## Code for Sustainable Homes (November 2010) Design - Draft

Additional allowable generation and its CO<sub>2</sub> emissions offset

Net CO₂ emissions

CO<sub>2</sub> emissions offset from additional allowable generation

CO<sub>2</sub> emissions offset from community biofuel CHP systems



#### This report details the calculations and results for Ene 1, 2 and 7 of the Code For Sustainable Homes.

This Design Assessment has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed. Code calculations are from the Technical Guide (November 2010).

Assessor name	Mr Stuart Searle		Assessor num	ber 2	435	
Client			Last modified	O	01/02/2013	
Address	P01 4 St Augustines,	London, NW1				
Building regulation assess	ment - criterion 1					
					kg/m²/yr	
DER					10.82	
TER					17.77	
Assessment of zero carbo	n home and low or zer	o carbon technologies				
				Credits	Level	
Dwelling emission rate (Ene	2 1)	CO <sub>2</sub> reduction = 39.1 %		4.2	4	
Fabric Energy Efficiency		FEE = 48.1		No credits		
Low or zero carbon technol	ogies (Ene 7)	CO <sub>2</sub> reduction = 14 %		1		
Ene 1 - dwelling emission	rate					
			%	kWh/m²	kgCO₂/m²/yr	
Assessment of Ene 1 (level	1-5)					
					10.82	
DER from SAP 2009 DER wo	orksheet			0.00	10.82	
DER from SAP 2009 DER wo Additional allowable genera	orksheet			0.00	10.82	
DER from SAP 2009 DER wo Additional allowable genera CO₂ emissions offs	orksheet	ofuel CHP systems		0.00		
DER from SAP 2009 DER wo Additional allowable genera CO <sub>2</sub> emissions offs CO <sub>2</sub> emissions offs	orksheet ation et from generation et from community bio			0.00	0.00	
DER from SAP 2009 DER wo Additional allowable genera CO <sub>2</sub> emissions offs CO <sub>2</sub> emissions offset f	orksheet etion et from generation et from community bio from SAP section 16 allo			0.00	0.00	
Additional allowable genera CO <sub>2</sub> emissions offs	orksheet eation et from generation et from community bio from SAP section 16 allo tion 16 allowances			0.00	0.00	
DER from SAP 2009 DER wo Additional allowable general CO <sub>2</sub> emissions offs CO <sub>2</sub> emissions offset f DER accounting for SAP sec	orksheet eation et from generation et from community bio from SAP section 16 allo tion 16 allowances		39.1	0.00	0.00 0.00 0.00 10.82	
DER from SAP 2009 DER wo Additional allowable genera CO <sub>2</sub> emissions offset CO <sub>2</sub> emissions offset f  DER accounting for SAP sect CO <sub>2</sub> reduction compared to CO <sub>2</sub> reduction as % of TER	orksheet etion et from generation et from community bio from SAP section 16 allo tion 16 allowances		39.1	0.00	0.00 0.00 0.00 10.82	
DER from SAP 2009 DER wo Additional allowable general CO <sub>2</sub> emissions offst CO <sub>2</sub> emissions offset f DER accounting for SAP sect CO <sub>2</sub> reduction compared to CO <sub>2</sub> reduction as % of TER  Assessment of Ene 1 (level	orksheet etion et from generation et from community bio from SAP section 16 allo tion 16 allowances TER		39.1	0.00	0.00 0.00 0.00 10.82	(ZC:
DER from SAP 2009 DER wo Additional allowable general CO <sub>2</sub> emissions offse CO <sub>2</sub> emissions offset f Total CO <sub>2</sub> emissions offset f DER accounting for SAP sec CO <sub>2</sub> reduction compared to	orksheet etion et from generation et from community bio from SAP section 16 allo tion 16 allowances TER  6) orksheet		39.1	0.00	0.00 0.00 0.00 10.82 6.95	(ZC:
DER from SAP 2009 DER wo Additional allowable genera  CO <sub>2</sub> emissions offset  CO <sub>2</sub> emissions offset f  DER accounting for SAP sect  CO <sub>2</sub> reduction compared to  CO <sub>2</sub> reduction as % of TER  Assessment of Ene 1 (level  DER from SAP 2009 DER wo	orksheet eation et from generation et from community bio from SAP section 16 allo tion 16 allowances TER  6) orksheet aces (equation L14)		39.1	0.00	0.00 0.00 0.00 10.82 6.95	

0.00

0.00

27.14

(ZC6)

(ZC7)

(ZC5)

(ZC8)

0.00

#### Ene 1 - dwelling emission rate - level 6 There is no Zero Carbon Home definition in the current technical guide Criterion Value Pass/Fail FEE <= 39 48.1 Fail 27.14 Net CO₂ emissions <= 0.00 Fail Result: Not level 6 Number of credits for Ene 1 4.2 Ene 2 - Fabric Energy Efficiency 48.1 FEE Number of credits for Ene 2 No credits Ene 7 - low or zero carbon technologies **Emissions** Reduction kgCO₂/yr kgCO<sub>2</sub>/yr Standard case 1543.43 Space and water heating (265) Mechanical cooling (266) 0.00 Pumps and fans (267) 132.49 Lighting (268) 220.41 Appliances and cooking 1786.65 Total CO₂ 1880.02 **Actual case** Space and water heating (265) or (376) 1543.43 Space and water heating from LZCT considered in SAP 2009 0.00 Pumps and fans (267) or (378) 132.49 Pumps and fans 0.00 Electricity generated by LZCT (269) + (380)) -540.37 Additional allowable electricity generation considered in SAP 2009 section 16 0.00 Offset from biofuel CHP $[-1 \times [(363)..(366) + (368)...(372)]]$ 0.00 LZCT electricity generation -540.37 LZCT thermal generation 0 Total from specified LZCT -540.37 **Emissions** $kgCO_2/m^2/yr$ Reduction in CO<sub>2</sub> Emissions Standard Case CO<sub>2</sub> 33.64

28.70

14

1

Actual Case CO2

% Reduction in CO<sub>2</sub>

Number of credits for Ene 7

## DER 2009 Worksheet

### Design - Draft



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Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P01 4 St Augustines, London, NW1		

	, ,			
1. Overall dwelling dime	nsions			
		Area (m²)	Average storey height (m)	Volume (m³)
owest occupied	[	109.50 (1a) x	2.60 (2a) =	284.70
otal floor area	(1a) + (1b) + (1c) + (1d)(1n) = [	109.50 (4)		
Owelling volume			(3a) + (3b) + (3c) + (3d)(3n)	= 284.70
2. Ventilation rate				
				m³ per hour
lumber of chimneys			0 x 40 =	0
lumber of open flues			0 x 20 =	0
lumber of intermittent fa	nns		0 x 10 =	0
Number of passive vents			0 x 10 =	0
Number of flueless gas fir	es		0 x 40 =	0 (
				Air changes per hour
nfiltration due to chimne	ys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7b)	7c) = 0 ÷ (5) =	0.00
a pressurisation test has	s been carried out or is intended, proceed to	o (17), otherwise continue f	from (9) to (16)	
ir permeability value, q5	0, expressed in cubic metres per hour per	square metre of envelope a	area	5.00
based on air permeabili	ty value, then (18) = $[(17) \div 20] + (8)$ , other	wise (18) = (16)		0.25
Air permeability value app	olies if a pressurisation test has been done,	or a design or specified air	permeability is being used	
lumber of sides on which	dwelling is sheltered			1
helter factor			1 - [0.075 x (19)]	= 0.92
Adjusted infiltration rate			(18) x (20)	= 0.23
nfiltration rate modified	for monthly wind speed:			

Infiltration rate mo	odified for	monthly wi	nd speed:										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average v	vind speed	from Table	7										
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	]
										∑(22)1	.12 =	54.10	(22)
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	1.20	1.27	]
										∑(22a)1	.12 =	13.52	(22a)
Adjusted infiltration	n rate (allo	owing for sh	nelter and v	wind speed	) = (21) × (2	.2a)m							
(22b)m	0.31	0.29	0.29	0.26	0.24	0.23	0.21	0.21	0.24	0.26	0.28	0.29	]
										∑(22b)1	.12 =	3.13	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system

If exhaust air heat pump using Appendix N,  $(23b) = (23a) \times Fmv$  (equation (N5)), otherwise (23b) = (23a)

0.5 (23a)

If balanced wi	th heat rec	overy: effic	ency in % all	owing for	in-use fact	or (from Ta	ble 4h) =							N/A	(23c)
c) If whole ho	use extract	ventilation	or positive i	nput venti	lation from	n outside									
if (22b)m <	0.5 x (23b)	), then (24c	) = (23b); oth	nerwise (2	4c) = (22b)	m + 0.5 x (2	3b)								
(24c)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0	).50	0.50	0.51	0.	.53	0.54	(24c)
Effective air chan	ge rate - en	nter (24a) o	r (24b) or (24	lc) or (24d	) in box (25	5)									
(25)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0	).50	0.50	0.51	0.	.53	0.54	(25)
3. Heat losses a	nd heat los	s paramete	r												
The κ-value is the	heat capa	city per unit	area, see To	ible 1e.											
E	lement		Gross Area, m²	-	nings, n²	Net area A, m²		value, //m²K		A x U, W/K		value, J/m².K		Ахк, kJ/K	
Doors						2.10	х	1.60	=	3.36		N/A	]	N/A	(26)
Window*						8.68	х	1.15	=	9.94		N/A	]	N/A	(27)
Window*						18.23	х	1.33	=	24.17		N/A	]	N/A	(27)
Ground floor						109.50	x	0.12	=	13.14		N/A	]	N/A	(28a)
External wall						83.91	x	0.20	=	16.78		N/A	]	N/A	(29a)
Party Wall						34.19	x	0.00	=	0.00		N/A	]	N/A	(32)
Total area of exte	ernal eleme	nts ∑A, m²				222.42	(31)								
* for windows an	d roof wind	lows, effect	ive window l	J-value is	calculated	using formu	la 1/[(1/	UValue	e)+0.04	!] paragraµ	oh 3.2				
Fabric heat loss, \	W/K = ∑(A ×	۷)								(2	6)(30)	+ (32) =		67.39	(33)
Heat capacity Cm	ı = Σ(A x κ)								(28)	(30) + (32)	+ (32a)	(32e) =		N/A	(34)
Thermal mass pa	rameter (TI	MP) in kJ/m	²K							Calcula	ted sepa	rately =	1	100.00	(35)
Thermal bridges:														17.55	(36)
if details of th	ermal bridg	ing are not	known then	(36) = 0.1	5 x (31)										_
Total fabric heat	loss										(33)	+ (36) =		84.94	(37)
Ventilation heat I		·													7
(38)m	52.82	51.19	51.19	47.93	46.98	46.98	46.98	40	6.98	46.98	47.93	49	0.56	51.19	(38)
Heat transfer coe				122.00	121.01	121.01	121.01	1 12	11 01	121.01	122.0		4.40	126 12	٦
(39)m	137.75	136.12	136.12	132.86	131.91	131.91	131.91	.   13	31.91	131.91	132.8		4.49	136.12	」 │(39)
Heat loss parame	+or (ULD) N	N/m²V /20	\m : (4)						•	Average =	Σ(39)1	12/12 -		133.83	] (39)
(40)m	1.26	1.24	1.24	1.21	1.20	1.20	1.20	1	.20	1.20	1.21	1	.23	1.24	7
(10)	1.20	1 2.2 .	1.2.	1,21	1.20	1.20	1.20			Average =	1		_	1.22	] (40)
									•	Weruge	Z( 10)1	,		1.22	
4. Water heatin	g energy re	quirement													
													kV	Vh/year	
Assumed occupar	ncy, N										2.	81	(42)		
If TFA > 13.9,	N = 1 + 1.76	6 x [1 - exp(-	·0.000349 x (	TFA - 13.9	) <sup>2</sup> )] + 0.00	13 x (TFA - 1	3.9)								
If TFA ≤ 13.9,	N = 1														
Annual average h	ot water us	sage in litre	s per day Vd,	average =	(25 x N) +	36					100	).98	(43)		
Annual average h	not water us	sage has be	en reduced b	by 5% if th	e dwelling	is designed	to achiev	e a wa	ater use	target of	not more	than 1.	25 litre	es	
per person per do	ay (all wate	r use, hot a	nd cold)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	,	Aug	Sep	Oct	N	ov	Dec	
Hot water usage			1		1	1					1 -	_			7
(44)m	111.08	107.04	103.00	98.96	94.92	90.88	90.88	94	4.92	98.96	103.0	- '	7.04	111.08	] ¬ .
_		_						,				112 =	1	211.76	(44)
Energy content of				-								<u> </u>	7.36	150.01	7
(45)m	165.12	144.41	149.02	129.92	124.66	107.57	99.68	11	.4.39	115.75	134.9		7.26	159.91	」 □
											<u>∠</u> (45)	112 =		592.61	(45)
											URI	N: 13-01	.0-01 F	Planning v	ersion 1

For community heating include distribution loss whether or not hot water tank is present

,	9					•							
Distribution loss	0.15 x (45)n	n											
(46)m	24.77	21.66	22.35	19.49	18.70	16.14	14.95	17.16	17.36	20.24	22.09	23.99	(46
Water storage los	ss:												
a) If manufacture	r's declared	loss factor	is known (I	kWh/day):					1.85	(47)			
Temperature 1	factor from	Table 2b							0.54	(48)			
Energy lost fro	m water sto	orage, kW	h/day (47)	) x (48)					1.00	(49)			
Enter (49) or (54)	in (55)								1.00	(55)			
Water storage los	s calculated	d for each n	nonth = (55	) x (41)m									
(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56
If cylinder contair	ns dedicated	l solar stora	age. = (56)n	n x [(50) - (I	H11)] ÷ (50)	). else = (56	)m where (	H11) is fro	m Appendi	· к Н	!	•	
(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57
Primary circuit los	ss (annual) f	rom Table	3						360.00	(58)			_
Primary circuit los				.)m						, ,			
(modified by facto			•	•	ng and a cy	linder theri	mostat)						
(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 for ea	ch month fr	om Table 3	a, 3b or 3c	(enter '0' if	not a com	bi boiler)			•			•	_
(61)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61
Total heat require	ed for water	heating ca	Iculated for	r each mon	th 0.85 × (4	15)m + (46)	m + (57)m ·	+ (59)m + (	61)m				
(62)m	226.66	200.00	210.57	189.48	186.21	167.13	161.23	175.93	175.31	196.45	206.81	221.45	(62
Solar DHW input	calculated u	ising Apper	ndix H (nega	ative quant	ity) ('0' ent	ered if no s	olar contrik	oution to w	ater heatin	g)			
(63)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
										∑(63)1	.12 =	0.00	(63
Output from wate	er heater fo	r each mon	th, kWh/m	onth (62)n	n + (63)m						<u> </u>		_
(64)m	226.66	200.00	210.57	189.48	186.21	167.13	161.23	175.93	175.31	196.45	206.81	221.45	
										∑(64)1	.12 = 2	2317.25	(64
													_

if (64)m < 0 then set to 0

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

(65)m 104.14 92.49 98.79 90.85 90.69 83.42 82.38 87.27 86.14 94.09 96.61 102.41 (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)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (T	able 5), Wa	itts											
(66)m	140.59	140.59	140.59	140.59	140.59	140.59	140.59	140.59	140.59	140.59	140.59	140.59	(66)
Lighting gains (cald	culated in A	ppendix L,	equation L	9 or L9a), a	lso see Tab	le 5							
(67)m	24.14	21.44	17.44	13.20	9.87	8.33	9.00	11.70	15.71	19.94	23.27	24.81	(67)
Appliances gains (	calculated i	n Appendix	L, equatio	n L13 or L1	3a), also se	e Table 5							
(68)m	270.84	273.65	266.56	251.49	232.45	214.57	202.62	199.81	206.89	221.97	241.00	258.89	(68)
Cooking gains (cale	culated in A	appendix L,	equation L	15 or L15a)	, also see T	able 5							
(69)m	37.06	37.06	37.06	37.06	37.06	37.06	37.06	37.06	37.06	37.06	37.06	37.06	(69)
Pumps and fans ga	ins (Table	5a)											
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evapor	ation (nega	tive values	) (Table 5)										
(71)m	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	(71)
Water heating gain	ns (Table 5)												
(72)m	139.97	137.63	132.78	126.18	121.89	115.86	110.73	117.30	119.63	126.47	134.18	137.64	(72)
Total internal gain	s (66)m + (	67)m + (68	)m + (69)m	+ (70)m +	(71)m + (72	.)m							
(73)m	510.12	507.90	491.95	466.04	439.39	413.93	397.52	403.98	417.40	443.55	473.63	496.52	(73)

#### 6. Solar gains

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

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

Details for month of Junual	Access factor Table 6d		Area m²		lar flux W/	m² į	g Specific dat or Table 6b	a FI	Specific da		Gains (W)	
West	0.54	] x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
South	0.54	] x	18.23	x	47.32	x 0.9 x	0.63	x	0.80	=	211.29	(78)
Solar gains in watts, calcula	ted for each	month ∑(74	4)m(82)m	1								
(83)m 253.54	426.51	551.69	663.67	721.12	732.95	717.84	672.25	602.93	480.55	302.87	217.42	(83)
Total gains - internal and se	olar (73)m + (	83)m										
(84)m 763.67	934.40	1043.64	1129.71	1160.51	1146.88	1115.36	1076.23	1020.34	924.10	776.50	713.94	(84)
7. Mean internal tempera	turo (boatin	g coacon)										
Temperature during heating	· · · · · ·	•	ea from Ta	hle 9 Th1/	,C)						21.00	(85)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	] (65)
Utilisation factor for gains			•	iviay	Jun	Jul	Aug	ЭСР	Oc.	1101	Dec	
(86)m 0.95	0.93	0.89	0.83	0.74	0.60	0.44	0.45	0.66	0.84	0.93	0.96	(86)
Mean internal temp of livir	g area T1 (st	eps 3 to 7 ir	n Table 9c)									_ ` '
(87)m 18.57	18.93	19.41	19.89	20.41	20.75	20.92	20.92	20.67	20.07	19.16	18.62	(87)
Temperature during heating	g periods in t	the living ar	ea from Ta	·ble 9, Th2(˚	· °C)							,
(88)m 19.88	19.89	19.89	19.91	19.92	19.92	19.92	19.92	19.92	19.91	19.90	19.89	(88)
Utilisation factor for gains	1	1	(see Table	9a)								_ ` `
(89)m 0.95	0.92	0.87	0.81	0.69	0.53	0.34	0.35	0.60	0.81	0.92	0.95	(89)
Mean internal temperature	in the rest o	f dwelling	Γ2 (follow s	teps 3 to 7	in Table 9c				1	•	1	_ ` '
(90)m 16.66	17.18	17.87	18.56	19.26	19.70	19.87	19.87	19.61	18.82	17.53	16.74	(90)
Living area fraction	<b>-</b>	•	1	•			fLA :	24.00	÷ (4) =	= [	0.22	(91)
Mean internal temperature	for the who	le dwelling	fl A x T1 +(	1 - fl A) x T2					. ,			. ,
(92)m 17.08	17.56	18.21	18.85	19.51	19.93	20.10	20.10	19.84	19.09	17.89	17.15	(92)
Apply adjustment to the m	ean internal t	temperatur	e from Tab	le 4e, wher	e appropri	ate	'		•		1	
(93)m 16.93	17.41	18.06	18.70	19.36	19.78	19.95	19.95	19.69	18.94	17.74	17.00	(93)
	·						'				1	
8. Space heating requirer	nent											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal		obtained a	it step 11 o	f Table 9b,	so that tim	= (93)m a	ind recalculat	e the utili	sation facto	or for gains	using Table	e 9a)
Utilisation factor for gains,		0.00	0.77	0.67	0.52	0.24	1 0 05	0.50		0.00	0.00	7 (0.4)
(94)m 0.92	0.88	0.83	0.77	0.67	0.52	0.34	0.35	0.58	0.77	0.89	0.93	(94)
Useful gains, ηmGm, W = (	· · ·		072.02	772.00	F04.70	202.02	1 200 00	504.46	744.04	604.05	560.50	7 (05)
(95)m 702.49		870.31	872.02	773.08	594.70	382.83	380.88	591.46	711.94	691.05	660.58	(95)
Monthly average external				1	1		1.000		1000		1	7 (0.5)
(96)m 4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean int												. ـ ر ٦
(97)m 1712.4		1532.10	1329.01	1010.65	682.96	402.79	402.28	710.95	1082.16	1443.96	1646.98	(97)
Space heating requirement									T	I	T =	٦
(98)m 751.4 <sup>4</sup>	580.93	492.37	329.03	176.75	0.00	0.00	0.00	0.00	275.44	542.10	733.88	_
						Total per	year (kWh/y	ear) = ∑(9			881.95	(98)
Space heating requirement	in kWh/m²/	year							(98)	÷ (4)	35.45	(99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11)

0.00 (201)

Fraction of space heating from main system(s) 1 - (201)					1.00	(202)			
Fraction of main heating from main system 2					0.00	(203)			
Fraction of total space heat from main system 1 (202) x [1 - (203)]					1.00	(204)			
Fraction of total space heat from main system 2 (202) x (203)					0.00	(205)			
Efficiency of main space heating system 1 (%)					93.00	(206)			
(from database or Table 4a/4b, adjusted where appropriate by the	e amount	shown in t	he 'space	efficiency of	ıdjustmeni	t' column of 1	Table 4c)		
Jan Feb Mar Apr N	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement, kWh/month (as calculated above)									
(98)m 751.44 580.93 492.37 329.03 17	76.75	0.00	0.00	0.00	0.00	275.44	542.10	733.88	]
Space heating fuel (main heating system 1), kWh/month = (98)m x	(204) x 1	100 ÷ (206)	ı						
(211)m 808.00 624.66 529.43 353.80 19	90.05	0.00	0.00	0.00	0.00	296.17	582.90	789.12	]
		To	tal per ye	ar (kWh/ye	ar) = ∑(21	1)15, 101	2 = 4	174.14	(211)
Water heating:									
Output from water heater, kWh/month (calculated above)									
(64)m 226.66 200.00 210.57 189.48 18	86.21	167.13	161.23	175.93	175.31	196.45	206.81	221.45	]
						∑(64)11	.2 = 2	2317.25	(64)
Efficiency of water heater per month									
(217)m 87.27 86.99 86.50 85.77 84	4.17	79.30	79.30	79.30	79.30	85.21	86.77	87.27	]
Fuel for water heating, kWh/month = $(64)$ m x $100 \div (217)$ m									
(219)m 259.72 229.91 243.42 220.92 22	21.22	210.76	203.31	221.86	221.08	230.53	238.36	253.76	]
			Total	per year (k	Wh/year)	= <u>∑</u> (219)1…1	2 = 2	2754.84	(219)
Annual Totals Summary:						kWh/yea	ır k\	Wh/year	
Annual Totals Summary: Space heating fuel used, main system 1						kWh/yea		<b>Wh/year</b> 1174.14	(211)
						kWh/yea	4		] (211) ] (219)
Space heating fuel used, main system 1						kWh/yea	4	1174.14	1
Space heating fuel used, main system 1 Water heating fuel used Electricity for pumps, fans and electric keep-hot (Table 4f):	t from ou	itside				kWh/yea	4	1174.14	1
Space heating fuel used, main system 1 Water heating fuel used	t from ou	ıtside					4	1174.14	(219)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input	t from ou	itside				81.28	4	1174.14	(219) (230a)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans	t from ou	ntside				81.28	4	1174.14	(230a) (230b)
Space heating fuel used, main system 1 Water heating fuel used Electricity for pumps, fans and electric keep-hot (Table 4f): mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump	t from ou	itside				81.28 0.00 130.00	4	1174.14	(230a) (230b) (230c)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler	t from ou	ntside				81.28 0.00 130.00 0.00 45.00 0.00	4	1174.14	(230a) (230b) (230c) (230d) (230e) (230f)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating	t from ou	itside				81.28 0.00 130.00 0.00 45.00 0.00 0.00		1174.14	(230a) (230b) (230c) (230d) (230e) (230f) (230g)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler	t from ou	ntside				81.28 0.00 130.00 0.00 45.00 0.00		1174.14	(230a) (230b) (230c) (230d) (230e) (230f)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above	t from ou	itside				81.28 0.00 130.00 0.00 45.00 0.00 0.00	0g)	256.28	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L):		ntside				81.28 0.00 130.00 0.00 45.00 0.00 0.00	0g)	1174.14	(230a) (230b) (230c) (230d) (230e) (230f) (230g)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q):		itside				81.28 0.00 130.00 0.00 45.00 0.00 0.00	0g)	256.28 426.33	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L):		ntside				81.28 0.00 130.00 0.00 45.00 0.00 0.00	0g)	256.28	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)						81.28 0.00 130.00 0.00 45.00 0.00 0.00	0g)	256.28 426.33	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q):	: uding mic	го-СНР		Em		81.28 0.00 130.00 0.00 45.00 0.00 0.00	0g)	256.28 426.33	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)	: uding mic				nissions Factor	81.28 0.00 130.00 0.00 45.00 0.00 0.00	0g)	256.28 426.33	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)	: uding mic Enc kWh	ro-CHP ergy	X	F	nissions	81.28 0.00 130.00 0.00 45.00 0.00 0.00	0g)	256.28 426.33 1021.50	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)  12a. Carbon dioxide emissions - Individual heating systems included	: Ending mic kwh	ergy Nyear	x x	F	nissions Factor	81.28 0.00 130.00 0.00 45.00 0.00 0.00 Σ(230a)(23	0g)	256.28 426.33 1021.50 missions	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (232)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)  12a. Carbon dioxide emissions - Individual heating systems included Space heating - main system 1	: Ending mic kwh	ero-CHP ergy l/year		F	nissions factor 0.198	81.28 0.00 130.00 0.00 45.00 0.00 Σ(230a)(23	0g)	256.28 426.33 1021.50 missions CO2/year)	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (232) (233)

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	4174.14	х	0.198	=	826.48	(261)
Water heating	2754.84	х	0.198	=	545.46	(264)
Space and water heating			(261) + (262)	+ (263) + (264) =	1371.94	(265)
Pumps, fans and electric keep-hot	256.28	х	0.517	=	132.49	(267)
Lighting	426.33	х	0.517	=	220.41	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-1021.50	х	0.529	=	-540.37	(269)
Total carbon dioxide emissions				∑(261)(271) =	1184.47	(272)

SAP version 9.90

# SAP 2009 Worksheet

## Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P01 4 St Augustines, London, NW1		

Address	FOT 4 St Augustines, London, NVVI			
1. Overall dwelling dimen	sions			
		Area (m²)	Average storey height (m)	Volume (m³)
owest occupied		109.50 (1a) x	2.60 (2a) =	284.70
otal floor area	(1a) + (1b) + (1c) + (1d)(1n) =	109.50 (4)		
Owelling volume			(3a) + (3b) + (3c) + (3d)(3	n) = 284.70 (
2. Ventilation rate				
				m³ per hour
lumber of chimneys			0 x 40 =	0 (
lumber of open flues			0 x 20 =	0 (
lumber of intermittent far	S		0 x 10 =	0 (
lumber of passive vents			0 x 10 =	0 (
lumber of flueless gas fire	5		0 x 40 =	0 (
				Air changes per hour
nfiltration due to chimney	s, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (	(7c) = 0 ÷ (5) =	0.00
a pressurisation test has	been carried out or is intended, proceed	to (17), otherwise continue	from (9) to (16)	
ir permeability value, q50	, expressed in cubic metres per hour per	square metre of envelope	area	5.00
based on air permeability	value, then (18) = $[(17) \div 20] + (8)$ , other	rwise (18) = (16)		0.25
ir permeability value appl	ies if a pressurisation test has been done	, or a design or specified air	permeability is being used	
lumber of sides on which	dwelling is sheltered			1 (
helter factor			1 - [0.075 x (19	9)] = 0.92 (
Adjusted infiltration rate			(18) x (2	0) = 0.23 (
nfiltration rate modified fo	r monthly wind speed:			

Infiltration rate mo	odified for	monthly wi	nd speed:										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average v	vind speed	from Table	7										_
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	]
										∑(22)1	.12 =	54.10	(22)
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	1.20	1.27	]
										∑(22a)1	.12 =	13.52	(22a)
Adjusted infiltration	n rate (allo	owing for sh	nelter and v	vind speed)	= (21) × (2	.2a)m							
(22b)m	0.31	0.29	0.29	0.26	0.24	0.23	0.21	0.21	0.24	0.26	0.28	0.29	

Calculate effective air change rate for the applicable case:

alculate effective air change rate for the applicable case:	
If mechanical ventilation: air change rate through system	

haust air heat num	n using Annandiy N	$(23b) = (23a) \times Emv (equ$	ation (NSI) otherwise	(22h) - (22a)

3.13

0.5

(22b)

(23a)

∑(22b)1...12 =

If balanced wi	th heat rec	overy: effic	ency in % all	owing for	in-use fact	or (from Ta	ble 4h) =							N/A	(23c)
c) If whole ho	use extract	ventilation	or positive i	nput venti	lation from	n outside									
if (22b)m <	0.5 x (23b)	), then (24c	) = (23b); oth	nerwise (2	4c) = (22b)	m + 0.5 x (2	3b)								
(24c)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0	).50	0.50	0.51	0.	.53	0.54	(24c)
Effective air chan	ge rate - en	nter (24a) o	r (24b) or (24	lc) or (24d	) in box (25	5)									
(25)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0	).50	0.50	0.51	0.	.53	0.54	(25)
3. Heat losses a	nd heat los	s paramete	r												
The κ-value is the	heat capa	city per unit	area, see To	able 1e.											
E	lement		Gross Area, m²	-	nings, n²	Net area A, m²		value, //m²K		A x U, W/K		value, J/m².K		Ахк, kJ/K	
Doors						2.10	х	1.60	=	3.36		N/A	]	N/A	(26)
Window*						8.68	х	1.15	=	9.94		N/A	]	N/A	(27)
Window*						18.23	х	1.33	=	24.17		N/A	]	N/A	(27)
Ground floor						109.50	x	0.12	=	13.14		N/A	]	N/A	(28a)
External wall						83.91	x	0.20	=	16.78		N/A	]	N/A	(29a)
Party Wall						34.19	x	0.00	=	0.00		N/A	]	N/A	(32)
Total area of exte	ernal eleme	nts ∑A, m²				222.42	(31)								
* for windows an	d roof wind	lows, effect	ive window l	J-value is	calculated	using formu	la 1/[(1/	UValue	e)+0.04	!] paragraµ	oh 3.2				
Fabric heat loss, \	W/K = ∑(A ×	۷)								(2	6)(30)	+ (32) =		67.39	(33)
Heat capacity Cm	ı = Σ(A x κ)								(28)	(30) + (32)	+ (32a)	(32e) =		N/A	(34)
Thermal mass pa	rameter (TI	MP) in kJ/m	²K							Calcula	ted sepa	rately =	1	100.00	(35)
Thermal bridges:														17.55	(36)
if details of th	ermal bridg	ing are not	known then	(36) = 0.1	5 x (31)										_
Total fabric heat	loss										(33)	+ (36) =		84.94	(37)
Ventilation heat I		·													7
(38)m	52.82	51.19	51.19	47.93	46.98	46.98	46.98	40	6.98	46.98	47.93	49	0.56	51.19	(38)
Heat transfer coe				122.00	121.01	121.01	121.01	1 12	11 01	121.01	122.0		4.40	126 12	٦
(39)m	137.75	136.12	136.12	132.86	131.91	131.91	131.91	.   13	31.91	131.91	132.8		4.49	136.12	」 │(39)
Heat loss parame	+or/UID) \	N/m²V /20	\m : (4)						•	Average =	Σ(39)1	12/12 -		133.83	] (39)
(40)m	1.26	1.24	1.24	1.21	1.20	1.20	1.20	1	.20	1.20	1.21	1	.23	1.24	7
(10)	1.20	1 2.2 .	1.2.	1,21	1.20	1.20	1.20			Average =	1		_	1.22	] (40)
									•	Weruge	Z( 10)1	,		1.22	
4. Water heatin	g energy re	quirement													
													kV	Vh/year	
Assumed occupar	ncy, N										2.	81	(42)		
If TFA > 13.9,	N = 1 + 1.76	6 x [1 - exp(-	·0.000349 x (	TFA - 13.9	) <sup>2</sup> )] + 0.00	13 x (TFA - 1	3.9)								
If TFA ≤ 13.9,	N = 1														
Annual average h	ot water us	sage in litre	s per day Vd,	average =	(25 x N) +	36					100	).98	(43)		
Annual average h	not water us	sage has be	en reduced b	by 5% if th	e dwelling	is designed	to achiev	e a wa	ater use	target of	not more	than 1.	25 litre	es	
per person per do	ay (all wate	r use, hot a	nd cold)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	,	Aug	Sep	Oct	N	ov	Dec	
Hot water usage			1		1	1					1 -	_			7
(44)m	111.08	107.04	103.00	98.96	94.92	90.88	90.88	94	4.92	98.96	103.0	- '	7.04	111.08	] ¬ .
_		_						,				112 =	1	211.76	(44)
Energy content of				-								<u> </u>	7.36	150.01	7
(45)m	165.12	144.41	149.02	129.92	124.66	107.57	99.68	11	.4.39	115.75	134.9		7.26	159.91	」 □
											<u>∠</u> (45)	112 =		592.61	(45)
											URI	N: 13-01	.0-01 F	Planning v	ersion 1

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0	).15 x (45)m	1											
(46)m	24.77	21.66	22.35	19.49	18.70	16.14	14.95	17.16	17.36	20.24	22.09	23.99	(46)
Water storage loss	s:												
a) If manufacturer	's declared	loss factor	is known (k	:Wh/day):					1.85	(47)			
Temperature fa	actor from <sup>-</sup>	Table 2b							0.54	(48)			
Energy lost from	m water sto	orage, kWl	n/day (47)	x (48)					1.00	(49)			
Enter (49) or (54) i	n (55)								1.00	(55)			
Water storage loss	calculated	l for each m	onth = (55)	) x (41)m									
(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)
If cylinder contains	s dedicated	l solar stora	ge, = (56)m	x [(50) - (H	H11)] ÷ (50)	, else = (56	)m where (	H11) is from	n Appendix	кH			

29.97

29.59

30.97

30.58

30.97

30.58

Primary circuit loss (annual) from Table 3

(57)m

(59)m

30.97

30.58

360.00 (58)

30.97

30.58

29.97

29.59

30.97

30.58

102.41

(57)

(59)

29.97

29.59

Primary circuit loss for each month (58)  $\div$  365  $\times$  (41)m

27.97

27.62

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat) 30.58

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

30.97

29.97

29.59

30.97

30.58

(61)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat require	d for water	heating ca	lculated for	each mon	th 0.85 × (4	5)m + (46)ı	m + (57)m +	+ (59)m + (6	51)m				
(62)m	226.66	200.00	210.57	189.48	186.21	167.13	161.23	175.93	175.31	196.45	206.81	221.45	(62)
Solar DHW input c	alculated u	sing Appen	dix H (nega	itive quanti	ty) ('0' ente	ered if no so	olar contrib	ution to wa	ater heating	g)			
(63)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	]
										∑(63)1	12 =	0.00	(63)

Output from water heater for each month, kWh/month (62)m + (63)m

			- ,	(- ,									
(64)m	226.66	200.00	210.57	189.48	186.21	167.13	161.23	175.93	175.31	196.45	206.81	221.45	
										∑(64)1	.12 = 2	2317.25	(64)

if (64)m < 0 then set to 0

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)\text{m} + (61)\text{m}] + 0.8 \times [(46)\text{m} + (57)\text{m} + (59)\text{m}]$ (65)m 104.14 92.49 98.79 90.85 90.69 83.42 82.38 87.27 86.14 94.09 96.61

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) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Metabolic gains (Table 5), Watts (66)m 168.71 | 168.71 168.71 168.71 168.71 168.71 168.71 168.71 168.71 168.71 168.71 168.71

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 (67)m 60.35 53.60 43.59 33.00 20.83 58.19 62.03 24.67 22.50 29.25 39.26 49.85

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

408.43 397.86 302.41 298.22 308.79 331.29 359.70 386.40 (68)m 404.23 375.35 346.95 320.25 (68) Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m 54.68 54.68 54.68 54.68 54.68 54.68 54.68 54.68 54.68 54.68 54.68 54.68

Pumps and fans gains (Table 5a) (70)m 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00

Losses e.g. evaporation (negative values) (Table 5) -112.47 -112.47 -112.47 -112.47 -112.47 -112.47 -112.47 -112.47 -112.47 -112.47 -112.47 -112.47 (71)m

Water heating gains (Table 5)

139.97 137.63 132.78 126.18 121.89 115.86 110.73 117.30 119.63 134.18 137.64 (72)m 126.47 Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m 725.47 720.58 695.14 655.45 614.43 577.85 556.56 565.69 588.60 628.53 672.98 706.98

