.85	x	0.7	=	432.52	(79)
Southwest0.9x	0.77	x	2.53	x	112.79		0.85	x	0.7	=	235.33	(79)
Southwest0.9x	0.77	x	4.14	x	105.34		0.76	x	0.7	=	160.78	(79)
Southwest0.9x	0.77	x	6.22	x	105.34		0.76	x	0.7	=	241.56	(79)
Southwest0.9x	0.77	x	1.86	x	105.34		0.85	x	0.7	=	403.95	(79)
Southwest0.9x	0.77	x	2.53	x	105.34		0.85	x	0.7	=	219.78	(79)
Southwest0.9x	0.77	x	4.14	x	92.9		0.76	x	0.7	=	141.79	(79)
Southwest0.9x	0.77	x	6.22	x	92.9		0.76	x	0.7	=	213.03	(79)
Southwest0.9x	0.77	x	1.86	x	92.9		0.85	x	0.7	=	356.23	(79)
Southwest0.9x	0.77	x	2.53	x	92.9		0.85	x	0.7	=	193.82	(79)
Southwest0.9x	0.77	x	4.14	x	72.36		0.76	x	0.7	=	110.45	(79)
Southwest0.9x	0.77	x	6.22	x	72.36		0.76	x	0.7	=	165.94	(79)
Southwest0.9x	0.77	x	1.86	x	72.36		0.85	x	0.7	=	277.49	(79)
Southwest0.9x	0.77	x	2.53	x	72.36		0.85	x	0.7	=	150.98	(79)

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Southwest0.9x	0.77	x	4.14	x	44.83	x	0.76	x	0.7	=	68.42	(79)
Southwest0.9x	0.77	x	6.22	x	44.83	x	0.76	x	0.7	=	102.79	(79)
Southwest0.9x	0.77	x	1.86	x	44.83	x	0.85	x	0.7	=	171.89	(79)
Southwest0.9x	0.77	x	2.53	x	44.83	x	0.85	x	0.7	=	93.52	(79)
Southwest0.9x	0.77	x	4.14	x	31.95	x	0.76	x	0.7	=	48.77	(79)
Southwest0.9x	0.77	x	6.22	x	31.95	x	0.76	x	0.7	=	73.27	(79)
Southwest0.9x	0.77	x	1.86	x	31.95	x	0.85	x	0.7	=	122.52	(79)
Southwest0.9x	0.77	x	2.53	x	31.95	x	0.85	x	0.7	=	66.66	(79)
Northwest0.9x	0.77	x	12.59	x	11.51	x	0.76	x	0.7	=	106.85	(81)
Northwest0.9x	0.77	x	12.92	x	11.51	x	0.76	x	0.7	=	54.82	(81)
Northwest0.9x	0.77	x	5.46	x	11.51	x	0.76	x	0.7	=	23.17	(81)
Northwest0.9x	0.77	x	13.52	x	11.51	x	0.76	x	0.7	=	57.37	(81)
Northwest0.9x	0.77	x	14.94	x	11.51	x	0.76	x	0.7	=	63.4	(81)
Northwest0.9x	0.77	x	7.14	x	11.51	x	0.76	x	0.7	=	30.3	(81)
Northwest0.9x	0.77	x	1.86	x	11.51	x	0.85	x	0.7	=	61.79	(81)
Northwest0.9x	0.77	x	3.5	x	11.51	x	0.85	x	0.7	=	33.22	(81)
Northwest0.9x	0.77	x	12.59	x	23.55	x	0.76	x	0.7	=	218.66	(81)
Northwest0.9x	0.77	x	12.92	x	23.55	x	0.76	x	0.7	=	112.2	(81)
Northwest0.9x	0.77	x	5.46	x	23.55	x	0.76	x	0.7	=	47.41	(81)
Northwest0.9x	0.77	x	13.52	x	23.55	x	0.76	x	0.7	=	117.41	(81)
Northwest0.9x	0.77	x	14.94	x	23.55	x	0.76	x	0.7	=	129.74	(81)
Northwest0.9x	0.77	x	7.14	x	23.55	x	0.76	x	0.7	=	62	(81)
Northwest0.9x	0.77	x	1.86	x	23.55	x	0.85	x	0.7	=	126.45	(81)
Northwest0.9x	0.77	x	3.5	x	23.55	x	0.85	x	0.7	=	67.99	(81)
Northwest0.9x	0.77	x	12.59	x	41.13	x	0.76	x	0.7	=	381.79	(81)
Northwest0.9x	0.77	x	12.92	x	41.13	x	0.76	x	0.7	=	195.9	(81)
Northwest0.9x	0.77	x	5.46	x	41.13	x	0.76	x	0.7	=	82.79	(81)
Northwest0.9x	0.77	x	13.52	x	41.13	x	0.76	x	0.7	=	205	(81)
Northwest0.9x	0.77	x	14.94	x	41.13	x	0.76	x	0.7	=	226.53	(81)
Northwest0.9x	0.77	x	7.14	x	41.13	x	0.76	x	0.7	=	108.26	(81)
Northwest0.9x	0.77	x	1.86	x	41.13	x	0.85	x	0.7	=	220.79	(81)
Northwest0.9x	0.77	x	3.5	x	41.13	x	0.85	x	0.7	=	118.71	(81)
Northwest0.9x	0.77	x	12.59	x	67.8	x	0.76	x	0.7	=	629.39	(81)
Northwest0.9x	0.77	x	12.92	x	67.8	x	0.76	x	0.7	=	322.94	(81)
Northwest0.9x	0.77	x	5.46	x	67.8	x	0.76	x	0.7	=	136.48	(81)
Northwest0.9x	0.77	x	13.52	x	67.8	x	0.76	x	0.7	=	337.94	(81)
Northwest0.9x	0.77	x	14.94	x	67.8	x	0.76	x	0.7	=	373.43	(81)
Northwest0.9x	0.77	x	7.14	x	67.8	x	0.76	x	0.7	=	178.47	(81)
Northwest0.9x	0.77	x	1.86	x	67.8	x	0.85	x	0.7	=	363.98	(81)
Northwest0.9x	0.77	x	3.5	x	67.8	x	0.85	x	0.7	=	195.69	(81)
Northwest0.9x	0.77	x	12.59	x	89.77	x	0.76	x	0.7	=	833.32	(81)

SAP WorkSheet: New dwelling as built

Northwest 0.9x	0.77	x	12.92	x	89.77	x	0.76	x	0.7	=	427.58	(81)
Northwest 0.9x	0.77	x	5.46	x	89.77	x	0.76	x	0.7	=	180.7	(81)
Northwest 0.9x	0.77	x	13.52	x	89.77	x	0.76	x	0.7	=	447.44	(81)
Northwest 0.9x	0.77	x	14.94	x	89.77	x	0.76	x	0.7	=	494.43	(81)
Northwest 0.9x	0.77	x	7.14	x	89.77	x	0.76	x	0.7	=	236.3	(81)
Northwest 0.9x	0.77	x	1.86	x	89.77	x	0.85	x	0.7	=	481.92	(81)
Northwest 0.9x	0.77	x	3.5	x	89.77	x	0.85	x	0.7	=	259.1	(81)
Northwest 0.9x	0.77	x	12.59	x	97.5	x	0.76	x	0.7	=	905.13	(81)
Northwest 0.9x	0.77	x	12.92	x	97.5	x	0.76	x	0.7	=	464.43	(81)
Northwest 0.9x	0.77	x	5.46	x	97.5	x	0.76	x	0.7	=	196.27	(81)
Northwest 0.9x	0.77	x	13.52	x	97.5	x	0.76	x	0.7	=	486	(81)
Northwest 0.9x	0.77	x	14.94	x	97.5	x	0.76	x	0.7	=	537.04	(81)
Northwest 0.9x	0.77	x	7.14	x	97.5	x	0.76	x	0.7	=	256.66	(81)
Northwest 0.9x	0.77	x	1.86	x	97.5	x	0.85	x	0.7	=	523.45	(81)
Northwest 0.9x	0.77	x	3.5	x	97.5	x	0.85	x	0.7	=	281.42	(81)
Northwest 0.9x	0.77	x	12.59	x	92.98	x	0.76	x	0.7	=	863.15	(81)
Northwest 0.9x	0.77	x	12.92	x	92.98	x	0.76	x	0.7	=	442.89	(81)
Northwest 0.9x	0.77	x	5.46	x	92.98	x	0.76	x	0.7	=	187.16	(81)
Northwest 0.9x	0.77	x	13.52	x	92.98	x	0.76	x	0.7	=	463.45	(81)
Northwest 0.9x	0.77	x	14.94	x	92.98	x	0.76	x	0.7	=	512.13	(81)
Northwest 0.9x	0.77	x	7.14	x	92.98	x	0.76	x	0.7	=	244.75	(81)
Northwest 0.9x	0.77	x	1.86	x	92.98	x	0.85	x	0.7	=	499.17	(81)
Northwest 0.9x	0.77	x	3.5	x	92.98	x	0.85	x	0.7	=	268.37	(81)
Northwest 0.9x	0.77	x	12.59	x	75.42	x	0.76	x	0.7	=	700.12	(81)
Northwest 0.9x	0.77	x	12.92	x	75.42	x	0.76	x	0.7	=	359.24	(81)
Northwest 0.9x	0.77	x	5.46	x	75.42	x	0.76	x	0.7	=	151.81	(81)
Northwest 0.9x	0.77	x	13.52	x	75.42	x	0.76	x	0.7	=	375.92	(81)
Northwest 0.9x	0.77	x	14.94	x	75.42	x	0.76	x	0.7	=	415.4	(81)
Northwest 0.9x	0.77	x	7.14	x	75.42	x	0.76	x	0.7	=	198.53	(81)
Northwest 0.9x	0.77	x	1.86	x	75.42	x	0.85	x	0.7	=	404.89	(81)
Northwest 0.9x	0.77	x	3.5	x	75.42	x	0.85	x	0.7	=	217.68	(81)
Northwest 0.9x	0.77	x	12.59	x	51.24	x	0.76	x	0.7	=	475.72	(81)
Northwest 0.9x	0.77	x	12.92	x	51.24	x	0.76	x	0.7	=	244.09	(81)
Northwest 0.9x	0.77	x	5.46	x	51.24	x	0.76	x	0.7	=	103.15	(81)
Northwest 0.9x	0.77	x	13.52	x	51.24	x	0.76	x	0.7	=	255.43	(81)
Northwest 0.9x	0.77	x	14.94	x	51.24	x	0.76	x	0.7	=	282.26	(81)
Northwest 0.9x	0.77	x	7.14	x	51.24	x	0.76	x	0.7	=	134.89	(81)
Northwest 0.9x	0.77	x	1.86	x	51.24	x	0.85	x	0.7	=	275.11	(81)
Northwest 0.9x	0.77	x	3.5	x	51.24	x	0.85	x	0.7	=	147.91	(81)
Northwest 0.9x	0.77	x	12.59	x	29.6	x	0.76	x	0.7	=	274.77	(81)
Northwest 0.9x	0.77	x	12.92	x	29.6	x	0.76	x	0.7	=	140.99	(81)