#### 6. Solar gains

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

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	ı	Access facto Table 6d	or	Area m²	So	lar flux W/	m² į	g Specific dat or Table 6b		Specific da or Table 60		Gains (W)	
West		0.54	x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
South		0.54	x	18.23	x	47.32	x 0.9 x	0.63	x	0.80	=	211.29	(78)
Solar gains in watt	s, calculate	ed for each	month ∑(7	4)m(82)m	I						•		
(83)m	253.54	426.51	551.69	663.67	721.12	732.95	717.84	672.25	602.93	480.55	302.87	217.42	(83
Total gains - interr	nal and sola	ar (73)m + (	83)m									_	
(84)m	979.01	1147.09	1246.83	1319.12	1335.55	1310.80	1274.40	1237.94	1191.54	1109.08	975.85	924.41	(84
7. Mean internal	temperati	ure (heating	g season)										
Temperature durii	ng heating	periods in t	he living ar	ea from Ta	ble 9, Th1(°	°C)						21.00	(85
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor f			, η1,m (see	Table 9a)									
(86)m	0.93	0.89	0.85	0.79	0.69	0.55	0.40	0.41	0.60	0.78	0.90	0.93	(86
Mean internal tem													
(87)m	18.85	19.18	19.62	20.05	20.50	20.80	20.94	20.94	20.74	20.22	19.40	18.89	(87
Temperature duri	ng heating	periods in t	he living ar	ea from Ta	ble 9, Th2(°	C)							
(88)m	19.88	19.89	19.89	19.91	19.92	19.92	19.92	19.92	19.92	19.91	19.90	19.89	(88
Utilisation factor f	or gains fo	r rest of dw	elling η2,m	(see Table	9a)								
(89)m	0.91	0.88	0.83	0.76	0.64	0.48	0.30	0.31	0.54	0.75	0.88	0.92	(89
Mean internal tem	nperature i	n the rest o	f dwelling <sup>-</sup>	Γ2 (follow s	teps 3 to 7	in Table 9c				_			
(90)m	17.06	17.53	18.15	18.77	19.38	19.74	19.88	19.88	19.68	19.02	17.86	17.13	(90
Living area fraction	n							fLA 2	24.00	÷ (4) =	=	0.22	(91
Mean internal tem	nperature f	or the whol	e dwelling	fLA x T1 +(:	L - fLA) x T2	!							
(92)m	17.45	17.89	18.47	19.05	19.62	19.97	20.12	20.11	19.91	19.28	18.20	17.52	(92
Apply adjustment	to the mea	an internal t	emperatur	e from Tab	le 4e, wher	e appropria	ate						
(93)m	17.30	17.74	18.32	18.90	19.47	19.82	19.97	19.96	19.76	19.13	18.05	17.37	(93
O Carra hardina													
8. Space heating									_	_			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean			obtained a	it step 11 o	f Table 9b,	so that tim	= (93)m a	ind recalculat	te the utili	sation facto	r for gains	using Table	9a)
Utilisation factor f			0.79	0.72	0.62	0.47	0.21	0.21	0.52	0.72	0.84	0.00	101
(94)m	0.88	0.84	!	0.73	0.62	0.47	0.31	0.31	0.52	0.72	0.84	0.89	(94
Useful gains, ηmG	m, w = (94 862.21	965.34	984.76	957.66	824.96	617.88	389.17	387.91	624.64	793.85	824.57	819.01	(95
(95)m			l .		624.90	017.00	309.17	307.91	024.04	793.63	024.37	819.01	(93
Monthly average (					11 70	14.60	16.00	16.00	14 20	10.00	7.00	4.00	100
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96
Heat loss rate for 1					1025 50	600.40	404 44	10444	720 11	1107 13	1496 15	1607.10	10-
(97)m	1763.47	1734.13	1568.31	1355.12	1025.59	689.18	404.44	404.11	720.11	1107.12	1486.15	1697.10	(97
Space heating req								1 0.00	0.00	222.07	476.24	CE2.20	
(98)m	670.54	516.63	434.17	286.17	149.27	0.00	0.00	0.00	0.00	233.07	476.34	653.30	
							Total per	year (kWh/y	ear) = ∑(9				(98
Space heating req	uirement ii	n kWh/m²/y	/ear							(98)	÷ (4)	31.23	(99

#### 9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11)

0.00 (201)

Fraction of space he	eating fro	m main syst	em(s) 1 -	(201)					1.00	(202)			
Fraction of main hea	ating fron	n main syste	em 2						0.00	(203)			
Fraction of total spa	ace heat fi	rom main sy	/stem 1 (2	02) x [1 - (2	.03)]				1.00	(204)			
Fraction of total spa	ace heat fi	rom main sy	/stem 2 (2	02) x (203)					0.00	(205)			
Efficiency of main sp	pace heat	ing system	1 (%)						93.00	(206)			
(from database or T	able 4a/4	1b, adjusted	where app	propriate by	the amou	ınt shown iı	n the 'space	efficiency	adjustmen	- t' column of Ta	ble 4c)		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requi	irement, k	kWh/month	(as calcula	ited above)									_
(98)m	670.54	516.63	434.17	286.17	149.27	0.00	0.00	0.00	0.00	233.07 4	176.34	653.30	
Space heating fuel (	main hea	ting system	1), kWh/m	nonth = (98	)m x (204)	x 100 ÷ (20	6)						_
(211)m	721.01	555.51	466.85	307.71	160.51	0.00	0.00	0.00	0.00	250.62 5	512.20	702.47	
						-	Total per ye	ar (kWh/ye	ear) = ∑(21	1)15, 1012	= 3	8676.87	(211)
Water heating:													
Output from water	heater, k\	Wh/month	(calculated	d above)									
(64)m	226.66	200.00	210.57	189.48	186.21	167.13	161.23	175.93	175.31	196.45 2	206.81	221.45	
										∑(64)112	= 2	317.25	(64)
Efficiency of water h	heater pe	r month											
(217)m	87.03	86.73	86.20	85.41	83.73	79.30	79.30	79.30	79.30	84.77	86.47	87.03	
Fuel for water heati	ing, kWh/	month = (64	1)m x 100 ÷	- (217)m									
(219)m	260.43	230.59	244.27	221.85	222.39	210.76	203.31	221.86	221.08	231.74 2	239.18	254.47	
							Total	per year (l	kWh/year)	= <u>∑</u> (219)112	= 2	2761.94	(219)
Annual Totals Sumr	mary:									kWh/year	k۱	Wh/year	
Space heating fuel (	used, mai	in system 1									3	8676.87	(211)
Water heating fuel		•										2761.94	(219)
Electricity for pump		nd electric k	eep-hot (T	able 4f):									] ( - /
mechanical vent					nout from	outside				81.28			(230a)
warm air heating			u, extract c	or positive i	nput nom	outside				0.00			(230b)
central heating p	•									130.00			(230c)
oil boiler pump										0.00			(230d)
boiler flue fan										45.00			(230e)
maintaining elec	tric keep-	hot facility	for gas con	nbi boiler						0.00			(230f)
pump for solar w	vater heat	ting								0.00			(230g)
Total electricity for	the above	9								∑(230a)(230g	g)	256.28	(231)
													_
Electricity for lighting	ng (calcul	ated in App	endix L):									426.33	(232)
Energy saving/gene	eration te	chnologies	(Appendic	es M, N and	d Q):								
Electricity generated	d by PVs (	Appendix N	1) (negative	e quantity)							-:	1021.50	(233)
10a. Fuel costs - In	idividual l	heating syst	tems includ	ding micro-									
					Fuel	l kWh/year			uel price able 12)		Fuel	cost £/yea	r
Space heating - mai	n system	1			3	3676.87	x		3.10	x 0.01 =		113.98	(240)
Water heating cost	(other fue	el)				2761.94	x		3.10	x 0.01 =		85.62	(247)
Pumps, fans and ele	ectric keep	p-hot				256.28	x		11.46	x 0.01 =		29.37	(249)
Energy for lighting						426.33	x		11.46	x 0.01 =		48.86	(250)
Additional standing	charges (	Table 12)					-			-		106.00	(251)
Energy saving/gene			(Appendic	es M, N and	d Q):								
PV savings (nega		_		,		1021.50	x		11.46	x 0.01 =		117.06	(252)
Total energy cost	ywull						_ ^			2) + (245)(25 <sup>4</sup>		266.77	(255)
. otal chergy cost								,	0,(2+2	., . (=+5)(25	.,		_ (233)

11a. SAP rating - Individual heating systems including micro-CHP			
Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.81	(257)
SAP value		88.68	]
SAP rating		89	(258)
SAP band		В	]

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	3676.87	х	0.198	=	728.02	(261)
Water heating	2761.94	x	0.198	=	546.86	(264)
Space and water heating			(261) + (262)	+ (263) + (264) =	1274.89	(265)
Pumps, fans and electric keep-hot	256.28	x	0.517	=	132.49	(267)
Lighting	426.33	x	0.517	=	220.41	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-1021.50	x	0.529	=	-540.37	(269)
Total carbon dioxide emissions				∑(261)(271) =	1087.42	(272)
Dwelling carbon dioxide emissions rate				(272) ÷ (4) =	9.93	(273)
El value					90.57	
El rating (see section 14)					91	(274)
El band					В	٦

13a. Primary energy - Individual heating systems including micro-CHP									
	Energy kWh/year		Primary Energy Factor	Primary Energy					
Space heating - main system 1	3676.87	x	1.02 =	3750.41 (261*)					
Water heating	2761.94	х	1.02 =	2817.18 (264*)					
Space and water heating			(261*) + (262*) + (263*) + (264*)	= 6567.59 (265*)					
Pumps, fans and electric keep-hot	256.28	x	2.92 =	748.33 (267*)					
Lighting	426.33	x	2.92 =	1244.88 (268*)					
Energy saving/generation technologies:									
PV primary energy savings (negative quantity)	-1021.50	х	2.92 =	-2982.77 (269*)					
Total primary energy kWh/year			∑(261*)(271*)	= 5578.03 (272*)					
Primary energy kWh/m2/year			(272*) ÷ (4)	= 50.94 (273*)					

## Code for Sustainable Homes (November 2010) Design - Draft

CO<sub>2</sub> emissions from appliances (equation L14)

Additional allowable generation and its CO<sub>2</sub> emissions offset

CO<sub>2</sub> emissions offset from additional allowable generation

CO<sub>2</sub> emissions offset from community biofuel CHP systems

CO<sub>2</sub> emissions from cooking (equation L16)

Total CO<sub>2</sub> emissions

Net CO₂ emissions



#### This report details the calculations and results for Ene 1, 2 and 7 of the Code For Sustainable Homes.

This Design Assessment has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed. Code calculations are from the Technical Guide (November 2010).

Assessor name M	r Stuart Searle		Assessor	number	2435
Client			Last mod	ified	01/02/2013
Address	)2 4 St Augustines, L	ondon, NW1			
Building regulation assessmen	t - criterion 1				
					kg/m²/yr
DER					13.69
TER					18.82
Assessment of zero carbon ho	me and low or zero	carbon technologies			
				Credits	Level
Dwelling emission rate (Ene 1)		CO₂ reduction = 27.3 %		3.2	4
Fabric Energy Efficiency		FEE = 53.8		No credit	:S
Low or zero carbon technologie	s (Ene 7)	CO <sub>2</sub> reduction = 12 %		1	
Ene 1 - dwelling emission rate					
•			%	kWh/m <sup>2</sup>	² kgCO₂/m²/yr
Assessment of Ene 1 (level 1-5)					
DER from SAP 2009 DER worksh	eet				13.69
Additional allowable generation				0.00	
CO <sub>2</sub> emissions offset fr	om generation				0.00
CO₂ emissions offset fr	om community biof	uel CHP systems			0.00
Total CO <sub>2</sub> emissions offset from	SAP section 16 allo	wances			0.00
DER accounting for SAP section	16 allowances				13.69
CO₂ reduction compared to TER					5.13
CO₂ reduction as % of TER			27.3		
CO <sub>2</sub> reduction as % of TER  Assessment of Ene 1 (level 6)			27.3		

16.21

2.23

32.12

0.00

0.00

32.12

0.00

(ZC2)

(ZC3)

(ZC4)

(ZC6)

(ZC7)

(ZC5)

(ZC8)

#### Ene 1 - dwelling emission rate - level 6 There is no Zero Carbon Home definition in the current technical guide Criterion Value Pass/Fail FEE <= 39 53.8 Fail Net CO<sub>2</sub> emissions <= 0.00 32.12 Fail Result: Not level 6 Number of credits for Ene 1 3.2 Ene 2 - Fabric Energy Efficiency 53.8 FEE Number of credits for Ene 2 No credits Ene 7 - low or zero carbon technologies **Emissions** Reduction kgCO₂/yr kgCO<sub>2</sub>/yr Standard case 1320.98 Space and water heating (265) 0.00 Mechanical cooling (266) Pumps and fans (267) 121.17 Lighting (268) 178.62 Appliances and cooking 1474.62 Total CO₂ 3095.39 **Actual case** Space and water heating (265) or (376) 1320.98 Space and water heating from LZCT considered in SAP 2009 0.00 Pumps and fans (267) or (378) 121.17 Pumps and fans 0.00 Electricity generated by LZCT (269) + (380)) -395.06 Additional allowable electricity generation considered in SAP 2009 section 16 0.00 Offset from biofuel CHP $[-1 \times [(363)..(366) + (368)...(372)]]$ 0.00 LZCT electricity generation -395.06 LZCT thermal generation 0 Total from specified LZCT -395.06 **Emissions** $kgCO_2/m^2/yr$ Reduction in CO<sub>2</sub> Emissions Standard Case CO<sub>2</sub> 38.69

33.75

12

1

Actual Case CO2

% Reduction in CO<sub>2</sub>

Number of credits for Ene 7

## DER 2009 Worksheet

### Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P02 4 St Augustines, London, NW1		

1. Overall dwelling dimensions								
		Area (m²)			Average store height (m)	ey	Volume (m³)	
Lowest occupied		80.00	(1a)	x	2.60	(2a) =	208.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)(1n) =	80.00	(4)					
Dwelling volume					(3a) + (3b) +	(3c) + (3d)(3n) =	208.00	(5)
2. Ventilation rate								
							m³ per hour	
Number of chimneys					0	x 40 =	0	(6a)
Number of open flues					0	x 20 =	0	(6b)
Number of intermittent fans					0	x 10 =	0	(7a)
Number of passive vents					0	x 10 =	0	(7b)
Number of flueless gas fires					0	x 40 =	0	(7c)
							Air changes pe hour	er
Infiltration due to chimneys, flue	s, fans, PSVs	(6a) + (6b) + (	7a) + (7b)	+ (7c) =	0	÷ (5) =	0.00	(8)
If a pressurisation test has been o	carried out or is intended, proceed to	o (17), otherw	ise contin	ue from	(9) to (16)			
Air permeability value, q50, expr	essed in cubic metres per hour per	square metre	of envelo	pe area			5.00	(17)
If based on air permeability value	e, then (18) = $[(17) \div 20] + (8)$ , other	wise (18) = (16	5)				0.25	(18)
Air permeability value applies if a	pressurisation test has been done,	or a design or	specified	air pern	meability is bein	g used		
Number of sides on which dwelling	ng is sheltered						2	(19)
Shelter factor					2	- [0.075 x (19)] =	0.85	(20)
Adjusted infiltration rate						(18) x (20) =	0.21	(21)
Infiltration rate modified for mor	thly wind speed:							

Infiltration rate mo	odified for	monthly wi	nd speed:										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average v	vind speed	from Table	7										
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	]
										∑(22)1	.12 =	54.10	(22)
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	1.20	1.27	]
										∑(22a)1	.12 =	13.52	(22a)
Adjusted infiltration	n rate (allo	owing for sh	elter and v	wind speed	) = (21) × (2	2a)m							
(22b)m	0.29	0.27	0.27	0.24	0.22	0.21	0.20	0.20	0.22	0.24	0.26	0.27	]
										∑(22b)1	.12 =	2.87	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system

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

0.5

0.5 (23b)

(23a)

If balanced w	ith heat rec	overy: effic	iency in % al	lowing for	in-use fact	or (from Ta	ble 4h) =							N/A	(23c)
c) If whole ho	use extract	ventilation	or positive i	nput venti	lation from	n outside									
if (22b)m <	< 0.5 x (23b)	), then (24c	) = (23b); oth	nerwise (2	4c) = (22b)	m + 0.5 x (23	3b)								
(24c)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.5	50	0.50	0.50		0.50	0.52	(24c)
Effective air chan	nge rate - er	nter (24a) o	r (24b) or (24	4c) or (24d	l) in box (25	5)									_
(25)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.5	50	0.50	0.50		0.50	0.52	(25)
3. Heat losses a	nd heat los	s paramete	er												
The κ-value is the	heat capa	city per unit	t area, see To	able 1e.											
E	lement		Gross Area, m²	-	nings, n²	Net area A, m²		value, //m²K		A x U, W/K		-value J/m².l	•	Αxκ, kJ/K	
Doors						2.10	x .	1.60	] = [	3.36		N/A		N/A	(26)
Window*						8.68	x :	1.15	= [	9.94		N/A		N/A	(27)
Window*						14.58	x .	1.33	= [	19.33		N/A		N/A	(27)
Ground floor						80.00	x (	0.12	= [	9.60		N/A		N/A	(28a)
External wall						50.20	x C	0.20	= [	10.04		N/A		N/A	(29a)
Party Wall						33.80	x	0.00	_ =	0.00		N/A		N/A	(32)
Total area of exte	ernal eleme	ents ∑A, m²				155.56	(31)								
* for windows an	nd roof wind	dows, effect	ive window (	U-value is	calculated	using formu	la 1/[(1/l	JValue)	+0.04]	paragra	oh 3.2				
Fabric heat loss,	W/K = ∑(A >	× U)								(2	6)(30)	+ (32)	=	52.27	(33)
Heat capacity Cm	$n = \sum (A \times \kappa)$							(:	28)(3	0) + (32)	+ (32a)	.(32e)	=	N/A	(34)
Thermal mass pa	rameter (TI	MP) in kJ/m	²K							Calcula	ted sepa	rately	=	100.00	(35)
Thermal bridges: if details of th					5 x (31)									13.72	(36)
Total fabric heat	loss										(33)	+ (36)	=	65.99	(37)
Ventilation heat	loss calcula	ted monthly	y 0.33 x (25	)m x (5)											_
(38)m	36.85	35.76	35.76	34.32	34.32	34.32	34.32	34.	.32	34.32	34.32	2 :	34.66	35.76	(38)
Heat transfer coe	efficient, W,	/K (37)m+	(38)m												_
(39)m	102.84	101.75	101.75	100.31	100.31	100.31	100.31	100	).31	100.31	100.3	1 1	.00.65	101.75	
									A۱	erage =	∑(39)1	12/12	=	100.91	(39)
Heat loss parame			1	1.05				Ι			1			1	7
(40)m	1.29	1.27	1.27	1.25	1.25	1.25	1.25	1.2		1.25	1.25		1.26	1.27	] ]
									A۱	erage =	∑(40)1	12/12	=	1.26	(40)
4. Water heatin	g energy re	equirement													
													k۱	Wh/year	
Assumed occupa	ncy, N										2	46	(42)	)	
If TFA > 13.9,	N = 1 + 1.76	6 x [1 - exp(-	-0.000349 x	(TFA - 13.9	) <sup>2</sup> )] + 0.00	13 x (TFA - 1	3.9)								
If TFA ≤ 13.9,	N = 1														
Annual average h	not water us	sage in litre	s per day Vd	,average =	(25 x N) +	36					92	.69	(43)	)	
Annual average l	hot water u	sage has be	en reduced l	by 5% if th	e dwelling	is designed	to achiev	e a wat	er use t	arget of	not mor	e than	125 liti	res	
per person per do	ay (all wate	r use, hot a	nd cold)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Αι	ug	Sep	Oct		Nov	Dec	
Hot water usage			1 1		1	1								1	_
(44)m	101.96	98.25	94.55	90.84	87.13	83.42	83.42	87.	.13	90.84	94.5		98.25	101.96	_
												112	=	1112.32	(44)
Energy content o				-								_		1 :	7
(45)m	151.57	132.56	136.79	119.26	114.43	98.75	91.50	105	0.00	106.26	123.8		.35.17	146.79	_ □ , , = :
											≥(45)	112	=	1461.91	(45)
												_			
											UR	N: 13-0	010-02	Planning v	ersion 1

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 v (15)m

(57)m

(59)m

Distribution loss (	0.15 x (45)m	า											
(46)m	22.74	19.88	20.52	17.89	17.16	14.81	13.73	15.75	15.94	18.57	20.28	22.02	(46)
Water storage los	s:												
a) If manufacture	's declared	loss factor	is known (k	:Wh/day):					1.85	(47)			
Temperature f	actor from	Table 2b							0.54	(48)			
Energy lost fro	m water sto	orage, kWl	h/day (47)	x (48)					1.00	(49)			
Enter (49) or (54)	in (55)								1.00	(55)			
Water storage los	s calculated	I for each m	nonth = (55)	) x (41)m									
(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)
If cylinder contain	s dedicated	l solar stora	ige. = (56)m	x [(50) - (H	H11)] ÷ (50)	. else = (56	)m where (	H11) is fror	n Appendix	ίΗ			

29.97

29.59

30.97

30.58

30.97

30.58

29.97

29.59

360.00

30.97

30.58

(58)

29.97

29.59

30.97

30.58

30.97

30.58

Primary circuit loss (annual) from Table 3

30.58

Primary circuit loss for each month (58)  $\div$  365  $\times$  (41)m

30.97

27.97

27.62

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat) 30.58

30.97

29.97

29.59

Combi loss for each	h month fr	om Table 3	a, 3b or 3c	(enter '0' if	not a comb	oi boiler)							
(61)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat require	d for water	heating ca	lculated for	each mon	th 0.85 × (4	15)m + (46)ı	m + (57)m -	+ (59)m + (6	51)m				
(62)m	213.11	188.15	198.34	178.82	175.98	158.31	153.05	166.55	165.81	185.37	194.73	208.33	(62)
Solar DHW input o	alculated u	sing Appen	dix H (nega	tive quanti	ty) ('0' ente	ered if no s	olar contrib	ution to w	ater heating	g)			_
(63)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
										2(63)1	12 =	0.00	(63)

Output from water heater for each month, kWh/month (62)m + (63)m

Output Hom wate	i ilcutci ioi	cucii iiioii	,	011111 (02)11	1 . (03)111								
(64)m	213.11	188.15	198.34	178.82	175.98	158.31	153.05	166.55	165.81	185.37	194.73	208.33	]
										∑(64)1	.12 = 2	2186.55	(64)

if (64)m < 0 then set to 0

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)\text{m} + (61)\text{m}] + 0.8 \times [(46)\text{m} + (57)\text{m} + (59)\text{m}]$ 88.55 94.72 87.30 87.28 80.48 82.98 90.41 92.59 98.04 (65)m 79.66 84.15

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

5. Internal gai	ns (see Table	5 and 5a)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	s (Table 5), Wa	atts											
(66)m	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	(66)
Lighting gains (	calculated in A	ppendix L,	equation L	9 or L9a), a	lso see Tab	le 5							
(67)m	19.56	17.38	14.13	10.70	8.00	6.75	7.30	9.48	12.73	16.16	18.86	20.11	(67)
Appliances gain	ıs (calculated i	n Appendix	L, equatio	n L13 or L1	3a), also se	e Table 5							
(68)m	219.44	221.72	215.98	203.76	188.34	173.85	164.17	161.89	167.63	179.84	195.27	209.76	(68)
Cooking gains (	calculated in A	Appendix L,	equation L	15 or L15a)	, also see T	able 5							
(69)m	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	(69)
Pumps and fan:	s gains (Table	5a)											
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evap	ooration (nega	itive values	) (Table 5)										
(71)m	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	(71)
Water heating	gains (Table 5)	)											
(72)m	133.91	131.77	127.31	121.25	117.32	111.78	107.07	113.10	115.25	121.52	128.60	131.78	(72)
Total internal g	ains (66)m + (	67)m + (68	)m + (69)m	+ (70)m + (	(71)m + (72	!)m							
(73)m	442.86	440.80	427.36	405.66	383.60	362.32	348.48	354.42	365.54	387.47	412.67	431.58	(73)

#### 6. Solar gains

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

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Å	Access facto Table 6d	or	Area m²	So	lar flux W/	m²	g Specific dat or Table 6b		Specific da or Table 6c		Gains (W)
West		0.54	x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25
Northwest		0.54	x	14.58	x	11.51	x 0.9 x	0.63	x	0.80	=	41.11
olar gains in wa	tts, calculate	ed for each i	month ∑(7	4)m(82)m	1							
(83)m	83.36	166.03	277.79	436.51	557.10	595.00	571.60	477.81	339.53	205.46	104.41	68.29
Total gains - inte	rnal and sola	ar (73)m + (8	83)m									
(84)m	526.22	606.83	705.16	842.17	940.70	957.33	920.07	832.23	705.07	592.92	517.08	499.87
7. Mean interna	al temperati	ure (heating	g season)									
emperature dur	ring heating	periods in t	he living ar	ea from Ta	ble 9, Th1(ʻ	°C)						21.00
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Itilisation factor	for gains for	r living area	, η1,m (see	Table 9a)								
(86)m	0.96	0.94	0.90	0.83	0.71	0.56	0.41	0.45	0.70	0.87	0.95	0.96
∕lean internal te	mp of living	area T1 (ste	eps 3 to 7 i	n Table 9c)								
(87)m	18.46	18.74	19.27	19.85	20.43	20.77	20.93	20.91	20.61	19.91	19.02	18.52
emperature dur	ring heating	periods in t	he living ar	ea from Ta	ble 9, Th2('	°C)						
(88)m	19.85	19.87	19.87	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.87
Jtilisation factor	for gains fo	r rest of dw	elling η2,m	(see Table	9a)							
(89)m	0.95	0.93	0.89	0.81	0.66	0.49	0.31	0.34	0.63	0.84	0.94	0.96
Mean internal te	mperature i	n the rest o	f dwelling <sup>-</sup>	T2 (follow s	teps 3 to 7	in Table 9c	)					
(90)m	16.49	16.90	17.66	18.48	19.26	19.68	19.84	19.83	19.51	18.59	17.32	16.59
iving area fraction	on							fLA :	31.30	÷ (4) =	=	0.39
Mean internal te	mperature f	or the whol	e dwelling	fLA x T1 +(:	1 - fLA) x T2	2						
(92)m	17.26	17.62	18.29	19.02	19.71	20.11	20.27	20.25	19.94	19.10	17.98	17.34
apply adjustmen	t to the mea	ın internal t	emperatur	e from Tab	le 4e, wher	e appropri	ate					
(93)m	17.11	17.47	18.14	18.87	19.56	19.96	20.12	20.10	19.79	18.95	17.83	17.19
8. Space heating	g requireme	ent										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
et Ti to the mea			obtained a	at step 11 o	f Table 9b,	so that tim	= (93)m a	and recalculat	te the utili	sation facto	r for gains	using Table
Jtilisation factor			0.00	0.70	0.65	0.40	0.22	0.25	0.62	0.00	0.04	0.00
(94)m	0.93	0.91	0.86	0.78	0.65	0.49	0.33	0.36	0.62	0.82	0.91	0.93
	_											
Jseful gains, ηm			1	CE 4 20	600.04	472.22	205.51	202.24	427.40	400.70	470.50	466.04
Jseful gains, ηmo (95)m	489.99	550.68	605.09	654.28	609.01	472.38	306.54	302.04	437.18	483.70	470.59	466.94
Jseful gains, ηmo (95)m Monthly average	489.99 external ter	550.68 mperature f	605.09 from Table	8								
Jseful gains, nm (95)m Aonthly average (96)m	489.99 external ter 4.50	550.68 mperature f 5.00	605.09 From Table 6.80	8 8.70	609.01	472.38 14.60	306.54	302.04	437.18	483.70	7.00	4.90
Jseful gains, nm (95)m Monthly average (96)m Heat loss rate for	489.99 external ter 4.50 mean inter	550.68 mperature f 5.00 nal tempera	605.09 From Table 6.80 ature, Lm,	8 8.70 W	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90
Jseful gains, nm (95)m Monthly average (96)m Heat loss rate for (97)m	489.99 external ter 4.50 mean inter 1296.72	550.68  mperature f 5.00  nal tempera 1268.45	605.09 from Table 6.80 ature, Lm, 1 1153.80	8 8.70 W 1019.88	11.70 788.87	14.60 537.60	16.90 322.57					
Useful gains, nm (95)m Monthly average (96)m Heat loss rate for (97)m Space heating re	489.99 external ter 4.50 r mean inter 1296.72 quirement for	550.68 mperature f 5.00 nal tempera 1268.45 or each more	605.09 from Table 6.80 ature, Lm, ' 1153.80 nth, kWh/r	8 8.70 W 1019.88 nonth = 0.0	11.70 788.87 24 x [(97)m	14.60 537.60 n - (95)m] x	16.90 322.57 (41)m	16.90 321.44	14.30 550.47	10.80	7.00	4.90
Jseful gains, nm (95)m Monthly average (96)m Heat loss rate for (97)m	489.99 external ter 4.50 mean inter 1296.72	550.68  mperature f 5.00  nal tempera 1268.45	605.09 from Table 6.80 ature, Lm, 1 1153.80	8 8.70 W 1019.88	11.70 788.87	14.60 537.60	16.90 322.57	16.90	14.30	10.80	7.00	4.90
Useful gains, nm (95)m Monthly average (96)m Heat loss rate for (97)m Space heating res	489.99 external ter 4.50 r mean inter 1296.72 quirement for	550.68 mperature f 5.00 nal tempera 1268.45 or each more	605.09 from Table 6.80 ature, Lm, ' 1153.80 nth, kWh/r	8 8.70 W 1019.88 nonth = 0.0	11.70 788.87 24 x [(97)m	14.60 537.60 n - (95)m] x	16.90 322.57 (41)m 0.00	16.90 321.44	14.30 550.47 0.00	10.80 817.82 248.59	7.00 1090.23 446.14	4.90

#### 9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11)

0.00 (201)

Fraction of space heating from main system(s) 1 - (201)					1.00	(202)			
Fraction of main heating from main system 2					0.00	(203)			
Fraction of total space heat from main system 1 (202) x [1 - (203)]					1.00	(204)			
Fraction of total space heat from main system 2 (202) x (203)					0.00	(205)			
Efficiency of main space heating system 1 (%)					93.00	(206)			
(from database or Table 4a/4b, adjusted where appropriate by the	amount sh	own in t	he 'space	efficiency of	adjustmen	t' column of ī	Table 4c)		
Jan Feb Mar Apr N	May J	un	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement, kWh/month (as calculated above)									
(98)m 600.21 482.34 408.23 263.23 13	33.82 0.	.00	0.00	0.00	0.00	248.59	446.14	583.13	]
Space heating fuel (main heating system 1), kWh/month = (98)m x	(204) x 100	÷ (206)							
(211)m 645.38 518.64 438.96 283.04 14	13.89 0.	.00	0.00	0.00	0.00	267.30	479.72	627.02	]
		То	tal per ye	ar (kWh/ye	ear) = ∑(21	1)15, 101	.2 = 3	3403.96	(211)
Water heating:									
Output from water heater, kWh/month (calculated above)									
(64)m 213.11 188.15 198.34 178.82 17	75.98 15	8.31	153.05	166.55	165.81	185.37	194.73	208.33	]
						∑(64)11	.2 = 2	2186.55	(64)
Efficiency of water heater per month									
(217)m 86.93 86.72 86.20 85.34 83	3.59 79	.30	79.30	79.30	79.30	85.10	86.46	86.91	
Fuel for water heating, kWh/month = $(64)$ m x $100 \div (217)$ m									
(219)m 245.16 216.97 230.10 209.53 21	10.52	9.63	193.00	210.02	209.10	217.84	225.24	239.70	]
			Total	per year (k	(Wh/year)	= <u>∑</u> (219)1…1	.2 = 2	2606.81	(219)
Annual Totals Summary:						kWh/yea	ar k\	Wh/year	
Annual Totals Summary: Space heating fuel used, main system 1						kWh/yea		<b>Wh/year</b> 3403.96	(211)
						kWh/yea	3		(211) (219)
Space heating fuel used, main system 1						kWh/yea	3	3403.96	1
Space heating fuel used, main system 1 Water heating fuel used Electricity for pumps, fans and electric keep-hot (Table 4f):	t from outsi	de				kWh/yea	3	3403.96	1
Space heating fuel used, main system 1 Water heating fuel used	t from outsi	de					3	3403.96	(219)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input	t from outsi	de				59.38	3	3403.96	(219) (230a)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans	t from outsi	de				59.38	3	3403.96	(230a) (230b)
Space heating fuel used, main system 1 Water heating fuel used Electricity for pumps, fans and electric keep-hot (Table 4f): mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump	t from outsi	de				59.38 0.00 130.00	3	3403.96	(230a) (230b) (230c)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler	t from outsi	de				59.38 0.00 130.00 0.00 45.00 0.00	3	3403.96	(230a) (230b) (230c) (230d) (230e) (230f)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating	t from outsi	de				59.38 0.00 130.00 0.00 45.00 0.00	2	3403.96 2606.81	(230a) (230b) (230c) (230d) (230e) (230f) (230g)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler	t from outsi	de				59.38 0.00 130.00 0.00 45.00 0.00	2	3403.96	(230a) (230b) (230c) (230d) (230e) (230f)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above	t from outsi	de				59.38 0.00 130.00 0.00 45.00 0.00	0g)	3403.96 2606.81 234.38	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L):		de				59.38 0.00 130.00 0.00 45.00 0.00	0g)	3403.96 2606.81	(230a) (230b) (230c) (230d) (230e) (230f) (230g)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q):		de				59.38 0.00 130.00 0.00 45.00 0.00	0g)	234.38 2345.49	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L):		de				59.38 0.00 130.00 0.00 45.00 0.00	0g)	3403.96 2606.81 234.38	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)						59.38 0.00 130.00 0.00 45.00 0.00	0g)	234.38 2345.49	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q):	iding micro-	СНР		En		59.38 0.00 130.00 0.00 45.00 0.00	0g)	234.38 246.81 246.81	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)		СНР			nissions Factor	59.38 0.00 130.00 0.00 45.00 0.00	0g)	234.38 2345.49	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)	: uding micro-	CHP Y ear	X		nissions	59.38 0.00 130.00 0.00 45.00 0.00	Og) Er (kgd	234.38 246.81 234.38 345.49	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)  12a. Carbon dioxide emissions - Individual heating systems included	eding micro- Energ kWh/ye	CHP Y ear	x x		nissions Factor	59.38 0.00 130.00 0.00 45.00 0.00 0.00 Σ(230a)(23	Og) Er (kgd	234.38 234.38 345.49 746.81 missions	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (232) (233)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)  12a. Carbon dioxide emissions - Individual heating systems included Space heating - main system 1	eding micro- Energ kWh/ye	CHP Y ear			nissions Factor 0.198	59.38 0.00 130.00 0.00 45.00 0.00 0.00 ∑(230a)(23	0g)	234.38 234.38 345.49 746.81 missions CO2/year) 673.98	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (232) (233)

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	3403.96	x	0.198	=	673.98	(261)
Water heating	2606.81	х	0.198	=	516.15	(264)
Space and water heating			(261) + (262)	+ (263) + (264) =	1190.13	(265)
Pumps, fans and electric keep-hot	234.38	х	0.517	=	121.17	(267)
Lighting	345.49	х	0.517	=	178.62	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-746.81	Х	0.529	=	-395.06	(269)
Total carbon dioxide emissions				∑(261)(271) =	1094.87	(272)

# SAP 2009 Worksheet

### Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P02 4 St Augustines, London, NW1		

1. Overall dwelling dimens	ions						
		Area (m²)		Average store height (m)	ey	Volume (m³)	
Lowest occupied		80.00	(1a) x	2.60	(2a) =	208.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)(1n) =	80.00	(4)				
Dwelling volume				(3a) + (3b) +	(3c) + (3d)(3n) =	208.00	(5)
2. Ventilation rate							
						m³ per hour	
Number of chimneys				0	x 40 =	0	(6a)
Number of open flues				0	x 20 =	0	(6b)
Number of intermittent fans	5			0	x 10 =	0	(7a)
Number of passive vents				0	x 10 =	0	(7b)
Number of flueless gas fires				0	x 40 =	0	(7c)
						Air changes pe hour	er
Infiltration due to chimneys,	flues, fans, PSVs	(6a) + (6b) + (7	7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)
If a pressurisation test has be	een carried out or is intended, proceed t	o (17), otherwi	se continue from	(9) to (16)			
Air permeability value, q50,	expressed in cubic metres per hour per	square metre o	of envelope area			5.00	(17)
If based on air permeability	value, then (18) = $[(17) \div 20] + (8)$ , other	wise (18) = (16	5)			0.25	(18)
Air permeability value applie	es if a pressurisation test has been done,	or a design or	specified air perr	neability is bein	g used		
Number of sides on which do	welling is sheltered					2	(19)
Shelter factor				-	- [0.075 x (19)] =	0.85	(20)
Adjusted infiltration rate					(18) x (20) =	0.21	(21)
Infiltration rate modified for	monthly wind speed:						

Adjusted infiltration ra	te	

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

1 - [0.075 x (19)] =	0.85	(20)
(18) x (20) =	0.21	(21)

Infiltration rate modified for monthly wind speed:

miniciación race mo	ballica loi i	inoniciny wi	na speca.										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average v	wind speed	from Table	7										
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	]
										∑(22)1	.12 =	54.10	(22)
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	1.20	1.27	]
										∑(22a)1	.12 =	13.52	(22a)
Adjusted infiltration	on rate (allo	owing for sh	nelter and v	vind speed)	= (21) × (2	.2a)m							
(22b)m	0.29	0.27	0.27	0.24	0.22	0.21	0.20	0.20	0.22	0.24	0.26	0.27	]
										∑(22b)1	.12 =	2.87	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system

0.5 (23b)

(23a)

0.5

If balanced w	ith heat rec	overy: effic	iency in % al	lowing for	in-use fact	or (from Ta	ble 4h) =							N/A	(23c)
c) If whole ho	use extract	ventilation	or positive i	nput venti	lation from	n outside									
if (22b)m <	< 0.5 x (23b)	), then (24c	) = (23b); oth	nerwise (2	4c) = (22b)	m + 0.5 x (23	3b)								
(24c)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.5	50	0.50	0.50		0.50	0.52	(24c)
Effective air chan	nge rate - er	nter (24a) o	r (24b) or (24	4c) or (24d	) in box (25	5)									_
(25)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.5	50	0.50	0.50		0.50	0.52	(25)
3. Heat losses a	nd heat los	s paramete	er												
The κ-value is the	heat capa	city per unit	t area, see To	able 1e.											
E	lement		Gross Area, m²	-	nings, n²	Net area A, m²		value, //m²K		A x U, W/K		-value J/m².l	•	Αxκ, kJ/K	
Doors						2.10	x .	1.60	] = [	3.36		N/A		N/A	(26)
Window*						8.68	x :	1.15	= [	9.94		N/A		N/A	(27)
Window*						14.58	x .	1.33	= [	19.33		N/A		N/A	(27)
Ground floor						80.00	x (	0.12	= [	9.60		N/A		N/A	(28a)
External wall						50.20	x C	0.20	= [	10.04		N/A		N/A	(29a)
Party Wall						33.80	x	0.00	_ =	0.00		N/A		N/A	(32)
Total area of exte	ernal eleme	ents ∑A, m²				155.56	(31)								
* for windows an	nd roof wind	dows, effect	ive window (	U-value is	calculated	using formu	la 1/[(1/l	JValue)	+0.04]	paragra	oh 3.2				
Fabric heat loss,	W/K = ∑(A >	× U)								(2	6)(30)	+ (32)	=	52.27	(33)
Heat capacity Cm	$n = \sum (A \times \kappa)$							(:	28)(3	0) + (32)	+ (32a)	.(32e)	=	N/A	(34)
Thermal mass pa	rameter (TI	MP) in kJ/m	²K							Calcula	ted sepa	rately	=	100.00	(35)
Thermal bridges: if details of th					5 x (31)									13.72	(36)
Total fabric heat	loss										(33)	+ (36)	=	65.99	(37)
Ventilation heat	loss calcula	ted monthly	y 0.33 x (25	)m x (5)											_
(38)m	36.85	35.76	35.76	34.32	34.32	34.32	34.32	34.	.32	34.32	34.32	2 :	34.66	35.76	(38)
Heat transfer coe	efficient, W,	/K (37)m+	(38)m												_
(39)m	102.84	101.75	101.75	100.31	100.31	100.31	100.31	100	).31	100.31	100.3	1 1	.00.65	101.75	
									A۱	erage =	∑(39)1	12/12	=	100.91	(39)
Heat loss parame			1	1.05				Ι			1			1	7
(40)m	1.29	1.27	1.27	1.25	1.25	1.25	1.25	1.2		1.25	1.25		1.26	1.27	] ]
									A۱	erage =	∑(40)1	12/12	=	1.26	(40)
4. Water heatin	g energy re	equirement													
													k۱	Wh/year	
Assumed occupa	ncy, N										2	46	(42)	)	
If TFA > 13.9,	N = 1 + 1.76	6 x [1 - exp(-	-0.000349 x	(TFA - 13.9	) <sup>2</sup> )] + 0.00	13 x (TFA - 1	3.9)						_		
If TFA ≤ 13.9,	N = 1														
Annual average h	not water us	sage in litre	s per day Vd	,average =	(25 x N) +	36					92	.69	(43)	)	
Annual average l	hot water u	sage has be	en reduced l	by 5% if th	e dwelling	is designed	to achiev	e a wat	er use t	arget of	not mor	e than	125 liti	res	
per person per do	ay (all wate	r use, hot a	nd cold)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Αι	ug	Sep	Oct		Nov	Dec	
Hot water usage			1 1		1	1								1	_
(44)m	101.96	98.25	94.55	90.84	87.13	83.42	83.42	87.	.13	90.84	94.5		98.25	101.96	_
												112	=	1112.32	(44)
Energy content o				-								_		1 :	7
(45)m	151.57	132.56	136.79	119.26	114.43	98.75	91.50	105	0.00	106.26	123.8		.35.17	146.79	_ □ , .=:
											≥(45)	112	=	1461.91	(45)
												_			
											UR	N: 13-0	010-02	Planning v	ersion 1

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 x (45)m 19.88 17.89 15.75 15.94 18.57 20.28 22.02 (46)m 22.74 20.52 17.16 14.81 13.73 Water storage loss: a) If manufacturer's declared loss factor is known (kWh/day): 1.85 (47)Temperature factor from Table 2b 0.54 (48)Energy lost from water storage, kWh/day (47) x (48) 1.00 (49)Enter (49) or (54) in (55) 1.00 (55)Water storage loss calculated for each month = (55) x (41)m 29.97 30.97 30.97 27.97 30.97 29.97 30.97 29.97 30.97 30.97 29.97 30.97 (56)m(56)If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H 30.97 30.97 30.97 29.97 30.97 30.97 30.97 29.97 30.97 (57)m27.97 29.97 29.97 (57)Primary circuit loss (annual) from Table 3 360.00 (58)Primary circuit loss for each month (58) ÷ 365 × (41)m (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat) 27.62 30.58 29.59 30.58 29.59 30.58 30.58 29.59 30.58 29.59 30.58 (59)m 30.58 (59)Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 (61)m(61)Total heat required for water heating calculated for each month  $0.85 \times (45)$ m + (46)m + (57)m + (59)m + (61)m 213.11 188.15 198.34 178.82 175.98 158.31 153.05 185.37 194.73 208.33 (62)m165.81 Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating) 0.00 0.00 0.00 0.00 (63)m0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00  $\Sigma$ (63)1...12 = (63)

Output from water heater for each month, kWh/month (62)m + (63)m

(64)m 213.11 188.15 198.34 178.82 175.98 158.31 153.05 166.55 165.81 185.37 194.73 208.33  $\Sigma(64)1...12 =$ 2186.55 (64)

if (64)m < 0 then set to 0

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

(65)m 99.63 88.55 94.72 87.30 87.28 80.48 79.66 84.15 82.98 90.41 92.59 98.04 (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	(soo Tablo	E and Eal					· ·						
5. Internal gams	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (	Table 5), Wa	atts											
(66)m	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	(66)
Lighting gains (ca	culated in A	ppendix L,	equation L	9 or L9a), a	lso see Tab	le 5							
(67)m	48.91	43.44	35.33	26.75	19.99	16.88	18.24	23.71	31.82	40.40	47.15	50.27	(67)
Appliances gains	(calculated i	n Appendix	L, equatio	n L13 or L1	3a), also se	e Table 5							_
(68)m	327.52	330.92	322.36	304.12	281.11	259.48	245.03	241.63	250.19	268.42	291.44	313.07	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	(69)
Pumps and fans g	ains (Table	5a)											
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evapo	ration (nega	itive values	) (Table 5)										
(71)m	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	(71)
Water heating ga	ins (Table 5)	)											
(72)m	133.91	131.77	127.31	121.25	117.32	111.78	107.07	113.10	115.25	121.52	128.60	131.78	(72)
Total internal gair	ns (66)m + (	67)m + (68	)m + (69)m	+ (70)m +	(71)m + (72	!)m				·			
(73)m	621.84	617.63	596.49	563.62	529.92	499.63	481.83	489.93	508.75	541.84	578.69	606.61	(73)

#### 6. Solar gains

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

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

,	,	Access facto Table 6d	or	Area m²	So	lar flux W/	m²	g Specific dat or Table 6b		Specific da or Table 60		Gains (W)	
West		0.54	] x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
Northwest		0.54	x	14.58	x	11.51	x 0.9 x	0.63	x	0.80	=	41.11	(81)
Solar gains in wat	ts, calculate	ed for each	month ∑(7	4)m(82)m	1								
(83)m	83.36	166.03	277.79	436.51	557.10	595.00	571.60	477.81	339.53	205.46	104.41	68.29	(83)
Total gains - inter	nal and sola	ar (73)m + (	83)m										
(84)m	705.21	783.66	874.29	1000.13	1087.01	1094.63	1053.43	967.75	848.28	747.30	683.10	674.90	(84)
7. Mean interna	l temperati	ure (heating	g season)										7
Temperature duri	ng heating	periods in t	he living ar	ea from Ta	ble 9, Th1('	°C)						21.00	(85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor				Table 9a)									7
(86)m	0.93	0.91	0.86	0.78	0.66	0.51	0.37	0.39	0.63	0.81	0.91	0.93	(86)
Mean internal ter	np of living	area T1 (ste	eps 3 to 7 i	n Table 9c)									_
(87)m	18.78	19.03	19.52	20.03	20.53	20.82	20.95	20.94	20.70	20.11	19.30	18.84	(87)
Temperature duri	ng heating	periods in t	he living ar	ea from Ta	ble 9, Th2('	°C)				_			_
(88)m	19.85	19.87	19.87	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.87	(88)
Utilisation factor	for gains fo	r rest of dw	elling η2,m	(see Table	9a)								_
(89)m	0.92	0.89	0.84	0.75	0.61	0.44	0.27	0.30	0.55	0.78	0.89	0.92	(89)
Mean internal ter	nperature i	n the rest o	f dwelling <sup>-</sup>	T2 (follow s	teps 3 to 7	in Table 9c	)						
(90)m	16.94	17.32	18.00	18.71	19.37	19.72	19.85	19.84	19.60	18.84	17.71	17.03	(90)
Living area fraction	n							fLA :	31.30	÷ (4) =	=	0.39	(91)
Mean internal ter	nperature f	or the whol	e dwelling	fLA x T1 +(:	L - fLA) x T2	2							
(92)m	17.66	17.99	18.59	19.23	19.82	20.15	20.28	20.27	20.03	19.34	18.33	17.74	(92)
Apply adjustment	to the mea	an internal t	emperatur	e from Tab	le 4e, wher	e appropri	ate						
(93)m	17.51	17.84	18.44	19.08	19.67	20.00	20.13	20.12	19.88	19.19	18.18	17.59	(93)
8. Space heating	requireme	ent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mear			obtained a	at step 11 o	f Table 9b,	so that tim	= (93)m a	and recalculat	te the utili	sation facto	or for gains	using Table	e 9a)
Utilisation factor						l a	0.55	1 0 1		T a ==			٠. م ٦
(94)m	0.89	0.86	0.81	0.73	0.60	0.45	0.30	0.32	0.55	0.75	0.86	0.89	(94)
Useful gains, ηmG	<u> </u>	, , ,					_	T T		T -	T	T	٦
(95)m	626.66	675.82	707.18	726.59	649.15	489.42	311.55	308.54	470.66	562.87	588.18	601.64	(95)
Monthly average						1				T	1		٦.
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for													7
(97)m	1337.96	1306.18	1184.56	1040.97	799.87	541.94	323.82	323.08	559.52	841.21	1125.44	1291.07	(97)
Space heating req			nth, kWh/r			n - (95)m] x	(41)m	<u>,                                     </u>				_	7
(98)m	529.21	423.60	355.17	226.35	112.13	0.00	0.00	0.00	0.00	207.08	386.83	512.94	
							Total per	year (kWh/y	ear) = ∑(9	8)15, 10	.12 = 2	2753.31	(98)
Space heating req	juirement i	n kWh/m²/y	vear .							(98)	÷ (4)	34.42	(99)

#### 9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11)

0.00 (201)

Fraction of space heating from main sy	ystem(s) 1 - (201)					1.00	(202)			
Fraction of main heating from main sy	stem 2					0.00	(203)			
Fraction of total space heat from main	system 1 (202) x [1 - (	203)]				1.00	(204)			
Fraction of total space heat from main	system 2 (202) x (203)	)				0.00	(205)			
Efficiency of main space heating system	m 1 (%)					93.00	(206)			
(from database or Table 4a/4b, adjust	ed where appropriate b	y the amour	nt shown in	the 'space	efficiency (	adjustmen	- :' column of Tab	le 4c)		
Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct N	lov	Dec	
Space heating requirement, kWh/mor	th (as calculated above	2)								_
(98)m 529.21 423.60	355.17 226.35	112.13	0.00	0.00	0.00	0.00	207.08 38	6.83	512.94	
Space heating fuel (main heating syste	m 1), kWh/month = (98	8)m x (204) x	( 100 ÷ (20	6)						_
(211)m 569.05 455.49	381.91 243.38	120.57	0.00	0.00	0.00	0.00	222.67 41	5.94	551.54	
			٦	Total per ye	ar (kWh/ye	ear) = ∑(21	1)15, 1012 =	29	60.54	(211)
Water heating:										
Output from water heater, kWh/mont	h (calculated above)									
(64)m 213.11 188.15	198.34 178.82	175.98	158.31	153.05	166.55	165.81	185.37 19	4.73	208.33	
							∑(64)112 =	21	86.55	(64)
Efficiency of water heater per month										
(217)m 86.64 86.41	85.85 84.94	83.15	79.30	79.30	79.30	79.30	84.61 8	5.11	86.62	
Fuel for water heating, kWh/month =	(64)m x 100 ÷ (217)m									
(219)m 245.97 217.73	231.03 210.52	211.64	199.63	193.00	210.02	209.10	219.10 22	6.14	240.50	]
				Total	per year (l	(Wh/year)	= ∑(219)112 =	26	14.38	(219)
Annual Totals Summary:							kWh/year	kW	h/year	
Space heating fuel used, main system	1							29	60.54	(211)
Water heating fuel used									14.38	(219)
Electricity for pumps, fans and electri	c keen-hot (Table 4f):									(===)
mechanical ventilation fans - balan		input from	outsido				59.38	٦		(230a)
warm air heating system fans	ceu, extract or positive	input iroin (	Jutside				0.00	1		(230a)
central heating pump							130.00	1		(230c)
oil boiler pump							0.00	i		(230d)
boiler flue fan							45.00	j		(230e)
maintaining electric keep-hot facili	ty for gas combi boiler						0.00			(230f)
pump for solar water heating							0.00			(230g)
Total electricity for the above							∑(230a)(230g)	23	34.38	(231)
										_
Electricity for lighting (calculated in A	ppendix L):							34	15.49	(232)
Energy saving/generation technologic	es (Appendices M, N ar	nd Q):								
Electricity generated by PVs (Appendix	( M) (negative quantity)	)						-74	46.81	(233)
10a. Fuel costs - Individual heating s	ystems including micro									
		Fuel	kWh/year			iel price able 12)		Fuel co	st £/year	•
Space heating - main system 1		2:	960.54	] x		3.10	x 0.01 =	9	1.78	(240)
Water heating cost (other fuel)		2	614.38	x		3.10	x 0.01 =	8	1.05	(247)
Pumps, fans and electric keep-hot		2	234.38	x		11.46	x 0.01 =	2	6.86	(249)
Energy for lighting		3	345.49	×		11.46	x 0.01 =	3	9.59	(250)
Additional standing charges (Table 12)				•			•		06.00	(251)
Energy saving/generation technologic		nd Q):								,
PV savings (negative quantity)	v -pp =//8/0000 (11) 14 df		746.81	] x		11.46	x 0.01 =	_9	5.58	(252)
Total energy cost		<u> </u>		,			) + (245)(254)		59.69	(255)
rotal chergy cost					'	01(242	., · (2-7-)(2-54)		,,,,,,	(233)

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.98	(257)
SAP value		86.38	
SAP rating		86	(258)
SAP band		В	7

12a. Carbon dioxide emissions - Individual heating syste	ems including micro-CHP					
	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	2960.54	x	0.198	=	586.19	(261)
Water heating	2614.38	x	0.198	=	517.65	(264)
Space and water heating			(261) + (262) + (	263) + (264) =	1103.83	(265)
Pumps, fans and electric keep-hot	234.38	x	0.517	=	121.17	(267)
Lighting	345.49	x	0.517	=	178.62	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-746.81	x	0.529	=	-395.06	(269)
Total carbon dioxide emissions			Σ(	261)(271) =	1008.57	(272)
Dwelling carbon dioxide emissions rate				(272) ÷ (4) =	12.61	(273)
El value					89.19	]
El rating (see section 14)					89	(274)
El band					В	

13a. Primary energy - Individual heating systems including	g micro-CHP					
	Energy kWh/year		Primary Energy Factor		Primary Energy	,
Space heating - main system 1	2960.54	x	1.02	=	3019.75	(261*)
Water heating	2614.38	х	1.02	=	2666.66	(264*)
Space and water heating			(261*) + (262*) + (26	63*) + (264*) =	5686.42	(265*)
Pumps, fans and electric keep-hot	234.38	x	2.92	=	684.39	(267*)
Lighting	345.49	x	2.92	=	1008.84	(268*)
Energy saving/generation technologies:						
PV primary energy savings (negative quantity)	-746.81	х	2.92	=	-2180.68	(269*)
Total primary energy kWh/year			∑(2	61*)(271*) =	5198.97	(272*)
Primary energy kWh/m2/year				(272*) ÷ (4) =	64.99	(273*)

## Code for Sustainable Homes (November 2010) Design - Draft

CO₂ emissions from cooking (equation L16)

Additional allowable generation and its CO2 emissions offset

CO<sub>2</sub> emissions offset from additional allowable generation

CO<sub>2</sub> emissions offset from community biofuel CHP systems

Total CO<sub>2</sub> emissions

Net CO₂ emissions



#### This report details the calculations and results for Ene 1, 2 and 7 of the Code For Sustainable Homes.

This Design Assessment has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed. Code calculations are from the Technical Guide (November 2010).

Assessor name	sor name Mr Stuart Searle			Assessor numb	per	2435		
Client				Last modified		01/02/2013		
Address	P03 4 St Augustines, Lon	don, NW1						
Building regulation assess	ment - criterion 1							
						kg/m²/yr		
DER						9.57		
TER						14.98		
Assessment of zero carbon	n home and low or zero ca	rbon technologies						
					Credits	Level		
Dwelling emission rate (Ene	2 1)	CO <sub>2</sub> reduction = 36.1 %			4	4		
Fabric Energy Efficiency		FEE = 40.8			6.1			
Low or zero carbon technology	ogies (Ene 7)	CO <sub>2</sub> reduction = 15 %			2			
Ene 1 - dwelling emission	rate							
				%	kWh/m²	kgCO₂/m²/yr		
				/0	,	1.6002/111 / 41		
Assessment of Ene 1 (level	1-5)			70	,			
Assessment of Ene 1 (level DER from SAP 2009 DER wo				,,	<b>,</b>	9.57		
	orksheet			7	0.00			
DER from SAP 2009 DER wo	orksheet ation			7				
DER from SAP 2009 DER wo Additional allowable genera CO <sub>2</sub> emissions offse	orksheet ation	CHP systems		7		9.57		
DER from SAP 2009 DER wo Additional allowable genera CO <sub>2</sub> emissions offse	orksheet ation et from generation et from community biofuel			7		9.57		
DER from SAP 2009 DER wo Additional allowable general CO <sub>2</sub> emissions offse CO <sub>2</sub> emissions offse	orksheet stion et from generation et from community biofuel from SAP section 16 allowa			7		9.57 0.00 0.00		
DER from SAP 2009 DER wo Additional allowable general CO <sub>2</sub> emissions offset CO <sub>2</sub> emissions offset for	orksheet ation et from generation et from community biofuel from SAP section 16 allowa tion 16 allowances			7		9.57 0.00 0.00 0.00		
DER from SAP 2009 DER wo Additional allowable general CO <sub>2</sub> emissions offset CO <sub>2</sub> emissions offset for the company of the com	orksheet ation et from generation et from community biofuel from SAP section 16 allowa tion 16 allowances			36.1		9.57 0.00 0.00 0.00 9.57		
DER from SAP 2009 DER wo Additional allowable general CO <sub>2</sub> emissions offset CO <sub>2</sub> emissions offset from SAP sectors accounting for SAP sectors reduction compared to	orksheet etion et from generation et from community biofuel from SAP section 16 allowa tion 16 allowances TER					9.57 0.00 0.00 0.00 9.57		
DER from SAP 2009 DER wo Additional allowable general CO <sub>2</sub> emissions offset CO <sub>2</sub> emissions offset from SAP sectors DER accounting for SAP sectors CO <sub>2</sub> reduction compared to CO <sub>2</sub> reduction as % of TER	orksheet ation et from generation et from community biofuel from SAP section 16 allowa tion 16 allowances TER					9.57  0.00  0.00  0.00  9.57  5.41	ZC1)	

1.74

26.06

0.00

0.00

26.06

0.00

(ZC3)

(ZC4)

(ZC6)

(ZC7)

(ZC5)

(ZC8)

#### Ene 1 - dwelling emission rate - level 6 There is no Zero Carbon Home definition in the current technical guide Criterion Value Pass/Fail FEE <= 39 40.8 Fail 26.06 Net CO<sub>2</sub> emissions <= 0.00 Fail Result: Not level 6 Number of credits for Ene 1 Ene 2 - Fabric Energy Efficiency 40.8 FEE Number of credits for Ene 2 6.1 Ene 7 - low or zero carbon technologies **Emissions** Reduction kgCO₂/yr kgCO<sub>2</sub>/yr Standard case 1338.74 Space and water heating (265) Mechanical cooling (266) 0.00 Pumps and fans (267) 131.54 Lighting (268) 217.44 Appliances and cooking 1764.63 Total CO₂ 3452.34 **Actual case** Space and water heating (265) or (376) 1338.74 Space and water heating from LZCT considered in SAP 2009 0.00 Pumps and fans (267) or (378) 131.54 Pumps and fans 0.00 Electricity generated by LZCT (269) + (380)) -528.11 Additional allowable electricity generation considered in SAP 2009 section 16 0.00 Offset from biofuel CHP $[-1 \times [(363)..(366) + (368)...(372)]]$ 0.00 LZCT electricity generation -528.11 LZCT thermal generation 0 Total from specified LZCT -528.11 **Emissions** $kgCO_2/m^2/yr$ Reduction in CO<sub>2</sub> Emissions Standard Case CO<sub>2</sub> 32.26 Actual Case CO2 27.33

15

2

% Reduction in CO<sub>2</sub>

Number of credits for Ene 7

## DER 2009 Worksheet

# Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P03 4 St Augustines, London, NW1		

1. Overall dwelling dimension	ns						
		Area (m²)		Average store height (m)	ey	Volume (m³)	
Lowest occupied		107.00	(1a) x	2.60	(2a) =	278.20	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)(1n) = [	107.00	<b>(4)</b>				
Dwelling volume				(3a) + (3b) +	(3c) + (3d)(3n) =	278.20	(5)
2. Ventilation rate							
						m³ per hour	
Number of chimneys				0	x 40 =	0	(6a)
Number of open flues				0	x 20 =	0	(6b)
Number of intermittent fans				0	x 10 =	0	(7a)
Number of passive vents				0	x 10 =	0	(7b)
Number of flueless gas fires				0	x 40 =	0	(7c)
						Air changes pe hour	r
Infiltration due to chimneys, flo	ues, fans, PSVs	(6a) + (6b) + (7a	a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)
If a pressurisation test has bee	n carried out or is intended, proceed t	o (17), otherwis	e continue from	(9) to (16)			
Air permeability value, q50, ex	pressed in cubic metres per hour per	square metre of	envelope area			5.00	(17)
If based on air permeability val	lue, then (18) = $[(17) \div 20] + (8)$ , other	wise (18) = (16)				0.25	(18)
Air permeability value applies i	if a pressurisation test has been done,	or a design or s	pecified air perm	neability is bein	g used		
Number of sides on which dwe	elling is sheltered					1	(19)
Shelter factor				:	1 - [0.075 x (19)] =	0.92	(20)
Adjusted infiltration rate					(18) x (20) =	0.23	(21)
Infiltration rate modified for m	onthly wind speed:						

Infiltration rate mo	pairiea for i	monthly wi	na speea:										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average v	vind speed	from Table	· 7										
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	]
										∑(22)1	.12 =	54.10	(22)
Wind Factor (22a)m = $(22)$ m $\div$ 4													
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	]
										∑(22a)1	.12 =	13.52	(22a)
Adjusted infiltration	n rate (allo	owing for sh	nelter and v	vind speed	) = (21) × (2	2a)m							
(22b)m	0.31	0.29	0.29	0.26	0.24	0.23	0.21	0.21	0.24	0.26	0.28	0.29	]
										∑(22b)1	.12 =	3.13	(22b)

Cal

alculate effective air change rate for the applicable case:	
If mechanical ventilation: air change rate through system	0.5

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

(23a)

If balanced with heat recovery: efficiency in % allowing for in-use fac	ctor (from Table 4h) = N/A (23c)
c) If whole house extract ventilation or positive input ventilation from if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b	
(24c)m 0.56 0.54 0.54 0.51 0.50	0.50 0.50 0.50 0.50 0.51 0.53 0.54 (24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (2	
(25)m 0.56 0.54 0.54 0.51 0.50	0.50 0.50 0.50 0.50 0.51 0.53 0.54 (25)
(23)111	0.50 0.50 0.50 0.51 0.55 0.54
3. Heat losses and heat loss parameter	
The κ-value is the heat capacity per unit area, see Table 1e.	
Element Gross Openings, Area, m <sup>2</sup> m <sup>2</sup>	Net area U-value, A x U, $\kappa$ -value, A x $\kappa$ , A, $m^2$ W/ $m^2$ K W/K kJ/ $m^2$ .K kJ/K
Doors	2.10 x 1.60 = 3.36 N/A N/A (26)
Window*	8.68 x 1.15 = 9.94 N/A N/A (27)
Window*	17.49 x $1.33$ = $23.19$ N/A N/A (27)
External wall	84.65 x 0.20 = 16.93 N/A N/A (29a)
Party Wall	$34.19 \times 0.00 = 0.00 N/A N/A (32)$
Total area of external elements ∑A, m²	112.92 (31)
* for windows and roof windows, effective window U-value is calculated	
Fabric heat loss, W/K = $\Sigma$ (A × U)	(26)(30) + (32) = 53.42  (33)
Heat capacity Cm = $\sum (A \times K)$	(28)(30) + (32) + (32a)(32e) = N/A (34)
Thermal mass parameter (TMP) in kJ/m²K	Calculated separately = $100.00$ (35)
Thermal bridges: $\sum (L \times \Psi)$ calculated using Appendix K	12.54 (36)
if details of thermal bridging are not known then (36) = $0.15 \times (31)$	
Total fabric heat loss	(33) + (36) = 65.96 (37)
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	
(38)m 51.61 50.02 50.02 46.84 45.90	45.90     45.90     45.90     46.84     48.43     50.02     (38)
Heat transfer coefficient, W/K (37)m + (38)m	
(39)m 117.57   115.98   115.98   112.79   111.86	
	Average = $\sum (39)112/12 = \boxed{113.73}$ (39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	105 105 105 105 105 105 105
(40)m 1.10 1.08 1.08 1.05 1.05	1.05   1.05   1.05   1.05   1.07   1.08
	Average = $\sum (40)112/12 = $ 1.06 (40)
4. Water heating energy requirement	
	kWh/year
Assumed occupancy, N	2.80 (42)
If TFA > 13.9, N = $1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.00$	
If TFA $\leq 13.9$ , N = 1	013 X (1171 13.3)
Annual average hot water usage in litres per day Vd,average = (25 x N) +	+ 36 100.59 (43)
Annual average hot water usage has been reduced by 5% if the dwelling	
per person per day (all water use, hot and cold)	g is designed to demove a water ase target of not more than 125 hates
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 Tal	
(44)m 110.65 106.63 102.61 98.58 94.56	
	$\Sigma(44)112 = 1207.14$ (44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x	
(45)m 164.49 143.86 148.45 129.43 124.19	
	$\Sigma(45)112 = 1586.53$ (45)
If instantaneous water heating at point of use (no hot water storage), e	
For community heating include distribution loss whether or not hot water	

Distribution loss				10.11	10.00	1.00	1	1	1 00				7 (46)
(46)m	24.67	21.58	22.27	19.41	18.63	16.07	14.90	17.09	17.30	20.16	22.00	23.89	(46)
Water storage los										7			
a) If manufacture	r's declared	l loss factor	is known (l	kWh/day):					1.85	(47)			
Temperature f	actor from	Table 2b						0.54 (48)					
Energy lost fro	m water st	orage, kW	h/day (47)	) x (48)					1.00	(49)			
Enter (49) or (54)	in (55)								1.00	(55)			
Water storage los	s calculated	d for each n	nonth = (55	) x (41)m									
(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)
If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H													
(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)
Primary circuit los	ss (annual) f	from Table	3						360.00	(58)			
Primary circuit los	s for each r	month (58)	÷ 365 × (41	.)m									
(modified by facto	or from Tab	le H5 if the	re is solar v	vater heati	ng and a cy	linder therr	nostat)						
(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 for ea	ch month fr	om Table 3	a, 3b or 3c	(enter '0' if	not a com	bi boiler)							
(61)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat require	ed for water	r heating ca	lculated fo	r each mon	th 0.85 × (4	15)m + (46)	m + (57)m ·	+ (59)m + (6	61)m				
(62)m	226.03	199.45	210.00	188.99	185.73	166.72	160.85	175.50	174.87	195.93	206.25	220.84	(62)
Solar DHW input	calculated ι	using Appen	dix H (nega	ative quant	ity) ('0' ent	ered if no s	olar contrik	oution to w	ater heatin	g)			
(63)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
										∑(63)1	.12 =	0.00	(63)
Output from water	er heater fo	r each mon	th, kWh/m	onth (62)n	n + (63)m								
(64)m	226.03	199.45	210.00	188.99	185.73	166.72	160.85	175.50	174.87	195.93	206.25	220.84	
										∑(64)1	.12 = 2	311.17	(64)
if (64)m < 0 then s	set to 0												_
Heat gains from v	vater heatir	ng, kWh/mc	onth 0.25 ×	[0.85 × (45	5)m + (61)m	n] + 0.8 × [(4	46)m + (57)	m + (59)m]					
(65)m	103.93	92.31	98.60	90.68	90.53	83.28	82.25	87.12	85.99	93.92	96.42	102.20	(65)
								•		•	•	•	-

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

	Jan	5 and 5a) Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	,
			IVIAI	Aþi	iviay	Juli	Jui	Aug	Зер	Oct	1404	Dec	
Metabolic gains	`												7
(66)m	139.78	139.78	139.78	139.78	139.78	139.78	139.78	139.78	139.78	139.78	139.78	139.78	(66)
Lighting gains (ca	alculated in A	ppendix L,	equation L	9 or L9a), a	lso see Tab	le 5							
(67)m	23.81	21.15	17.20	13.02	9.73	8.22	8.88	11.54	15.49	19.67	22.96	24.48	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	267.17	269.95	262.96	248.09	229.31	211.67	199.88	197.10	204.09	218.96	237.74	255.38	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	(69)
Pumps and fans	gains (Table	5a)											
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evap	oration (nega	itive values	) (Table 5)										
(71)m	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	(71)
Water heating g	ains (Table 5)	)											
(72)m	139.69	137.36	132.52	125.95	121.68	115.67	110.56	117.10	119.43	126.24	133.92	137.37	(72)
(72)m	Total internal gains (66)m + (67)m + (68)m + (70)m + (71)m + (72)m												
	ins (66)m + (	67)m + (68	)m + (69)m	+ (70)111 + (	(/1)111 + (/2	. / 1111							

#### 6. Solar gains

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

Details for month of Januar	•	•			, ,			,,,,				
	Access factor Table 6d	or	Area m²	So	lar flux W/	m² g	Specific dat or Table 6b	a FI	Specific da or Table 60		Gains (W)	)
West	0.54	] x	8.68	×	19.87	x 0.9 x	0.63	x	0.80	] =	42.25	(80)
South	0.54	] x	17.49	x	47.32	x 0.9 x	0.63	х	0.80	] =	202.77	(78)
Solar gains in watts, calcula	ted for each	month ∑(7	4)m(82)m									
(83)m 245.02	412.61	534.72	644.74	701.58	713.35	698.55	653.55	584.93	465.19	292.78	210.06	(83)
Total gains - internal and so	lar (73)m + (	83)m										
(84)m 750.63	916.00	1022.34	1106.73	1137.24	1123.83	1092.80	1054.23	998.88	905.00	762.33	702.22	(84)
7. Mean internal tempera	ture (heating	g season)										
Temperature during heating		-	ea from Ta	ble 9, Th1('	°C)						21.00	(85)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	_ ` `
Utilisation factor for gains f	or living area	ı, η1,m (see	· Table 9a)	•								
(86)m 0.95	0.92	0.87	0.81	0.70	0.56	0.40	0.41	0.62	0.81	0.93	0.95	(86)
Mean internal temp of livin	g area T1 (ste	eps 3 to 7 ii	n Table 9c)		•		•				•	_
(87)m 18.92	19.27	19.71	20.15	20.58	20.84	20.96	20.95	20.78	20.29	19.46	18.95	(87)
Temperature during heating	g periods in t	he living ar	ea from Ta	ble 9, Th2('	°C)						•	_
(88)m 20.00	20.02	20.02	20.04	20.05	20.05	20.05	20.05	20.05	20.04	20.03	20.02	(88)
Utilisation factor for gains f	or rest of dw	elling ŋ2,m	(see Table	9a)								_
(89)m 0.94	0.91	0.86	0.78	0.66	0.49	0.31	0.32	0.56	0.78	0.91	0.95	(89)
Mean internal temperature	in the rest o	f dwelling	T2 (follow s	teps 3 to 7	in Table 9c	)						_
(90)m 17.23	17.74	18.37	19.00	19.58	19.90	20.02	20.02	19.84	19.20	18.03	17.29	(90)
Living area fraction	•						fLA 2	24.00	÷ (4) =	=	0.22	(91)
Mean internal temperature	for the who	le dwelling	fLA x T1 +(1	L - fLA) x T2	<u>,                                     </u>							_ ` `
(92)m 17.61	18.08	18.67	19.26	19.80	20.11	20.23	20.23	20.05	19.44	18.35	17.67	(92)
Apply adjustment to the me		temperatur	e from Tab	le 4e. wher	e appropria				1	1	1	_ ` `
(93)m 17.46	17.93	18.52	19.11	19.65	19.96	20.08	20.08	19.90	19.29	18.20	17.52	(93)
	'								1	<b>'</b>	·	
8. Space heating requirem		24	<b>A</b> 11 11	24			<b>A</b>	C	0	N	<b>D</b>	
Jan	Feb	Mar	Apr	May	Jun	Jul - (02)m av	Aug	Sep	Oct	Nov	Dec	- O-1
Set Ti to the mean internal Utilisation factor for gains,		obtained a	it step 11 0	i Table 90,	SO that tim	= (93)111 a1	na recalculat	e the utili	Sation facto	or for gains	using rabie	2 9a)
(94)m 0.92	0.88	0.82	0.76	0.64	0.49	0.32	0.33	0.55	0.75	0.89	0.92	(94)
Useful gains, nmGm, W = (9			0.70	0.04	0.43	0.52	0.55	0.55	0.73	0.03	0.52	] (34)
(95)m 689.19		842.81	835.69	727.26	545.80	344.94	343.73	548.81	682.59	675.06	648.71	(95)
Monthly average external t		1		727.20	3 13.00	311.31	3 13.73	3 10.01	002.33	073.00	0 10.71	] (33)
(96)m 4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean inte		1		11.70	11.00	10.50	10.50	11.30	10.00	7.00	1.50	] (30)
(97)m 1523.38		1359.62	1174.08	889.71	600.01	355.80	355.51	626.12	957.76	1281.53	1463.25	(97)
Space heating requirement	_						333.31	020.12		1 1201.55	1 100.20	7 (21)
(98)m 620.63		384.50	243.64	120.86	0.00	0.00	0.00	0.00	204.73	436.66	606.02	7
(50)111 020.03	1 407.44	334.30	2-73.04	120.00	1		1				3084.49	] ] (00)
Chaco hosting as a circumstate	in 1/14/h /2/	voor.				rotal per	year (kWh/y	zai j – 2(9				] (98) ] (00)
Space heating requirement	111 KVVII/III-/\	yeai							(98)	÷ (4)	28.83	(99)
9a. Energy Requirements	- Individual h	neating sys	tems includ	ling micro-	СНР							