SAP WorkSheet: New dwelling as built

Northwest 0.9x	0.77	x	5.46	x	29.6	x	0.76	x	0.7	=	59.58	(81)
Northwest 0.9x	0.77	x	13.52	x	29.6	x	0.76	x	0.7	=	147.54	(81)
Northwest 0.9x	0.77	x	14.94	x	29.6	x	0.76	x	0.7	=	163.03	(81)
Northwest 0.9x	0.77	x	7.14	x	29.6	x	0.76	x	0.7	=	77.91	(81)
Northwest 0.9x	0.77	x	1.86	x	29.6	x	0.85	x	0.7	=	158.9	(81)
Northwest 0.9x	0.77	x	3.5	x	29.6	x	0.85	x	0.7	=	85.43	(81)
Northwest 0.9x	0.77	x	12.59	x	14.52	x	0.76	x	0.7	=	134.84	(81)
Northwest 0.9x	0.77	x	12.92	x	14.52	x	0.76	x	0.7	=	69.19	(81)
Northwest 0.9x	0.77	x	5.46	x	14.52	x	0.76	x	0.7	=	29.24	(81)
Northwest 0.9x	0.77	x	13.52	x	14.52	x	0.76	x	0.7	=	72.4	(81)
Northwest 0.9x	0.77	x	14.94	x	14.52	x	0.76	x	0.7	=	80	(81)
Northwest 0.9x	0.77	x	7.14	x	14.52	x	0.76	x	0.7	=	38.23	(81)
Northwest 0.9x	0.77	x	1.86	x	14.52	x	0.85	x	0.7	=	77.98	(81)
Northwest 0.9x	0.77	x	3.5	x	14.52	x	0.85	x	0.7	=	41.92	(81)
Northwest 0.9x	0.77	x	12.59	x	9.36	x	0.76	x	0.7	=	86.9	(81)
Northwest 0.9x	0.77	x	12.92	x	9.36	x	0.76	x	0.7	=	44.59	(81)
Northwest 0.9x	0.77	x	5.46	x	9.36	x	0.76	x	0.7	=	18.84	(81)
Northwest 0.9x	0.77	x	13.52	x	9.36	x	0.76	x	0.7	=	46.66	(81)
Northwest 0.9x	0.77	x	14.94	x	9.36	x	0.76	x	0.7	=	51.56	(81)
Northwest 0.9x	0.77	x	7.14	x	9.36	x	0.76	x	0.7	=	24.64	(81)
Northwest 0.9x	0.77	x	1.86	x	9.36	x	0.85	x	0.7	=	50.25	(81)
Northwest 0.9x	0.77	x	3.5	x	9.36	x	0.85	x	0.7	=	27.02	(81)
Rooflights 0.9x	1	x	1.13	x	26	x	0.63	x	0.8	=	13.33	(82)
Rooflights 0.9x	1	x	1.13	x	54	x	0.63	x	0.8	=	27.68	(82)
Rooflights 0.9x	1	x	1.13	x	94	x	0.63	x	0.8	=	48.18	(82)
Rooflights 0.9x	1	x	1.13	x	150	x	0.63	x	0.8	=	76.89	(82)
Rooflights 0.9x	1	x	1.13	x	190	x	0.63	x	0.8	=	97.39	(82)
Rooflights 0.9x	1	x	1.13	x	201	x	0.63	x	0.8	=	103.03	(82)
Rooflights 0.9x	1	x	1.13	x	194	x	0.63	x	0.8	=	99.44	(82)
Rooflights 0.9x	1	x	1.13	x	164	x	0.63	x	0.8	=	84.06	(82)
Rooflights 0.9x	1	x	1.13	x	116	x	0.63	x	0.8	=	59.46	(82)
Rooflights 0.9x	1	x	1.13	x	68	x	0.63	x	0.8	=	34.85	(82)
Rooflights 0.9x	1	x	1.13	x	33	x	0.63	x	0.8	=	16.91	(82)
Rooflights 0.9x	1	x	1.13	x	21	x	0.63	x	0.8	=	10.76	(82)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 1448.65 2662.44 4007.54 5766.98 7070.3 7485.97 7212.96 6182.07 4707.83 3162.72 1772.44 1214.63 (83)

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

(84)m= 3452.62 4648.2 5906.29 7532.49 8695.2 8993.41 8658.98 7652.1 6261.41 4849.87 3604.9 3161.02 (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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SAP WorkSheet: New dwelling as built

(86)m=	1	1	0.99	0.99	0.97	0.92	0.84	0.87	0.97	0.99	1	1	(86)
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Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	17.64	17.86	18.33	18.89	19.61	20.22	20.64	20.6	20	19.16	18.25	17.74	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	18.68	18.71	18.71	18.75	18.77	18.79	18.8	18.8	18.77	18.75	18.73	18.71	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.94	0.83	0.57	0.62	0.92	0.99	1	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	14.5	14.83	15.51	16.35	17.41	18.25	18.71	18.69	17.96	16.75	15.41	14.65	(90)
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$$fLA = \text{Living area} + (4) = 0.04 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	14.62	14.94	15.62	16.45	17.49	18.32	18.78	18.76	18.04	16.84	15.51	14.77	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	14.62	14.94	15.62	16.45	17.49	18.32	18.78	18.76	18.04	16.84	15.51	14.77	(93)
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5. 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
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Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.96	0.91	0.8	0.56	0.61	0.89	0.98	0.99	1	(94)
--------	---	------	------	------	------	-----	------	------	------	------	------	---	------

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

(95)m=	3441.08	4616.18	5813.92	7264.61	7940.07	7208.87	4887.87	4659.23	5596.43	4736.21	3585.38	3152.07	(95)
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Monthly average external temperature from Table 8

(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)
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Heat loss rate for mean internal temperature, Lm, W = [(39)m x ((93)m - (96)m)]

(97)m=	33498.26	32425.6	28769.67	24562.42	18045.99	11510.77	5771.09	5707.95	11698.97	19151.91	27368.64	32189.34	(97)
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Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	22362.54	18687.93	17079.07	12454.42	7518.8	0	0	0	0	10725.28	17123.95	21603.73	(98)
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$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{\text{Jan-Dec}} = 127555.73 \quad (99)$$

Space heating requirement in kWh/m²/year

$$122.05 \quad (99)$$

5c. 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	26583.05	19015.83	19015.83	0	0	0	0	(100)
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Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.38	0.48	0.44	0	0	0	0	(101)
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Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	10161.77	9205.13	8404.66	0	0	0	0	(102)
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Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	10830.16	10298.8	9192.36	0	0	0	0	(103)
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Space cooling requirement for month, whole dwelling, continuous (kWh) = $0.024 \times [(103)m - (102)m] \times (41)m$

set (104)m to zero if (104)m < 3 x (98)m

(104)m=	0	0	0	0	0	0	813.69	586.05	0	0	0	0	(104)
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$$\text{Total} = \text{Sum}(104) = 1399.74 \quad (104)$$

SAP WorkSheet: New dwelling as built

Cooled fraction $f_c = \text{cooled area} \div (4) =$ 0.11 (105)

Intermittency factor (Table 10b)

(106)m=

0	0	0	0	0	0.25	0.25	0.25	0	0	0	0
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 $\text{Total} = \text{Sum}(104) =$ 0 (106)

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

(107)m=

0	0	0	0	0	0	23.36	16.82	0	0	0	0
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 $\text{Total} = \text{Sum}(107) =$ 40.18 (107)

Space cooling requirement in kWh/m²/year $(107) \div (4) =$ 0.04 (108)

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

Space heating:

Fraction of space heat from secondary/supplementary system 0.1 (201)

Fraction of space heat from main system(s) $(202) = 1 - (201) =$ 0.9 (202)

Fraction of total heating from main system 1 $(204) = (202) \times [1 - (203)] =$ 0.9 (204)

Efficiency of main space heating system 1 89 (206)

Efficiency of secondary/supplementary heating system, % 100 (208)

Cooling System Energy Efficiency Ratio 4.32 (209)

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

Space heating requirement (calculated above)

22362.54	18687.93	17079.07	12454.42	7518.8	0	0	0	0	10725.28	17123.95	21603.73
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(211)m = $\{[(98)m \times (204)] + (210)m\} \times 100 \div (206)$ (211)

22613.8	18897.91	17270.97	12594.36	7603.29	0	0	0	0	10845.79	17316.35	21846.47
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$\text{Total (kWh/year)} = \text{Sum}(211)_{1,2,10-12} =$ 128988.94 (211)

Space heating fuel (secondary), kWh/month

= $\{[(98)m \times (201)] + (214)m\} \times 100 \div (208)$

(215)m=

2236.25	1868.79	1707.91	1245.44	751.88	0	0	0	0	1072.53	1712.39	2160.37
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 $\text{Total (kWh/year)} = \text{Sum}(215)_{1,2,10-12} =$ 12755.57 (215)

Water heating

Output from water heater (calculated above)

304.95	268.95	282.87	254.14	249.45	223.48	215.19	235.36	234.7	263.5	277.91	297.8
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Efficiency of water heater 78.3 (216)

(217)m=

88.82	88.81	88.78	88.73	88.57	78.3	78.3	78.3	78.3	88.68	88.79	88.82
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(217)

Fuel for water heating, kWh/month

(219)m = $(64)m \times 100 \div (217)m$

(219)m=

343.34	302.85	318.61	286.41	281.65	285.42	274.83	300.59	299.75	297.14	313.02	335.3
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 $\text{Total} = \text{Sum}(219a)_{1-12} =$ 3638.88 (219)

Space cooling fuel, kWh/month.