Fraction of space heating from secondary/supplementary system (Table 11)	0.00	(201)
Fraction of space heating from main system(s) 1 - (201)	1.00	(202)
Fraction of main heating from main system 2	0.00	(203)

Space heating:

Frestian of total areas heat from main quetom 1 (202) v [1 (202)]									
Fraction of total space heat from main system 1 (202) x [1 - (203)]  1.00 (204)									
Fraction of total space heat from main system 2 (202) x (203)  0.00 (205)									
Efficiency of main space heating system 1 (%)  93.00 (206)									
(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Tall Jan Feb Mar Apr May Jun Jul Aug Sep Oct	Nov Dec								
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Space heating requirement, kWh/month (as calculated above)	NOV DEC								
	36.66 606.02								
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)									
	69.53 651.63								
Total per year (kWh/year) = ∑(211)15, 1012	= 3316.65 (211)								
Water heating:									
Output from water heater, kWh/month (calculated above)									
	06.25 220.84								
Σ(64)112	= 2311.17 (64)								
Efficiency of water heater per month									
(217)m 86.87 86.51 85.91 84.99 83.20 79.30 79.30 79.30 79.30 84.43 8	86.27 86.87								
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m									
(219)m 260.20 230.56 244.45 222.36 223.24 210.24 202.83 221.31 220.52 232.07 2	39.09 254.23								
Total per year (kWh/year) = $\Sigma$ (219)112	= 2761.09 (219)								
Annual Totals Summary: kWh/year	kWh/year								
Space heating fuel used, main system 1	3316.65 (211)								
Water heating fuel used	2761.09 (219)								
Electricity for pumps, fans and electric keep-hot (Table 4f):									
mechanical ventilation fans - balanced, extract or positive input from outside 79.42	(230a)								
warm air heating system fans 0.00	(230b)								
central heating pump 130.00	(230c)								
oil boiler pump 0.00	(230d)								
boiler flue fan 45.00	(230e)								
maintaining electric keep-hot facility for gas combi boiler 0.00	(230f)								
pump for solar water heating 0.00	(230g)								
Total electricity for the above ∑(230a)(230g	254.42 (231)								
Electricity for lighting (calculated in Appendix L):	420.57 (232)								
Energy saving/generation technologies (Appendices M, N and Q):	420.37 (232)								
	-998.32 (233)								
Electricity generated by PVs (Appendix M) (negative quantity)	-338.32 (233)								
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP									
Energy Emissions	Emissions								
kWh/year Factor	(kgCO2/year)								
Space heating - main system 1 3316.65 x 0.198 =	656.70 (261)								
Water heating 2761.09 x 0.198 =	546.70 (264)								
Space and water heating (261) + (262) + (263) + (264)	= 1203.39 (265)								
Pumps, fans and electric keep-hot 254.42 x 0.517 =	131.54 (267)								
Lighting 420.57 x 0.517 =	217.44 (268)								
Energy saving/generation technologies:	_								
PV emission savings (negative quantity) -998.32 x 0.529 =	-528.11 (269)								
Total carbon dioxide emissions $\Sigma(261)(271)$									
Dwelling Carbon Dioxide Emissions Rate (DER)	9.57 (273)								

# SAP 2009 Worksheet

### Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P03 4 St Augustines, London, NW1		

1. Overall dwelling dimension	ons						
		Area (m²)		Average stor height (m)		Volume (m³)	
Lowest occupied		107.00 (1	a) x	2.60	(2a) =	278.20	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)(1n) =	107.00 (4	)				
Dwelling volume				(3a) + (3b) +	(3c) + (3d)(3n) =	278.20	(5)
2. Ventilation rate							
						m³ per hour	
Number of chimneys				0	x 40 =	0	(6a)
Number of open flues				0	x 20 =	0	(6b)
Number of intermittent fans				0	x 10 =	0	(7a)
Number of passive vents				0	x 10 =	0	(7b)
Number of flueless gas fires				0	x 40 =	0	(7c)
						Air changes pe hour	r
Infiltration due to chimneys,	flues, fans, PSVs	(6a) + (6b) + (7a) +	(7b) + (7c) =	0	÷ (5) =	0.00	(8)
If a pressurisation test has be	een carried out or is intended, proceed to	o (17), otherwise co	ntinue from	(9) to (16)			
Air permeability value, q50, e			5.00	(17)			
If based on air permeability v			0.25	(18)			
Air permeability value applies	s if a pressurisation test has been done,	or a design or spec	ified air pern	neability is bei	ng used		
Number of sides on which dw	velling is sheltered					1	(19)
Shelter factor					1 - [0.075 x (19)] =	0.92	(20)
Adjusted infiltration rate					(18) x (20) =	0.23	(21)
Infiltration rate modified for	monthly wind speed:						

•										. , .	· —		J ' '
Infiltration rate m	odified for	monthly wi	nd speed:										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average	wind speed	from Table	· 7										
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	]
										∑(22)1	.12 =	54.10	(22)
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	1.20	1.27	]
										∑(22a)1	.12 =	13.52	(22a)
Adjusted infiltration	on rate (allo	owing for sh	nelter and v	vind speed	) = (21) × (2	2a)m							
(22b)m	0.31	0.29	0.29	0.26	0.24	0.23	0.21	0.21	0.24	0.26	0.28	0.29	]
										∑(22b)1	.12 =	3.13	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system

0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use fac	ctor (from Table 4h) = N/A (23c)
c) If whole house extract ventilation or positive input ventilation from if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b	
(24c)m 0.56 0.54 0.54 0.51 0.50	0.50 0.50 0.50 0.50 0.51 0.53 0.54 (24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (2	
(25)m 0.56 0.54 0.54 0.51 0.50	0.50 0.50 0.50 0.50 0.51 0.53 0.54 (25)
(23)111	0.50 0.50 0.50 0.51 0.55 0.54
3. Heat losses and heat loss parameter	
The κ-value is the heat capacity per unit area, see Table 1e.	
Element Gross Openings, Area, m <sup>2</sup> m <sup>2</sup>	Net area U-value, A x U, $\kappa$ -value, A x $\kappa$ , A, $m^2$ W/ $m^2$ K W/K kJ/ $m^2$ .K kJ/K
Doors	2.10 x 1.60 = 3.36 N/A N/A (26)
Window*	8.68 x 1.15 = 9.94 N/A N/A (27)
Window*	17.49 x $1.33$ = $23.19$ N/A N/A (27)
External wall	84.65 x 0.20 = 16.93 N/A N/A (29a)
Party Wall	$34.19 \times 0.00 = 0.00 N/A N/A (32)$
Total area of external elements ∑A, m²	112.92 (31)
* for windows and roof windows, effective window U-value is calculated	
Fabric heat loss, W/K = $\Sigma$ (A × U)	(26)(30) + (32) = 53.42  (33)
Heat capacity Cm = $\sum (A \times K)$	(28)(30) + (32) + (32a)(32e) = N/A (34)
Thermal mass parameter (TMP) in kJ/m²K	Calculated separately = $100.00$ (35)
Thermal bridges: $\sum (L \times \Psi)$ calculated using Appendix K	12.54 (36)
if details of thermal bridging are not known then (36) = $0.15 \times (31)$	
Total fabric heat loss	(33) + (36) = 65.96 (37)
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	
(38)m 51.61 50.02 50.02 46.84 45.90	45.90     45.90     45.90     46.84     48.43     50.02     (38)
Heat transfer coefficient, W/K (37)m + (38)m	
(39)m 117.57   115.98   115.98   112.79   111.86	
	Average = $\sum (39)112/12 = \boxed{113.73}$ (39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	105 105 105 105 105 105 105
(40)m 1.10 1.08 1.08 1.05 1.05	1.05   1.05   1.05   1.05   1.07   1.08
	Average = $\sum (40)112/12 = $ 1.06 (40)
4. Water heating energy requirement	
	kWh/year
Assumed occupancy, N	2.80 (42)
If TFA > 13.9, N = $1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.00$	
If TFA $\leq 13.9$ , N = 1	013 X (1171 13.3)
Annual average hot water usage in litres per day Vd,average = (25 x N) +	+ 36 100.59 (43)
Annual average hot water usage has been reduced by 5% if the dwelling	
per person per day (all water use, hot and cold)	g is designed to demove a water ase target of not more than 125 hates
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 Tal	
(44)m 110.65 106.63 102.61 98.58 94.56	
	$\Sigma(44)112 = 1207.14$ (44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x	
(45)m 164.49 143.86 148.45 129.43 124.19	
	$\Sigma(45)112 = 1586.53$ (45)
If instantaneous water heating at point of use (no hot water storage), e	
For community heating include distribution loss whether or not hot water	

Distribution loss	0.15 x (45)r	n					•						_
(46)m	24.67	21.58	22.27	19.41	18.63	16.07	14.90	17.09	17.30	20.16	22.00	23.89	(46)
Water storage lo	ss:									_			
a) If manufacture	er's declared	loss factor	is known (I	kWh/day):					1.85	(47)			
Temperature	factor from	Table 2b							0.54	(48)			
Energy lost fro	om water st	orage, kW	h/day (47)	) x (48)					1.00	(49)			
Enter (49) or (54)	in (55)								1.00	(55)			
Water storage lo	ss calculated	d for each n	nonth = (55	) x (41)m									
(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)
If cylinder contain	ns dedicated	d solar stora	nge, = (56)n	n x [(50) - (I	H11)] ÷ (50)	, else = (56	i)m where (	H11) is fror	n Appendi	хН			
(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)
Primary circuit lo	ss (annual) 1	from Table	3					3	360.00	(58)			
Primary circuit lo	ss for each i	month (58)	÷ 365 × (41	.)m									
(modified by fact	or from Tab	le H5 if the	re is solar v	vater heatii	ng and a cyl	linder theri	mostat)						
(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 for ea	ch month fr	om Table 3	a, 3b or 3c	(enter '0' if	not a coml	bi boiler)							
(61)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requir	ed for wate	r heating ca	lculated fo	r each mon	th 0.85 × (4	15)m + (46)	m + (57)m ·	+ (59)m + (6	51)m				
(62)m	226.03	199.45	210.00	188.99	185.73	166.72	160.85	175.50	174.87	195.93	206.25	220.84	(62)
Solar DHW input	calculated ι	using Appen	dix H (nega	ative quant	ity) ('0' ente	ered if no s	olar contrib	oution to wa	ater heatin	g)			
(63)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	]
										∑(63)1	.12 =	0.00	(63)
Output from wat	er heater fo	r each mon	th, kWh/m	onth (62)n	n + (63)m								
(64)m	226.03	199.45	210.00	188.99	185.73	166.72	160.85	175.50	174.87	195.93	206.25	220.84	
										∑(64)1	.12 = 2	311.17	(64)
if (64)m < 0 then	set to 0												
Heat gains from v	water heatir	ng, kWh/mc	onth 0.25 ×	[0.85 × (45	5)m + (61)m	n] + 0.8 × [(	46)m + (57)	m + (59)m]					
(65)m	103.93	92.31	98.60	90.68	90.53	83.28	82.25	87.12	85.99	93.92	96.42	102.20	(65)
include (57	7)m in calcul	lation of (65	m only if	vlinder is i	n the dwelli	na or hot w	vater is fron	n communi	tv heatina				_

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (	Table 5), Wa	atts											
(66)m	167.73	167.73	167.73	167.73	167.73	167.73	167.73	167.73	167.73	167.73	167.73	167.73	(66)
Lighting gains (ca	Iculated in A	ppendix L,	equation L	9 or L9a), a	lso see Tab	le 5							
(67)m	59.54	52.88	43.00	32.56	24.34	20.55	22.20	28.86	38.73	49.18	57.40	61.19	(67)
Appliances gains	(calculated i	n Appendix	L, equatio	n L13 or L1	3a), also se	e Table 5							
(68)m	398.77	402.90	392.48	370.28	342.26	315.92	298.32	294.19	304.61	326.81	354.83	381.17	(68)
Cooking gains (ca	Iculated in A	Appendix L,	equation L	15 or L15a)	, also see T	able 5							
(69)m	54.57	54.57	54.57	54.57	54.57	54.57	54.57	54.57	54.57	54.57	54.57	54.57	(69)
Pumps and fans g	gains (Table	5a)											
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evapo	ration (nega	itive values	) (Table 5)										
(71)m	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	(71)
Water heating ga	ins (Table 5)	)											
(72)m	139.69	137.36	132.52	125.95	121.68	115.67	110.56	117.10	119.43	126.24	133.92	137.37	(72)
Total internal gai	ns (66)m + (	67)m + (68	)m + (69)m	+ (70)m +	(71)m + (72	.)m							
rotal internal gar													

### 6. Solar gains

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

	uary and annua											
	Access factor Table 6d	or	Area m²	So	lar flux W/	m² g	Specific dat or Table 6b	a FI	Specific da or Table 60		Gains (W)	
West	0.54	x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
South	0.54	x	17.49	x	47.32	x 0.9 x	0.63	х	0.80	=	202.77	(78)
Solar gains in watts, cald	ulated for each	month ∑(74	4)m(82)m									
(83)m 245	.02 412.61	534.72	644.74	701.58	713.35	698.55	653.55	584.93	465.19	292.78	210.06	(83)
Total gains - internal and	l solar (73)m + (	(83)m										
(84)m 963	.49 1126.23	1223.20	1294.00	1310.33	1285.96	1250.11	1214.18	1168.19	1087.90	959.41	910.27	(84)
7. Mean internal temp	oraturo (hoatin	a coacon)										
		-	as from Tol	blo 0 Tb1/	°C)						21.00	1 (05)
Temperature during hea		_				11	A.u.a	Com	0.4	No.	21.00	(85)
Ja Utilisation factor for gai		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m 0.9		0.83	0.76	0.65	0.50	0.35	0.36	0.56	0.75	0.88	0.92	(86)
Mean internal temp of I		1		0.03	0.50	0.33	0.50	0.50	0.73	0.00	0.32	] (00)
(87)m 19.		19.92	20.30	20.66	20.88	20.97	20.97	20.83	20.43	19.71	19.24	(87)
Temperature during hea	ting periods in t	the living ar	ea from Tal	ble 9. Th2('	°C)							, ,
(88)m 20.	<del></del>	20.02	20.04	20.05	20.05	20.05	20.05	20.05	20.04	20.03	20.02	(88)
Utilisation factor for gai	ns for rest of dw	relling n2,m	(see Table	9a)	!						!	
(89)m 0.9	1	0.81	0.73	0.60	0.44	0.28	0.28	0.50	0.72	0.87	0.91	(89)
Mean internal temperat	ure in the rest o	of dwelling 1	Γ2 (follow st	teps 3 to 7	in Table 9c	)			•		•	_
(90)m 17.		18.65	19.19	19.68	19.94	20.03	20.03	19.89	19.38	18.37	17.70	(90)
Living area fraction	•	•					fLA 2	4.00	÷ (4) =	=	0.22	(91)
Mean internal temperat	ure for the who	le dwelling	fLA x T1 +(1	L - fLA) x T2								
(92)m 17.	99 18.41	18.93	19.44	19.90	20.15	20.24	20.24	20.10	19.62	18.67	18.05	(92)
										20.07	10.03	
Apply adjustment to the	mean internal	temperatur	e from Tabl	le 4e, wher					1	1 20.07	10.03	
Apply adjustment to the (93)m		temperatur 18.78	e from Tabl 19.29	le 4e, wher 19.75			20.09	19.95	19.47	18.52	17.90	(93)
(93)m 17.	84 18.26				e appropria	ite		19.95	19.47			(93)
(93)m 17.	84 18.26 rement	18.78	19.29	19.75	e appropria	20.09	20.09			18.52	17.90	(93)
(93)m 17.  8. Space heating requi	18.26 rement n Feb	18.78 Mar	19.29	19.75 <b>May</b>	e appropria 20.00 Jun	20.09 Jul	20.09 Aug	Sep	Oct	18.52 Nov	17.90 Dec	
8. Space heating requi	rement n Feb nal temperature	18.78 Mar	19.29	19.75 <b>May</b>	e appropria 20.00 Jun	20.09 Jul	20.09 Aug	Sep	Oct	18.52 Nov	17.90 Dec	
8. Space heating requi	rement n Feb nal temperature	Mar e obtained a	Apr	19.75  May f Table 9b,	20.00  Jun so that tim	Jul = (93)m ar	Aug nd recalculat	<b>Sep</b> e the utili	<b>Oct</b> sation facto	18.52  Nov or for gains	Dec using Table	e 9a)
8. Space heating requirements  8. State of the mean interpolation factor for gain (94)m  0.8	rement n Feb nal temperature ns, nm 88 0.83	Mar e obtained a	19.29	19.75 <b>May</b>	e appropria 20.00 Jun	20.09 Jul	20.09 Aug	Sep	Oct	18.52 Nov	17.90 Dec	
8. Space heating requi  Ja  Set Ti to the mean inter  Utilisation factor for gai (94)m  0.9  Useful gains, ηmGm, W	18.26  rement n Feb nal temperature ns, ηm 88 0.83 = (94)m x (84)m	Mar e obtained a 0.78	Apr at step 11 of 0.70	19.75  May f Table 9b,  0.59	Jun so that tim	Jul = (93)m ar	Aug nd recalculat	Sep e the utili 0.49	Oct sation facto 0.69	Nov or for gains	Dec using Table	e 9a)
8. Space heating requi  Set Ti to the mean inter  Utilisation factor for gai  (94)m  0.3  Useful gains, ηmGm, W  (95)m  843	rement  n Feb nal temperature ns, nm 38 0.83 = (94)m x (84)m .08 937.07	Mar e obtained a 0.78 948.13	Apr t step 11 of 0.70	19.75  May f Table 9b,	20.00  Jun so that tim	Jul = (93)m ar	Aug nd recalculat	<b>Sep</b> e the utili	<b>Oct</b> sation facto	18.52  Nov or for gains	Dec using Table	e 9a)
8. Space heating requi  Ja  Set Ti to the mean inter  Utilisation factor for gai (94)m  0.9  Useful gains, ηmGm, W	18.26  rement n Feb nal temperature ns, ηm 18 0.83 = (94)m x (84)m 1.08 937.07 al temperature	Mar e obtained a 0.78 948.13	Apr t step 11 of 0.70	19.75  May f Table 9b,  0.59	Jun so that tim	Jul = (93)m ar	Aug nd recalculat	Sep e the utili 0.49	Oct sation facto 0.69	Nov or for gains	Dec using Table	e 9a)
(93)m  17.  8. Space heating required by the second of the	rement  n Feb nal temperature ns, nm 38 0.83 = (94)m x (84)m .08 937.07 al temperature 50 5.00	Mar e obtained a 0.78 948.13 from Table 6.80	Apr t step 11 of  0.70  910.77  8  8.70	19.75  May f Table 9b,  0.59  768.86	Jun so that tim 0.44	Jul = (93)m ar 0.28	Aug nd recalculat  0.29  348.02	<b>Sep</b> e the utili 0.49 573.53	Oct sation facto 0.69 754.32	Nov or for gains  0.84  801.51	Dec using Table 0.88	9a) (94) (95)
8. Space heating required Ja Set Ti to the mean inter Utilisation factor for gai (94)m 0.9 Useful gains, ηmGm, W (95)m 843 Monthly average extern	18.26  rement n Feb nal temperature ns, ηm 18 0.83 = (94)m x (84)m 1.08 937.07 al temperature 15 5.00 internal temper	Mar e obtained a 0.78 948.13 from Table 6.80	Apr t step 11 of  0.70  910.77  8  8.70	19.75  May f Table 9b,  0.59  768.86	Jun so that tim 0.44	Jul = (93)m ar 0.28	Aug nd recalculat  0.29  348.02	<b>Sep</b> e the utili 0.49 573.53	Oct sation facto 0.69 754.32	Nov or for gains  0.84  801.51	Dec using Table 0.88	9a) (94) (95)
(93)m  17.  8. Space heating required by the second of the	rement  n Feb nal temperature ns, nm 88 0.83 = (94)m x (84)m .08 937.07 al temperature 50 5.00 internal temper 3.36 1538.38	Mar e obtained a 0.78 948.13 from Table 6.80 ature, Lm, \ 1389.79	Apr at step 11 of 0.70  910.77 8 8.70  N 1194.59	19.75  May f Table 9b,  0.59  768.86  11.70	Jun so that tim 0.44 562.08 14.60	Jul = (93)m ar 0.28  348.76  16.90	Aug nd recalculat  0.29  348.02	Sep e the utili  0.49  573.53	Oct sation facto 0.69 754.32	Nov or for gains 0.84 801.51 7.00	Dec using Table 0.88 801.56	9a) (94) (95) (96)
(93)m  17.  8. Space heating required by the second of the	rement  n Feb nal temperature ns, nm 38 0.83 = (94)m x (84)m .08 937.07 al temperature 50 5.00 internal temper 3.36 1538.38 ent for each mo	Mar e obtained a 0.78 948.13 from Table 6.80 ature, Lm, \ 1389.79	Apr at step 11 of 0.70  910.77 8 8.70  N 1194.59	19.75  May f Table 9b,  0.59  768.86  11.70	Jun so that tim 0.44 562.08 14.60	Jul = (93)m ar 0.28  348.76  16.90	Aug nd recalculat  0.29  348.02	Sep e the utili  0.49  573.53	Oct sation facto 0.69 754.32	Nov or for gains 0.84 801.51 7.00	Dec using Table 0.88 801.56	9a) (94) (95) (96)
(93)m 17.  8. Space heating requirem (93)m Ja Set Ti to the mean inter Utilisation factor for gair (94)m 0.3 Useful gains, nmGm, Wright (95)m 843 Monthly average extern (96)m 4.3 Heat loss rate for mean (97)m 1566 Space heating requirem	rement  n Feb nal temperature ns, nm 38 0.83 = (94)m x (84)m .08 937.07 al temperature 50 5.00 internal temper 3.36 1538.38 ent for each mo	Mar e obtained a 0.78 948.13 from Table 6.80 rature, Lm, V 1389.79 nth, kWh/n	19.29  Apr It step 11 of  0.70  910.77  8  8.70  W  1194.59  month = 0.0	19.75  May f Table 9b,  0.59  768.86  11.70  900.38  24 x [(97)m	Jun so that tim 0.44 562.08 14.60 603.94 n - (95)m] x 0.00	Jul = (93)m ar 0.28  348.76  16.90  356.72 (41)m 0.00	Aug nd recalculat  0.29  348.02  16.90  356.54	Sep e the utili  0.49  573.53  14.30  632.24	Oct sation facto  0.69  754.32  10.80  977.35	Nov or for gains  0.84  801.51  7.00  1317.89	Dec using Table 0.88 801.56 4.90	9a) (94) (95) (96)
(93)m 17.  8. Space heating requirem (94)m 0.3  Useful gains, ηmGm, W (95)m 843  Monthly average extern (96)m 4.3  Heat loss rate for mean (97)m 1566  Space heating requirem	rement  n Feb nal temperature ns, nm 38 0.83 = (94)m x (84)m .08 937.07 al temperature so 5.00 internal temper 3.36 1538.38 ent for each mo .61 404.08	Mar e obtained a 0.78 948.13 from Table 6.80 rature, Lm, V 1389.79 nth, kWh/n 328.60	19.29  Apr It step 11 of  0.70  910.77  8  8.70  W  1194.59  month = 0.0	19.75  May f Table 9b,  0.59  768.86  11.70  900.38  24 x [(97)m	Jun so that tim 0.44 562.08 14.60 603.94 n - (95)m] x 0.00	Jul = (93)m ar 0.28  348.76  16.90  356.72 (41)m 0.00	20.09  Aug nd recalculat  0.29  348.02  16.90  356.54	Sep e the utili  0.49  573.53  14.30  632.24	Oct sation facto  0.69  754.32  10.80  977.35  165.94  8)15, 10	Nov or for gains  0.84  801.51  7.00  1317.89	Dec using Table 0.88 801.56 4.90 1507.50	(94) (95) (96) (97)
(93)m 17.  8. Space heating requirem (93)m Ja  Set Ti to the mean inter  Utilisation factor for gair (94)m 0.3  Useful gains, nmGm, Wright (95)m 843  Monthly average extern (96)m 4.3  Heat loss rate for mean (97)m 1566  Space heating requirem (98)m 539	rement  n Feb nal temperature ns, nm 38 0.83 = (94)m x (84)m .08 937.07 al temperature so 5.00 internal temper 3.36 1538.38 ent for each mo .61 404.08	Mar e obtained a 0.78 948.13 from Table 6.80 rature, Lm, V 1389.79 nth, kWh/n 328.60	19.29  Apr It step 11 of  0.70  910.77  8  8.70  W  1194.59  month = 0.0	19.75  May f Table 9b,  0.59  768.86  11.70  900.38  24 x [(97)m	Jun so that tim 0.44 562.08 14.60 603.94 n - (95)m] x 0.00	Jul = (93)m ar 0.28  348.76  16.90  356.72 (41)m 0.00	20.09  Aug nd recalculat  0.29  348.02  16.90  356.54	Sep e the utili  0.49  573.53  14.30  632.24	Oct sation facto  0.69  754.32  10.80  977.35  165.94  8)15, 10	Nov or for gains 0.84 801.51 7.00 1317.89 371.79	Dec using Table 0.88 801.56 4.90 1507.50 525.22 2637.44	9a) (94) (95) (96) (97)

Space	heating:
-------	----------

Fraction of space heating from secondary/supplementary system (Table 11)

Fraction of space heating from main system(s) 1 - (201)

Fraction of main heating from main system  ${\bf 2}$ 

0.00	(201)
1.00	(202)
0.00	(203)

Fraction of total sp	ace heat f	om main s	vstem 1 (20	)2) x [1 - (2)	03)]				1.00	(204)		
Fraction of total sp									0.00	(205)		
Efficiency of main s				, (,					93.00	(206)		
(from database or				ropriate by	the amoui	nt shown in	the 'space	efficiency of	adjustment	_	ole 4c)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov De	<b>c</b>
Space heating requ	uirement, k	:Wh/month	(as calcula	ted above)								
(98)m	539.61	404.08	328.60	204.35	97.86	0.00	0.00	0.00	0.00	165.94 3	71.79 525.2	22
Space heating fuel												
(211)m	580.23	434.49	353.33	219.73	105.22	0.00	0.00	0.00	0.00		99.78 564.	
						7	Total per ye	ar (kWh/ye	ear) = ∑(211	1)15, 1012 =	= 2835.96	(211)
Water heating:												
Output from water		1	· ·	· · · · · · · · · · · · · · · · · · ·	405.72	166.72	460.05	475 50	474.07	405.02	06.25 220	24
(64)m	226.03	199.45	210.00	188.99	185.73	166.72	160.85	175.50	174.87	!	06.25   220.8	
Efficiency of water	h t									∑(64)112 =	= 2311.17	(64)
Efficiency of water (217)m	86.55	86.16	85.50	84.52	82.69	79.30	79.30	79.30	79.30	83.87 8	35.87 86.5	i.4
Fuel for water heat					62.03	79.30	79.30	79.30	79.30	05.87	55.67   60.5	14
(219)m	261.15	231.50	245.61	223.60	224.61	210.24	202.83	221.31	220.52	233.61 24	40.20 255.:	18
(===),			2.0.01							= Σ(219)112 =		=
								, pe. yea. (.	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	2(223/22	2770.00	(===)
Annual Totals Sum	ımarv:									kWh/year	kWh/yea	r
Space heating fuel	-	n svstem 1								.,	2835.96	
Water heating fuel		<b>,</b>									2770.35	== ` '
Electricity for pum		nd electric l	keep-hot (T	able 4f):								
mechanical ven	-				nput from (	outside				79.42		(230a)
warm air heatin			.,							0.00	7	(230b)
central heating	pump									130.00		(230c)
oil boiler pump										0.00		(230d)
boiler flue fan										45.00	$\downarrow$	(230e)
maintaining ele		-	for gas com	nbi boiler						0.00	$\dashv$	(230f)
pump for solar v Total electricity for		_								0.00 Σ(230a)(230g	) 254.42	(230g) (231)
Total electricity for	the above	:							•	<u> </u>	) 234.42	(231)
Electricity for lighti	ing (calcul	ated in Apr	endix L):								420.57	(232)
Energy saving/gen				es M, N and	I Q):							, ` ,
Electricity generate					•						-998.32	(233)
10a. Fuel costs - I	ndividual l	neating sys	tems includ	ling micro-	СНР							
					Fuel	kWh/year			iel price able 12)		Fuel cost £/	year
Space heating - ma	in system	1			2	835.96	] x		3.10	x 0.01 =	87.91	(240)
Water heating cost	t (other fue	el)			2	770.35	] x		3.10	x 0.01 =	85.88	(247)
Pumps, fans and el	ectric keep	o-hot			2	254.42	] x		11.46	x 0.01 =	29.16	(249)
Energy for lighting					4	120.57	] x		11.46	x 0.01 =	48.20	(250)
Additional standing	g charges (	Table 12)									106.00	(251)
Energy saving/gen	eration te	chnologies	(Appendice	es M, N and	I Q):							
PV savings (neg	ative quan	tity)			-!	998.32	] x		11.46	x 0.01 =	-114.41	(252)
Total energy cost								(	240)(242	2) + (245)(254	) 242.74	(255)
11. 640	las al table de	h a a t' a ————		di	CLID							
11a. SAP rating - I			tems inclu	uing micro-	СНР							(0=6)
Energy cost deflato	or (Table 12	<u> </u>									0.47	(256)
										URN: 13-0	110-03 Plannin	g version 1

Energy cost factor (ECF)			[(255) x (256)]	÷ [(4) + 45.0] =	0.75	(257)
SAP value					89.53	
SAP rating					90	(258)
SAP band					В	
12a. Carbon dioxide emissions - Individual heating systems included in the control of the contro						
	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	2835.96	x	0.198	=	561.52	(261)
Water heating	2770.35	x	0.198	=	548.53	(264)
Space and water heating			(261) + (262) +	(263) + (264) =	1110.05	(265)
Pumps, fans and electric keep-hot	254.42	х	0.517	=	131.54	(267)
Lighting	420.57	x	0.517	=	217.44	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-998.32	x	0.529	=	-528.11	(269)
Total carbon dioxide emissions				∑(261)(271) =	930.91	(272)
Dwelling carbon dioxide emissions rate				(272) ÷ (4) =	8.70	(273)
El value					91.79	
El rating (see section 14)					92	(274)
El band					А	
13a. Primary energy - Individual heating systems including micro	-СНР					
	Energy kWh/year		Primary Energy Factor		Primary Energy	
Space heating - main system 1	2835.96	х	1.02	=	2892.68	(261*)
Water heating	2770.35	x	1.02	=	2825.76	(264*)
Space and water heating		(2	261*) + (262*) + (2	63*) + (264*) =	5718.44	(265*)

254.42

420.57

-998.32

Pumps, fans and electric keep-hot

Total primary energy kWh/year

Primary energy kWh/m2/year

Energy saving/generation technologies:

PV primary energy savings (negative quantity)

Lighting

2.92

2.92

2.92

∑(261\*)...(271\*) =

(272\*) ÷ (4) = [

742.91

1228.08

-2915.09

4774.33

44.62

(267\*)

(268\*)

(269\*)

(272\*)

(273\*)

# Code for Sustainable Homes (November 2010) Design - Draft

CO₂ reduction as % of TER

Total CO<sub>2</sub> emissions

Net CO<sub>2</sub> emissions

Assessment of Ene 1 (level 6) DER from SAP 2009 DER worksheet

CO<sub>2</sub> emissions from appliances (equation L14)

Additional allowable generation and its CO2 emissions offset

CO<sub>2</sub> emissions offset from additional allowable generation

CO<sub>2</sub> emissions offset from community biofuel CHP systems

CO<sub>2</sub> emissions from cooking (equation L16)



### This report details the calculations and results for Ene 1, 2 and 7 of the Code For Sustainable Homes.

This Design Assessment has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed. Code calculations are from the Technical Guide (November 2010).

22.9

Assessor name	Mr Stuart Searle		Assessor num	ber	2435
Client			Last modified		01/02/2013
Address	P04 4 St Augustines, Lo	ndon, NW1			
Building regulation assessi	ment - criterion 1				
					kg/m²/yr
DER					12.12
TER					15.73
Assessment of zero carbor	n home and low or zero o	arbon technologies			
				Credits	Level
Dwelling emission rate (Ene	1)	CO <sub>2</sub> reduction = 22.9 %		2.7	3
Fabric Energy Efficiency		FEE = 45.6		3.7	
Low or zero carbon technolo	ogies (Ene 7)	CO <sub>2</sub> reduction = 13 %		1	
Ene 1 - dwelling emission r	ate				
			%	kWh/m²	kgCO₂/m²/yr
Assessment of Ene 1 (level :	1-5)				
DER from SAP 2009 DER wo	rksheet				12.12
Additional allowable genera	tion			0.00	
CO₂ emissions offse	et from generation				0.00
CO <sub>2</sub> emissions offse	et from community biofu	el CHP systems			0.00
Total CO₂ emissions offset fr	om SAP section 16 allow	ances			0.00
DER accounting for SAP sect	ion 16 allowances				12.12
CO₂ reduction compared to	TER				3.61

0.00

SAP version 9.90

12.12

16.21

2.23

30.55

0.00

0.00

30.55

(ZC1)

(ZC2)

(ZC3)

(ZC4)

(ZC6)

(ZC7)

(ZC5)

(ZC8)

#### Ene 1 - dwelling emission rate - level 6 There is no Zero Carbon Home definition in the current technical guide Criterion Value Pass/Fail FEE <= 39 45.6 Fail Net CO<sub>2</sub> emissions <= 0.00 30.55 Fail Result: Not level 6 Number of credits for Ene 1 2.7 Ene 2 - Fabric Energy Efficiency 45.6 FEE Number of credits for Ene 2 3.7 Ene 7 - low or zero carbon technologies **Emissions** Reduction kgCO₂/yr kgCO<sub>2</sub>/yr Standard case 1172.98 Space and water heating (265) Mechanical cooling (266) 0.00 Pumps and fans (267) 121.17 Lighting (268) 178.62 Appliances and cooking 1474.62 Total CO₂ 2947.40 **Actual case** Space and water heating (265) or (376) 1172.98 Space and water heating from LZCT considered in SAP 2009 0.00 Pumps and fans (267) or (378) 121.17 Pumps and fans 0.00 Electricity generated by LZCT (269) + (380)) -395.06 Additional allowable electricity generation considered in SAP 2009 section 16 0.00 Offset from biofuel CHP $[-1 \times [(363)..(366) + (368)...(372)]]$ 0.00 LZCT electricity generation -395.06 LZCT thermal generation 0 Total from specified LZCT -395.06 **Emissions** $kgCO_2/m^2/yr$ Reduction in CO<sub>2</sub> Emissions Standard Case CO<sub>2</sub> 36.84

31.90

13

1

Actual Case CO2

% Reduction in CO<sub>2</sub>

Number of credits for Ene 7

# DER 2009 Worksheet

### Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P04 4 St Augustines, London, NW1		

1. Overall dwelling dimensio	ns						
		Area (m²)		Average stor height (m)	•	Volume (m³)	
Lowest occupied		80.00	(1a) x	2.60	(2a) =	208.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)(1n) = [	80.00	(4)				
Dwelling volume				(3a) + (3b) +	(3c) + (3d)(3n) =	208.00	(5)
2. Ventilation rate							
						m³ per hour	
Number of chimneys				0	x 40 =	0	(6a)
Number of open flues				0	x 20 =	0	(6b)
Number of intermittent fans				0	x 10 =	0	(7a)
Number of passive vents				0	x 10 =	0	(7b)
Number of flueless gas fires				0	x 40 =	0	(7c)
						Air changes pe hour	er
Infiltration due to chimneys, fl	ues, fans, PSVs	(6a) + (6b) + (7a	) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)
If a pressurisation test has bee	en carried out or is intended, proceed to	o (17), otherwise	continue from	(9) to (16)			
Air permeability value, q50, ex	pressed in cubic metres per hour per	square metre of	envelope area			5.00	(17)
If based on air permeability va	lue, then (18) = $[(17) \div 20] + (8)$ , other	wise (18) = (16)				0.25	(18)
Air permeability value applies	if a pressurisation test has been done,	or a design or s <sub>i</sub>	ecified air pern	neability is bei	ng used		
Number of sides on which dwe	elling is sheltered					2	(19)
Shelter factor					1 - [0.075 x (19)] =	0.85	(20)
Adjusted infiltration rate					(18) x (20) =	0.21	(21)
Infiltration rate modified for m	nonthly wind speed:						

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average v	Monthly average wind speed from Table 7												
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1	.12 =	54.10	(22)
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	1.20	1.27	]
										∑(22a)1	.12 =	13.52	(22a)
Adjusted infiltration	on rate (allo	wing for sh	nelter and v	wind speed	) = (21) × (2	2a)m							

0.20

0.22

0.24

(22b)m 0.29 0.27 0.27 0.24 0.22 0.21 0.20

Σ(22b)112 =	2.87	(22b)
2(220)112	2.07	(220)

0.26

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system

0.5 (23a)

0.27

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

If balanced with I	heat reco	very: effici	ency in % a	llowing for	in-use fact	or (from Ta	ble 4h) =					N/A	(23c)
c) If whole house if (22b)m < 0.!				•			3h)						
(24c)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(24c)
Effective air change		I.				1	0.50	0.50	0.50	0.50	0.50	0.52	(240)
(25)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(25)
(23)111	0.54	0.52	0.32	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	] (23)
3. Heat losses and	heat loss	paramete											
The κ-value is the he	at capaci	ity per unit	area, see 1	able 1e.									
Elem	nent		Gross	Oper	nings,	Net area	U-va	alue,	A x U,	K-va	ılue,	Α x κ,	
			Area, m <sup>2</sup>	n	1 <sup>2</sup>	A, m²	W/	m²K	W/K	kJ/ı	m².K	kJ/K	
Doors						2.10	x 1.	60 =	3.36	N	/A	N/A	(26)
Window*						8.68	x 1.	15 =	9.94	N	/A	N/A	(27)
Window*						13.99	x 1.	33 =	18.55	N	/A	N/A	(27)
External wall						50.79	x 0.	20 =	10.16	N	/A	N/A	(29a)
Party Wall						33.80	x 0.	00 =	0.00	N	/A	N/A	(32)
Total area of externa	al elemen	its ∑A, m²				75.56	(31)						
* for windows and ro	oof windo	ows, effecti	ve window	U-value is	calculated	using formเ	ıla 1/[(1/U	Value)+0.0	4] paragrap	oh 3.2			
Fabric heat loss, W/H	K = ∑(A ×	U)							(2	6)(30) + (	32) =	42.01	(33)
Heat capacity Cm = 2	∑(Ахк)							(28)	(30) + (32)	+ (32a)(3	2e) =	N/A	(34)
Thermal mass param	neter (TM	1P) in kJ/m²	K						Calculat	ted separat	ely =	100.00	(35)
Thermal bridges: ∑(L	_x Ψ) calo	culated usir	ng Appendi	хK								10.02	(36)
if details of therm	nal bridgi	ng are not	known the	n (36) = 0.1.	5 x (31)								_
Total fabric heat loss	S									(33) + (	36) =	52.03	(37)
Ventilation heat loss	calculate	ed monthly	0.33 x (2	5)m x (5)									
(38)m	36.85	35.76	35.76	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.66	35.76	(38)
Heat transfer coeffic	cient, W/I	K (37)m+	(38)m										
(39)m	88.88	87.79	87.79	86.35	86.35	86.35	86.35	86.35	86.35	86.35	86.69	87.79	
									Average = 2	∑(39)112,	/12 =	86.95	(39)
Heat loss parameter	(HLP), W	//m²K (39)	m ÷ (4)										
(40)m	1.11	1.10	1.10	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.10	
									Average = 2	∑(40)112,	/12 =	1.09	(40)
4. Water heating e	nergy rec	quirement											
												Wh/year	
Assumed occupancy										2.46	(42	)	
If TFA > 13.9, N =		x [1 - exp(-	0.000349 x	(TFA - 13.9	) <sup>2</sup> )] + 0.001	L3 x (TFA - 1	13.9)						
If TFA ≤ 13.9, N =	1												
Annual average hot		-		_						92.69	,		
Annual average hot		-		by 5% if the	e dwelling i	is designed	to achieve	a water us	e target of	not more th	nan 125 lit	res	
per person per day (	all water	use, hot an	d cold)										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in li	-			1			00.10	0= 10				1	7
(44)m	101.96	98.25	94.55	90.84	87.13	83.42	83.42	87.13	90.84	94.55	98.25	101.96	]
_						_				∑(44)1	.12 =	1112.32	(44)
Energy content of ho		i		1	i	1		· · · · · ·	1		125.47	146.70	٦
(45)m	151.57	132.56	136.79	119.26	114.43	98.75	91.50	105.00	106.26	123.83	135.17	146.79	] ]
If in about two			<b>-£</b> / '			tan O ta 1	(46): '	C4)		∑(45)1	.12 =	1461.91	(45)
If instantaneous wat For community heat		-						01)					
i or community near	ing menul	יב מוסנו ושענ	OII IUSS WII	carer or 110	i noi watel	turik is pre	Jene						

Distribution loss	0.15 x (45)n	n					•						
(46)m	22.74	19.88	20.52	17.89	17.16	14.81	13.73	15.75	15.94	18.57	20.28	22.02	(46)
Water storage lo	ss:									_			
a) If manufacture	er's declared	loss factor	is known (I	kWh/day):					1.85	(47)			
Temperature	factor from	Table 2b							0.54	(48)			
Energy lost fr	om water st	orage, kW	h/day (47)	) x (48)					1.00	(49)			
Enter (49) or (54)	in (55)								1.00	(55)			
Water storage lo	ss calculated	d for each n	nonth = (55	) x (41)m									
(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)
If cylinder contai	ns dedicated	d solar stora	nge, = (56)n	n x [(50) - (I	H11)] ÷ (50)	, else = (56	i)m where (	H11) is from	n Appendi	хН			
(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)
Primary circuit lo	ss (annual) 1	from Table	3						360.00	(58)			
Primary circuit lo	ss for each r	month (58)	÷ 365 × (41	.)m									
(modified by fact	or from Tab	le H5 if the	re is solar v	vater heatii	ng and a cy	linder ther	mostat)						
(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 for ea	ich month fr	om Table 3	a, 3b or 3c	(enter '0' if	not a com	bi boiler)							
(61)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requir	ed for water	heating ca	lculated fo	r each mon	th 0.85 × (4	15)m + (46)	m + (57)m ·	+ (59)m + (6	61)m				
(62)m	213.11	188.15	198.34	178.82	175.98	158.31	153.05	166.55	165.81	185.37	194.73	208.33	(62)
Solar DHW input	calculated u	ising Appen	dix H (nega	ative quant	ity) ('0' ente	ered if no s	olar contrib	oution to w	ater heatin	ıg)			
(63)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
										∑(63)1	.12 =	0.00	(63)
Output from wat	er heater fo	r each mon	th, kWh/m	onth (62)n	n + (63)m								
(64)m	213.11	188.15	198.34	178.82	175.98	158.31	153.05	166.55	165.81	185.37	194.73	208.33	
										∑(64)1	.12 = 2	186.55	(64)
if (64)m < 0 then	set to 0												
Heat gains from	water heatir	ng, kWh/mo	onth 0.25 ×	[0.85 × (45	5)m + (61)m	n] + 0.8 × [(4	46)m + (57)	m + (59)m]					
(65)m	99.63	88.55	94.72	87.30	87.28	80.48	79.66	84.15	82.98	90.41	92.59	98.04	(65)
include (5)	7)m in calcul	ation of (65	m only if	cylinder is in	n the dwelli	ng or hot w	vater is fror	n communi	ty heating				

5. Internal gains	(see Table	5 and 5a)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (1	Гable 5), Wa	itts											
(66)m	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	19.56	17.38	14.13	10.70	8.00	6.75	7.30	9.48	12.73	16.16	18.86	20.11	(67)
Appliances gains (	calculated i	n Appendix	L, equatio	n L13 or L1	3a), also se	e Table 5							
(68)m	219.44	221.72	215.98	203.76	188.34	173.85	164.17	161.89	167.63	179.84	195.27	209.76	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	(69)
Pumps and fans g	ains (Table !	5a)											
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evapor	ration (nega	tive values	) (Table 5)										
(71)m	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	(71)
Water heating gains (Table 5)													
(72)m	133.91	131.77	127.31	121.25	117.32	111.78	107.07	113.10	115.25	121.52	128.60	131.78	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	442.86	440.80	427.36	405.66	383.60	362.32	348.48	354.42	365.54	387.47	412.67	431.58	(73)

### 6. Solar gains

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11)

Fraction of space heating from main system(s) 1 - (201)

Fraction of main heating from main system  ${\bf 2}$ 

		totals are	shown belo	· · ·								
	Access factor Table 6d	or	Area m²	So	lar flux W/	m² g	Specific data or Table 6b	a F	F Specific da or Table 6c		Gains (W)	
West	0.54	] x	8.68	х	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
Northwest	0.54	] x	13.99	х	11.51	x 0.9 x	0.63	x	0.80	=	39.45	(81)
Solar gains in watts, calcula	ted for each	month ∑(7	4)m(82)m									
(83)m 81.70	162.64	271.87	426.75	544.17	580.96	558.21	466.95	332.15	201.19	102.32	66.94	(83)
Total gains - internal and so	lar (73)m + (	83)m										_
(84)m 524.57	603.44	699.23	832.40	927.77	943.28	906.68	821.37	697.69	588.66	514.99	498.52	(84)
7. Mean internal tempera	turo (hoatin	r coacon)										
		-	f	blo O That's	(C)						24.00	7 (05)
Temperature during heating		_				11		Carr	0-4	N.	21.00	(85)
Jan Utilisation factor for gains for	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m 0.96	0.94	0.89	0.81	0.68	0.52	0.37	0.40	0.66	0.86	0.94	0.96	(86)
Mean internal temp of living		1		0.00	0.32	0.57	0.40	0.00	0.00	0.54	0.50	] (00)
(87)m 18.82	19.09	19.59	20.12	20.60	20.86	20.96	20.95	20.73	20.14	19.33	18.87	(87)
Temperature during heating		1				20.50		20175		23.33	1 20.07	] (0.)
(88)m 19.99	20.01	20.01	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.01	(88)
Utilisation factor for gains for	_											] (,
(89)m 0.95	0.93	0.88	0.79	0.63	0.46	0.29	0.32	0.60	0.83	0.93	0.95	(89)
Mean internal temperature		1										] (,
(90)m 17.08	17.49	18.19	18.94	19.58	19.89	20.00	19.99	19.76	18.99	17.84	17.17	(90)
Living area fraction								1.30	÷ (4) =		0.39	(91)
Mean internal temperature	for the who	le dwelling	fLA x T1 +(1	L - fLA) x T2								] (0 = /
(92)m 17.76	18.11	18.74	19.40	19.98	20.27	20.37	20.37	20.14	19.44	18.43	17.84	(92)
Apply adjustment to the me	an internal t	temperatur	e from Tabl	e 4e, wher	e appropria	ate						
(93)m 17.61	17.96	18.59	19.25	19.83	20.12	20.22	20.22	19.99	19.29	18.28	17.69	(93)
8. Space heating requirem	ent											
o. Space fleating requirem												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Jan Set Ti to the mean internal	<b>Feb</b> temperature			-				-				e 9a)
Jan Set Ti to the mean internal Utilisation factor for gains,	Feb temperature	obtained a	t step 11 of	f Table 9b,	so that tim	= (93)m aı	nd recalculate	e the utili	isation facto	r for gains	using Table	_
Jan Set Ti to the mean internal Utilisation factor for gains, (94)m 0.93	Feb temperature nm 0.91	obtained a		-				-				e 9a) (94)
Jan  Set Ti to the mean internal to tilisation factor for gains, (94)m  Useful gains, ηmGm, W = (94)	Feb temperature nm 0.91 4)m x (84)m	obtained a	ot step 11 of	0.62	so that tim	= (93)m ar 0.31	nd recalculate	e the utili	0.81	r for gains 0.91	using Table	(94)
Jan  Set Ti to the mean internal (Utilisation factor for gains, (94)m 0.93  Useful gains, ηmGm, W = (95)m 488.30	Feb temperature nm 0.91 4)m x (84)m 546.43	0.85 595.78	0.76 635.04	f Table 9b,	so that tim	= (93)m aı	nd recalculate	e the utili	isation facto	r for gains	using Table	_
Jan  Set Ti to the mean internal to tilisation factor for gains, (94)m 0.93  Useful gains, ηmGm, W = (96)m 488.30  Monthly average external to the control of the control o	Feb temperature nm 0.91 4)m x (84)m 546.43 emperature	obtained a  0.85  595.78  from Table	0.76 635.04	0.62 577.69	0.46 436.55	= (93)m ar 0.31 278.22	0.34 275.45	0.59 414.22	0.81 473.98	0.91 467.66	0.93 465.59	(94)
Jan  Set Ti to the mean internal (94)m  Useful gains, ηmGm, W = (96)m  Monthly average external to (96)m  Jan  0.93  488.30  488.30	Feb temperature 0.91 4)m x (84)m 546.43 emperature 5.00	0.85  595.78  from Table 6.80	0.76 635.04 8 8.70	0.62	so that tim	= (93)m ar 0.31	nd recalculate	e the utili	0.81	r for gains 0.91	using Table	(94)
Jan  Set Ti to the mean internal to tilisation factor for gains, 194)m  Useful gains, 196, W = (95)m  488.30  Monthly average external to (96)m  4.50  Heat loss rate for mean internal to the factor of the factor	Feb temperature nm 0.91 4)m x (84)m 546.43 emperature 5.00 ernal temper	0.85 595.78 from Table 6.80 ature, Lm, V	0.76 0.76 635.04 8 8.70	0.62 577.69	0.46 436.55 14.60	= (93)m ar 0.31 278.22 16.90	0.34 275.45 16.90	0.59 414.22 14.30	0.81 473.98	0.91 467.66 7.00	0.93 465.59	(94) (95) (96)
Jan  Set Ti to the mean internal of the second of the seco	Feb temperature  1 0.91 4)m x (84)m 546.43 temperature 5.00 trinal temperature 1 1138.11	0.85  595.78  from Table 6.80  ature, Lm, V	0.76  635.04  8  8.70  W  910.93	577.69 11.70	0.46 436.55 14.60	= (93)m ar 0.31 278.22 16.90 286.96	0.34 275.45	0.59 414.22	0.81 473.98	0.91 467.66	0.93 465.59	(94)
Jan  Set Ti to the mean internal of the set of the mean internal of the set o	Feb temperature 10.91 4)m x (84)m 546.43 temperature 5.00 trinal temperature 1138.11 for each mo	0.85  595.78  from Table 6.80  ature, Lm, V 1034.80  nth, kWh/n	0.76  635.04  8  8.70  W  910.93  nonth = 0.0	701.73 24 x [(97)m	0.46 436.55 14.60 476.67 1 - (95)m] x	= (93)m ar 0.31 278.22 16.90 286.96 (41)m	0.34 275.45 16.90 286.33	0.59 414.22 14.30 491.14	0.81 473.98 10.80	0.91 467.66 7.00	using Table  0.93  465.59  4.90  1122.56	(94) (95) (96)
Jan  Set Ti to the mean internal of the second of the seco	Feb temperature  1 0.91 4)m x (84)m 546.43 temperature 5.00 trinal temperature 1 1138.11	0.85  595.78  from Table 6.80  ature, Lm, V	0.76  635.04  8  8.70  W  910.93	577.69 11.70	0.46 436.55 14.60 476.67 1 - (95)m] x 0.00	= (93)m ar 0.31 278.22 16.90 286.96 (41)m 0.00	0.34   275.45   16.90   286.33   0.00	0.59 414.22 14.30 491.14	0.81 473.98 10.80 732.96	7.00 977.64	0.93 465.59 4.90 1122.56	] (94) ] (95) ] (96) ] (97)
Jan  Set Ti to the mean internal of the set of the mean internal of the set o	Feb temperature 1 0.91 4)m x (84)m 546.43 emperature 5.00 ernal tempera 1138.11 for each mo 397.61	0.85  595.78  from Table  6.80  ature, Lm, N  1034.80  nth, kWh/n  326.63	0.76  635.04  8  8.70  W  910.93  nonth = 0.0	701.73 24 x [(97)m	0.46 436.55 14.60 476.67 1 - (95)m] x 0.00	= (93)m ar 0.31 278.22 16.90 286.96 (41)m 0.00	0.34 275.45 16.90 286.33	0.59 414.22 14.30 491.14	0.81 473.98 10.80 732.96 192.68 8)15, 10	7.00 977.64 367.18	using Table  0.93  465.59  4.90  1122.56  488.78	(94) (95) (96) (97)
Jan  Set Ti to the mean internal of the set of the mean internal of the set o	Feb temperature 1 0.91 4)m x (84)m 546.43 emperature 5.00 ernal tempera 1138.11 for each mo 397.61	0.85  595.78  from Table  6.80  ature, Lm, N  1034.80  nth, kWh/n  326.63	0.76  635.04  8  8.70  W  910.93  nonth = 0.0	701.73 24 x [(97)m	0.46 436.55 14.60 476.67 1 - (95)m] x 0.00	= (93)m ar 0.31 278.22 16.90 286.96 (41)m 0.00	0.34   275.45   16.90   286.33   0.00	0.59 414.22 14.30 491.14	0.81 473.98 10.80 732.96	7.00 977.64 367.18	0.93 465.59 4.90 1122.56	] (94) ] (95) ] (96) ] (97)

0.00	(203)

(201)

(202)

0.00 1.00

Fraction of total space heat from main system 1 (202) x [1 - (203)] 1.00 (204)	
Fraction of total space heat from main system 2 (202) x (203) 0.00 (205)	
Efficiency of main space heating system 1 (%) 93.00 (206)	
(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Tab	ole 4c)
, ,	Nov Dec
Space heating requirement, kWh/month (as calculated above)	
	67.18 488.78
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)	
	94.82 525.57
Total per year (kWh/year) = ∑(211)15, 1012 =	= 2760.80 (211)
Water heating:	
Output from water heater, kWh/month (calculated above)	
	94.73 208.33
$\Sigma$ (64)112 :	= 2186.55 (64)
Efficiency of water heater per month	
	85.98 86.51
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m	
	26.48 240.81
Total per year (kWh/year) = $\sum (219)112$	= 2618.88 (219)
Annual Totals Summary: kWh/year	kWh/year
Space heating fuel used, main system 1	2760.80 (211)
Water heating fuel used	2618.88 (219)
Electricity for pumps, fans and electric keep-hot (Table 4f):	
mechanical ventilation fans - balanced, extract or positive input from outside 59.38	(230a)
warm air heating system fans 0.00	(230b)
central heating pump 130.00	(230c)
oil boiler pump	(230d)
boiler flue fan 45.00 maintaining electric keep-hot facility for gas combi boiler 0.00	(230e) (230f)
pump for solar water heating 0.00	(230g)
Total electricity for the above Σ(230a)(230g	
2(2500)(2500)	,
Electricity for lighting (calculated in Appendix L):	345.49 (232)
Energy saving/generation technologies (Appendices M, N and Q):	
Electricity generated by PVs (Appendix M) (negative quantity)	-746.81 (233)
Electricity generated by 1 vo (Appendix III) (negative quantity)	7 10.01
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP	
Energy Emissions	Emissions
kWh/year Factor	(kgCO2/year)
Space heating - main system 1 2760.80 x 0.198 =	546.64 (261)
Water heating 2618.88 x 0.198 =	518.54 (264)
Space and water heating (261) + (262) + (263) + (264)	= 1065.18 (265)
Pumps, fans and electric keep-hot 234.38 x 0.517 =	121.17 (267)
Lighting 345.49 x 0.517 =	178.62 (268)
Energy saving/generation technologies:	
PV emission savings (negative quantity) -746.81 x 0.529 =	-395.06 (269)
Total carbon dioxide emissions $\Sigma(261)(271)$ :	
Dwelling Carbon Dioxide Emissions Rate (DER)	12.12 (273)

# SAP 2009 Worksheet

## Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P04 4 St Augustines, London, NW1		

1. Overall dwelling dime	nsions				
		Area (m²)	Average storey height (m)	Volume (m³)	
Lowest occupied		80.00 (1a) x	2.60 (2a) =	208.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)(1n) =	80.00 (4)			
Dwelling volume			(3a) + (3b) + (3c) + (3d)(3n)	= 208.00	(5)
2. Ventilation rate					
				m³ per hour	
Number of chimneys			0 x 40 =	0	(6a)
Number of open flues			0 x 20 =	0	(6b)
Number of intermittent fa	ns		0 x 10 =	0	(7a)
Number of passive vents			0 x 10 =	0	(7b)
Number of flueless gas fire	25		0 x 40 =	0	(7c)
				Air changes pe hour	er
Infiltration due to chimney	rs, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c)	= 0 ÷ (5) =	0.00	(8)
If a pressurisation test has	been carried out or is intended, proceed	to (17), otherwise continue from	m (9) to (16)		
Air permeability value, q50	), expressed in cubic metres per hour per	square metre of envelope area	a	5.00	(17)
If based on air permeabilit	y value, then (18) = $[(17) \div 20] + (8)$ , othe	rwise (18) = (16)		0.25	(18)
Air permeability value app	lies if a pressurisation test has been done	, or a design or specified air pe	rmeability is being used		
Number of sides on which	dwelling is sheltered			2	(19)
Shelter factor			1 - [0.075 x (19)]	= 0.85	(20)
Adjusted infiltration rate			(18) x (20)	= 0.21	(21)
Infiltration rate modified f	or monthly wind speed:				

Infiltration rate m	odified for	monthly wi	nd speed:										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average	wind speed	from Table	· 7										
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1	.12 =	54.10	(22)
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	1.20	1.27	
										∑(22a)1	.12 =	13.52	(22a)
Adjusted infiltration	on rate (allo	owing for sh	nelter and v	vind speed	) = (21) × (2	.2a)m							
(22b)m	0.29	0.27	0.27	0.24	0.22	0.21	0.20	0.20	0.22	0.24	0.26	0.27	
										Σ(22b)1	.12 =	2.87	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system

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

(23a)

If balanced with I	heat reco	very: effici	ency in % a	llowing for	in-use fact	or (from Ta	ble 4h) =					N/A	(23c)
c) If whole house if (22b)m < 0.!				•			3h)						
(24c)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(24c)
Effective air change		I.				1	0.50	0.50	0.50	0.50	0.50	0.52	(240)
(25)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(25)
(23)111	0.54	0.52	0.32	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	] (23)
3. Heat losses and	heat loss	paramete											
The κ-value is the he	at capaci	ity per unit	area, see 1	able 1e.									
Elem	nent		Gross	Oper	nings,	Net area	U-va	alue,	A x U,	K-va	ılue,	Α x κ,	
			Area, m <sup>2</sup>	n	1 <sup>2</sup>	A, m²	W/	m²K	W/K	kJ/ı	m².K	kJ/K	
Doors						2.10	x 1.	60 =	3.36	N	/A	N/A	(26)
Window*						8.68	x 1.	15 =	9.94	N	/A	N/A	(27)
Window*						13.99	x 1.	33 =	18.55	N	/A	N/A	(27)
External wall						50.79	x 0.	20 =	10.16	N	/A	N/A	(29a)
Party Wall						33.80	x 0.	00 =	0.00	N	/A	N/A	(32)
Total area of externa	al elemen	its ∑A, m²				75.56	(31)						
* for windows and ro	oof windo	ows, effecti	ve window	U-value is	calculated	using formเ	ıla 1/[(1/U	Value)+0.0	4] paragrap	oh 3.2			
Fabric heat loss, W/H	K = ∑(A ×	U)							(2	6)(30) + (	32) =	42.01	(33)
Heat capacity Cm = 2	∑(Ахк)							(28)	(30) + (32)	+ (32a)(3	2e) =	N/A	(34)
Thermal mass param	neter (TM	1P) in kJ/m²	K						Calculat	ted separat	ely =	100.00	(35)
Thermal bridges: ∑(L	_x Ψ) calo	culated usir	ng Appendi	хK								10.02	(36)
if details of therm	nal bridgi	ng are not	known the	n (36) = 0.1.	5 x (31)								_
Total fabric heat loss	S									(33) + (	36) =	52.03	(37)
Ventilation heat loss	calculate	ed monthly	0.33 x (2	5)m x (5)									
(38)m	36.85	35.76	35.76	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.66	35.76	(38)
Heat transfer coeffic	cient, W/I	K (37)m+	(38)m										
(39)m	88.88	87.79	87.79	86.35	86.35	86.35	86.35	86.35	86.35	86.35	86.69	87.79	
									Average = 2	∑(39)112,	/12 =	86.95	(39)
Heat loss parameter	(HLP), W	//m²K (39)	m ÷ (4)										
(40)m	1.11	1.10	1.10	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.10	
									Average = 2	∑(40)112,	/12 =	1.09	(40)
4. Water heating e	nergy rec	quirement											
												Wh/year	
Assumed occupancy										2.46	(42	)	
If TFA > 13.9, N =		x [1 - exp(-	0.000349 x	(TFA - 13.9	) <sup>2</sup> )] + 0.001	L3 x (TFA - 1	13.9)						
If TFA ≤ 13.9, N =	1												
Annual average hot		-		_						92.69	,		
Annual average hot		-		by 5% if the	e dwelling i	is designed	to achieve	a water us	e target of	not more th	nan 125 lit	res	
per person per day (	all water	use, hot an	d cold)										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in li	-			1			00.10	0= 10				1	7
(44)m	101.96	98.25	94.55	90.84	87.13	83.42	83.42	87.13	90.84	94.55	98.25	101.96	]
_						_				∑(44)1	.12 =	1112.32	(44)
Energy content of ho		i		1	i	1		· · · · · ·	1		125.47	146.70	٦
(45)m	151.57	132.56	136.79	119.26	114.43	98.75	91.50	105.00	106.26	123.83	135.17	146.79	] ]
If in about two			<b>-£</b> / '			tan O ta 1	(46): '	C4)		∑(45)1	.12 =	1461.91	(45)
If instantaneous wat For community heat		-						01)					
i or community near	ing menul	יב מוסנו ושענ	OII IUSS WII	carer or 110	i noi watel	turik is pre	Jene						

Distribution loss	0.15 x (45)n	n		1			1		•				7
(46)m	22.74	19.88	20.52	17.89	17.16	14.81	13.73	15.75	15.94	18.57	20.28	22.02	(46)
Water storage los	ss:									_			
a) If manufacture	r's declared	loss factor	is known (I	kWh/day):					1.85	(47)			
Temperature	factor from	Table 2b							0.54	(48)			
Energy lost fro	om water st	orage, kW	h/day (47)	) x (48)				1.00 (49)					
Enter (49) or (54)	in (55)								1.00	(55)			
Water storage los	s calculated	d for each m	nonth = (55	) x (41)m									
(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)
If cylinder contain	ns dedicated	d solar stora	nge, = (56)n	n x [(50) - (I	H11)] ÷ (50)	, else = (56	)m where (	H11) is fror	n Appendi	хН			
(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)
Primary circuit lo	ss (annual) 1	from Table	3					3	360.00	(58)			
Primary circuit lo	ss for each r	month (58)	÷ 365 × (41	.)m									
(modified by fact	or from Tab	le H5 if the	re is solar v	vater heatii	ng and a cyl	inder ther	mostat)						
(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 for ea	ch month fr	om Table 3	a, 3b or 3c	(enter '0' if	not a coml	oi boiler)							
(61)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat require	ed for water	heating ca	lculated fo	r each mon	th 0.85 × (4	15)m + (46)	m + (57)m -	+ (59)m + (6	61)m				
(62)m	213.11	188.15	198.34	178.82	175.98	158.31	153.05	166.55	165.81	185.37	194.73	208.33	(62)
Solar DHW input	calculated ι	ising Appen	dix H (nega	ative quant	ity) ('0' ente	ered if no s	olar contrib	oution to wa	ater heatin	g)			
(63)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	]
										∑(63)1	.12 =	0.00	(63)
Output from wat	er heater fo	r each mon	th, kWh/m	onth (62)n	n + (63)m								
(64)m	213.11	188.15	198.34	178.82	175.98	158.31	153.05	166.55	165.81	185.37	194.73	208.33	]
										∑(64)1	.12 = 2	186.55	(64)
if (64)m < 0 then	set to 0												
Heat gains from v	vater heatir	ng, kWh/mo	onth 0.25 ×	[0.85 × (45	5)m + (61)m	n] + 0.8 × [(4	46)m + (57)	m + (59)m]					
(65)m	99.63	88.55	94.72	87.30	87.28	80.48	79.66	84.15	82.98	90.41	92.59	98.04	(65)
include (57	)m in calcul	ation of (65	m only if a	vlinder is i	the dwelli	na or hot w	vater is fron	n communi	tv heatina				_

5. Internal gains	(see Table	5 and 5a)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (1	Гable 5), Wa	atts											
(66)m	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	48.91	43.44	35.33	26.75	19.99	16.88	18.24	23.71	31.82	40.40	47.15	50.27	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	327.52	330.92	322.36	304.12	281.11	259.48	245.03	241.63	250.19	268.42	291.44	313.07	(68)
Cooking gains (cal	culated in A	Appendix L,	equation L	15 or L15a)	, also see T	able 5							
(69)m	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	(69)
Pumps and fans g	ains (Table !	5a)											
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evapor	ration (nega	ative values	) (Table 5)										
(71)m	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	(71)
Water heating gai	ns (Table 5)	)											
(72)m	133.91	131.77	127.31	121.25	117.32	111.78	107.07	113.10	115.25	121.52	128.60	131.78	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	621.84	617.63	596.49	563.62	529.92	499.63	481.83	489.93	508.75	541.84	578.69	606.61	(73)

### 6. Solar gains

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January	y and annual totals a	re shown belo	w:								
	Access factor Table 6d	Area m²	So	olar flux W/	m² g	Specific data or Table 6b	a F	F Specific da or Table 6c	ta	Gains (W)	
West	0.54 x	8.68	x	19.87	x 0.9 x	0.63	х	0.80	=	42.25	(80)
Northwest	0.54 x	13.99	] x	11.51	x 0.9 x	0.63	x	0.80	=	39.45	(81)
Solar gains in watts, calculat	ted for each month 2	(74)m(82)m	1								
(83)m 81.70	162.64 271.8	7 426.75	544.17	580.96	558.21	466.95	332.15	201.19	102.32	66.94	(83)
Total gains - internal and so	lar (73)m + (83)m										
(84)m 703.55	780.26 868.3	6 990.37	1074.09	1080.59	1040.04	956.89	840.90	743.03	681.01	673.55	(84)
7. Mean internal temperat	ture (heating season	)									
Temperature during heating			ble 9, Th1('	°C)						21.00	(85)
Jan	Feb Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	-
Utilisation factor for gains for	or living area, η1,m (	see Table 9a)									
(86)m 0.92	0.90 0.84	0.76	0.62	0.47	0.33	0.35	0.58	0.79	0.90	0.92	(86)
Mean internal temp of living	g area T1 (steps 3 to	7 in Table 9c)									
(87)m 19.15	19.40 19.83	3 20.28	20.68	20.89	20.97	20.96	20.80	20.33	19.62	19.20	(87)
Temperature during heating	g periods in the living	area from Ta	ble 9, Th2('	°C)							
(88)m 19.99	20.01 20.01		20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.01	(88)
Utilisation factor for gains for	or rest of dwelling η2	.,m (see Table	9a)					•			-
(89)m 0.91	0.88 0.82		0.57	0.41	0.25	0.27	0.52	0.76	0.88	0.91	(89)
Mean internal temperature	in the rest of dwellir	ng T2 (follow s	teps 3 to 7	in Table 9c	)					•	_
(90)m 17.55	17.91 18.53		19.67	19.92	20.00	20.00	19.83	19.23	18.25	17.64	(90)
Living area fraction		<u>'</u>					1.30	÷ (4) =		0.39	(91)
Mean internal temperature	for the whole dwelli	ng flΔxT1+/	1 - fl Δ) x T2	,							_
(92)m 18.18	18.49 19.04	_	20.07	20.30	20.38	20.38	20.21	19.66	18.78	18.25	(92)
Apply adjustment to the me	an internal tempera	ture from Tab	le 4e. wher					-1			
(93)m 18.03	18.34 18.89		19.92	20.15	20.23	20.23	20.06	19.51	18.63	18.10	(93)
· · ·	-										J \
8. Space heating requirem						_				_	
Jan	Feb Mar		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	٥. ١
Set Ti to the mean internal t	•	d at step 11 o	f Table 9b,	so that tim	= (93)m ar	nd recalculate	e the util	isation facto	r for gains	using Table	e 9a)
Utilisation factor for gains, r	1	0.71	0.57	0.42	0.27	0.20	0.53	0.74	0.05	0.00	(04)
(94)m 0.88	0.86 0.80	0.71	0.57	0.42	0.27	0.29	0.52	0.74	0.85	0.89	(94)
Useful gains, $\eta$ mGm, W = (9	1 - 1 - 1	2 600.91	610.21	440 50	281.26	270.52	440.56	F46.27	F01 40	F07.6F	(05)
(95)m 622.23			610.21	448.58	281.20	279.52	440.56	546.37	581.48	597.65	(95)
Monthly average external to	1		11.70	14.60	16.00	16.00	14.20	10.00	7.00	4.00	1 (00)
(96)m 4.50	5.00 6.80		11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean inte			700.67	470.40	207.66	207.26	407.50	75240	4000.50	4450.64	7 (07)
(97)m 1202.27	· · · · · · ·		709.67	479.43	287.66	287.26	497.50	752.18	1008.60	1158.64	(97)
Space heating requirement							0.05	1 4=0 := 1	20===	44	7
(98)m 431.54	338.48 274.4	5   164.18	74.00	0.00	0.00	0.00	0.00	153.12	307.53	417.38	]
					Total per	year (kWh/ye	ear) = ∑(9		_	2160.68	<u> </u> (98)
Space heating requirement	in kWh/m²/vear							(98) -	- (4)	27.01	(99)
9a. Energy Requirements - Individual heating systems including micro-CHP											

### Space heating:

Fraction of space heating from secondary/supplementary system (Table 11)

Fraction of space heating from main system(s) 1 - (201)

Fraction of main heating from main system  ${\bf 2}$ 

0.00	(201)
1.00	(202)
0.00	(203)

Fraction of total s	pace heat f	rom main s	vstem 1 <i>(2</i> )	02) x [1 - (2	03)]				1.00	(204)		
Fraction of total s					03/]				0.00	(205)		
Efficiency of main				02) X (203)					93.00	(206)		
(from database of				ropriate by	the amoui	nt shown ir	the 'snace			_	ale 4c)	
grom database s.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	-	Nov Dec	:
Space heating req	juirement, l	kWh/month	ı (as calcula	ted above)								
(98)m	431.54	338.48	274.45	164.18	74.00	0.00	0.00	0.00	0.00	153.12	07.53 417.3	38
Space heating fue	l (main hea	ting system	1), kWh/m	onth = (98	)m x (204) >	( 100 ÷ (20	6)					
(211)m	464.03	363.96	295.10	176.54	79.57	0.00	0.00	0.00	0.00	164.65 3	30.67 448.7	79
						٦	Total per ye	ar (kWh/ye	ear) = ∑(211	1)15, 1012 :	2323.31	(211)
Water heating:												
Output from water	er heater, k	Wh/month	(calculated	l above)							į	
(64)m	213.11	188.15	198.34	178.82	175.98	158.31	153.05	166.55	165.81	!	94.73 208.3	33
										∑(64)112	2186.55	(64)
Efficiency of wate										I I .		
(217)m	86.16	85.86	85.18	84.09	82.19	79.30	79.30	79.30	79.30	83.81	85.53 86.1	3
Fuel for water hea					214.10	100.63	102.00	210.02	200.10	221.10	27.60 241.6	20
(219)m	247.35	219.14	232.85	212.66	214.10	199.63	193.00	210.02	209.10		27.68 241.8	
							Total	i per year (i	kwn/year)	= ∑(219)112 :	= 2628.60	(219)
Annual Tatala Sur										kWh/year	kWh/yea	
Annual Totals Sur	•	: <b></b> 1								KWII/ year		
Space heating fue		in system 1									2323.31	(211)
Water heating fur Electricity for pur		ا منسخمام ام	room hot /T	abla 4f\.							2628.60	(219)
	-				6					F0.20	$\neg$	(220-)
mechanical ve warm air heati			a, extract c	or positive i	nput from (	outside				59.38 0.00		(230a) (230b)
central heating		14113								130.00		(230c)
oil boiler pum										0.00		(230d)
boiler flue fan										45.00		(230e)
maintaining el	ectric keep	hot facility	for gas con	nbi boiler						0.00		(230f)
pump for solar		-								0.00		(230g)
Total electricity fo	or the above	9							2	∑(230a)(230g	) 234.38	(231)
Floresteller for the											245.40	(222)
Electricity for ligh					4.0%						345.49	(232)
Energy saving/ge					aQ):						746.04	(222)
Electricity general	ted by PVS (	Appendix N	n) (negative	e quantity)							-746.81	(233)
10a. Fuel costs -	Individual	heating sys	tems includ	ling micro-	СНР							
					Fuel	kWh/year			iel price able 12)		Fuel cost £/y	/ear
Space heating - m	ain system	1			2	323.31	x		3.10	x 0.01 =	72.02	(240)
Water heating cos	-					628.60	×		3.10	x 0.01 =	81.49	(247)
Pumps, fans and e					2	234.38	×		11.46	x 0.01 =	26.86	(249)
Energy for lighting						345.49	×		11.46	x 0.01 =	39.59	(250)
Additional standir	_	Table 12)									106.00	(251)
Energy saving/ge			(Appendice	es M, N and	d Q):							
PV savings (ne			- *	-		746.81	x		11.46	x 0.01 =	-85.58	(252)
Total energy cost		••					ı			) + (245)(254		(255)
6,								· ·	. , (= /=	, , -,(=3 .		
11a. SAP rating -	- Individual	heating sys	stems inclu	ding micro	-СНР							
Energy cost deflat	tor (Table 1	2)									0.47	(256)
										URN: 13-0	10-04 Planning	g version 1

						1
Energy cost factor (ECF)			[(255) x (256)	] ÷ [(4) + 45.0] =	0.90	(257)
SAP value					87.39	
SAP rating					87	(258)
SAP band					В	
12a. Carbon dioxide emissions - Individual heating systems inclu	ıding micro-CHP					
	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	2323.31	x	0.198	=	460.02	(261)
Water heating	2628.60	х	0.198	=	520.46	(264)
Space and water heating			(261) + (262) -	+ (263) + (264) =	980.48	(265)
Pumps, fans and electric keep-hot	234.38	х	0.517	=	121.17	(267)
Lighting	345.49	x	0.517	=	178.62	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-746.81	x	0.529	=	-395.06	(269)
Total carbon dioxide emissions				∑(261)(271) =	885.21	(272)
Dwelling carbon dioxide emissions rate				(272) ÷ (4) =	11.07	(273)
El value					90.51	
El rating (see section 14)					91	(274)
El band					В	
13a. Primary energy - Individual heating systems including micro	o-CHP					
	Energy kWh/year		Primary Energy Factor		Primary Energy	
Space heating - main system 1	2323.31	х	1.02	=	2369.78	(261*)
Water heating	2628.60	x	1.02	=	2681.18	(264*)

234.38

345.49

-746.81

Space and water heating

Lighting

Pumps, fans and electric keep-hot

Total primary energy kWh/year

Primary energy kWh/m2/year

Energy saving/generation technologies:

PV primary energy savings (negative quantity)

5050.96

684.39

1008.84

-2180.68

4563.51

57.04

(265\*)

(267\*)

(268\*)

(269\*)

(272\*)

(273\*)

(261\*) + (262\*) + (263\*) + (264\*) =

 $\sum (261^*)...(271^*) =$ 

(272\*) ÷ (4) =

2.92

2.92

# Code for Sustainable Homes (November 2010) Design - Draft

CO<sub>2</sub> emissions offset from additional allowable generation

CO<sub>2</sub> emissions offset from community biofuel CHP systems

Net CO₂ emissions



### This report details the calculations and results for Ene 1, 2 and 7 of the Code For Sustainable Homes.

This Design Assessment has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed. Code calculations are from the Technical Guide (November 2010).