(221)m = $(107)m \div (209)$

(221)m=

0	0	0	0	0	0	5.41	3.89	0	0	0	0
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 $\text{Total} = \text{Sum}(221)_{1-12} =$ 9.3 (221)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1		128988.94
Space heating fuel used, secondary		12755.57
Water heating fuel used		3638.88

SAP WorkSheet: New dwelling as built

Space cooling fuel used		9.3	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	130		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	175	(231)
Electricity for lighting		1864.52	(232)

10a Fuel costs - individual heating systems

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	3.1	x 0.01 = 3998.66 (240)
Space heating - main system 2	(213) x	0	x 0.01 = 0 (241)
Space heating - secondary	(215) x	11.46	x 0.01 = 1461.79 (242)
Water heating cost (other fuel)	(219)	3.1	x 0.01 = 112.81 (247)
Space cooling	(221)	11.46	x 0.01 = 1.07 (248)
Pumps, fans and electric keep-hot	(231)	11.46	x 0.01 = 20.06 (249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a)			
Energy for lighting	(232)	11.46	x 0.01 = 213.67 (250)
Additional standing charges (Table 12)			106 (251)
Appendix Q items: repeat lines (253) and (254) as needed			
Total energy cost	(245)...(247) + (250)...(254) =		5914.05 (255)

11a SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	2.55	(257)
SAP rating (Section 12)		64.43	(258)

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

	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year
Space heating (main system 1)	(211) x	0.198	= 25539.81 (261)
Space heating (secondary)	(215) x	0.517	= 6594.63 (263)
Water heating	(219) x	0.198	= 720.5 (264)
Space and water heating	(261) + (262) + (263) + (264) =		32854.94 (265)
Space cooling	(221) x	0.517	= 4.81 (266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517	= 90.48 (267)
Electricity for lighting	(232) x	0.517	= 963.96 (268)
Total CO ₂ , kg/year		sum of (265)...(271) =	33914.18 (272)
CO₂ emissions per m²		(272) ÷ (4) =	32.45 (273)

SAP WorkSheet: New dwelling as built

EI rating (section 14)

58

(274)

13a Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	1.02	=	131568.71	(261)
Space heating (secondary)	(215) x	2.92	=	37246.27	(263)
Energy for water heating	(219) x	1.02	=	3711.66	(264)
Space and water heating	(261) + (262) + (263) + (264) =			172526.65	(265)
Space cooling	(221) x	2.92	=	27.16	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92	=	511	(267)
Electricity for lighting	(232) x	0	=	5444.4	(268)
Total Primary Energy		sum of (265)...(271) =		178509.21	(272)
Primary energy kWh/m ² /year		(272) ÷ (4) =		170.8	(273)

APPENDIX (E)

PROPOSED PEA - PREDICTED ENERGY ASSESSMENT (OUTLINE EPC)

Predicted Energy Assessment

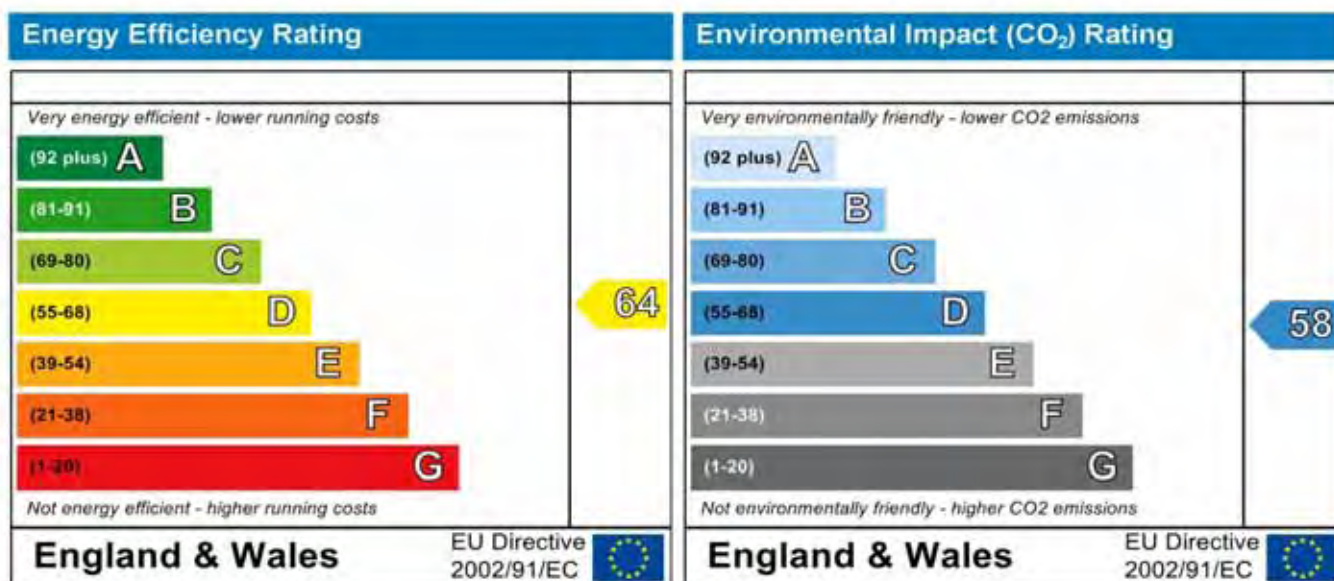
9 Templewood Avenue
London
NW3 7UY

Dwelling type:
Date of assessment:
Produced by:
Total floor area:

Detached House
29 August 2012
Ondrej Gajdos
1045.13 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 2009 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.



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

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

APPENDIX (F)

SAP WORKSHEET – NOTIONAL DWELLING
*(FOR ENERGY MODELLING)

SAP WorkSheet: New dwelling as built

User Details												
Assessor Name:	Ondrej Gajdos	Stroma Number:	STRO006629									
Software Name:	Stroma FSAP 2009	Software Version:	Version: 1.5.0.18									
Property Address: Notional												
Address :	Notional House, 9 Templewood Avenue, London, NW3 7UY											
1. Overall dwelling dimensions												
	Area(m²)		Ave Height(m)		Volume(m³)							
Basement	322.13 (1a)	x	2.6 (2a)	=	837.54 (3a)							
Ground floor	325 (1b)	x	3.2 (2b)	=	1040 (3b)							
First floor	248 (1c)	x	2.9 (2c)	=	719.2 (3c)							
Second floor	150 (1d)	x	2.9 (2d)	=	435 (3d)							
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	1045.13 (4)											
Dwelling volume	(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =				3031.74 (5)							
2. Ventilation rate												
	main heating		Secondary heating		other		total		m³ per hour			
Number of chimneys	0	+	0	+	4	=	4	x 40 =	160 (6a)			
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (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) =								260	+ (5) =	0.09 (8)		
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>												
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 <i>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</i>									0 (11)			
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									15 (17)			
If based on air permeability value, then (18) = [(17) + 20]x(8), otherwise (18) = (16)									0.84 (18)			
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>												
Number of sides on which sheltered									2 (19)			
Shelter factor (20) = 1 - [0.075 x (19)] =									0.85 (20)			
Infiltration rate incorporating shelter factor (21) = (18) x (20) =									0.71 (21)			
Infiltration rate modified for monthly wind speed												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

SAP WorkSheet: New dwelling as built

Monthly average wind speed from Table 7

(22)m=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1
--------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Wind Factor (22a)m = (22)m + 4

(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.96	0.91	0.91	0.8	0.73	0.69	0.66	0.66	0.75	0.8	0.85	0.91
--	------	------	------	-----	------	------	------	------	------	-----	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x 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) x [1 - (23c) + 100]

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

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

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

(24c)m= 0 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= 0.96 0.91 0.91 0.82 0.77 0.74 0.72 0.72 0.78 0.82 0.86 0.91 (24d)

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

(25)m= 0.96 0.91 0.91 0.82 0.77 0.74 0.72 0.72 0.78 0.82 0.86 0.91 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A _n m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² K	A X k kJ/K
Doors Type 1			2.15	x 3	= 6.45		(26)
Doors Type 2			5.5	x 3.9	= 21.45		(26)
Doors Type 3			2.15	x 3	= 6.45		(26)
Windows Type 1			3.83	x 1/(1/(4.8) + 0.04)	= 15.42		(27)
Windows Type 2			2.49	x 1/(1/(4.8) + 0.04)	= 10.03		(27)
Windows Type 3			1.86	x 1/(1/(4.8) + 0.04)	= 7.49		(27)
Windows Type 4			2.48	x 1/(1/(4.8) + 0.04)	= 9.99		(27)
Windows Type 5			1.36	x 1/(1/(4.8) + 0.04)	= 5.48		(27)
Windows Type 6			1.95	x 1/(1/(1.6) + 0.04)	= 2.93		(27)
Windows Type 7			8.97	x 1/(1/(1.6) + 0.04)	= 13.49		(27)
Windows Type 8			9.2	x 1/(1/(1.6) + 0.04)	= 13.83		(27)
Windows Type 9			3.89	x 1/(1/(1.6) + 0.04)	= 5.85		(27)
Windows Type 10			9.63	x 1/(1/(1.6) + 0.04)	= 14.48		(27)
Windows Type 11			10.65	x 1/(1/(1.6) + 0.04)	= 16.02		(27)

SAP WorkSheet: New dwelling as built

Windows Type 12			2.95	$\times 1/[1/(1.6) + 0.04] =$	4.44			(27)
Windows Type 13			5.09	$\times 1/[1/(1.6) + 0.04] =$	7.65			(27)
Windows Type 14			4.43	$\times 1/[1/(1.6) + 0.04] =$	6.66			(27)
Windows Type 15			4.43	$\times 1/[1/(1.6) + 0.04] =$	6.66			(27)
Windows Type 16			1.86	$\times 1/[1/(4.8) + 0.04] =$	7.49			(27)
Windows Type 17			1.86	$\times 1/[1/(4.8) + 0.04] =$	7.49			(27)
Windows Type 18			1.86	$\times 1/[1/(4.8) + 0.04] =$	7.49			(27)
Windows Type 19			1.86	$\times 1/[1/(4.8) + 0.04] =$	7.49			(27)
Windows Type 20			3.5	$\times 1/[1/(4.8) + 0.04] =$	14.09			(27)
Windows Type 21			1.87	$\times 1/[1/(4.8) + 0.04] =$	7.53			(27)
Windows Type 22			2.53	$\times 1/[1/(4.8) + 0.04] =$	10.19			(27)
Windows Type 23			2.04	$\times 1/[1/(4.8) + 0.04] =$	8.21			(27)
Rooflights			1.13	$\times 1/[1/(1.6) + 0.04] =$	1.808			(27b)
Floor Type 1			145	$\times$	0.22	=	31.9	(28)
Floor Type 2			177.13	$\times$	0.22	=	38.9686	(28)
Floor Type 3			38.58	$\times$	0.5	=	19.29	(28)
Walls Type1	316.83	74.84	241.99	$\times$	2.1	=	508.18	(29)
Walls Type2	82.16	0	82.16	$\times$	2.1	=	172.54	(29)
Walls Type3	173.99	76.01	97.98	$\times$	0.28	=	27.43	(29)
Walls Type4	52.81	0	52.81	$\times$	0.28	=	14.79	(29)
Walls Type5	25	17.84	7.16	$\times$	2.1	=	15.04	(29)
Roof Type1	46.96	1.13	45.83	$\times$	0.18	=	8.25	(30)
Roof Type2	27.3	0	27.3	$\times$	2.3	=	62.79	(30)
Roof Type3	290	0	290	$\times$	2.3	=	667	(30)
Roof Type4	25.6	0	25.6	$\times$	2.3	=	58.88	(30)
Total area of elements, m ²			1401.36					(31)