Assessor name	Mr Stuart Searle		Assessor num	2435		
Client			Last modified	C	01/02/2013	
Address	P05 4 St Augustines,	London, NW1				
Building regulation assess	ment - criterion 1					
					kg/m²/yr	
DER					9.58	]
TER					15.02	l
Assessment of zero carbon	n home and low or zei	ro carbon technologies				
				Credits	Level	
Dwelling emission rate (Ene	1)	CO <sub>2</sub> reduction = 36.2 %		4	4	
Fabric Energy Efficiency		FEE = 40.4		6.3		
Low or zero carbon technolo	ogies (Ene 7)	CO <sub>2</sub> reduction = 15 %		2		
Ene 1 - dwelling emission	rate					
			%	kWh/m²	kgCO₂/m²/yr	
Assessment of Ene 1 (level	1-5)					
DER from SAP 2009 DER wo	rksheet				9.58	
Additional allowable genera	ition			0.00	7	
CO₂ emissions offse	et from generation				0.00	]
	et from generation et from community bio	ofuel CHP systems			0.00	] 
CO <sub>2</sub> emissions offse	et from community bio					]   
CO <sub>2</sub> emissions offse	et from community bio				0.00	] ] ]
CO <sub>2</sub> emissions offset for	et from community bio rom SAP section 16 all tion 16 allowances				0.00	] ]   
CO <sub>2</sub> emissions offset for DER accounting for SAP sect	et from community bio rom SAP section 16 all tion 16 allowances		36.2		0.00 0.00 9.58	] ]   
CO <sub>2</sub> emissions offset for Total CO <sub>2</sub> emissions offset for DER accounting for SAP section compared to CO <sub>2</sub> reduction as % of TER	et from community bio rom SAP section 16 all tion 16 allowances TER		36.2		0.00 0.00 9.58	] ] ] 
CO <sub>2</sub> emissions offset for DER accounting for SAP sections compared to	et from community bio rom SAP section 16 all tion 16 allowances TER		36.2		0.00 0.00 9.58	] ] ] ]
CO <sub>2</sub> emissions offset for Total CO <sub>2</sub> emissions offset for DER accounting for SAP section compared to CO <sub>2</sub> reduction as % of TER  Assessment of Ene 1 (level)	et from community bio rom SAP section 16 all tion 16 allowances TER 6) rksheet		36.2		0.00 0.00 9.58 5.44	] ] ] ] [ (zc:
CO <sub>2</sub> emissions offset for Total CO <sub>2</sub> emissions offset for DER accounting for SAP section CO <sub>2</sub> reduction compared to CO <sub>2</sub> reduction as % of TER  Assessment of Ene 1 (level DER from SAP 2009 DER wo	et from community bio rom SAP section 16 all tion 16 allowances TER  6) rksheet ces (equation L14)		36.2		0.00 0.00 9.58 5.44	,
CO <sub>2</sub> emissions offset for Total CO <sub>2</sub> emissions offset for DER accounting for SAP section compared to CO <sub>2</sub> reduction as % of TER  Assessment of Ene 1 (level DER from SAP 2009 DER wo CO <sub>2</sub> emissions from appliance)	et from community bio rom SAP section 16 all tion 16 allowances TER  6) rksheet ces (equation L14)		36.2		0.00 0.00 9.58 5.44 9.58 14.78	(ZC

0.00

0.00

26.11

(ZC7)

(ZC5)

(ZC8)

#### Ene 1 - dwelling emission rate - level 6 There is no Zero Carbon Home definition in the current technical guide Criterion Value Pass/Fail FEE <= 39 40.4 Fail 26.11 Net CO<sub>2</sub> emissions <= 0.00 Fail Result: Not level 6 Number of credits for Ene 1 Ene 2 - Fabric Energy Efficiency 40.4 FEE Number of credits for Ene 2 6.3 Ene 7 - low or zero carbon technologies **Emissions** Reduction kgCO₂/yr kgCO<sub>2</sub>/yr Standard case 1329.90 Space and water heating (265) Mechanical cooling (266) 0.00 Pumps and fans (267) 131.34 Lighting (268) 218.06 Appliances and cooking 1760.14 Total CO₂ 1662.77 **Actual case** Space and water heating (265) or (376) 1329.90 Space and water heating from LZCT considered in SAP 2009 0.00 Pumps and fans (267) or (378) 131.34 Pumps and fans 0.00 Electricity generated by LZCT (269) + (380)) -525.84 Additional allowable electricity generation considered in SAP 2009 section 16 0.00 Offset from biofuel CHP $[-1 \times [(363)..(366) + (368)...(372)]]$ 0.00 LZCT electricity generation -525.84 LZCT thermal generation 0 Total from specified LZCT -525.84 **Emissions** $kgCO_2/m^2/yr$ Reduction in CO<sub>2</sub> Emissions Standard Case CO<sub>2</sub> 32.30 Actual Case CO2 27.36

15

2

% Reduction in CO<sub>2</sub>

Number of credits for Ene 7

# DER 2009 Worksheet

## Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P05 4 St Augustines, London, NW1		

1. Overall dwelling dimer	nsions			
		Area (m²)	Average storey height (m)	Volume (m³)
Lowest occupied		106.50 (1a) x	2.60 (2a) =	276.90 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d	)(1n) = 106.50 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)(3n)	= 276.90 (5)
2. Ventilation rate				
				m³ per hour
Number of chimneys			0 x 40 =	0 (6a)
Number of open flues			0 x 20 =	0 (6b
Number of intermittent far	ns		0 x 10 =	0 (7a)
Number of passive vents			0 x 10 =	0 (7b
Number of flueless gas fire	<b>2</b> S		0 x 40 =	0 (7c)
				Air changes per hour
Infiltration due to chimney	rs, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) +	$(7c) = 0 \div (5) =$	0.00 (8)
If a pressurisation test has	been carried out or is intended,	proceed to (17), otherwise continue	e from (9) to (16)	
Air permeability value, q50	), expressed in cubic metres per	hour per square metre of envelope	e area	5.00 (17)
If based on air permeability	y value, then (18) = $[(17) \div 20] +$	(8), otherwise (18) = (16)		0.25 (18
Air permeability value appl	lies if a pressurisation test has b	een done, or a design or specified a	ir permeability is being used	
Number of sides on which	dwelling is sheltered			1 (19
Shelter factor			1 - [0.075 x (19)]	= 0.92 (20)
Adjusted infiltration rate			(18) x (20)	= 0.23 (21)
Infiltration rate modified for	or monthly wind speed:			

Infiltration rate modified for monthly wind speed:

Infiltration rate mo	odified for i	monthly wi	na speea:										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average v	wind speed	from Table	7										
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1	.12 =	54.10	(22)
Wind Factor (22a)	m = (22)m <del>-</del>	÷ 4											
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	
										∑(22a)1	.12 =	13.52	(22a)
Adjusted infiltration	on rate (allo	wing for sh	elter and v	vind speed)	= (21) × (2	2a)m							
(22b)m	0.31	0.29	0.29	0.26	0.24	0.23	0.21	0.21	0.24	0.26	0.28	0.29	
										∑(22b)1	.12 =	3.13	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system

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

0.5 (23b)

(23a)

If balanced with heat recovery: efficiency in % allowing for in-use fac	ctor (from Table 4h) = N/A (23c)										
c) If whole house extract ventilation or positive input ventilation from if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)											
(24c)m 0.56 0.54 0.54 0.51 0.50	0.50 0.50 0.50 0.50 0.51 0.53 0.54 (24c)										
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (2											
(25)m 0.56 0.54 0.54 0.51 0.50	0.50 0.50 0.50 0.50 0.51 0.53 0.54 (25)										
(23)111 0.30 0.34 0.34 0.31 0.30	0.50 0.50 0.50 0.51 0.55 0.54 (25)										
3. Heat losses and heat loss parameter											
The κ-value is the heat capacity per unit area, see Table 1e.											
Element Gross Openings, Area, m <sup>2</sup> m <sup>2</sup>	Net area U-value, A x U, $\kappa$ -value, A x $\kappa$ , A, $m^2$ W/ $m^2$ K W/K kJ/ $m^2$ .K kJ/K										
Doors	2.10 x 1.60 = 3.36 N/A N/A (26)										
Window*	8.68 x 1.15 = 9.94 N/A N/A (27)										
Window*	14.77 x 1.33 = 19.59 N/A N/A (27)										
External wall	87.37 x 0.20 = 17.47 N/A N/A (29a)										
Party Wall	$34.19 \times 0.00 = 0.00 N/A N/A (32)$										
Total area of external elements ∑A, m²	112.92 (31)										
* for windows and roof windows, effective window U-value is calculated											
Fabric heat loss, W/K = $\sum (A \times U)$	(26)(30) + (32) = 50.36 (33)										
Heat capacity Cm = $\sum (A \times K)$	(28)(30) + (32) + (32a)(32e) = N/A (34)										
Thermal mass parameter (TMP) in kJ/m²K	Calculated separately = 100.00 (35)										
Thermal bridges: $\Sigma(L \times \Psi)$ calculated using Appendix K	12.35 (36)										
if details of thermal bridging are not known then (36) = $0.15 \times (31)$											
Total fabric heat loss $(33) + (36) = 62.71 $											
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)											
(38)m 51.37 49.79 49.79 46.62 45.69	45.69     45.69     45.69     46.62     48.20     49.79     (38)										
Heat transfer coefficient, W/K (37)m + (38)m											
(39)m 114.08 112.50 112.50 109.33 108.40											
	Average = $\sum (39)112/12 = 110.26$ (39)										
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)											
(40)m 1.07 1.06 1.06 1.03 1.02	1.02   1.02   1.02   1.03   1.04   1.06										
	Average = $\sum (40)112/12 = 2.04$ (40)										
4. Water heating energy requirement											
	kWh/year										
Assumed occupancy, N	2.79 (42)										
If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9) <sup>2</sup> )] + 0.00											
If TFA $\leq 13.9$ , N = 1	013 \( ( \) \										
Annual average hot water usage in litres per day Vd, average = (25 x N) -	+ 36 100.51 (43)										
Annual average hot water usage has been reduced by 5% if the dwelling											
per person per day (all water use, hot and cold)	g is designed to demote a water use target of not more than 125 notes										
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 Tal											
(44)m 110.56 106.54 102.52 98.50 94.48											
	$\Sigma(44)112 = 1206.15$ (44)										
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x											
(45)m 164.36 143.75 148.33 129.32 124.09											
	$\Sigma(45)112 = 1585.24$ (45)										
If instantaneous water heating at point of use (no hot water storage), e.											
For community heating include distribution loss whether or not hot water	er tank is present										

Distribution loss				1							I		7
(46)m	24.65	21.56	22.25	19.40	18.61	16.06	14.88	17.08	17.28	20.14	21.99	23.88	(46)
Water storage los										7			
a) If manufacture	r's declared	loss factor	is known (I	kWh/day):					1.85	<b>(47)</b>			
Temperature f	actor from	Table 2b						0.54 (48)					
Energy lost fro	m water st	orage, kW	h/day (47)	) x (48)				1.00 (49)					
Enter (49) or (54)	in (55)								1.00	(55)			
Water storage los	s calculated	d for each n	nonth = (55	) x (41)m									
(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)
If cylinder contain	s dedicated	d solar stora	nge, = (56)n	n x [(50) - (I	H11)] ÷ (50)	, else = (56	)m where (	H11) is fror	n Appendi	хН			
(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)
Primary circuit los	s (annual) f	from Table	3					3	360.00	(58)			
Primary circuit los	s for each r	month (58)	÷ 365 × (41	.)m									
(modified by facto	or from Tab	le H5 if the	re is solar v	vater heatii	ng and a cyl	inder therr	mostat)						
(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 for each	ch month fr	om Table 3	a, 3b or 3c	(enter '0' if	f not a coml	oi boiler)							
(61)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat require	d for water	r heating ca	lculated fo	r each mon	th 0.85 × (4	5)m + (46)	m + (57)m ·	+ (59)m + (6	61)m				
(62)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	195.82	206.13	220.71	(62)
Solar DHW input	calculated ι	ısing Appen	dix H (nega	ative quant	ity) ('0' ente	ered if no s	olar contrib	oution to w	ater heatin	g)			
(63)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	]
										∑(63)1	.12 =	0.00	(63)
Output from water	er heater fo	r each mon	th, kWh/m	onth (62)n	n + (63)m								
(64)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	195.82	206.13	220.71	]
										∑(64)1	.12 = 2	309.87	(64)
if (64)m < 0 then s	set to 0												_
Heat gains from w	ater heatir	ng, kWh/mo	onth 0.25 ×	[0.85 × (45	5)m + (61)m	n] + 0.8 × [(4	46)m + (57)	m + (59)m]					
(65)m	103.88	92.27	98.56	90.65	90.49	83.25	82.23	87.09	85.96	93.88	96.38	102.16	(65)
include /F7	\ : l l	J-4:	1										_

5. Internal gains	(see Table	5 and 5a)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (1	Table 5), Wa	itts											
(66)m	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	(66)
Lighting gains (cal	culated in A	ppendix L,	equation L	9 or L9a), a	lso see Tab	le 5							
(67)m	23.88	21.21	17.25	13.06	9.76	8.24	8.91	11.58	15.54	19.73	23.03	24.55	(67)
Appliances gains (	calculated i	n Appendix	L, equatio	n L13 or L1	3a), also se	e Table 5							
(68)m	266.43	269.19	262.23	247.39	228.67	211.08	199.32	196.56	203.52	218.35	237.08	254.67	(68)
Cooking gains (cal	culated in A	ppendix L,	equation L	15 or L15a)	, also see T	able 5							
(69)m	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	(69)
Pumps and fans g	ains (Table	5a)											
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evapor	ration (nega	tive values	) (Table 5)										
(71)m	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	(71)
Water heating gai	ns (Table 5)	1											
(72)m	139.63	137.30	132.47	125.90	121.63	115.63	110.52	117.06	119.39	126.19	133.87	137.31	(72)
Total internal gair	ıs (66)m + (	67)m + (68	)m + (69)m	+ (70)m +	(71)m + (72	?)m							
(73)m	504.82	502.59	486.83	461.23	434.95	409.82	393.63	400.07	413.33	439.15	468.85	491.41	(73)

### 6. Solar gains

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of Januar	y and annual	totals are	shown belo	w:	·			,,				
	Access factor Table 6d	or	Area m²	So	lar flux W/	m² g	g Specific data or Table 6b	a Fi	Specific da or Table 60		Gains (W)	
West	0.54	] x	8.68	x	19.87	x 0.9 x	0.63	х	0.80	=	42.25	(80)
South	0.54	] x	14.77	x	47.32	x 0.9 x	0.63	х	0.80	=	171.25	(78)
Solar gains in watts, calcula	ted for each	month ∑(7	4)m(82)m									
(83)m 213.50	361.20	471.94	574.72	629.27	640.81	627.19	584.35	518.33	408.38	255.43	182.82	(83)
Total gains - internal and so	lar (73)m + (	83)m										
(84)m 718.32	863.78	958.77	1035.96	1064.22	1050.63	1020.81	984.42	931.65	847.53	724.27	674.23	(84)
7. Mean internal tempera	ture (heating	s season)										
Temperature during heatin			rea from Ta	ble 9. Th1('	°C)						21.00	(85)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	] (00)
Utilisation factor for gains f			•	way	,	<b>5</b> 0.	7.008	JCP	00.		200	
(86)m 0.95	0.93	0.89	0.82	0.72	0.57	0.41	0.42	0.64	0.83	0.93	0.96	(86)
Mean internal temp of livin	g area T1 (ste		n Table 9c)				-\\			I.		. ,
(87)m 18.94	19.27	19.70	20.14	20.57	20.84	20.96	20.95	20.77	20.28	19.47	18.98	(87)
Temperature during heatin		1	1									_
(88)m 20.03	20.04	20.04	20.06	20.07	20.07	20.07	20.07	20.07	20.06	20.05	20.04	(88)
Utilisation factor for gains f			ļ				1 20.07					] (00)
(89)m 0.95	0.92	0.87	0.80	0.68	0.51	0.33	0.34	0.58	0.80	0.92	0.95	(89)
Mean internal temperature	ļ						0.51	0.50	0.00	0.52	0.55	] (03)
(90)m 17.27	17.75	18.37	19.00	19.59	19.92	20.04	20.04	19.85	19.20	18.06	17.34	(90)
Living area fraction	17.75	10.57	15.00	15.55	13.32	20.04		4.00	7		0.23	7
-	fan Albalbal	مماليم المام	fi A T1 . //	. f. a\ <del>.</del> .			ILAZ	4.00	÷ (4) =		0.23	(91)
Mean internal temperature (92)m 17.65	18.09	18.67	19.26	19.81	20.13	20.25	20.25	20.06	19.44	18.38	17.71	(92)
	<u> </u>						20.23	20.00	13.44	10.30	17.71	[32]
Apply adjustment to the mo (93)m 17.50	17.94	18.52	19.11	19.66	19.98	20.10	20.10	19.91	19.29	18.23	17.56	(93)
(55)111	17.54	10.52	13.11	15.00	15.56	20.10	20.10	13.31	13.23	10.23	17.50	] (55)
8. Space heating requirem	nent											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal	temperature	obtained a	at step 11 o	f Table 9b,	so that tim	= (93)m a	nd recalculate	e the utili	sation facto	r for gains	using Table	e 9a)
Utilisation factor for gains,	<u> </u>	1					1 1		1	1	1	7
(94)m 0.92	0.89	0.84	0.77	0.66	0.50	0.33	0.34	0.57	0.77	0.89	0.93	(94)
Useful gains, ηmGm, W = (9	94)m x (84)m				1							7
(95)m 663.38	766.66	802.81	798.37	698.88	527.82	335.62	334.36	529.08	652.42	647.07	626.03	(95)
Monthly average external t		from Table	8									_
(96)m 4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean into	ernal tempera	ature, Lm, \	W						_		_	_
(97)m 1482.66	1456.12	1318.66	1137.88	862.85	582.92	346.70	346.40	607.90	928.57	1245.19	1424.37	(97)
Space heating requirement	for each mo	nth, kWh/n	month = 0.0	24 x [(97)m	n - (95)m] x	(41)m						_
(98)m 609.54	463.32	383.80	244.45	121.99	0.00	0.00	0.00	0.00	205.46	430.65	593.97	
						Total per	year (kWh/ye	ear) = ∑(9	8)15, 10	.12 = 3	3053.18	(98)
Space heating requirement	in kWh/m²/y	/ear							(98)	÷ (4)	28.67	(99)
9a. Energy Requirements	- Individual h	neating sys	tems includ	ling micro-	СНР							

### Space heating:

Fraction of space heating from secondary/supplementary system (Table 11)

Fraction of space heating from main system(s) 1 - (201)

Fraction of main heating from main system  ${\bf 2}$ 

0.00	(201)
1.00	(202)
0.00	(203)

	(2.2)	
Fraction of total space heat from main system 1 (202) x [1 - (203)]	1.00 (204)	
Fraction of total space heat from main system 2 (202) x (203)	0.00 (205)	
Efficiency of main space heating system 1 (%)	93.00 (206)	
(from database or Table 4a/4b, adjusted where appropriate by the amount	own in the 'space efficiency adjustment' column o	f Table 4c)
Jan Feb Mar Apr May	un Jul Aug Sep Oct	Nov Dec
Space heating requirement, kWh/month (as calculated above)		
(98)m 609.54 463.32 383.80 244.45 121.99	.00 0.00 0.00 0.00 205.46	430.65 593.97
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 1		
(211)m 655.42 498.19 412.68 262.85 131.18	.00   0.00   0.00   0.00   220.93	463.06   638.68
	Total per year (kWh/year) = $\sum$ (211)15, 10	.12 = 3282.99 (211)
Water heating:		
Output from water heater, kWh/month (calculated above)		
(64)m 225.90 199.33 209.88 188.88 185.63	6.64   160.77   175.40   174.78   195.82	206.13   220.71
	∑(64)1	.12 = 2309.87 (64)
Efficiency of water heater per month		
(217)m 86.83 86.49 85.90 85.00 83.22	0.30   79.30   79.30   79.30   84.44	86.23 86.83
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m		
(219)m 260.16 230.47 244.32 222.21 223.05	0.13   202.73   221.19   220.40   231.91	239.04 254.20
	Total per year (kWh/year) = ∑(219)1	.12 = 2759.81 (219)
Annual Totals Summary:	kWh/ye	ear kWh/year
Space heating fuel used, main system 1		3282.99 (211)
Water heating fuel used		2759.81 (219)
Electricity for pumps, fans and electric keep-hot (Table 4f):		
mechanical ventilation fans - balanced, extract or positive input from ou	de 79.05	(230a)
warm air heating system fans	0.00	
central heating pump	130.0	
oil boiler pump	0.00	(230d)
boiler flue fan maintaining electric keep-hot facility for gas combi boiler	0.00	(230e) (230f)
pump for solar water heating	0.00	(230g)
Total electricity for the above	Σ(230a)(2	
	2( 33), (	( )
Electricity for lighting (calculated in Appendix L):		421.77 (232)
Energy saving/generation technologies (Appendices M, N and Q):		
Electricity generated by PVs (Appendix M) (negative quantity)		-994.03 (233)
12a. Carbon dioxide emissions - Individual heating systems including mic	СНР	
En(	•	Emissions
kWh		(kgCO2/year)
Space heating - main system 1 328		650.03 (261)
Water heating 275		546.44 (264)
Space and water heating	(261) + (262) + (263) + (2	64) = 1196.47 (265)
Pumps, fans and electric keep-hot 25-	5 x 0.517 =	131.34 (267)
Lighting 42:	7 x 0.517 =	218.06 (268)
Energy saving/generation technologies:		
PV emission savings (negative quantity) -99	03 x 0.529 =	-525.84 ( <mark>269</mark> )
Total carbon dioxide emissions	∑(261)(2	71) = 1020.03 (272)
Dwelling Carbon Dioxide Emissions Rate (DER)		9.58 (273)

# SAP 2009 Worksheet

### Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P05 4 St Augustines, London, NW1		

1. Overall dwelling dimens	sions			
		Area (m²)	Average storey height (m)	Volume (m³)
Lowest occupied		106.50 (1a) x	2.60 (2a) =	276.90 (3a
Total floor area	(1a) + (1b) + (1c) + (1d)	(1n) = 106.50 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)(3n)	= 276.90 (5)
2. Ventilation rate				
				m³ per hour
Number of chimneys			0 x 40 =	0 (6a
Number of open flues			0 x 20 =	0 (66
Number of intermittent fans	5		0 x 10 =	0 (7a
Number of passive vents			0 x 10 =	0 (7)
Number of flueless gas fires			0 x 40 =	0 (70
				Air changes per hour
Infiltration due to chimneys,	, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7	$\dot{c}$ (5) =	0.00 (8)
If a pressurisation test has b	een carried out or is intended, pro	oceed to (17), otherwise continue fr	rom (9) to (16)	
Air permeability value, q50,	expressed in cubic metres per ho	our per square metre of envelope ar	rea	5.00 (17
If based on air permeability	value, then (18) = [(17) ÷ 20] + (8)	), otherwise (18) = (16)		0.25
Air permeability value applie	es if a pressurisation test has beer	n done, or a design or specified air p	permeability is being used	
Number of sides on which d	welling is sheltered			1 (19
Shelter factor			1 - [0.075 x (19)]	= 0.92 (20
Adjusted infiltration rate			(18) x (20)	= 0.23 (21
Infiltration rate modified for	monthly wind speed:			

•										, , ,	,	-	_ ` '
Infiltration rate mo	odified for r	monthly wi	nd speed:										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average v	vind speed	from Table	2 7										
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1	12 =	54.10	(22)

(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1	12 =	54.10	(22)
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	1.20	1.27	
										∑(22a)1	12 =	13.52	(22a)

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

(22b)m

0.31

0.29

0.29

0.26

0.24

0.23

0.21

0.21

0.24

0.26

0.28

0.29

 $\Sigma(22b)1...12 = 3.13$  (22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system

0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use fac	ctor (from Table 4h) = N/A (23c)
c) If whole house extract ventilation or positive input ventilation from if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)	
(24c)m 0.56 0.54 0.54 0.51 0.50	0.50 0.50 0.50 0.50 0.51 0.53 0.54 (24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (2	
(25)m 0.56 0.54 0.54 0.51 0.50	0.50 0.50 0.50 0.50 0.51 0.53 0.54 (25)
(23)111 0.30 0.34 0.34 0.31 0.30	0.50 0.50 0.50 0.51 0.55 0.54 (25)
3. Heat losses and heat loss parameter	
The κ-value is the heat capacity per unit area, see Table 1e.	
Element Gross Openings, Area, m <sup>2</sup> m <sup>2</sup>	Net area U-value, A x U, $\kappa$ -value, A x $\kappa$ , A, $m^2$ W/ $m^2$ K W/K kJ/ $m^2$ .K kJ/K
Doors	2.10 x 1.60 = 3.36 N/A N/A (26)
Window*	8.68 x 1.15 = 9.94 N/A N/A (27)
Window*	14.77 x 1.33 = 19.59 N/A N/A (27)
External wall	87.37 x 0.20 = 17.47 N/A N/A (29a)
Party Wall	$34.19 \times 0.00 = 0.00 N/A N/A (32)$
Total area of external elements ∑A, m²	112.92 (31)
* for windows and roof windows, effective window U-value is calculated	
Fabric heat loss, W/K = $\sum (A \times U)$	(26)(30) + (32) = 50.36 (33)
Heat capacity Cm = $\sum (A \times K)$	(28)(30) + (32) + (32a)(32e) = N/A (34)
Thermal mass parameter (TMP) in kJ/m²K	Calculated separately = 100.00 (35)
Thermal bridges: $\Sigma(L \times \Psi)$ calculated using Appendix K	12.35 (36)
if details of thermal bridging are not known then (36) = $0.15 \times (31)$	
Total fabric heat loss	(33) + (36) = 62.71  (37)
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	
(38)m 51.37 49.79 49.79 46.62 45.69	45.69     45.69     45.69     46.62     48.20     49.79     (38)
Heat transfer coefficient, W/K (37)m + (38)m	
(39)m 114.08 112.50 112.50 109.33 108.40	
	Average = $\sum (39)112/12 = 110.26$ (39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	
(40)m 1.07 1.06 1.06 1.03 1.02	1.02   1.02   1.02   1.03   1.04   1.06
	Average = $\sum (40)112/12 = 2.04$ (40)
4. Water heating energy requirement	
	kWh/year
Assumed occupancy, N	2.79 (42)
If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9) <sup>2</sup> )] + 0.00	
If TFA $\leq 13.9$ , N = 1	013 \( ( \) \
Annual average hot water usage in litres per day Vd, average = (25 x N) -	+ 36 100.51 (43)
Annual average hot water usage has been reduced by 5% if the dwelling	
per person per day (all water use, hot and cold)	g is designed to demote a water use target of not more than 125 notes
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 Tal	
(44)m 110.56 106.54 102.52 98.50 94.48	
	$\Sigma(44)112 = 1206.15$ (44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x	
(45)m 164.36 143.75 148.33 129.32 124.09	
	$\Sigma(45)112 = 1585.24$ (45)
If instantaneous water heating at point of use (no hot water storage), e.	
For community heating include distribution loss whether or not hot water	er tank is present

Distribution loss	0.15 x (45)n	n		1		1	1					1	_
(46)m	24.65	21.56	22.25	19.40	18.61	16.06	14.88	17.08	17.28	20.14	21.99	23.88	(46)
Water storage lo	ss:									_			
a) If manufacture	r's declared	loss factor	is known (I	kWh/day):					1.85	(47)			
Temperature	factor from	Table 2b							0.54	(48)			
Energy lost fro	om water st	orage, kW	h/day (47)	) x (48)					1.00	(49)			
Enter (49) or (54)	in (55)							1.00 (55)					
Water storage lo	ss calculated	d for each n	nonth = (55	) x (41)m									
(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)
If cylinder contai	ns dedicated	d solar stora	nge, = (56)n	n x [(50) - (H	H11)] ÷ (50)	), else = (56	)m where (	H11) is fror	n Appendi	хН			
(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)
Primary circuit loss (annual) from Table 3 360.00 (58)													
Primary circuit lo	ss for each r	month (58)	÷ 365 × (41	.)m									
(modified by fact	or from Tab	le H5 if the	re is solar v	vater heatir	ng and a cy	linder ther	mostat)						
(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 for ea	ch month fr	om Table 3	a, 3b or 3c	(enter '0' if	not a com	bi boiler)							
(61)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requir	ed for water	heating ca	lculated fo	r each mon	th 0.85 × (4	15)m + (46)	m + (57)m ·	+ (59)m + (6	61)m				
(62)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	195.82	206.13	220.71	(62)
Solar DHW input	calculated ι	ising Appen	dix H (nega	ative quant	ity) ('0' ent	ered if no s	olar contrib	oution to wa	ater heatin	g)			
(63)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
										∑(63)1	.12 =	0.00	(63)
Output from wat	er heater fo	r each mon	th, kWh/m	onth (62)m	n + (63)m								
(64)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	195.82	206.13	220.71	
										∑(64)1	.12 = 2	309.87	(64)
if (64)m < 0 then	set to 0												
Heat gains from	water heatir	ng, kWh/mc	onth 0.25 ×	[0.85 × (45	5)m + (61)m	n] + 0.8 × [(4	46)m + (57)	m + (59)m]					
(65)m	103.88	92.27	98.56	90.65	90.49	83.25	82.23	87.09	85.96	93.88	96.38	102.16	(65)
include (57	7)m in calcul	ation of (65	m only if o	cylinder is in	the dwelli	ing or hot w	vater is fror	n communi	ty heating				_

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	(Table 5), Wa	atts											
(66)m	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	(66)
Lighting gains (ca	alculated in A	ppendix L,	equation L	9 or L9a), a	lso see Tab	le 5							
(67)m	59.71	53.03	43.13	32.65	24.41	20.60	22.26	28.94	38.84	49.32	57.56	61.37	(67)
Appliances gains	(calculated i	n Appendix	L, equatio	n L13 or L1	3a), also se	e Table 5							
(68)m	397.65	401.78	391.38	369.25	341.30	315.04	297.49	293.37	303.76	325.90	353.85	380.11	(68)
Cooking gains (c	alculated in A	Appendix L,	equation L	15 or L15a)	, also see T	able 5							
(69)m	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	(69)
Pumps and fans	gains (Table	5a)											
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evapo	oration (nega	itive values	) (Table 5)										
(71)m	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	(71)
Water heating g	ains (Table 5)	)											
(72)m	139.63	137.30	132.47	125.90	121.63	115.63	110.52	117.06	119.39	126.19	133.87	137.31	(72)
			\ (60)	. (70)	(71)m + (72	llm.							
Total internal ga	ins (66)m + (	67)m + (68	)m + (69)m	+ (70)m + (	(/1)    + (/2	. / 1111							

### 6. Solar gains

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January	y and annual totals o	are shown belo	w:								
	Access factor Table 6d	Area m²	So	olar flux W/	m² g	Specific dat or Table 6b	a F	F Specific da or Table 6c		Gains (W)	)
West	0.54 x	8.68	x	19.87	x 0.9 x	0.63	х	0.80	=	42.25	(80)
South	0.54 x	14.77	x	47.32	x 0.9 x	0.63	х	0.80	=	171.25	(78)
Solar gains in watts, calculat	ted for each month ?	∑(74)m(82)m	l								
(83)m 213.50	361.20 471.9	574.72	629.27	640.81	627.19	584.35	518.33	408.38	255.43	182.82	(83)
Total gains - internal and so	lar (73)m + (83)m										
(84)m 930.87	1073.69 1159.3	30 1222.90	1237.00	1212.46	1177.85	1144.10	1100.70	1030.17	921.09	881.99	(84)
7. Mean internal tempera	ture (heating seasor	ո)									
Temperature during heating	g periods in the living	g area from Ta	ble 9, Th1(	°C)						21.00	(85)
Jan	Feb Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for	or living area, η1,m (	see Table 9a)	•								
(86)m 0.92	0.89 0.84		0.66	0.51	0.36	0.37	0.57	0.77	0.89	0.92	(86)
Mean internal temp of living	g area T1 (steps 3 to	7 in Table 9c)								•	_
(87)m 19.23	19.53 19.93		20.66	20.88	20.97	20.97	20.83	20.43	19.72	19.27	(87)
Temperature during heating	g periods in the living	g area from Ta	ble 9, Th2(	°C)						•	_
(88)m 20.03	20.04 20.04	_	20.07	20.07	20.07	20.07	20.07	20.06	20.05	20.04	(88)
Utilisation factor for gains for	or rest of dwelling n	2.m (see Table	9a)	1.				!		·!	
(89)m 0.91	0.87 0.82		0.62	0.45	0.29	0.29	0.51	0.73	0.87	0.91	(89)
Mean internal temperature	in the rest of dwelli	ng T2 (follow s	tens 3 to 7	in Table 9c							_ ` `
(90)m 17.69	18.12 18.60		19.70	19.96	20.05	20.05	19.91	19.40	18.41	17.76	(90)
Living area fraction							4.00	÷ (4) =		0.23	(91)
Mean internal temperature	for the whole dwell	ing fl Λ v T1 ±/′	I _ fl Λ\ v T3	,			. 1.00			0.23	] (31)
(92)m 18.04	18.44 18.95	_	19.91	20.17	20.26	20.26	20.12	19.63	18.70	18.10	(92)
Apply adjustment to the me						10.20		13.00	20.70	10.10	] (32)
(93)m 17.89	18.29 18.80		19.76	20.02	20.11	20.11	19.97	19.48	18.55	17.95	(93)
(55)	10.23   10.00	23.30	25.7.0			1 20:22	13.37	131.10	20.00	17.55	
8. Space heating requirem	ent										
Jan	Feb Mar		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal t		ed at step 11 o	f Table 9b,	so that tim	= (93)m a	nd recalculat	e the util	isation facto	r for gains	using Table	e 9a)
Utilisation factor for gains, r	·					1 1		1 - 1		1	٦
(94)m 0.88	0.84 0.79	0.72	0.60	0.45	0.29	0.30	0.50	0.71	0.84	0.88	(94)
Useful gains, ηmGm, W = (9										1	7
(95)m 819.11	902.67 911.8	876.88	742.91	545.29	339.74	339.00	555.60	727.39	775.91	780.42	(95)
Monthly average external to	1							, ,		1	7
(96)m 4.50	5.00 6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean inte	rnal temperature, L	m, W									_
(97)m 1527.37	1494.88   1349.4	44   1159.06	874.03	587.10	347.67	347.50	614.39	948.80	1281.58	1468.26	(97)
Space heating requirement	for each month, kW	h/month = 0.0	24 x [(97)n	n - (95)m] x	(41)m						_
(98)m 526.94	397.96 325.5	9 203.17	97.56	0.00	0.00	0.00	0.00	164.73	364.08	511.75	
					Total per	year (kWh/ye	ear) = ∑(9	8)15, 10	12 = 2	2591.78	(98)
Space heating requirement in kWh/m <sup>2</sup> /year (98) $\div$ (4) 24.34 (99)											
9a. Energy Requirements - Individual heating systems including micro-CHP											

Space	heating:
-------	----------

Fraction of space heating from secondary/supplementary system (Table 11)

Fraction of space heating from main system(s) 1 - (201)

Fraction of main heating from main system  ${\bf 2}$ 

0.00	(201)
1.00	(202)
0.00	(203)

Fraction of total sp	oace heat fi	rom main s	vstem 1 (2)	02) x [1 - (2	03)]				1.00	(204)		
Fraction of total sp					00/]				0.00	(205)		
Efficiency of main				- , (,					93.00	(206)		
, (from database or				ropriate by	the amoui	nt shown ir	n the 'space	efficiency o	adjustment		ble 4c)	
J	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	-		Dec
Space heating requ	uirement, k	:Wh/month	ı (as calcula	ted above)								
(98)m	526.94	397.96	325.59	203.17	97.56	0.00	0.00	0.00	0.00	164.73 3	64.08 51	1.75
Space heating fuel	(main hea		1), kWh/m	onth = (98	)m x (204) >	× 100 ÷ (20	6)					
(211)m	566.61	427.92	350.10	218.46	104.90	0.00	0.00	0.00	0.00			0.27
						٦	Total per ye	ear (kWh/ye	ear) = ∑(211	L)15, 1012	= 2786.	86 (211)
Water heating:												
Output from water		i			10= 50		1.00 ==			105.00	00.10	
(64)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	ļ ļ		0.71
										∑(64)112	= 2309.	87 (64)
Efficiency of water			OF 40	04.51	92.60	70.20	70.20	79.30	70.20	02.05	05.01 0/	5.48
(217)m [ Fuel for water hear	86.50	86.12	85.48	84.51	82.69	79.30	79.30	79.30	79.30	83.85	35.81 86	0.48
(219)m	261.16	231.46	245.53	223.51	224.50	210.13	202.73	221.19	220.40	233.52 2	40.21 25	5.21
(213)	201.10	251.40	243.33	223.31	224.30	210.13				= ∑(219)112 :		
							10ta	i per yeur (i	(VVII) year y		2703.	(213)
Annual Totals Sum	nmarv:									kWh/year	kWh/y	ear
Space heating fuel	-	n svstem 1								.,	2786.	
Water heating fue											2769.	
Electricity for pum		nd electric l	keep-hot (T	able 4f):								
mechanical ven	-				nput from (	outside				79.05		(230a)
warm air heatir			,							0.00		(230b)
central heating	pump									130.00		(230c)
oil boiler pump	ı									0.00		(230d)
boiler flue fan										45.00		(230e)
maintaining ele		-	for gas con	nbi boiler						0.00		(230f)
pump for solar  Total electricity for		_								0.00 (230a)(230g	254.0	(230g) 05 (231)
rotal electricity for	i tile above	:							•	<u>&gt;(</u> 250a)(250g	254.0	)5 (251)
Electricity for light	ting (calcul	ated in Apr	endix L):								421.7	77 (232)
Energy saving/gen				es M, N and	d Q):							
Electricity generate					,						-994.0	03 (233)
, 0												
10a. Fuel costs - I	Individual I	neating sys	tems includ	ling micro-	СНР							
					Fuel	kWh/year			iel price able 12)		Fuel cost	£/year
Space heating - ma	ain system	1			2	786.86	] x		3.10	x 0.01 =	86.3	9 (240)
Water heating cost	t (other fue	el)			2	769.55	] x		3.10	x 0.01 =	85.8	6 (247)
Pumps, fans and el	lectric keep	o-hot			2	254.05	] x		11.46	x 0.01 =	29.1	1 (249)
Energy for lighting					4	121.77	] x		11.46	x 0.01 =	48.3	3 (250)
Additional standing	g charges (	Table 12)									106.0	00 (251)
Energy saving/gen	eration te	chnologies	(Appendice	es M, N and	d Q):							
PV savings (neg	gative quan	tity)			-!	994.03	x		11.46	x 0.01 =	-113.9	92 (252)
Total energy cost								(	240)(242	) + (245)(254	241.7	78 (255)
11a. SAP rating -	Individual	heating sys	stems inclu	ding micro	-CHP							
Energy cost deflato											0.47	7 (256)
										URN: 13-0	10-05 Plann	ning version 1

Energy cost factor (ECF)			[(255) x (256)	] ÷ [(4) + 45.0] =	0.75	(257)
SAP value					89.54	
SAP rating					90	(258)
SAP band					В	
12a. Carbon dioxide emissions - Individual heating systems include	ding micro-CHP					
	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	2786.86	x	0.198	=	551.80	(261)
Water heating	2769.55	x	0.198	=	548.37	(264)
Space and water heating			(261) + (262) +	+ (263) + (264) =	1100.17	(265)
Pumps, fans and electric keep-hot	254.05	x	0.517	=	131.34	(267)
Lighting	421.77	x	0.517	=	218.06	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-994.03	x	0.529	=	-525.84	(269)
Total carbon dioxide emissions				∑(261)(271) =	923.73	(272)
Dwelling carbon dioxide emissions rate				(272) ÷ (4) =	8.67	(273)
El value					91.83	
El rating (see section 14)					92	(274)
El band					А	
13a. Primary energy - Individual heating systems including micro	-СНР					
	Energy kWh/year		Primary Energy Factor		Primary Energy	
Space heating - main system 1	2786.86	х	1.02	=	2842.60	(261*)
Water heating	2769.55	x	1.02	=	2824.94	(264*)

254.05

421.77

-994.03

Space and water heating

Lighting

Pumps, fans and electric keep-hot

Total primary energy kWh/year

Primary energy kWh/m2/year

Energy saving/generation technologies:

PV primary energy savings (negative quantity)

5667.54

741.82

1231.57

-2902.56

4738.37

44.49

(265\*)

(267\*)

(268\*)

(269\*)

(272\*)

(273\*)

(261\*) + (262\*) + (263\*) + (264\*) =

∑(261\*)...(271\*) =

 $(272*) \div (4) =$ 

2.92

2.92

# Code for Sustainable Homes (November 2010) Design - Draft



### This report details the calculations and results for Ene 1, 2 and 7 of the Code For Sustainable Homes.

This Design Assessment has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed. Code calculations are from the Technical Guide (November 2010).

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P06 4 St Augustines, London, NW1		

Building regulation assessment - criterion 1				
				kg/m²/yr
DER				10.53
TER				15.03
Assessment of zero carbon home and low or ze	ro carbon technologies			
			Credits	Level
Dwelling emission rate (Ene 1)	CO <sub>2</sub> reduction = 29.9 %		3.4	4
Fabric Energy Efficiency	FEE = 41.7		5.6	
Low or zero carbon technologies (Ene 7)	CO <sub>2</sub> reduction = 14 %		1	
Ene 1 - dwelling emission rate				
		%	kWh/m²	kgCO₂/m²/yr
Assessment of Ene 1 (level 1-5)				
DER from SAP 2009 DER worksheet				10.53
Additional allowable generation			0.00	]
CO₂ emissions offset from generation			0.00	0.00
CO₂ emissions offset from community bio	ofuel CHP systems			0.00
Total CO <sub>2</sub> emissions offset from SAP section 16 all				0.00
DER accounting for SAP section 16 allowances				10.53
CO₂ reduction compared to TER				4.50
CO₂ reduction as % of TER		29.9		4.50
		23.3		
Assessment of Ene 1 (level 6)				(704)
DER from SAP 2009 DER worksheet				10.53 (ZC1)
CO₂ emissions from appliances (equation L14)				15.39 (ZC2)
CO₂ emissions from cooking (equation L16)				1.92 (ZC3)
Total CO₂ emissions				27.85 (ZC4)
Additional allowable generation and its CO <sub>2</sub> emiss	sions offset		0.00	(ZC6)
CO₂ emissions offset from additional allo	wable generation			0.00 (ZC7)
CO₂ emissions offset from community bi	ofuel CHP systems			0.00 (ZC5)
Net CO₂ emissions				27.85 (ZC8)

#### Ene 1 - dwelling emission rate - level 6 There is no Zero Carbon Home definition in the current technical guide Criterion Value Pass/Fail FEE <= 39 41.7 Fail Net CO<sub>2</sub> emissions <= 0.00 27.85 Fail Result: Not level 6 Number of credits for Ene 1 3.4 Ene 2 - Fabric Energy Efficiency 41.7 FEE Number of credits for Ene 2 5.6 Ene 7 - low or zero carbon technologies **Emissions** Reduction kgCO₂/yr kgCO<sub>2</sub>/yr Standard case Space and water heating (265) 1264.06 Mechanical cooling (266) 0.00 Pumps and fans (267) 127.12 Lighting (268) 204.20 Appliances and cooking 1653.87 Total CO₂ 1578.06 **Actual case** Space and water heating (265) or (376) 1264.06 Space and water heating from LZCT considered in SAP 2009 0.00 Pumps and fans (267) or (378) 127.12 Pumps and fans 0.00 Electricity generated by LZCT (269) + (380)) -471.35 Additional allowable electricity generation considered in SAP 2009 section 16 0.00 Offset from biofuel CHP $[-1 \times [(363)..(366) + (368)...(372)]]$ 0.00 LZCT electricity generation -471.35 LZCT thermal generation 0 Total from specified LZCT -471.35 **Emissions** $kgCO_2/m^2/yr$ Reduction in CO<sub>2</sub> Emissions Standard Case CO<sub>2</sub> 34.03 Actual Case CO2 29.09

14

1

% Reduction in CO<sub>2</sub>

Number of credits for Ene 7

# DER 2009 Worksheet

### Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P06 4 St Augustines, London, NW1		

1. Overall dwelling dimension	ons						
		Area (m²)		Average stor height (m)	еу	Volume (m³)	
Lowest occupied		95.50	(1a) x	2.60	(2a) =	248.30	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)(1n) =	95.50	(4)				
Dwelling volume				(3a) + (3b) +	(3c) + (3d)(3n) =	248.30	(5)
2. Ventilation rate							
						m³ per hour	
Number of chimneys				0	x 40 =	0	(6a)
Number of open flues				0	x 20 =	0	(6b)
Number of intermittent fans				0	x 10 =	0	(7a)
Number of passive vents				0	x 10 =	0	(7b)
Number of flueless gas fires				0	x 40 =	0	(7c)
						Air changes pe hour	er
Infiltration due to chimneys, f	lues, fans, PSVs	(6a) + (6b) + (	7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)
If a pressurisation test has bee	en carried out or is intended, proceed t	o (17), otherw	ise continue from	(9) to (16)			
Air permeability value, q50, ex	xpressed in cubic metres per hour per	square metre	of envelope area			5.00	(17)
If based on air permeability va	alue, then (18) = [(17) ÷ 20] + (8), other	wise (18) = (16	5)			0.25	(18)
Air permeability value applies	if a pressurisation test has been done,	or a design or	specified air perm	neability is bein	g used		
Number of sides on which dw	relling is sheltered					2	(19)
Shelter factor					1 - [0.075 x (19)] =	0.85	(20)
Adjusted infiltration rate					(18) x (20) =	0.21	(21)
Infiltration rate modified for r	monthly wind speed:						

Infiltration rate modified for monthly wind speed:													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average v	Monthly average wind speed from Table 7												
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	]
										∑(22)1	.12 =	54.10	(22)
Wind Factor (22a)ı	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	1.20	1.27	]
										∑(22a)1	.12 =	13.52	(22a)
Adjusted infiltration	n rate (allo	owing for sh	nelter and v	wind speed	) = (21) × (2	.2a)m							
(22b)m	0.29	0.27	0.27	0.24	0.22	0.21	0.20	0.20	0.22	0.24	0.26	0.27	]
										∑(22b)1	.12 =	2.87	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system

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

0.5 (23b)

(23a)

If balanced w	ith heat rec	overy: effici	ency in % all	owing for	in-use fact	or (from Ta	ble 4h)	=					N/A	(23c)
c) If whole ho			•	•										
			) = (23b); oth								T	1 0 -0	0.50	7 (0.4.)
(24c)m	0.54	0.52	(2.11) (2.1	0.50	0.50	0.50	0.5	0   0	.50	0.50	0.50	0.50	0.52	(24c)
Effective air char	_				1					0.50	T 0.50	0.50	0.52	7 (25)
(25)m	0.54	0.52	0.52	0.50	0.50	0.50	0.5	0   0	.50	0.50	0.50	0.50	0.52	(25)
3. Heat losses a	nd heat los	s paramete	r											
The κ-value is the heat capacity per unit area, see Table 1e.  Element Gross Openings, Net area U-value, A x U, κ-value, A x κ,														
E	Element		Gross Area, m²	•	nings, n²	Net area A, m²		U-value, W/m²K		A x U, W/K		value, J/m².K	Αxκ, kJ/K	
Doors						2.10	] x [	1.60	] =	3.36		N/A	N/A	(26)
Window*						8.68	] x [	1.15	=	9.94		N/A	N/A	(27)
Window*						11.82	] x [	1.33	] =	15.67		N/A	N/A	(27)
Exposed floor						15.50	] x [	0.20	] =	3.10		N/A	N/A	(28b)
External wall						52.96	x [	0.20	] =	10.59		N/A	N/A	(29a)
Party Wall						33.80	] x [	0.00	] =	0.00		N/A	N/A	(32)
Total area of ext	ernal eleme	ents ∑A, m²				91.06	(31)							
* for windows ar	nd roof wind	dows, effect	ive window l	J-value is	calculated	using formเ	ıla 1/[(	1/UValue	)+0.04	!] paragra <sub>l</sub>	oh 3.2			
Fabric heat loss,	W/K = ∑(A >	≺ U)								(2	(30) -	+ (32) =	42.66	(33)
Heat capacity Cn	n = ∑(A x κ)								(28)	(30) + (32)	+ (32a)	(32e) =	N/A	(34)
Thermal mass pa	rameter (TI	MP) in kJ/m	²K							Calcula	ted separ	ately =	100.00	(35)
Thermal bridges	: ∑(L x Ψ) ca	lculated usi	ng Appendix	K									9.87	(36)
if details of th	nermal bridg	ging are not	known then	(36) = 0.1	5 x (31)									
Total fabric heat	loss										(33) -	+ (36) =	52.53	(37)
Ventilation heat	loss calcula	ted monthly	0.33 x (25)	m x (5)										
(38)m	43.99	42.69	42.69	40.97	40.97	40.97	40.9	97 40	).97	40.97	40.97	41.38	42.69	(38)
Heat transfer co			(38)m								_			_
(39)m	96.53	95.22	95.22	93.50	93.50	93.50	93.5	50 93	3.50	93.50	93.50		95.22	
									,	Average =	∑(39)11	12/12 =	94.22	(39)
Heat loss parame										Г				_
(40)m	1.01	1.00	1.00	0.98	0.98	0.98	0.9	8 0	.98	0.98	0.98	0.98	1.00	_
										Average =	∑(40)11	12/12 =	0.99	(40)
4. Water heatir	ng energy re	equirement												
	<del>5 5,</del>												kWh/year	
Assumed occupa	incv. N										2.6	69 (4	12)	
If TFA > 13.9,		5 x [1 - exp(-	0.000349 x (	TFA - 13.9	9)²)1 + 0.00′	13 x (TFA - 1	3.9)							
If TFA ≤ 13.9,					,,,,		,							
Annual average I		sage in litre	s ner day Vd	average =	: (25 x N) +	36					98.	18 (/	13)	
Annual average		_					to achi	ieve a wa	ter use	r taraet of				
per person per de		_		,, 0,0 ,,	c arrening	.o aco.g.rca				. ca. get ej				
,	Jan	Feb	Mar	Apr	May	Jun	Ju	I A	ug	Sep	Oct	Nov	Dec	
Hot water usage				•	•				-	•				
(44)m	108.00	104.07	100.14	96.21	92.29	88.36	88.3	36 92	2.29	96.21	100.14	104.0	7 108.00	
											∑(44):	112 =	1178.13	(44)
Energy content of	of hot water	used - calc	ulated montl	nly = 4.19	0 x Vd,m x	nm x Tm/36	00 k\	Wh/mont	h (see	Tables 1b	, 1c 1d)			
(45)m	160.54	140.41	144.89	126.32	121.20	104.59	96.9	92 11	1.21	112.54	131.16	5 143.1	7 155.47	
											∑(45):	112 =	1548.41	(45)
														_
											URN	v: 13-010-0	6 Planning v	ersion 1

For community heating include distribution loss whether or not hot water tank is present

•	-					•							
Distribution loss (	).15 x (45)m	า											
(46)m	24.08	21.06	21.73	18.95	18.18	15.69	14.54	16.68	16.88	19.67	21.48	23.32	(46)
Water storage loss	s:												
a) If manufacturer	's declared	loss factor	is known (k		1.85 (47)								
Temperature f	actor from <sup>-</sup>			0.54	(48)								
Energy lost from water storage, kWh/day (47) x (48)									1.00	(49)			
Enter (49) or (54) in (55)									1.00	(55)			
Water storage loss calculated for each month = (55) x (41)m													
(56)m	30.97	29.97	30.97	29.97	30.97	(56)							
If cylinder contain	s dedicated	l solar stora	nge, = (56)m	n x [(50) - (H	H11)] ÷ (50)	, else = (56	)m where (	H11) is from	m Appendix	кH			
(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)
Primary circuit los	s (annual) f	rom Table	3					:	360.00	(58)			
Primary circuit los	s for each n	nonth (58)	÷ 365 × (41	)m									
(modified by facto	r from Tabl	le H5 if the	re is solar w	ater heatir	ng and a cyl	linder therr	nostat)						
(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 for eac	h month fr	om Table 3	a, 3b or 3c	(enter '0' if	not a coml	bi boiler)							
(61)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat require	d for water	heating ca	lculated for	each mon	th 0.85 × (4	15)m + (46)	m + (57)m -	+ (59)m + (6	61)m				_
(62)m	222.08	195.99	206.43	185.87	182.75	164.15	158.46	172.76	172.10	192.70	202.73	217.02	(62)
Solar DHW input o	alculated u	sing Appen	dix H (nega	itive quanti	ity) ('0' ente	ered if no s	olar contrib	oution to w	ater heatin	g)			_
(63)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	]
										∑(63)1	.12 =	0.00	(63)
Output from wate	r heater for	r each mon	th, kWh/m	onth (62)m	n + (63)m								
(64)m	222.08	195.99	206.43	185.87	182.75	164.15	158.46	172.76	172.10	192.70	202.73	217.02	
										∑(64)1	.12 = 2	273.04	(64)

if (64)m < 0 then set to 0

Heat gains from w	vater heatin	g, kWh/mo	onth 0.25 ×	$[0.85 \times (45)]$	5)m + (61)m	n] + 0.8 × [(4	46)m + (57)	m + (59)m]					
(65)m	102.61	91.16	97.41	89.65	89.54	82.42	81.46	86.21	85.07	92.85	95.25	100.93	(65

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	(Table 5), Wa	atts											
(66)m	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	(66)
Lighting gains (d	calculated in A	Appendix L,	equation L	9 or L9a), a	lso see Tab	le 5							
(67)m	22.36	19.86	16.15	12.23	9.14	7.72	8.34	10.84	14.55	18.47	21.56	22.99	(67)
Appliances gain	s (calculated i	n Appendix	L, equatio	n L13 or L1	3a), also se	e Table 5							
(68)m	248.84	251.42	244.92	231.06	213.58	197.14	186.16	183.58	190.09	203.94	221.43	237.86	(68)
Cooking gains (d	calculated in A	Appendix L,	equation L	15 or L15a)	, also see T	able 5							
(69)m	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	(69)
Pumps and fans	gains (Table	5a)											
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evap	oration (nega	ntive values	) (Table 5)										
(71)m	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	(71)
Water heating g	gains (Table 5)	)											
(72)m	137.92	135.65	130.93	124.51	120.34	114.48	109.49	115.88	118.15	124.79	132.29	135.66	(72)
	ains (66)m + (	67)m + (68	)m + (69)m	+ (70)m +	(71)m + (72	?)m							
Total internal ga	31113 (00)111 . (	(07) (00	, (,	/	. , .	,							

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

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

•	Access factor Table 6d		Area m²	Solar flux W/m <sup>2</sup>		m² g	g Specific dat or Table 6b	a FF	FF Specific data or Table 6c		Gains (W)	
West	0.54	] x [	8.68	] x	19.87	x 0.9 x	0.63	Х	0.80	=	42.25	(80)
Northwest	0.54	] x [	11.82	] x	11.51	x 0.9 x	0.63	x	0.80	=	33.32	(81)
Solar gains in watts, calculat	ed for each r	month ∑(74	l)m(82)m	l								
(83)m 75.57	150.08	249.95	390.62	496.33	529.00	508.66	426.76	304.84	185.42	94.58	61.95	(83)
Total gains - internal and sol	ar (73)m + (8	83)m										
(84)m 558.11	630.43	715.36	831.83	912.80	921.74	886.06	810.47	701.03	606.03	543.27	531.86	(84)
7 Manusintanual tananana	una (la antica											
7. Mean internal temperat	_		f	bla O Tha/°	°C)						24.00	7 (05)
Temperature during heating		_				14.1	A	Care	0.4		21.00	(85)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for (86)m 0.97	0.95	, η1,m (see 0.92	0.85	0.72	0.57	0.41	0.44	0.70	0.88	0.95	0.97	(86)
,		l l		0.72	0.57	0.41	0.44	0.70	0.88	0.95	0.97	] (80)
Mean internal temp of living (87)m 18.93	19.18	19.62	20.12	20.59	20.85	20.96	20.95	20.73	20.17	19.42	18.99	(87)
		I I				20.96	20.95	20.73	20.17	19.42	10.99	] (0/)
Temperature during heating (88)m 20.08	20.09	ne living are	20.10	20.10	20.10	20.10	20.10	20.10	20.10	20.10	20.09	(88)
		l l	<u> </u>		20.10	20.10	20.10	20.10	20.10	20.10	20.09	] (00)
Utilisation factor for gains fo			-		0.54	0.22	0.26	0.64	0.06	0.04	0.00	7 (00)
(89)m 0.96	0.94	0.90	0.83	0.68	0.51	0.33	0.36	0.64	0.86	0.94	0.96	(89)
Mean internal temperature							20.07	10.00	10.00	40.04	47.00	7 (00)
(90)m 17.29	17.65	18.30	19.00	19.64	19.97	20.08	20.07	19.83	19.08	18.01	17.39	(90)
Living area fraction							fLA 3	31.30	÷ (4) =	=	0.33	(91)
Mean internal temperature						20.27	20.25	20.42	10.44	40.47	17.04	7 (00)
(92)m 17.83	18.15	18.73	19.37	19.95	20.26	20.37	20.36	20.13	19.44	18.47	17.91	(92)
Apply adjustment to the me							20.24	10.00	40.20	40.22	17.76	7 (02)
(93)m 17.68	18.00	18.58	19.22	19.80	20.11	20.22	20.21	19.98	19.29	18.32	17.76	(93)
8. Space heating requireme	ent											
8. Space heating requirements	ent Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	Feb			•			-	•				e 9a)
Jan	<b>Feb</b> emperature			•			-	•				e 9a)
Jan Set Ti to the mean internal to	<b>Feb</b> emperature			•			-	•				e 9a)
Jan Set Ti to the mean internal to Utilisation factor for gains, n	Feb emperature Im 0.92	obtained a	t step 11 o	f Table 9b, s	so that tim	= (93)m a	nd recalculat	e the utilis	sation facto	or for gains	using Table	,
Jan Set Ti to the mean internal to Utilisation factor for gains, n (94)m  0.94	Feb emperature Im 0.92	obtained a	t step 11 o	f Table 9b, s	so that tim	= (93)m a	nd recalculat	e the utilis	sation facto	or for gains	using Table	,
Jan  Set Ti to the mean internal to Utilisation factor for gains, $\eta$ (94)m 0.94  Useful gains, $\eta$ mGm, W = (94)	Feb emperature m 0.92 4)m x (84)m 581.85	0.88 628.37	0.80 666.73	f Table 9b, s	so that tim	= (93)m a	nd recalculat	e the utilis	0.83	or for gains	using Table	(94)
Jan Set Ti to the mean internal to Utilisation factor for gains, $\eta$ (94)m 0.94 Useful gains, $\eta$ mGm, W = (94) (95)m 526.38	Feb emperature m 0.92 4)m x (84)m 581.85	0.88 628.37	0.80 666.73	f Table 9b, s	so that tim	= (93)m a	nd recalculat	e the utilis	0.83	or for gains	using Table	(94)
Jan  Set Ti to the mean internal to Utilisation factor for gains, η (94)m 0.94  Useful gains, ηmGm, W = (94) (95)m 526.38  Monthly average external te	Feb emperature m 0.92 4)m x (84)m 581.85 emperature f 5.00	0.88	0.80 0.666.73 8 8.70	f Table 9b, 9	0.51 467.79	= (93)m a 0.34 300.25	0.37 297.33	0.63 443.58	0.83 504.99	0.92 501.90	0.95 502.94	(94)
Jan  Set Ti to the mean internal to Utilisation factor for gains, η (94)m 0.94  Useful gains, ηmGm, W = (94)m 526.38  Monthly average external te (96)m 4.50	Feb emperature m 0.92 4)m x (84)m 581.85 emperature f 5.00 rnal tempera	0.88	0.80 0.666.73 8 8.70	f Table 9b, 9	0.51 467.79	= (93)m a 0.34 300.25	0.37 297.33	0.63 443.58	0.83 504.99	0.92 501.90	0.95 502.94	(94)
Jan  Set Ti to the mean internal to Utilisation factor for gains, η (94)m 0.94  Useful gains, ηmGm, W = (94)m 526.38  Monthly average external te (96)m 4.50  Heat loss rate for mean internal te (96)m	Feb emperature m 0.92 4)m x (84)m 581.85 emperature f 5.00 rnal tempera	0.88  628.37  from Table 8  6.80  ature, Lm, V	0.80 0.80 666.73 8 8.70 W	f Table 9b, s  0.67  611.65  11.70	0.51 467.79 14.60	= (93)m a  0.34  300.25  16.90  310.10	0.37 297.33 16.90	0.63 443.58	0.83 504.99	0.92 501.90 7.00	0.95 502.94 4.90	(94) (95) (96)
Jan  Set Ti to the mean internal to Utilisation factor for gains, $\eta$ (94)m 0.94  Useful gains, $\eta$ mGm, $W = (94)$ (95)m 526.38  Monthly average external to (96)m 4.50  Heat loss rate for mean inter(97)m 1272.07	Feb emperature m 0.92 4)m x (84)m 581.85 emperature f 5.00 rnal tempera	0.88  628.37  from Table 8  6.80  ature, Lm, V	0.80 0.80 666.73 8 8.70 W	f Table 9b, s  0.67  611.65  11.70	0.51 467.79 14.60	= (93)m a  0.34  300.25  16.90  310.10	0.37 297.33 16.90	0.63 443.58	0.83 504.99	0.92 501.90 7.00	0.95 502.94 4.90	(94) (95) (96)
Jan  Set Ti to the mean internal to Utilisation factor for gains, $\eta$ (94)m 0.94  Useful gains, $\eta$ mGm, $W = (94)$ (95)m 526.38  Monthly average external te (96)m 4.50  Heat loss rate for mean inter (97)m 1272.07  Space heating requirement for	Feb emperature m 0.92 4)m x (84)m 581.85 emperature f 5.00 rnal tempera 1238.05 for each mor	0.88  628.37  from Table 6.80  ature, Lm, V  1121.94  nth, kWh/m	0.80 0.80 666.73 8 8.70 W 983.31 nonth = 0.0	f Table 9b, s  0.67  611.65  11.70  757.09  24 x [(97)m	0.51 467.79 14.60 514.87 1- (95)m] x 0.00	= (93)m a  0.34  300.25  16.90  310.10  (41)m  0.00	0.37   297.33   16.90   309.44	0.63 443.58 14.30 530.79	0.83  504.99  10.80  793.75	7.00 7.00 404.33	0.95 502.94 4.90	(94) (95) (96)
Jan  Set Ti to the mean internal to Utilisation factor for gains, $\eta$ (94)m 0.94  Useful gains, $\eta$ mGm, $W = (94)$ (95)m 526.38  Monthly average external te (96)m 4.50  Heat loss rate for mean inter (97)m 1272.07  Space heating requirement for	Feb emperature m 0.92 4)m x (84)m 581.85 emperature f 5.00 rnal tempera 1238.05 for each mor 440.97	0.88  628.37  from Table 8  6.80  ature, Lm, V  1121.94  nth, kWh/m  367.21	0.80 0.80 666.73 8 8.70 W 983.31 nonth = 0.0	f Table 9b, s  0.67  611.65  11.70  757.09  24 x [(97)m	0.51 467.79 14.60 514.87 1- (95)m] x 0.00	= (93)m a  0.34  300.25  16.90  310.10  (41)m  0.00	0.37   297.33   16.90   309.44	0.63 443.58 14.30 530.79	0.83  504.99  10.80  793.75  214.84  3)15, 10	7.00 7.00 1063.47 404.33 12 = 2	0.95 502.94 4.90 1224.57	(94) (95) (96) (97)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11)

Fraction of space heating from main system(s) 1 - (201)				1.00	(202)		
Fraction of main heating from main system 2				0.00	(203)		
Fraction of total space heat from main system 1 (202) x [1 - (203)]				1.00	(204)		
Fraction of total space heat from main system 2 (202) x (203)				0.00	(205)		
Efficiency of main space heating system 1 (%)				93.00	(206)		
(from database or Table 4a/4b, adjusted where appropriate by the	amount sho	vn in the 'spac	ce efficiency	adjustmen	t' column of Tabl	e 4c)	
Jan Feb Mar Apr N	May Ju	n Jul	Aug	Sep	Oct N	ov Dec	
Space heating requirement, kWh/month (as calculated above)							1
	0.0		0.00	0.00	214.84 404	1.33 536.90	
Space heating fuel (main heating system 1), kWh/month = (98)m x	· · · · · · · · · · · · · · · · · · ·				1		1
(211)m 596.55   474.16   394.85   245.10   11	16.36 0.0	!	0.00	0.00	ļ ļ	1.77 577.31	1
		Total per y	year (kWh/y	ear) = ∑(21	1)15, 1012 =	3070.10	(211)
Water heating:							
Output from water heater, kWh/month (calculated above)							1
(64)m 222.08 195.99 206.43 185.87 18	32.75 164	15 158.46	172.76	172.10		2.73 217.02	1
					∑(64)112 =	2273.04	(64)
Efficiency of water heater per month			1	T			1
	2.97 79.	30 79.30	79.30	79.30	84.60 86	.12 86.64	
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m	20.26 207	00 400 03	247.05	247.02		- 40   250 40	1
(219)m 256.27 226.81 240.51 219.04 22	20.26 207		217.85	217.03	!	5.40   250.49	] ]
		lot	al per year (	kWh/year)	= ∑(219)112 =	2718.27	(219)
					kWh/year	LAMB for an	
Annual Totals Summary:					kwn/vear	kwn/vear	
					Kern, year	kWh/year	1
Space heating fuel used, main system 1					icitin, yeur	3070.10	(211)
Space heating fuel used, main system 1 Water heating fuel used					, year	-	(211) (219)
Space heating fuel used, main system 1 Water heating fuel used Electricity for pumps, fans and electric keep-hot (Table 4f):						3070.10	1
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input	t from outsid				70.88	3070.10	(219) (230a)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans	t from outsid				70.88	3070.10	(219) (230a) (230b)
Space heating fuel used, main system 1 Water heating fuel used Electricity for pumps, fans and electric keep-hot (Table 4f): mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump	t from outsid	2			70.88 0.00 130.00	3070.10	(219) (230a) (230b) (230c)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump	t from outsid	9			70.88 0.00 130.00 0.00	3070.10	(230a) (230b) (230c) (230d)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan	t from outsid	2			70.88 0.00 130.00	3070.10	(230a) (230b) (230c) (230d) (230e)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump	t from outsid				70.88 0.00 130.00 0.00 45.00	3070.10	(230a) (230b) (230c) (230d)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler	t from outsid				70.88 0.00 130.00 0.00 45.00 0.00	3070.10	(230a) (230b) (230c) (230d) (230e) (230f)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating	t from outsid				70.88 0.00 130.00 0.00 45.00 0.00 0.00	3070.10	(230a) (230b) (230c) (230d) (230e) (230f) (230g)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating	t from outsid				70.88 0.00 130.00 0.00 45.00 0.00 0.00	3070.10	(230a) (230b) (230c) (230d) (230e) (230f) (230g)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above					70.88 0.00 130.00 0.00 45.00 0.00 0.00	3070.10  2718.27	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L):					70.88 0.00 130.00 0.00 45.00 0.00 0.00	3070.10  2718.27	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)					70.88 0.00 130.00 0.00 45.00 0.00 0.00	3070.10 2718.27	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q):	ding micro-C	НР			70.88 0.00 130.00 0.00 45.00 0.00 0.00	3070.10 2718.27 245.88 394.96	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)		НР		missions Factor	70.88 0.00 130.00 0.00 45.00 0.00 0.00	3070.10 2718.27	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)  12a. Carbon dioxide emissions - Individual heating systems included	eding micro-C Energy kWh/ye	HP ar		missions	70.88 0.00 130.00 0.00 45.00 0.00 0.00	3070.10  2718.27  245.88  394.96  -891.02	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (232)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)  12a. Carbon dioxide emissions - Individual heating systems included the space of the systems included the systems in	Energy kWh/ye	HP ar		missions Factor 0.198	70.88 0.00 130.00 0.00 45.00 0.00 Σ(230a)(230g)	3070.10  2718.27  245.88  394.96  -891.02  Emissions (kgCO2/year)  607.88	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (232) (233)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)  12a. Carbon dioxide emissions - Individual heating systems inclu  Space heating - main system 1  Water heating	eding micro-C Energy kWh/ye	HP ar		missions Factor 0.198 0.198	70.88 0.00 130.00 0.00 45.00 0.00 Σ(230a)(230g)	3070.10  2718.27  2718.27  245.88  394.96  -891.02  Emissions (kgCO2/year)  607.88  538.22	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (232) (233)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)  12a. Carbon dioxide emissions - Individual heating systems included the space of the systems included the systems in	Energy kWh/ye	HP x x	(26	missions Factor 0.198 0.198	70.88 0.00 130.00 0.00 45.00 0.00 Σ(230a)(230g)	3070.10  2718.27  245.88  394.96  -891.02  Emissions (kgCO2/year)  607.88	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (232) (233)

The same constraints and the same species	Energy	Energy Emissions					
	kWh/year		Factor		(kgCO2/year)		
Space heating - main system 1	3070.10	х	0.198	= [	607.88	(261)	
Water heating	2718.27	x	0.198	= [	538.22	(264)	
Space and water heating			(261) + (262) -	- (263) + (264) =	1146.10	(265)	
Pumps, fans and electric keep-hot	245.88	x	0.517	= [	127.12	(267)	
Lighting	394.96	x	0.517	= [	204.20	(268)	
Energy saving/generation technologies:							
PV emission savings (negative quantity)	-891.02	x	0.529	= [	-471.35	(269)	
Total carbon dioxide emissions				∑(261)(271) =	1006.07	(272)	

SAP version 9.90

# SAP 2009 Worksheet

# Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P06 4 St Augustines, London, NW1		