* for windows and roof windows, use effective window U-value calculated using formula $1/[1/(U\text{-value}) + 0.04]$ 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) = 2106.94 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 35785.33 (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 210.2 (36)

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

Total fabric heat loss (33) + (36) = 2317.14 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	960.33	910.63	910.63	819.74	765.47	740.22	716.24	716.24	778.56	819.74	863.77	910.63	(38)

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

(39)m=	3277.47	3227.77	3227.77	3136.88	3082.61	3057.36	3033.38	3033.38	3095.7	3136.88	3180.9	3227.77	
Average = Sum(39).../12=												3143.16	(39)

SAP WorkSheet: New dwelling as built

Heat loss parameter (HLP), W/m²K

(40)m = (39)m + (4)

(40)m=	3.14	3.09	3.09	3	2.95	2.93	2.9	2.9	2.96	3	3.04	3.09	
Average = Sum(40) / 12 =													3.01 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N

4.1 (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

138.51 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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=	152.37	146.83	141.29	135.74	130.2	124.66	124.66	130.2	135.74	141.29	146.83	152.37	
Total = Sum(44) / 12 =													1662.18 (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=	226.5	198.09	204.42	178.21	171	147.56	136.74	156.91	158.78	185.04	201.99	219.35	
Total = Sum(45) / 12 =													2184.59 (45)

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

(46)m=	33.97	29.71	30.66	26.73	25.65	22.13	20.51	23.54	23.82	27.76	30.3	32.9	(46)
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Water storage loss:

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

2.86 (47)

Temperature factor from Table 2b

0.54 (48)

Energy lost from water storage, kWh/year

(47) x (48) = 1.54 (49)

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

Cylinder volume (litres) including any solar storage within same

0 (50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

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

0 (51)

Volume factor from Table 2a

0 (52)

Temperature factor from Table 2b

0 (53)

Energy lost from water storage, kWh/year

((50) x (51) x (52) x (53) = 0 (54)

Enter (49) or (54) in (55)

1.54 (55)

Water storage loss calculated for each month

((56)m = (55) x (41)m

(56)m=	47.88	43.24	47.88	46.33	47.88	46.33	47.88	47.88	46.33	47.88	46.33	47.88	(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=	47.88	43.24	47.88	46.33	47.88	46.33	47.88	47.88	46.33	47.88	46.33	47.88	(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Primary circuit loss (annual) from Table 3

360 (58)

Primary circuit loss calculated for each month (59)m = (58) / 365 x (41)m

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

(59)m=	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Combi loss calculated for each month (61)m = (60) / 365 x (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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SAP WorkSheet: New dwelling as built

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

(62)m=	304.95	268.95	282.87	254.14	249.45	223.48	215.19	235.36	234.7	263.5	277.91	297.8	(62)
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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)
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Output from water heater

(64)m=	304.95	268.95	282.87	254.14	249.45	223.48	215.19	235.36	234.7	263.5	277.91	297.8	
Output from water heater (annual) ₁₋₁₂												3108.3	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	138.07	122.55	130.73	119.99	119.62	109.8	108.23	114.93	113.53	124.29	127.9	135.69	(65)
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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=	246.04	246.04	246.04	246.04	246.04	246.04	246.04	246.04	246.04	246.04	246.04	246.04	(66)

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

(67)m=	270.15	239.94	195.13	147.73	110.43	93.23	100.74	130.94	175.75	223.15	260.45	277.65	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	1398.73	1413.24	1376.67	1298.8	1200.51	1108.13	1046.41	1031.9	1068.48	1146.34	1244.63	1337.01	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	63.7	63.7	63.7	63.7	63.7	63.7	63.7	63.7	63.7	63.7	63.7	63.7	(69)
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Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-164.02	-164.02	-164.02	-164.02	-164.02	-164.02	-164.02	-164.02	-164.02	-164.02	-164.02	-164.02	(71)
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Water heating gains (Table 5)

(72)m=	185.58	182.37	175.71	166.66	160.78	152.5	145.47	154.48	157.68	167.05	177.64	182.39	(72)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

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

(73)m=	2010.17	1991.27	1903.23	1768.9	1627.43	1509.58	1448.33	1473.04	1557.62	1692.27	1838.44	1952.77	(73)
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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 m ²		Flux Table 6a		g Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	1.36	x	11.51	x	0.85	x	0.7	=	6.45	(75)
Northeast 0.9x	0.77	x	1.95	x	11.51	x	0.76	x	0.7	=	33.1	(75)
Northeast 0.9x	0.77	x	4.43	x	11.51	x	0.76	x	0.7	=	18.8	(75)
Northeast 0.9x	0.77	x	1.86	x	11.51	x	0.85	x	0.7	=	35.31	(75)
Northeast 0.9x	0.77	x	1.87	x	11.51	x	0.85	x	0.7	=	17.75	(75)
Northeast 0.9x	0.77	x	1.36	x	23.55	x	0.85	x	0.7	=	13.21	(75)
Northeast 0.9x	0.77	x	1.95	x	23.55	x	0.76	x	0.7	=	67.73	(75)
Northeast 0.9x	0.77	x	4.43	x	23.55	x	0.76	x	0.7	=	38.47	(75)

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Northeast 0.9x	0.77	x	1.86	x	23.55	x	0.85	x	0.7	=	72.26	(75)
Northeast 0.9x	0.77	x	1.87	x	23.55	x	0.85	x	0.7	=	36.32	(75)
Northeast 0.9x	0.77	x	1.36	x	41.13	x	0.85	x	0.7	=	23.06	(75)
Northeast 0.9x	0.77	x	1.95	x	41.13	x	0.76	x	0.7	=	118.27	(75)
Northeast 0.9x	0.77	x	4.43	x	41.13	x	0.76	x	0.7	=	67.17	(75)
Northeast 0.9x	0.77	x	1.86	x	41.13	x	0.85	x	0.7	=	126.17	(75)
Northeast 0.9x	0.77	x	1.87	x	41.13	x	0.85	x	0.7	=	63.42	(75)
Northeast 0.9x	0.77	x	1.36	x	67.8	x	0.85	x	0.7	=	38.02	(75)
Northeast 0.9x	0.77	x	1.95	x	67.8	x	0.76	x	0.7	=	194.96	(75)
Northeast 0.9x	0.77	x	4.43	x	67.8	x	0.76	x	0.7	=	110.73	(75)
Northeast 0.9x	0.77	x	1.86	x	67.8	x	0.85	x	0.7	=	207.99	(75)
Northeast 0.9x	0.77	x	1.87	x	67.8	x	0.85	x	0.7	=	104.55	(75)
Northeast 0.9x	0.77	x	1.36	x	89.77	x	0.85	x	0.7	=	50.34	(75)
Northeast 0.9x	0.77	x	1.95	x	89.77	x	0.76	x	0.7	=	258.14	(75)
Northeast 0.9x	0.77	x	4.43	x	89.77	x	0.76	x	0.7	=	146.61	(75)
Northeast 0.9x	0.77	x	1.86	x	89.77	x	0.85	x	0.7	=	275.38	(75)
Northeast 0.9x	0.77	x	1.87	x	89.77	x	0.85	x	0.7	=	138.43	(75)
Northeast 0.9x	0.77	x	1.36	x	97.5	x	0.85	x	0.7	=	54.68	(75)
Northeast 0.9x	0.77	x	1.95	x	97.5	x	0.76	x	0.7	=	280.38	(75)
Northeast 0.9x	0.77	x	4.43	x	97.5	x	0.76	x	0.7	=	159.24	(75)
Northeast 0.9x	0.77	x	1.86	x	97.5	x	0.85	x	0.7	=	299.11	(75)
Northeast 0.9x	0.77	x	1.87	x	97.5	x	0.85	x	0.7	=	150.36	(75)
Northeast 0.9x	0.77	x	1.36	x	92.98	x	0.85	x	0.7	=	52.14	(75)
Northeast 0.9x	0.77	x	1.95	x	92.98	x	0.76	x	0.7	=	267.38	(75)
Northeast 0.9x	0.77	x	4.43	x	92.98	x	0.76	x	0.7	=	151.86	(75)
Northeast 0.9x	0.77	x	1.86	x	92.98	x	0.85	x	0.7	=	285.24	(75)
Northeast 0.9x	0.77	x	1.87	x	92.98	x	0.85	x	0.7	=	143.39	(75)
Northeast 0.9x	0.77	x	1.36	x	75.42	x	0.85	x	0.7	=	42.29	(75)
Northeast 0.9x	0.77	x	1.95	x	75.42	x	0.76	x	0.7	=	216.88	(75)
Northeast 0.9x	0.77	x	4.43	x	75.42	x	0.76	x	0.7	=	123.17	(75)
Northeast 0.9x	0.77	x	1.86	x	75.42	x	0.85	x	0.7	=	231.36	(75)
Northeast 0.9x	0.77	x	1.87	x	75.42	x	0.85	x	0.7	=	116.3	(75)
Northeast 0.9x	0.77	x	1.36	x	51.24	x	0.85	x	0.7	=	28.74	(75)
Northeast 0.9x	0.77	x	1.95	x	51.24	x	0.76	x	0.7	=	147.36	(75)
Northeast 0.9x	0.77	x	4.43	x	51.24	x	0.76	x	0.7	=	83.69	(75)
Northeast 0.9x	0.77	x	1.86	x	51.24	x	0.85	x	0.7	=	157.21	(75)
Northeast 0.9x	0.77	x	1.87	x	51.24	x	0.85	x	0.7	=	79.03	(75)
Northeast 0.9x	0.77	x	1.36	x	29.6	x	0.85	x	0.7	=	16.6	(75)
Northeast 0.9x	0.77	x	1.95	x	29.6	x	0.76	x	0.7	=	85.12	(75)
Northeast 0.9x	0.77	x	4.43	x	29.6	x	0.76	x	0.7	=	48.34	(75)
Northeast 0.9x	0.77	x	1.86	x	29.6	x	0.85	x	0.7	=	90.8	(75)

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Northeast 0.9x	0.77	x	1.87	x	29.6	x	0.85	x	0.7	=	45.65	(75)
Northeast 0.9x	0.77	x	1.36	x	14.52	x	0.85	x	0.7	=	8.15	(75)
Northeast 0.9x	0.77	x	1.95	x	14.52	x	0.76	x	0.7	=	41.77	(75)
Northeast 0.9x	0.77	x	4.43	x	14.52	x	0.76	x	0.7	=	23.72	(75)
Northeast 0.9x	0.77	x	1.86	x	14.52	x	0.85	x	0.7	=	44.56	(75)
Northeast 0.9x	0.77	x	1.87	x	14.52	x	0.85	x	0.7	=	22.4	(75)
Northeast 0.9x	0.77	x	1.36	x	9.36	x	0.85	x	0.7	=	5.25	(75)
Northeast 0.9x	0.77	x	1.95	x	9.36	x	0.76	x	0.7	=	26.92	(75)
Northeast 0.9x	0.77	x	4.43	x	9.36	x	0.76	x	0.7	=	15.29	(75)
Northeast 0.9x	0.77	x	1.86	x	9.36	x	0.85	x	0.7	=	28.72	(75)
Northeast 0.9x	0.77	x	1.87	x	9.36	x	0.85	x	0.7	=	14.44	(75)
Southeast 0.9x	0.77	x	3.83	x	37.39	x	0.85	x	0.7	=	59.04	(77)
Southeast 0.9x	0.77	x	2.49	x	37.39	x	0.85	x	0.7	=	153.55	(77)
Southeast 0.9x	0.77	x	1.86	x	37.39	x	0.85	x	0.7	=	28.67	(77)
Southeast 0.9x	0.77	x	2.48	x	37.39	x	0.85	x	0.7	=	76.46	(77)
Southeast 0.9x	0.77	x	1.86	x	37.39	x	0.85	x	0.7	=	172.05	(77)
Southeast 0.9x	0.77	x	2.04	x	37.39	x	0.85	x	0.7	=	31.45	(77)
Southeast 0.9x	0.77	x	3.83	x	63.74	x	0.85	x	0.7	=	100.65	(77)
Southeast 0.9x	0.77	x	2.49	x	63.74	x	0.85	x	0.7	=	261.75	(77)
Southeast 0.9x	0.77	x	1.86	x	63.74	x	0.85	x	0.7	=	48.88	(77)
Southeast 0.9x	0.77	x	2.48	x	63.74	x	0.85	x	0.7	=	130.35	(77)
Southeast 0.9x	0.77	x	1.86	x	63.74	x	0.85	x	0.7	=	293.29	(77)
Southeast 0.9x	0.77	x	2.04	x	63.74	x	0.85	x	0.7	=	53.61	(77)
Southeast 0.9x	0.77	x	3.83	x	84.22	x	0.85	x	0.7	=	133	(77)
Southeast 0.9x	0.77	x	2.49	x	84.22	x	0.85	x	0.7	=	345.86	(77)
Southeast 0.9x	0.77	x	1.86	x	84.22	x	0.85	x	0.7	=	64.59	(77)
Southeast 0.9x	0.77	x	2.48	x	84.22	x	0.85	x	0.7	=	172.24	(77)
Southeast 0.9x	0.77	x	1.86	x	84.22	x	0.85	x	0.7	=	387.53	(77)
Southeast 0.9x	0.77	x	2.04	x	84.22	x	0.85	x	0.7	=	70.84	(77)
Southeast 0.9x	0.77	x	3.83	x	103.49	x	0.85	x	0.7	=	163.43	(77)
Southeast 0.9x	0.77	x	2.49	x	103.49	x	0.85	x	0.7	=	425.01	(77)
Southeast 0.9x	0.77	x	1.86	x	103.49	x	0.85	x	0.7	=	79.37	(77)
Southeast 0.9x	0.77	x	2.48	x	103.49	x	0.85	x	0.7	=	211.65	(77)
Southeast 0.9x	0.77	x	1.86	x	103.49	x	0.85	x	0.7	=	476.22	(77)
Southeast 0.9x	0.77	x	2.04	x	103.49	x	0.85	x	0.7	=	87.05	(77)
Southeast 0.9x	0.77	x	3.83	x	113.34	x	0.85	x	0.7	=	178.99	(77)
Southeast 0.9x	0.77	x	2.49	x	113.34	x	0.85	x	0.7	=	465.46	(77)
Southeast 0.9x	0.77	x	1.86	x	113.34	x	0.85	x	0.7	=	86.92	(77)
Southeast 0.9x	0.77	x	2.48	x	113.34	x	0.85	x	0.7	=	231.79	(77)
Southeast 0.9x	0.77	x	1.86	x	113.34	x	0.85	x	0.7	=	521.54	(77)
Southeast 0.9x	0.77	x	2.04	x	113.34	x	0.85	x	0.7	=	95.33	(77)

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Southeast 0.9x	0.77	x	3.83	x	115.04	x	0.85	x	0.7	=	181.68	(77)
Southeast 0.9x	0.77	x	2.49	x	115.04	x	0.85	x	0.7	=	472.47	(77)
Southeast 0.9x	0.77	x	1.86	x	115.04	x	0.85	x	0.7	=	88.23	(77)
Southeast 0.9x	0.77	x	2.48	x	115.04	x	0.85	x	0.7	=	235.29	(77)
Southeast 0.9x	0.77	x	1.86	x	115.04	x	0.85	x	0.7	=	529.39	(77)
Southeast 0.9x	0.77	x	2.04	x	115.04	x	0.85	x	0.7	=	96.77	(77)
Southeast 0.9x	0.77	x	3.83	x	112.79	x	0.85	x	0.7	=	178.12	(77)
Southeast 0.9x	0.77	x	2.49	x	112.79	x	0.85	x	0.7	=	463.22	(77)
Southeast 0.9x	0.77	x	1.86	x	112.79	x	0.85	x	0.7	=	86.5	(77)
Southeast 0.9x	0.77	x	2.48	x	112.79	x	0.85	x	0.7	=	230.68	(77)
Southeast 0.9x	0.77	x	1.86	x	112.79	x	0.85	x	0.7	=	519.03	(77)
Southeast 0.9x	0.77	x	2.04	x	112.79	x	0.85	x	0.7	=	94.88	(77)
Southeast 0.9x	0.77	x	3.83	x	105.34	x	0.85	x	0.7	=	166.36	(77)
Southeast 0.9x	0.77	x	2.49	x	105.34	x	0.85	x	0.7	=	432.62	(77)
Southeast 0.9x	0.77	x	1.86	x	105.34	x	0.85	x	0.7	=	80.79	(77)
Southeast 0.9x	0.77	x	2.48	x	105.34	x	0.85	x	0.7	=	215.44	(77)
Southeast 0.9x	0.77	x	1.86	x	105.34	x	0.85	x	0.7	=	484.74	(77)
Southeast 0.9x	0.77	x	2.04	x	105.34	x	0.85	x	0.7	=	88.61	(77)
Southeast 0.9x	0.77	x	3.83	x	92.9	x	0.85	x	0.7	=	146.71	(77)
Southeast 0.9x	0.77	x	2.49	x	92.9	x	0.85	x	0.7	=	381.52	(77)
Southeast 0.9x	0.77	x	1.86	x	92.9	x	0.85	x	0.7	=	71.25	(77)
Southeast 0.9x	0.77	x	2.48	x	92.9	x	0.85	x	0.7	=	189.99	(77)
Southeast 0.9x	0.77	x	1.86	x	92.9	x	0.85	x	0.7	=	427.48	(77)
Southeast 0.9x	0.77	x	2.04	x	92.9	x	0.85	x	0.7	=	78.14	(77)
Southeast 0.9x	0.77	x	3.83	x	72.36	x	0.85	x	0.7	=	114.28	(77)
Southeast 0.9x	0.77	x	2.49	x	72.36	x	0.85	x	0.7	=	297.18	(77)
Southeast 0.9x	0.77	x	1.86	x	72.36	x	0.85	x	0.7	=	55.5	(77)
Southeast 0.9x	0.77	x	2.48	x	72.36	x	0.85	x	0.7	=	148	(77)
Southeast 0.9x	0.77	x	1.86	x	72.36	x	0.85	x	0.7	=	332.99	(77)
Southeast 0.9x	0.77	x	2.04	x	72.36	x	0.85	x	0.7	=	60.87	(77)
Southeast 0.9x	0.77	x	3.83	x	44.83	x	0.85	x	0.7	=	70.79	(77)
Southeast 0.9x	0.77	x	2.49	x	44.83	x	0.85	x	0.7	=	184.09	(77)
Southeast 0.9x	0.77	x	1.86	x	44.83	x	0.85	x	0.7	=	34.38	(77)
Southeast 0.9x	0.77	x	2.48	x	44.83	x	0.85	x	0.7	=	91.68	(77)
Southeast 0.9x	0.77	x	1.86	x	44.83	x	0.85	x	0.7	=	206.27	(77)
Southeast 0.9x	0.77	x	2.04	x	44.83	x	0.85	x	0.7	=	37.71	(77)
Southeast 0.9x	0.77	x	3.83	x	31.95	x	0.85	x	0.7	=	50.46	(77)
Southeast 0.9x	0.77	x	2.49	x	31.95	x	0.85	x	0.7	=	131.21	(77)
Southeast 0.9x	0.77	x	1.86	x	31.95	x	0.85	x	0.7	=	24.5	(77)
Southeast 0.9x	0.77	x	2.48	x	31.95	x	0.85	x	0.7	=	65.34	(77)
Southeast 0.9x	0.77	x	1.86	x	31.95	x	0.85	x	0.7	=	147.02	(77)

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Southeast 0.9x	0.77	x	2.04	x	31.95	x	0.85	x	0.7	=	26.87	(77)
Southwest0.9x	0.77	x	2.95	x	37.39		0.76	x	0.7	=	40.66	(79)
Southwest0.9x	0.77	x	4.43	x	37.39		0.76	x	0.7	=	61.06	(79)
Southwest0.9x	0.77	x	1.86	x	37.39		0.85	x	0.7	=	143.37	(79)
Southwest0.9x	0.77	x	2.53	x	37.39		0.85	x	0.7	=	78.01	(79)
Southwest0.9x	0.77	x	2.95	x	63.74		0.76	x	0.7	=	69.32	(79)
Southwest0.9x	0.77	x	4.43	x	63.74		0.76	x	0.7	=	104.09	(79)
Southwest0.9x	0.77	x	1.86	x	63.74		0.85	x	0.7	=	244.41	(79)
Southwest0.9x	0.77	x	2.53	x	63.74		0.85	x	0.7	=	132.98	(79)
Southwest0.9x	0.77	x	2.95	x	84.22		0.76	x	0.7	=	91.59	(79)
Southwest0.9x	0.77	x	4.43	x	84.22		0.76	x	0.7	=	137.54	(79)
Southwest0.9x	0.77	x	1.86	x	84.22		0.85	x	0.7	=	322.94	(79)
Southwest0.9x	0.77	x	2.53	x	84.22		0.85	x	0.7	=	175.71	(79)
Southwest0.9x	0.77	x	2.95	x	103.49		0.76	x	0.7	=	112.55	(79)
Southwest0.9x	0.77	x	4.43	x	103.49		0.76	x	0.7	=	169.02	(79)
Southwest0.9x	0.77	x	1.86	x	103.49		0.85	x	0.7	=	396.65	(79)
Southwest0.9x	0.77	x	2.53	x	103.49		0.85	x	0.7	=	215.92	(79)
Southwest0.9x	0.77	x	2.95	x	113.34		0.76	x	0.7	=	123.26	(79)
Southwest0.9x	0.77	x	4.43	x	113.34		0.76	x	0.7	=	185.11	(79)
Southwest0.9x	0.77	x	1.86	x	113.34		0.85	x	0.7	=	434.61	(79)
Southwest0.9x	0.77	x	2.53	x	113.34		0.85	x	0.7	=	236.47	(79)
Southwest0.9x	0.77	x	2.95	x	115.04		0.76	x	0.7	=	125.12	(79)
Southwest0.9x	0.77	x	4.43	x	115.04		0.76	x	0.7	=	187.89	(79)
Southwest0.9x	0.77	x	1.86	x	115.04		0.85	x	0.7	=	441.16	(79)
Southwest0.9x	0.77	x	2.53	x	115.04		0.85	x	0.7	=	240.03	(79)
Southwest0.9x	0.77	x	2.95	x	112.79		0.76	x	0.7	=	122.67	(79)
Southwest0.9x	0.77	x	4.43	x	112.79		0.76	x	0.7	=	184.21	(79)
Southwest0.9x	0.77	x	1.86	x	112.79		0.85	x	0.7	=	432.52	(79)
Southwest0.9x	0.77	x	2.53	x	112.79		0.85	x	0.7	=	235.33	(79)
Southwest0.9x	0.77	x	2.95	x	105.34		0.76	x	0.7	=	114.57	(79)
Southwest0.9x	0.77	x	4.43	x	105.34		0.76	x	0.7	=	172.05	(79)
Southwest0.9x	0.77	x	1.86	x	105.34		0.85	x	0.7	=	403.95	(79)
Southwest0.9x	0.77	x	2.53	x	105.34		0.85	x	0.7	=	219.78	(79)
Southwest0.9x	0.77	x	2.95	x	92.9		0.76	x	0.7	=	101.03	(79)
Southwest0.9x	0.77	x	4.43	x	92.9		0.76	x	0.7	=	151.72	(79)
Southwest0.9x	0.77	x	1.86	x	92.9		0.85	x	0.7	=	356.23	(79)
Southwest0.9x	0.77	x	2.53	x	92.9		0.85	x	0.7	=	193.82	(79)
Southwest0.9x	0.77	x	2.95	x	72.36		0.76	x	0.7	=	78.7	(79)
Southwest0.9x	0.77	x	4.43	x	72.36		0.76	x	0.7	=	118.19	(79)
Southwest0.9x	0.77	x	1.86	x	72.36		0.85	x	0.7	=	277.49	(79)
Southwest0.9x	0.77	x	2.53	x	72.36		0.85	x	0.7	=	150.98	(79)

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Southwest0.9x	0.77	x	2.95	x	44.83	0.76	x	0.7	=	48.75	(79)
Southwest0.9x	0.77	x	4.43	x	44.83	0.76	x	0.7	=	73.21	(79)
Southwest0.9x	0.77	x	1.86	x	44.83	0.85	x	0.7	=	171.89	(79)
Southwest0.9x	0.77	x	2.53	x	44.83	0.85	x	0.7	=	93.52	(79)
Southwest0.9x	0.77	x	2.95	x	31.95	0.76	x	0.7	=	34.75	(79)
Southwest0.9x	0.77	x	4.43	x	31.95	0.76	x	0.7	=	52.18	(79)
Southwest0.9x	0.77	x	1.86	x	31.95	0.85	x	0.7	=	122.52	(79)
Southwest0.9x	0.77	x	2.53	x	31.95	0.85	x	0.7	=	66.66	(79)
Northwest 0.9x	0.77	x	8.97	x	11.51	0.76	x	0.7	=	76.13	(81)
Northwest 0.9x	0.77	x	9.2	x	11.51	0.76	x	0.7	=	39.04	(81)
Northwest 0.9x	0.77	x	3.89	x	11.51	0.76	x	0.7	=	16.51	(81)
Northwest 0.9x	0.77	x	9.63	x	11.51	0.76	x	0.7	=	40.86	(81)
Northwest 0.9x	0.77	x	10.65	x	11.51	0.76	x	0.7	=	45.19	(81)
Northwest 0.9x	0.77	x	5.09	x	11.51	0.76	x	0.7	=	21.6	(81)
Northwest 0.9x	0.77	x	1.86	x	11.51	0.85	x	0.7	=	61.79	(81)
Northwest 0.9x	0.77	x	3.5	x	11.51	0.85	x	0.7	=	33.22	(81)
Northwest 0.9x	0.77	x	8.97	x	23.55	0.76	x	0.7	=	155.79	(81)
Northwest 0.9x	0.77	x	9.2	x	23.55	0.76	x	0.7	=	79.89	(81)
Northwest 0.9x	0.77	x	3.89	x	23.55	0.76	x	0.7	=	33.78	(81)
Northwest 0.9x	0.77	x	9.63	x	23.55	0.76	x	0.7	=	83.63	(81)
Northwest 0.9x	0.77	x	10.65	x	23.55	0.76	x	0.7	=	92.48	(81)
Northwest 0.9x	0.77	x	5.09	x	23.55	0.76	x	0.7	=	44.2	(81)
Northwest 0.9x	0.77	x	1.86	x	23.55	0.85	x	0.7	=	126.45	(81)
Northwest 0.9x	0.77	x	3.5	x	23.55	0.85	x	0.7	=	67.99	(81)
Northwest 0.9x	0.77	x	8.97	x	41.13	0.76	x	0.7	=	272.01	(81)
Northwest 0.9x	0.77	x	9.2	x	41.13	0.76	x	0.7	=	139.49	(81)
Northwest 0.9x	0.77	x	3.89	x	41.13	0.76	x	0.7	=	58.98	(81)
Northwest 0.9x	0.77	x	9.63	x	41.13	0.76	x	0.7	=	146.01	(81)
Northwest 0.9x	0.77	x	10.65	x	41.13	0.76	x	0.7	=	161.48	(81)
Northwest 0.9x	0.77	x	5.09	x	41.13	0.76	x	0.7	=	77.18	(81)
Northwest 0.9x	0.77	x	1.86	x	41.13	0.85	x	0.7	=	220.79	(81)
Northwest 0.9x	0.77	x	3.5	x	41.13	0.85	x	0.7	=	118.71	(81)
Northwest 0.9x	0.77	x	8.97	x	67.8	0.76	x	0.7	=	448.42	(81)
Northwest 0.9x	0.77	x	9.2	x	67.8	0.76	x	0.7	=	229.96	(81)
Northwest 0.9x	0.77	x	3.89	x	67.8	0.76	x	0.7	=	97.23	(81)
Northwest 0.9x	0.77	x	9.63	x	67.8	0.76	x	0.7	=	240.71	(81)
Northwest 0.9x	0.77	x	10.65	x	67.8	0.76	x	0.7	=	266.2	(81)
Northwest 0.9x	0.77	x	5.09	x	67.8	0.76	x	0.7	=	127.23	(81)
Northwest 0.9x	0.77	x	1.86	x	67.8	0.85	x	0.7	=	363.98	(81)
Northwest 0.9x	0.77	x	3.5	x	67.8	0.85	x	0.7	=	195.69	(81)
Northwest 0.9x	0.77	x	8.97	x	89.77	0.76	x	0.7	=	593.72	(81)

SAP WorkSheet: New dwelling as built

Northwest 0.9x	0.77	x	9.2	x	89.77	x	0.76	x	0.7	=	304.47	(81)
Northwest 0.9x	0.77	x	3.89	x	89.77	x	0.76	x	0.7	=	128.74	(81)
Northwest 0.9x	0.77	x	9.63	x	89.77	x	0.76	x	0.7	=	318.7	(81)
Northwest 0.9x	0.77	x	10.65	x	89.77	x	0.76	x	0.7	=	352.46	(81)
Northwest 0.9x	0.77	x	5.09	x	89.77	x	0.76	x	0.7	=	168.45	(81)
Northwest 0.9x	0.77	x	1.86	x	89.77	x	0.85	x	0.7	=	481.92	(81)
Northwest 0.9x	0.77	x	3.5	x	89.77	x	0.85	x	0.7	=	259.1	(81)
Northwest 0.9x	0.77	x	8.97	x	97.5	x	0.76	x	0.7	=	644.88	(81)
Northwest 0.9x	0.77	x	9.2	x	97.5	x	0.76	x	0.7	=	330.71	(81)
Northwest 0.9x	0.77	x	3.89	x	97.5	x	0.76	x	0.7	=	139.83	(81)
Northwest 0.9x	0.77	x	9.63	x	97.5	x	0.76	x	0.7	=	346.16	(81)
Northwest 0.9x	0.77	x	10.65	x	97.5	x	0.76	x	0.7	=	382.83	(81)
Northwest 0.9x	0.77	x	5.09	x	97.5	x	0.76	x	0.7	=	182.97	(81)
Northwest 0.9x	0.77	x	1.86	x	97.5	x	0.85	x	0.7	=	523.45	(81)
Northwest 0.9x	0.77	x	3.5	x	97.5	x	0.85	x	0.7	=	281.42	(81)
Northwest 0.9x	0.77	x	8.97	x	92.98	x	0.76	x	0.7	=	614.97	(81)
Northwest 0.9x	0.77	x	9.2	x	92.98	x	0.76	x	0.7	=	315.37	(81)
Northwest 0.9x	0.77	x	3.89	x	92.98	x	0.76	x	0.7	=	133.35	(81)
Northwest 0.9x	0.77	x	9.63	x	92.98	x	0.76	x	0.7	=	330.11	(81)
Northwest 0.9x	0.77	x	10.65	x	92.98	x	0.76	x	0.7	=	365.07	(81)
Northwest 0.9x	0.77	x	5.09	x	92.98	x	0.76	x	0.7	=	174.48	(81)
Northwest 0.9x	0.77	x	1.86	x	92.98	x	0.85	x	0.7	=	499.17	(81)
Northwest 0.9x	0.77	x	3.5	x	92.98	x	0.85	x	0.7	=	268.37	(81)
Northwest 0.9x	0.77	x	8.97	x	75.42	x	0.76	x	0.7	=	498.82	(81)
Northwest 0.9x	0.77	x	9.2	x	75.42	x	0.76	x	0.7	=	255.8	(81)
Northwest 0.9x	0.77	x	3.89	x	75.42	x	0.76	x	0.7	=	108.16	(81)
Northwest 0.9x	0.77	x	9.63	x	75.42	x	0.76	x	0.7	=	267.76	(81)
Northwest 0.9x	0.77	x	10.65	x	75.42	x	0.76	x	0.7	=	296.12	(81)
Northwest 0.9x	0.77	x	5.09	x	75.42	x	0.76	x	0.7	=	141.53	(81)
Northwest 0.9x	0.77	x	1.86	x	75.42	x	0.85	x	0.7	=	404.89	(81)
Northwest 0.9x	0.77	x	3.5	x	75.42	x	0.85	x	0.7	=	217.68	(81)
Northwest 0.9x	0.77	x	8.97	x	51.24	x	0.76	x	0.7	=	338.93	(81)
Northwest 0.9x	0.77	x	9.2	x	51.24	x	0.76	x	0.7	=	173.81	(81)
Northwest 0.9x	0.77	x	3.89	x	51.24	x	0.76	x	0.7	=	73.49	(81)
Northwest 0.9x	0.77	x	9.63	x	51.24	x	0.76	x	0.7	=	181.94	(81)
Northwest 0.9x	0.77	x	10.65	x	51.24	x	0.76	x	0.7	=	201.21	(81)
Northwest 0.9x	0.77	x	5.09	x	51.24	x	0.76	x	0.7	=	96.16	(81)
Northwest 0.9x	0.77	x	1.86	x	51.24	x	0.85	x	0.7	=	275.11	(81)
Northwest 0.9x	0.77	x	3.5	x	51.24	x	0.85	x	0.7	=	147.91	(81)
Northwest 0.9x	0.77	x	8.97	x	29.6	x	0.76	x	0.7	=	195.77	(81)
Northwest 0.9x	0.77	x	9.2	x	29.6	x	0.76	x	0.7	=	100.39	(81)

SAP WorkSheet: New dwelling as built

Northwest 0.9x	0.77	x	3.89	x	29.6	x	0.76	x	0.7	=	42.45	(81)
Northwest 0.9x	0.77	x	9.63	x	29.6	x	0.76	x	0.7	=	105.09	(81)
Northwest 0.9x	0.77	x	10.65	x	29.6	x	0.76	x	0.7	=	116.22	(81)
Northwest 0.9x	0.77	x	5.09	x	29.6	x	0.76	x	0.7	=	55.54	(81)
Northwest 0.9x	0.77	x	1.86	x	29.6	x	0.85	x	0.7	=	158.9	(81)
Northwest 0.9x	0.77	x	3.5	x	29.6	x	0.85	x	0.7	=	85.43	(81)
Northwest 0.9x	0.77	x	8.97	x	14.52	x	0.76	x	0.7	=	96.07	(81)
Northwest 0.9x	0.77	x	9.2	x	14.52	x	0.76	x	0.7	=	49.27	(81)
Northwest 0.9x	0.77	x	3.89	x	14.52	x	0.76	x	0.7	=	20.83	(81)
Northwest 0.9x	0.77	x	9.63	x	14.52	x	0.76	x	0.7	=	51.57	(81)
Northwest 0.9x	0.77	x	10.65	x	14.52	x	0.76	x	0.7	=	57.03	(81)
Northwest 0.9x	0.77	x	5.09	x	14.52	x	0.76	x	0.7	=	27.26	(81)
Northwest 0.9x	0.77	x	1.86	x	14.52	x	0.85	x	0.7	=	77.98	(81)
Northwest 0.9x	0.77	x	3.5	x	14.52	x	0.85	x	0.7	=	41.92	(81)
Northwest 0.9x	0.77	x	8.97	x	9.36	x	0.76	x	0.7	=	61.91	(81)
Northwest 0.9x	0.77	x	9.2	x	9.36	x	0.76	x	0.7	=	31.75	(81)
Northwest 0.9x	0.77	x	3.89	x	9.36	x	0.76	x	0.7	=	13.42	(81)
Northwest 0.9x	0.77	x	9.63	x	9.36	x	0.76	x	0.7	=	33.23	(81)
Northwest 0.9x	0.77	x	10.65	x	9.36	x	0.76	x	0.7	=	36.75	(81)
Northwest 0.9x	0.77	x	5.09	x	9.36	x	0.76	x	0.7	=	17.57	(81)
Northwest 0.9x	0.77	x	1.86	x	9.36	x	0.85	x	0.7	=	50.25	(81)
Northwest 0.9x	0.77	x	3.5	x	9.36	x	0.85	x	0.7	=	27.02	(81)
Rooflights 0.9x	1	x	1.13	x	26	x	0.63	x	0.8	=	13.33	(82)
Rooflights 0.9x	1	x	1.13	x	54	x	0.63	x	0.8	=	27.68	(82)
Rooflights 0.9x	1	x	1.13	x	94	x	0.63	x	0.8	=	48.18	(82)
Rooflights 0.9x	1	x	1.13	x	150	x	0.63	x	0.8	=	76.89	(82)
Rooflights 0.9x	1	x	1.13	x	190	x	0.63	x	0.8	=	97.39	(82)
Rooflights 0.9x	1	x	1.13	x	201	x	0.63	x	0.8	=	103.03	(82)
Rooflights 0.9x	1	x	1.13	x	194	x	0.63	x	0.8	=	99.44	(82)
Rooflights 0.9x	1	x	1.13	x	164	x	0.63	x	0.8	=	84.06	(82)
Rooflights 0.9x	1	x	1.13	x	116	x	0.63	x	0.8	=	59.46	(82)
Rooflights 0.9x	1	x	1.13	x	68	x	0.63	x	0.8	=	34.85	(82)
Rooflights 0.9x	1	x	1.13	x	33	x	0.63	x	0.8	=	16.91	(82)
Rooflights 0.9x	1	x	1.13	x	21	x	0.63	x	0.8	=	10.76	(82)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 1303.4 2379.22 3542.78 5039.64 6133.31 6477.09 6247.48 5383.73 4141.95 2815.32 1591.73 1094.8 (83)

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

(84)m= 3313.57 4370.5 5446.01 6808.55 7760.75 7986.67 7695.82 6856.77 5699.57 4507.59 3430.17 3047.57 (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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SAP WorkSheet: New dwelling as built

(86)m=	1	1	1	0.99	0.97	0.94	0.87	0.89	0.97	0.99	1	1	(86)
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Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	17.65	17.86	18.32	18.86	19.57	20.18	20.61	20.57	19.97	19.15	18.25	17.75	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	18.7	18.72	18.72	18.76	18.79	18.8	18.81	18.81	18.78	18.76	18.74	18.72	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.95	0.86	0.61	0.66	0.94	0.99	1	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	14.52	14.84	15.51	16.32	17.36	18.21	18.71	18.69	17.94	16.74	15.42	14.68	(90)
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$$fLA = \text{Living area} \times (4) = 0.04 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	14.64	14.95	15.61	16.41	17.44	18.29	18.78	18.76	18.02	16.84	15.53	14.8	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	14.64	14.95	15.61	16.41	17.44	18.29	18.78	18.76	18.02	16.84	15.53	14.8	(93)
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8 Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(92)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	1	0.99	0.99	0.97	0.93	0.83	0.61	0.65	0.91	0.98	1	1	(94)
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Useful gains, hmGm, W = (94)m x (84)m

(95)m=	3303.68	4344.65	5375.06	6611.63	7207.81	6637.87	4672.37	4442.94	5181.95	4417.69	3413.87	3039.8	(95)
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Monthly average external temperature from Table 8

(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)
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Heat loss rate for mean internal temperature, Lm, W = [(93)m x (96)m]

(97)m=	33237.82	32127.76	28446.23	24197.31	17700.32	11270.61	5699.57	5635.16	11505.61	18935.64	27137.42	31942.76	(97)
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Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	22271	18670.25	17164.95	12661.69	7806.43	0	0	0	10801.36	17080.96	21503.8		(98)
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$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{\text{Jan-Dec}} = 127960.42 \quad (98)$$

Space heating requirement in kWh/m²/year

$$122.43 \quad (99)$$

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	26293.32	18806.95	18806.95	0	0	0	0	(100)
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Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.35	0.44	0.41	0	0	0	0	(101)
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Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	9105.62	8332.68	7622.63	0	0	0	0	(102)
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Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	9564.63	9104.3	8184.44	0	0	0	0	(103)
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Space cooling requirement for month, whole dwelling, continuous (kWh) = $0.024 \times [(103)m - (102)m] \times (41)m$
set (104)m to zero if (104)m < 3 x (98)m

(104)m=	0	0	0	0	0	0	574.09	417.99	0	0	0	0	(104)
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$$\text{Total} = \text{Sum}(104) = 992.08 \quad (104)$$

SAP WorkSheet: New dwelling as built

Cooled fraction	$f C = \text{cooled area} \div (4) =$												0.11	(105)
Intermittency factor (Table 10b)														
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0		
												$Total = \text{Sum}(104) =$	0	(106)
Space cooling requirement for month = (104)m × (105) × (106)m														
(107)m=	0	0	0	0	0	0	16.48	12	0	0	0	0		
												$Total = \text{Sum}(107) =$	28.48	(107)
Space cooling requirement in kWh/m ² /year	$(107) \div (4) =$												0.03	(108)

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

Space heating:

Fraction of space heat from secondary/supplementary system													0.1	(201)
Fraction of space heat from main system(s)	$(202) = 1 - (201) =$												0.9	(202)
Fraction of total heating from main system 1	$(204) = (202) \times [1 - (203)] =$												0.9	(204)
Efficiency of main space heating system 1													89	(206)
Efficiency of secondary/supplementary heating system, %													100	(208)
Cooling System Energy Efficiency Ratio													4.32	(209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	22271	18670.25	17164.95	12661.69	7806.43	0	0	0	0	10801.36	17080.96	21503.8		
(211)m = $\{[(98)m \times (204)] + (210)m\} \times 100 \div (206)$														(211)
	22521.23	18880.03	17357.81	12803.95	7894.14	0	0	0	0	10922.72	17272.88	21745.42		
$Total (kWh/year) = \text{Sum}(211)_{1..12} =$													129398.18	(211)

Space heating fuel (secondary), kWh/month														
= $\{[(98)m \times (201)] + (214)m\} \times 100 \div (208)$														
(215)m=	2227.1	1867.02	1716.49	1266.17	780.64	0	0	0	0	1080.14	1708.1	2150.38		
$Total (kWh/year) = \text{Sum}(215)_{1..12} =$													12796.04	(215)

Water heating

Output from water heater (calculated above)	304.95	268.95	282.87	254.14	249.45	223.48	215.19	235.36	234.7	263.5	277.91	297.8		
Efficiency of water heater													78.3	(216)
(217)m=	88.82	88.81	88.78	88.74	88.58	78.3	78.3	78.3	78.3	88.68	88.78	88.82		
Fuel for water heating, kWh/month														
(219)m = $(64)m \times 100 \div (217)m$														
(219)m=	343.34	302.85	318.61	286.4	281.6	285.42	274.83	300.59	299.75	297.13	313.02	335.3		
$Total = \text{Sum}(219a)_{1..12} =$													3638.82	(219)

Space cooling fuel, kWh/month.

(221)m = $(107)m \div (209)$														
(221)m=	0	0	0	0	0	0	3.81	2.78	0	0	0	0		
$Total = \text{Sum}(221)_{1..12} =$													6.59	(221)

Annual totals

	kWh/year		kWh/year
Space heating fuel used, main system 1			129398.18
Space heating fuel used, secondary			12796.04
Water heating fuel used			3638.82

SAP WorkSheet: New dwelling as built

Space cooling fuel used		6.59	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	130		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	175	(231)
Electricity for lighting		1908.34	(232)

10a. Fuel costs - individual heating systems

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year	
Space heating - main system 1	(211) x	3.1	x 0.01 =	4011.34 (240)
Space heating - main system 2	(213) x	0	x 0.01 =	0 (241)
Space heating - secondary	(215) x	11.46	x 0.01 =	1466.43 (242)
Water heating cost (other fuel)	(219)	3.1	x 0.01 =	112.8 (247)
Space cooling	(221)	11.46	x 0.01 =	0.76 (248)
Pumps, fans and electric keep-hot	(231)	11.46	x 0.01 =	20.06 (249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a)				
Energy for lighting	(232)	11.46	x 0.01 =	218.7 (250)
Additional standing charges (Table 12)				106 (251)
Appendix Q items: repeat lines (253) and (254) as needed				
Total energy cost	(245)...(247) + (250)...(254) =			5936.08 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] + [(4) + 45.0] =	2.56	(257)
SAP rating (Section 12)		64.3	(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	0.198	=	25620.84 (261)
Space heating (secondary)	(215) x	0.517	=	6615.55 (263)
Water heating	(219) x	0.198	=	720.49 (264)
Space and water heating	(261) + (262) + (263) + (264) =			32956.88 (265)
Space cooling	(221) x	0.517	=	3.41 (266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517	=	90.48 (267)
Electricity for lighting	(232) x	0.517	=	986.61 (268)
Total CO2, kg/year		sum of (265)...(271) =		34037.37 (272)
CO2 emissions per m²		(272) ÷ (4) =		32.57 (273)

SAP WorkSheet: New dwelling as built

EI rating (section 14)

58

 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year
Space heating (main system 1)	(211) x	1.02	=	131986.14
Space heating (secondary)	(215) x	2.92	=	37364.44
Energy for water heating	(219) x	1.02	=	3711.59
Space and water heating	(261) + (262) + (263) + (264) =			173062.18
Space cooling	(221) x	2.92	=	19.25
Electricity for pumps, fans and electric keep-hot	(231) x	2.92	=	511
Electricity for lighting	(232) x	0	=	5572.35
Total Primary Energy	sum of (265)...(271) =			179164.78
Primary energy kWh/m²/year	(272) ÷ (4) =			171.43

APPENDIX (G)

NOTIONAL DWELLING PEA - PREDICTED ENERGY ASSESSMENT (OUTLINE EPC)

Predicted Energy Assessment

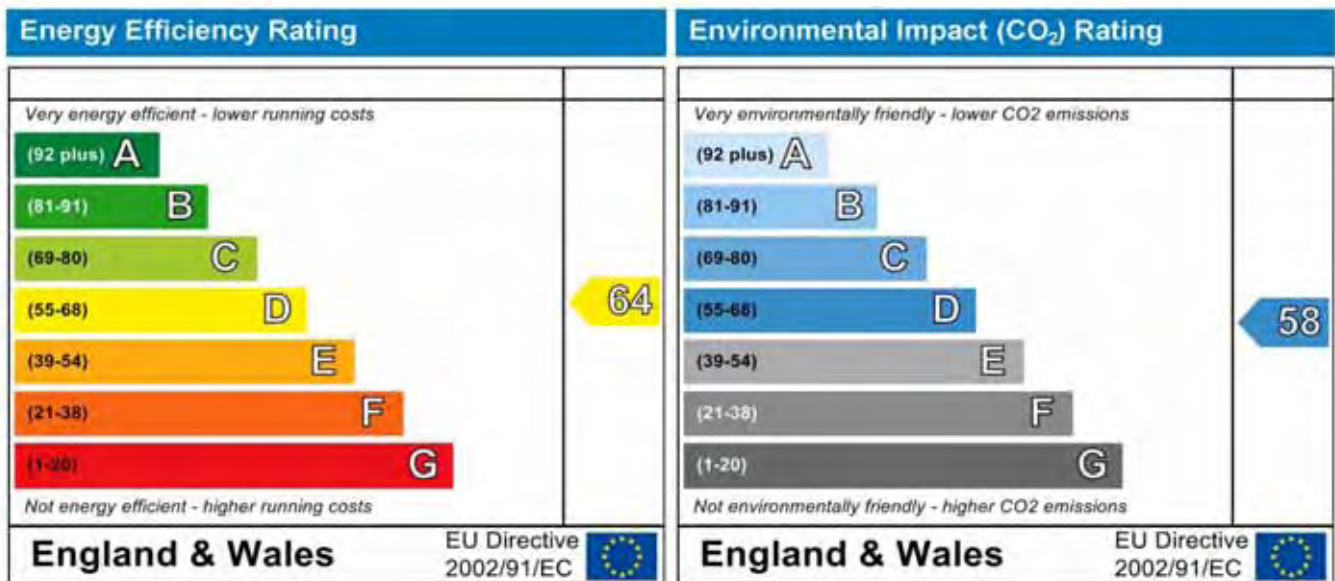
Notional House
9 Templewood Avenue
London
NW3 7UY

Dwelling type:
Date of assessment:
Produced by:
Total floor area:

Detached House
29 August 2012
Ondrej Gajdos
1045.13 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 2009 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.



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

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

APPENDIX (H)

UNDERGROUND DRAINAGE WITH SUDS/RAINWATER RECYCLING
AND ABOVEGROUND DRAINAGE



Unit 2, Rays / Ray Bar, Ray Bar
 Ignition, Spark Plug, etc.
 Fuel, Oil, etc.
 Tel: 440-277-3022
 Wile, Doreen, Ray, Doreen

**BASEMENT PLAN
DRAINAGE AND
PUBLIC HEALTH SERVICES**

1 TEMPLEWOOD AVENUE
HAMPSTEAD
LONDON
NW3 7UY

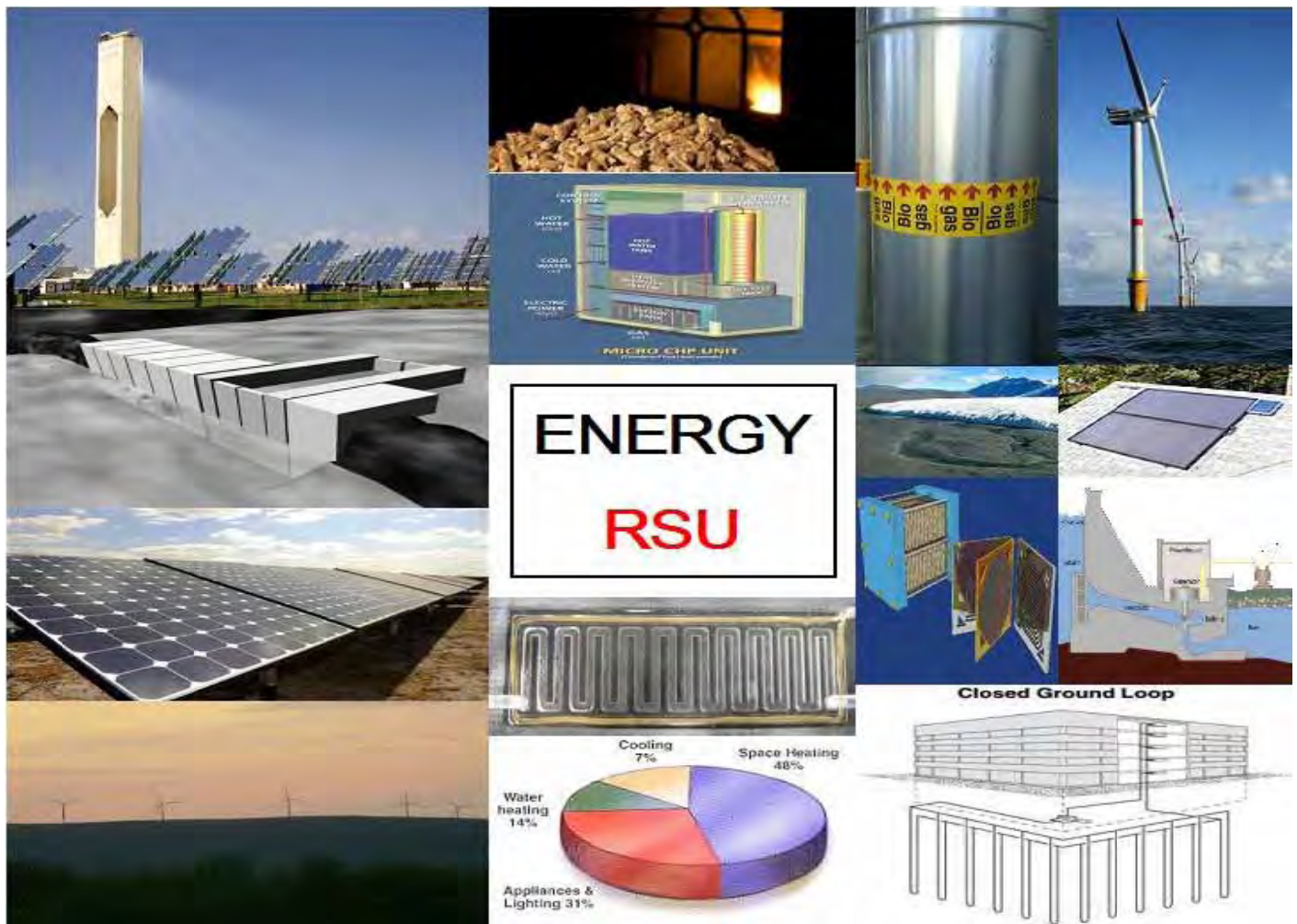
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PRELIMINARY

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APPENDIX (I)

ASHP PLANTROOM/ATTENUATION



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 (BRE 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 (BRE certified)
- Solar Shading/Sun Studies



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M&E Consultants

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