1. Overall dwelling dimen	sions						
		Area (m²)		Average store height (m)	ey	Volume (m³)	
Lowest occupied		95.50	(1a) x	2.60	(2a) =	248.30	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)(1n) = [	95.50	(4)				
Dwelling volume				(3a) + (3b) +	(3c) + (3d)(3n) =	248.30	(5)
2. Ventilation rate							
						m³ per hour	
Number of chimneys				0	x 40 =	0	(6a)
Number of open flues				0	x 20 =	0	(6b)
Number of intermittent fan	ns			0	x 10 =	0	(7a)
Number of passive vents				0	x 10 =	0	(7b)
Number of flueless gas fires	S			0	x 40 =	0	(7c)
						Air changes pe hour	er
Infiltration due to chimneys	s, flues, fans, PSVs	(6a) + (6b) + (	7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)
If a pressurisation test has b	been carried out or is intended, proceed to	o (17), otherw	ise continue from	(9) to (16)			
Air permeability value, q50,	, expressed in cubic metres per hour per	square metre	of envelope area			5.00	(17)
If based on air permeability	value, then (18) = $[(17) \div 20] + (8)$ , other	wise (18) = (16	5)			0.25	(18)
Air permeability value appli	ies if a pressurisation test has been done,	or a design or	specified air perr	meability is bein	g used		
Number of sides on which o	dwelling is sheltered					2	(19)
Shelter factor				1	- [0.075 x (19)] =	0.85	(20)
Adjusted infiltration rate					(18) x (20) =	0.21	(21)
Infiltration rate modified fo	or monthly wind speed:						

Adjusted illilitration rate		
Infiltration rate modified for monthly wind speed:		

Infiltration rate mo	odified for i	monthly wi	nd speed:										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average v	vind speed	from Table	· 7										
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1	.12 =	54.10	(22)
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	1.20	1.27	]
										∑(22a)1	.12 =	13.52	(22a)
Adjusted infiltration	n rate (allo	wing for sh	nelter and v	vind speed)	) = (21) × (2	2a)m							
(22b)m	0.29	0.27	0.27	0.24	0.22	0.21	0.20	0.20	0.22	0.24	0.26	0.27	
										∑(22b)1	.12 =	2.87	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)

0.5

(23a)

If balanced w	ith heat rec	overy: effici	ency in % all	owing for	in-use fact	or (from Ta	ble 4h)	=					N/A	(23c)
c) If whole ho			•	•										
			) = (23b); oth								T	1 0 -0	0.50	7 (0.4.)
(24c)m	0.54	0.52	(2.11) (2.1	0.50	0.50	0.50	0.5	0   0	.50	0.50	0.50	0.50	0.52	(24c)
Effective air char	_				1					0.50	T 0.50	0.50	0.52	7 (25)
(25)m	0.54	0.52	0.52	0.50	0.50	0.50	0.5	0   0	.50	0.50	0.50	0.50	0.52	(25)
3. Heat losses a	nd heat los	s paramete	r											
The κ-value is the	e heat capa	city per unit	area, see To	ıble 1e.										
E	Element		Gross Area, m²	•	nings, n²	Net area A, m²		U-value, W/m²K		A x U, W/K		value, J/m².K	Αxκ, kJ/K	
Doors						2.10	] x [	1.60	] =	3.36		N/A	N/A	(26)
Window*						8.68	] x [	1.15	=	9.94		N/A	N/A	(27)
Window*						11.82	] x [	1.33	] =	15.67		N/A	N/A	(27)
Exposed floor						15.50	] x [	0.20	] =	3.10		N/A	N/A	(28b)
External wall						52.96	x [	0.20	] =	10.59		N/A	N/A	(29a)
Party Wall						33.80	] x [	0.00	] =	0.00		N/A	N/A	(32)
Total area of ext	ernal eleme	ents ∑A, m²				91.06	(31)							
* for windows ar	nd roof wind	dows, effect	ive window l	J-value is	calculated	using formเ	ıla 1/[(	1/UValue	)+0.04	!] paragra <sub>l</sub>	oh 3.2			
Fabric heat loss,	W/K = ∑(A >	≺ U)								(2	(30) -	+ (32) =	42.66	(33)
Heat capacity Cn	n = ∑(A x κ)								(28)	(30) + (32)	+ (32a)	(32e) =	N/A	(34)
Thermal mass pa	rameter (TI	MP) in kJ/m	²K							Calcula	ted separ	ately =	100.00	(35)
Thermal bridges	: ∑(L x Ψ) ca	lculated usi	ng Appendix	K									9.87	(36)
if details of th	nermal bridg	ging are not	known then	(36) = 0.1	5 x (31)									
Total fabric heat	loss										(33) -	+ (36) =	52.53	(37)
Ventilation heat	loss calcula	ted monthly	0.33 x (25)	m x (5)										
(38)m	43.99	42.69	42.69	40.97	40.97	40.97	40.9	97 40	).97	40.97	40.97	41.38	42.69	(38)
Heat transfer co			(38)m								_			_
(39)m	96.53	95.22	95.22	93.50	93.50	93.50	93.5	50 93	3.50	93.50	93.50		95.22	
									,	Average =	∑(39)11	12/12 =	94.22	(39)
Heat loss parame										Г				_
(40)m	1.01	1.00	1.00	0.98	0.98	0.98	0.9	8 0	.98	0.98	0.98	0.98	1.00	_
										Average =	∑(40)11	12/12 =	0.99	(40)
4. Water heatir	ng energy re	equirement												
	<u> </u>												kWh/year	
Assumed occupa	incv. N										2.6	69 (4	12)	
If TFA > 13.9,		5 x [1 - exp(-	0.000349 x (	TFA - 13.9	9)²)] + 0.00′	13 x (TFA - 1	3.9)							
If TFA ≤ 13.9,					,,,,		,							
Annual average I		sage in litre	s ner day Vd	average =	: (25 x N) +	36					98.	18 (/	13)	
Annual average		_					to achi	ieve a wa	ter use	r taraet of				
per person per de		_		,, 0,0 ,,	c arrening	.o aco.g.rca				. ca. get ej				
,	Jan	Feb	Mar	Apr	May	Jun	Ju	I A	ug	Sep	Oct	Nov	Dec	
Hot water usage				•	•				-	•				
(44)m	108.00	104.07	100.14	96.21	92.29	88.36	88.3	36 92	2.29	96.21	100.14	104.0	7 108.00	
											∑(44):	112 =	1178.13	(44)
Energy content of	of hot water	used - calc	ulated montl	nly = 4.19	0 x Vd,m x	nm x Tm/36	00 k	Wh/mont	h (see	Tables 1b	, 1c 1d)			
(45)m	160.54	140.41	144.89	126.32	121.20	104.59	96.9	92 11	1.21	112.54	131.16	5 143.1	7 155.47	
											∑(45):	112 =	1548.41	(45)
														_
											URN	v: 13-010-0	6 Planning v	ersion 1

· · · · · · · · · · · · · · · · · · ·													
Distribution loss (	0.15 x (45)m	า											
(46)m	24.08	21.06	21.73	18.95	18.18	15.69	14.54	16.68	16.88	19.67	21.48	23.32	(46)
Water storage los	s:												
a) If manufacture	's declared	loss factor	is known (l	(Wh/day):					1.85	(47)			
Temperature f			0.54	(48)									
Energy lost fro			1.00	(49)									
Enter (49) or (54)			1.00	(55)									
Water storage los	s calculated	l for each m	nonth = (55	) x (41)m									
(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)
If cylinder contain	s dedicated	l solar stora	ige, = (56)m	n x [(50) - (H	H11)] ÷ (50)	, else = (56	)m where (	H11) is fror	n Appendix	кH			
(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)
Primary circuit los	s (annual) f	rom Table 3	3					3	360.00	(58)			
Primary circuit los	s for each n	nonth (58)	÷ 365 × (41	)m									
(modified by facto	or from Tabl	le H5 if the	re is solar w	ater heatir	ng and a cyl	inder therr	nostat)						
(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 for eac	ch month fr	om Table 3	a, 3b or 3c	(enter '0' if	not a coml	oi boiler)							
(61)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating) 0.00 0.00 (63)m 0.00 0.00 0.00 0.00 0.00 0.00

206.43

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

185.87

			∑(63)112 =	0.00	(63)
Output from water heater for each month, kWh/month (62)m + (63)m					

158.46

172.76 172.10

0.00

192.70

0.00

202.73

0.00

217.02

0.00

182.75 164.15

195.99

222.08

(64)m	222.08	195.99	206.43	185.87	182.75	164.15	158.46	172.76	172.10	192.70	202.7	3 217.02	
										∑(64)1	.12 =	2273.04	(64)

if (64)m < 0 then set to 0

(62)m

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

(65)m	102.61	91.16	97.41	89.65	89.54	82.42	81.46	86.21	85.07	92.85	95.25	100.93	(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 gain	s (see Table	5 and 5a)					/						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	Table 5), Wa	itts											_
(66)m	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	(66)
Lighting gains (ca	Iculated in A	ppendix L,	equation L	9 or L9a), a	lso see Tab	le 5							
(67)m	55.91	49.66	40.39	30.57	22.86	19.30	20.85	27.10	36.37	46.19	53.91	57.47	(67)
Appliances gains	(calculated i	n Appendix	L, equatio	n L13 or L1	3a), also se	e Table 5							
(68)m	371.40	375.26	365.55	344.87	318.77	294.24	277.85	274.00	283.71	304.39	330.49	355.02	(68)
Cooking gains (ca	lculated in A	appendix L,	equation L	15 or L15a)	, also see T	able 5							
(69)m	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	(69)
Pumps and fans	gains (Table	5a)											
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evapo	ration (nega	tive values	) (Table 5)										
(71)m	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	(71)
Water heating ga	ins (Table 5)	1											
(72)m	137.92	135.65	130.93	124.51	120.34	114.48	109.49	115.88	118.15	124.79	132.29	135.66	(72)
Total internal gai	ns (66)m + (	67)m + (68	)m + (69)m	+ (70)m +	(71)m + (72	.)m							
(73)m	682.97	678.30	654.59	617.69	579.70	545.75	525.93	534.71	555.97	593.10	634.42	665.87	(73)

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

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Access factor Table 6d	or	Area m²	So	lar flux W/	m²	g Specific dat or Table 6b	a FI	F Specific da or Table 60		Gains (W)	)
West	0.54	] x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80
Northwest	0.54	x	11.82	x	11.51	x 0.9 x	0.63	x	0.80	=	33.32	(81
Solar gains in watts, calcu	lated for each	month ∑(7	4)m(82)m	l								
(83)m 75.5	7 150.08	249.95	390.62	496.33	529.00	508.66	426.76	304.84	185.42	94.58	61.95	(83
Total gains - internal and	solar (73)m + (	83)m										
(84)m 758.	828.38	904.55	1008.31	1076.04	1074.75	1034.58	961.47	860.81	778.52	729.00	727.82	(84
7. Mean internal tempe	rature (heatin	g season)										
Temperature during heat		_	rea from Ta	ble 9, Th1(ʻ	°C)						21.00	(85
Jar	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gain	s for living area	a, η1,m (see	e Table 9a)									
(86)m 0.9	0.91	0.87	0.79	0.66	0.51	0.36	0.38	0.62	0.81	0.91	0.93	(86
Mean internal temp of liv	ing area T1 (st	eps 3 to 7 i	n Table 9c)									
(87)m 19.2	6 19.48	19.88	20.30	20.68	20.89	20.97	20.97	20.81	20.36	19.71	19.31	(87
Temperature during heat	ing periods in	the living ar	rea from Ta	ble 9, Th2('	°C)							
(88)m 20.0	8 20.09	20.09	20.10	20.10	20.10	20.10	20.10	20.10	20.10	20.10	20.09	(88
Utilisation factor for gain	s for rest of dw	elling η2,m	ı (see Table	9a)								
(89)m 0.9	0.90	0.85	0.76	0.62	0.45	0.28	0.30	0.56	0.78	0.90	0.92	(89
Mean internal temperatu	re in the rest o	of dwelling	T2 (follow s	teps 3 to 7	in Table 9c							_
(90)m 17.7	6 18.09	18.65	19.24	19.75	20.00	20.09	20.08	19.92	19.34	18.42	17.85	(90
iving area fraction	·						fLA 3	31.30	÷ (4) =	=	0.33	(91
Mean internal temperatu	re for the who	le dwelling	fLA x T1 +(1	L - fLA) x T2					_			_
(92)m 18.2	1	19.05	19.59	20.06	20.29	20.38	20.37	20.21	19.68	18.84	18.33	(92
Apply adjustment to the	mean internal	temperatur	re from Tab	le 4e, wher	e appropria	ite			•	•	•	_
(93)m 18.1	1	18.90	19.44	19.91	20.14	20.23	20.22	20.06	19.53	18.69	18.18	(93
	•									•	•	_
8. Space heating require	ement											j
Jar	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean intern	al temperature	obtained a	at step 11 o	f Table 9b,	so that tim	= (93)m a	and recalculat	e the utili	sation facto	or for gains	using Table	e 9a)
Jtilisation factor for gain												7
(94)m 0.9	0.87	0.82	0.74	0.61	0.45	0.29	0.31	0.55	0.76	0.87	0.90	(94
Useful gains, ηmGm, W =	(94)m x (84)m								•			_
(95)m 681.	724.04	744.12	747.52	654.10	483.83	304.18	302.48	476.64	591.86	634.54	655.51	(95
Monthly average externa	l temperature	from Table	8									_
(96)m 4.5	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96
leat loss rate for mean in	nternal temper	ature, Lm,	W									_
(97)m 1313	09 1275.49	1152.38	1003.81	767.24	518.48	310.98	310.60	538.59	816.05	1098.09	1264.55	(97
Space heating requireme	nt for each mo	nth, kWh/r	month = 0.0	24 x [(97)m	n - (95)m] x	(41)m						_
(98)m 469.	370.58	303.75	184.53	84.18	0.00	0.00	0.00	0.00	166.79	333.76	453.13	
						Total per	year (kWh/y	ear) = ∑(9	8)15, 10	.12 = 2	2366.68	(98
Space heating requireme	nt in kWh/m²/	year							(98)	÷ (4)	24.78	(99
										•		

### 9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11)

Fraction of space heat	ing from main sy	stem(s) 1 -	(201)					1.00	(202)			
Fraction of main heati	ng from main sys	stem 2						0.00	(203)			
Fraction of total space	heat from main	system 1 (2	02) x [1 - (2	.03)]				1.00	(204)			
Fraction of total space	heat from main	system 2 (2	02) x (203)					0.00	(205)			
Efficiency of main space	ce heating syster	n 1 (%)						93.00	(206)			
(from database or Tab	ole 4a/4b, adjusto	ed where ap	oropriate by	the amou	nt shown ii	n the 'space	efficiency (	adjustmen	- t' column of To	able 4c)		
	Jan Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating require	ment, kWh/mon	th (as calcula	ated above)									
(98)m 46	69.97 370.58	303.75	184.53	84.18	0.00	0.00	0.00	0.00	166.79	333.76	453.13	
Space heating fuel (ma	ain heating syste	m 1), kWh/n	nonth = (98	)m x (204)	x 100 ÷ (20	6)						_
(211)m 50	05.34 398.47	326.61	198.42	90.51	0.00	0.00	0.00	0.00	179.35	358.88	487.24	
					•	Total per ye	ar (kWh/ye	ear) = ∑(21	1)15, 1012	! = 2	2544.81	(211)
Water heating:												
Output from water he	ater, kWh/mont	h (calculated	d above)									
(64)m 22	22.08 195.99	206.43	185.87	182.75	164.15	158.46	172.76	172.10	192.70	202.73	217.02	
									∑(64)112	! = 2	273.04	(64)
Efficiency of water hea	ater per month											
(217)m 8	86.26 85.99	85.34	84.29	82.39	79.30	79.30	79.30	79.30	83.93	85.63	86.23	
Fuel for water heating	g, kWh/month = (	64)m x 100 -	÷ (217)m									
(219)m 25	57.44 227.94	241.89	220.51	221.81	207.00	199.83	217.85	217.03	229.60	236.74	251.66	
						Total	per year (I	kWh/year)	= <u>∑</u> (219)112	! = 2	729.29	(219)
Annual Totals Summa	ıry:								kWh/year	· k\	Wh/year	
Space heating fuel use	-	1									2544.81	(211)
Water heating fuel us	-										2729.29	(219)
Electricity for pumps,		keen-hot (1	Table 4f)								.,	] (=15)
mechanical ventila				nout from	outsido				70.88			(230a)
warm air heating s		eu, extract (	or positive i	iiput iioiii	outside				0.00			(230a)
central heating pur									130.00			(230c)
oil boiler pump	p								0.00			(230d)
boiler flue fan									45.00			(230e)
maintaining electri	c keep-hot facilit	y for gas cor	nbi boiler						0.00			(230f)
pump for solar wat	ter heating								0.00			(230g)
Total electricity for the	e above								∑(230a)(230	g)	245.88	(231)
Electricity for lighting	(calculated in A	ppendix L):									394.96	(232)
Energy saving/genera	tion technologie	s (Appendic	es M, N and	d Q):								
Electricity generated b	y PVs (Appendix	M) (negativ	e quantity)							-	891.02	(233)
10a. Fuel costs - Indi	vidual heating sy	stems inclu	ding micro-									
				Fuel	kWh/year			uel price able 12)		Fuel	cost £/yea	r
Space heating - main s	system 1			2	2544.81	x		3.10	x 0.01 =		78.89	(240)
Water heating cost (of	ther fuel)			2	729.29	x		3.10	x 0.01 =		84.61	(247)
Pumps, fans and elect	ric keep-hot				245.88	x		11.46	x 0.01 =		28.18	(249)
Energy for lighting					394.96	x		11.46	x 0.01 =		45.26	(250)
Additional standing ch	narges (Table 12)					_			-		106.00	(251)
Energy saving/genera		s (Appendic	es M. N and	d Q):								. ,
PV savings (negative	_	- 1	,		891.02	] x		11.46	x 0.01 =		102.11	(252)
	quantity)					_ ^			_		240.83	7
Total energy cost							(	(240)(242	2) + (245)(25	<b>→</b> /	<u> </u>	(255)

ergy cost deflator (Table 12) ergy cost factor (ECF) [(	· · · · · · · · · · · · · · · · · · ·	0.47	(256)
ergy cost factor (ECF)			
	$(255) \times (256)] \div [(4) + 45.0] =$	0.81	(257)
P value		88.76	
P rating		89	(258)
P band		В	

	Energy		Emissions		Emissions	
	kWh/year		Factor		(kgCO2/year)	
Space heating - main system 1	2544.81	x	0.198	=	503.87	(261)
Water heating	2729.29	x	0.198	=	540.40	(264)
Space and water heating			(261) + (262)	+ (263) + (264) =	1044.27	(265)
Pumps, fans and electric keep-hot	245.88	x	0.517	=	127.12	(267)
Lighting	394.96	x	0.517	=	204.20	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-891.02	x	0.529	=	-471.35	(269)
Total carbon dioxide emissions				∑(261)(271) =	904.24	(272)
Dwelling carbon dioxide emissions rate				(272) ÷ (4) =	9.47	(273)
El value					91.38	
El rating (see section 14)					91	(274)
EI band					В	7

13a. Primary energy - Individual heating systems including	micro-CHP					
	Energy kWh/year		Primary Energy Factor		Primary Energy	,
Space heating - main system 1	2544.81	x	1.02	=	2595.71	(261*)
Water heating	2729.29	х	1.02	=	2783.88	(264*)
Space and water heating			(261*) + (262*) + (263	s*) + (264*) =	5379.59	(265*)
Pumps, fans and electric keep-hot	245.88	x	2.92	=	717.98	(267*)
Lighting	394.96	x	2.92	=	1153.29	(268*)
Energy saving/generation technologies:						
PV primary energy savings (negative quantity)	-891.02	х	2.92	=	-2601.78	(269*)
Total primary energy kWh/year			∑(26:	1*)(271*) =	4649.09	(272*)
Primary energy kWh/m2/year			(	(272*) ÷ (4) =	48.68	(273*)

# Code for Sustainable Homes (November 2010) Design - Draft

Mr Stuart Searle

Assessor name

Net CO<sub>2</sub> emissions



2435

### This report details the calculations and results for Ene 1, 2 and 7 of the Code For Sustainable Homes.

This Design Assessment has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed. Code calculations are from the Technical Guide (November 2010).

Assessor number

Client			ast modified		01/02/2013
Address	P07 4 St Augustines	s, London, NW1			
Building regulation assess	sment - criterion 1				
					kg/m²/yr
ER					9.95
ER					15.66
Assessment of zero carbo	n home and low or ze	ro carbon technologies		Credits	Level
)welling emission rate (En	e 1)	CO₂ reduction = 36.5 %		4	4
Owelling emission rate (En	e 1)	$CO_2$ reduction = 36.5 % FEE = 42.0		5.5	4
					4
Fabric Energy Efficiency	ologies (Ene 7)	FEE = 42.0		5.5	4

	76	KVVN/M-	kgCO₂/m⁻/yr
Assessment of Ene 1 (level 1-5)			
DER from SAP 2009 DER worksheet			9.95
Additional allowable generation		0.00	
CO₂ emissions offset from generation			0.00
CO₂ emissions offset from community biofuel CHP systems			0.00
Total CO₂ emissions offset from SAP section 16 allowances			0.00
DER accounting for SAP section 16 allowances			9.95
CO₂ reduction compared to TER			5.71
CO₂ reduction as % of TER	36.5		

		1
0.00		
	0.00	]
	0.00	]
	0.00	]
	9.95	]
	5.71	]
	9.95	(ZC1)
	14.78	(ZC2)
	1.75	(ZC3)
	26.48	(ZC4)
0.00		(ZC6)
	0.00	(ZC7)
	0.00	(ZC5)
		0.00 0.00 0.00 9.95 5.71 9.95 14.78 1.75 26.48 0.00

26.48

(ZC8)

Ene 1 - dwelling emission rate - level 6			
There is no Zero Carbon Home definition in the current technical guide			
	Criterion	Value	Pass/Fail
FEE	<= 39	42.0	Fail
Net CO₂ emissions	<= 0.00	26.48	Fail
Result: Not level 6			
Number of credits for Ene 1			4
Ene 2 - Fabric Energy Efficiency			
FEE			42.0
Number of credits for Ene 2			5.5
Ene 7 - low or zero carbon technologies			
		Emissions	Reduction
Standard case		kgCO₂/yr	kgCO₂/yr
Space and water heating (265)		1373.23	
Mechanical cooling (266)		0.00	
Pumps and fans (267)		131.34	
Lighting (268)		221.45	
Appliances and cooking		1760.14	
Total CO₂		1709.50	
Actual case			
Space and water heating (265) or (376)		1373.23	
Space and water heating from LZCT considered in SAP 2009			0.00
Pumps and fans (267) or (378)		131.34	
Pumps and fans			0.00
Electricity generated by LZCT (269) + (380))			-525.84
Additional allowable electricity generation considered in SAP 2009 section 16			0.00
Offset from biofuel CHP [-1 x [(363)(366) + (368)(372)]]			0.00
LZCT electricity generation			-525.84
LZCT thermal generation			0
Total from specified LZCT			-525.84
		Emissions	
Reduction in CO₂ Emissions		kgCO <sub>2</sub> /m²/yr	
Standard Case CO <sub>2</sub>		32.74	
Actual Case CO₂		27.80	

15 **2** 

% Reduction in  $CO_2$ 

Number of credits for Ene 7

# DER 2009 Worksheet

## Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P07 4 St Augustines, London, NW1		

1. Overall dwelling dimens	sions			
		Area (m²)	Average storey height (m)	Volume (m³)
Lowest occupied		106.50 (1a) x	2.60 (2a) =	276.90 (3a
Total floor area	(1a) + (1b) + (1c) + (1d)	(1n) = 106.50 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)(3n)	= 276.90 (5)
2. Ventilation rate				
				m³ per hour
Number of chimneys			0 x 40 =	0 (6a
Number of open flues			0 x 20 =	0 (65
Number of intermittent fans	5		0 x 10 =	0 (7a
Number of passive vents			0 x 10 =	0 (7)
Number of flueless gas fires			0 x 40 =	0 (70
				Air changes per hour
Infiltration due to chimneys,	, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7	$\dot{c}$ (5) =	0.00 (8)
If a pressurisation test has b	een carried out or is intended, pro	oceed to (17), otherwise continue fr	rom (9) to (16)	
Air permeability value, q50,	expressed in cubic metres per ho	our per square metre of envelope ar	rea	5.00 (17
If based on air permeability	value, then (18) = [(17) ÷ 20] + (8)	), otherwise (18) = (16)		0.25
Air permeability value applie	es if a pressurisation test has beer	n done, or a design or specified air p	permeability is being used	
Number of sides on which d	welling is sheltered			1 (19
Shelter factor			1 - [0.075 x (19)]	= 0.92 (20
Adjusted infiltration rate			(18) x (20)	= 0.23 (21
Infiltration rate modified for	monthly wind speed:			

Sherier ractor	1 [0.075 x (15)] -	0.52	(20)
Adjusted infiltration rate	(18) x (20) =	0.23	(21)
Infiltration rate modified for monthly wind speed:			

Infiltration rate mo	pairiea for i	monthly wi	na speea:										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average v	vind speed	from Table	· 7										
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	]
										∑(22)1	.12 =	54.10	(22)
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	1.20	1.27	]
										∑(22a)1	.12 =	13.52	(22a)
Adjusted infiltration	n rate (allo	owing for sh	nelter and v	vind speed	) = (21) × (2	2a)m							
(22b)m	0.31	0.29	0.29	0.26	0.24	0.23	0.21	0.21	0.24	0.26	0.28	0.29	]
										∑(22b)1	.12 =	3.13	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system

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

(23a)

0.5

If balanced wi	th heat rec	overy: effici	ency in % all	lowing for	in-use fact	or (from Ta	ble 4h) =							N/A	(23c)
c) If whole hou	use extract	ventilation	or positive i	nput venti	lation from	n outside									
if (22b)m <	0.5 x (23b)	, then (24c)	) = (23b); oth	nerwise (2	4c) = (22b)	m + 0.5 x (23	3b)								
(24c)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	(	0.50	0.50	0.51	0	.53	0.54	(24c
Effective air chan	ge rate - en	iter (24a) oi	r (24b) or (24	1c) or (24c	l) in box (25	5)									_
(25)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	(	0.50	0.50	0.51	0	.53	0.54	(25)
3. Heat losses ar	nd heat los	s paramete	r												
The κ-value is the	heat capa	city per unit	area, see To	able 1e.											
E	lement		Gross Area, m²	-	nings, n²	Net area A, m²		-value, V/m²K		A x U, W/K		-value, :J/m².K		Αxκ, kJ/K	
Doors						2.10	х 🗌	1.60	] =	3.36		N/A		N/A	(26)
Window*						8.68	х	1.15	=	9.94		N/A		N/A	(27)
Window*						12.13	х	1.33	=	16.08		N/A		N/A	(27)
External wall						90.01	x	0.20	=	18.00		N/A		N/A	(29a
Party Wall						34.19	x	0.00	=	0.00		N/A		N/A	(32)
Roof						30.00	x	0.15	=	4.50		N/A		N/A	(30)
Total area of exte	rnal eleme	nts ∑A, m²				142.92	(31)								
* for windows and	d roof wind	lows, effect	ive window l	U-value is	calculated	using formu	la 1/[(1/	'UValu	e)+0.04	!] paragraµ	oh 3.2				
Fabric heat loss, \	N/K = ∑(A >	( U)								(2	6)(30)	+ (32) =		51.88	(33)
Heat capacity Cm	$= \sum (A \times \kappa)$								(28)(	(30) + (32)	+ (32a)	.(32e) =		N/A	(34)
Thermal mass par	rameter (TI	MP) in kJ/m	²K							Calcula	ted sepa	rately =	:	100.00	(35)
Thermal bridges: if details of the					5 x (31)									12.17	(36)
Total fabric heat I	oss										(33)	+ (36) =		64.05	(37)
Ventilation heat l	oss calculat	ted monthly	0.33 x (25)	)m x (5)											_
(38)m	51.37	49.79	49.79	46.62	45.69	45.69	45.69	4	5.69	45.69	46.62	2 48	3.20	49.79	(38)
Heat transfer coe	fficient, W	/K (37)m+	(38)m												_
(39)m	115.42	113.84	113.84	110.67	109.74	109.74	109.74	1 10	09.74	109.74	110.6	7 11	2.25	113.84	_
									,	Average =	∑(39)1	12/12 =	:	111.60	(39)
Heat loss parame														1 -	7
(40)m	1.08	1.07	1.07	1.04	1.03	1.03	1.03	_   1	1.03	1.03	1.04		.05	1.07	] 7
									,	Average =	∑(40)1	12/12 =		1.05	(40)
4. Water heating	g energy re	quirement													
													k۷	Wh/year	
Assumed occupar	ncy, N										2.	79	(42)		
If TFA > 13.9, I	N = 1 + 1.76	5 x [1 - exp(-	·0.000349 x (	(TFA - 13.9	9) <sup>2</sup> )] + 0.00	13 x (TFA - 1	3.9)						_		
If TFA ≤ 13.9, I	N = 1														
Annual average h	ot water us	sage in litre	s per day Vd	,average =	(25 x N) +	36					100	0.51	(43)		
Annual average h	ot water us	sage has be	en reduced l	by 5% if th	e dwelling	is designed	to achiev	ve a wa	ater use	target of	not more	e than 1	 25 litr	es	
per person per da	ıy (all wateı	r use, hot ai	nd cold)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	,	Aug	Sep	Oct	N	lov	Dec	
Hot water usage i		-	1			1					1			1	7
(44)m	110.56	106.54	102.52	98.50	94.48	90.46	90.46	9	4.48	98.50	102.5	-	6.54	110.56	_
												112 =	1	.206.15	(44)
Energy content of				-								_		l	7
(45)m	164.36	143.75	148.33	129.32	124.09	107.08	99.22	11	13.86	115.22	134.2		6.57	159.17	] ¬
											∑(45)	112 =	1	.585.24	(45)
											UR	N: 13-01	10-07 I	Planning v	ersion

,						•							
Distribution loss	0.15 x (45)n	า											
(46)m	24.65	21.56	22.25	19.40	18.61	16.06	14.88	17.08	17.28	20.14	21.99	23.88	(46)
Water storage los	s:												
a) If manufacture	r's declared	loss factor	is known (I	«Wh/day):					1.85	(47)			
Temperature f	actor from	Table 2b							0.54	(48)			
Energy lost fro	m water sto	orage, kW	h/day (47)	x (48)					1.00	(49)			
Enter (49) or (54)	in (55)								1.00	(55)			
Water storage los	s calculated	I for each m	nonth = (55	) x (41)m									
(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)
If cylinder contain	s dedicated	l solar stora	ige, = (56)n	n x [(50) - (I	H11)] ÷ (50)	, else = (56	)m where (	H11) is from	n Appendix	άН			
(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)
Primary circuit los	ss (annual) f	rom Table	3					3	360.00	(58)			
Primary circuit los	s for each r	month (58)	÷ 365 × (41	)m									
(modified by facto	or from Tab	le H5 if the	re is solar v	vater heatii	ng and a cyl	linder therr	mostat)						
(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 for each	ch month fr	om Table 3	a, 3b or 3c	(enter '0' if	not a coml	bi boiler)							
(61)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat require	ed for water	heating ca	lculated fo	r each mon	th 0.85 × (4	15)m + (46)	m + (57)m -	+ (59)m + (6	61)m				
(62)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	195.82	206.13	220.71	(62)
Solar DHW input	calculated u	ising Appen	dix H (nega	ative quant	ity) ('0' ente	ered if no s	olar contrib	ution to wa	ater heating	g)			
(63)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
										∑(63)1	12 =	0.00	(63)
Output from water	er heater fo	r each mon	th, kWh/m	onth (62)n	n + (63)m								
													_

if (64)m < 0 then set to 0

225.90

199.33

(64)m

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

188.88

209.88

(65)m 103.88 92.27 98.56 90.65 90.49 83.25 82.23 87.09 85.96 93.88 96.38 102.16 (65)

166.64

160.77

175.40

174.78

195.82

∑(64)1...12 =

206.13

220.71

2309.87

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

185.63

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	(Table 5), Wa	atts			,			Ü	•				
(66)m	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	(66)
Lighting gains (c	alculated in A	Appendix L,	eguation L	9 or L9a), a	lso see Tab	le 5							
(67)m	24.25	21.54	17.52	13.26	9.91	8.37	9.04	11.76	15.78	20.04	23.38	24.93	(67)
Appliances gains	(calculated i	in Appendi	κ L, equatio	n L13 or L1	3a), also se	e Table 5							_ , ,
(68)m	266.43	269.19	262.23	247.39	228.67	211.08	199.32	196.56	203.52	218.35	237.08	254.67	(68)
Cooking gains (c	alculated in A	Appendix L,	equation L	.15 or L15a)	, also see T	able 5							_ , ,
(69)m	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	(69)
Pumps and fans	gains (Table	5a)			•								_
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evap	oration (nega	tive values	) (Table 5)		•								_
(71)m	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	(71)
	ains (Table 5)	)			•							1	
Water heating g			122.47	125.90	121.63	115.63	110.52	117.06	119.39	126.19	133.87	137.31	(72)
Water heating g (72)m	139.63	137.30	132.47	123.30									
Water heating g (72)m Total internal ga		1		1		.)m							_

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

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

betuis joi month of Junual	Access factor Table 6d		Area m²		lar flux W/	m²	g Specific dat or Table 6b		Specific da or Table 6		Gains (W	)
West	0.54	] x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
South	0.54	] x	12.13	x	47.32	x 0.9 x	0.63	x	0.80	] =	140.58	(78)
Solar gains in watts, calcula	ted for each	month ∑(74	4)m(82)m	1								
(83)m 182.83	311.17	410.86	506.60	558.92	570.23	557.75	517.02	453.52	353.10	219.09	156.32	(83)
Total gains - internal and so	olar (73)m + (	83)m										
(84)m 688.02	814.09	897.95	968.03	994.02	980.18	951.51	917.28	867.09	792.55	688.29	648.11	(84)
7. Mean internal tempera	ture (heating	g season)										
Temperature during heating	g periods in t	the living ar	ea from Ta	ble 9, Th1(˚	°C)						21.00	(85)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	_
Utilisation factor for gains	or living area	a, η1,m (see	Table 9a)									
(86)m 0.96	0.94	0.90	0.85	0.75	0.61	0.44	0.45	0.67	0.85	0.94	0.96	(86)
Mean internal temp of livir	g area T1 (st	eps 3 to 7 ir	n Table 9c)									
(87)m 18.86	19.17	19.60	20.05	20.51	20.81	20.95	20.94	20.73	20.20	19.40	18.91	(87)
Temperature during heating	g periods in t	the living ar	ea from Ta	ble 9, Th2('	°C)							
(88)m 20.02	20.03	20.03	20.05	20.06	20.06	20.06	20.06	20.06	20.05	20.04	20.03	(88)
Utilisation factor for gains	or rest of dw	elling η2,m	(see Table	9a)								
(89)m 0.95	0.93	0.89	0.82	0.71	0.54	0.35	0.36	0.61	0.82	0.93	0.96	(89)
Mean internal temperature	in the rest o	of dwelling 1	Γ2 (follow s	teps 3 to 7	in Table 9c							
(90)m 17.16	17.61	18.23	18.88	19.51	19.88	20.03	20.02	19.80	19.10	17.95	17.24	(90)
Living area fraction							fLA 2	24.00	÷ (4) :	=	0.23	(91)
Mean internal temperature	for the who	le dwelling	fLA x T1 +(:	1 - fLA) x T2	2				_			_
(92)m 17.54	17.96	18.54	19.14	19.73	20.09	20.23	20.23	20.01	19.35	18.27	17.62	(92)
Apply adjustment to the m	ean internal t	temperatur	e from Tab	le 4e, wher	e appropri	ate						
(93)m 17.39	17.81	18.39	18.99	19.58	19.94	20.08	20.08	19.86	19.20	18.12	17.47	(93)
												_
8. Space heating requiren									_			
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal		obtained a	it step 11 o	f Table 9b,	so that tim	= (93)m a	and recalculat	te the utili	sation facto	or for gains	using Tabl	e 9a)
Utilisation factor for gains, (94)m 0.93	ηm 0.90	0.85	0.79	0.68	0.53	0.35	0.36	0.60	0.79	0.90	0.93	(94)
` ,		1	0.79	0.08	0.55	0.55	0.50	0.60	0.79	0.90	0.93	] (94)
Useful gains, $\eta$ mGm, W = (95)m 639.48	1	766.46	766.88	679.57	520.92	335.59	334.07	518.38	627.00	621.35	605.14	(95)
		1		0/3.3/	320.32	333.39	334.07	210.30	027.00	021.33	003.14	اردو) [
Monthly average external to (96)m 4.50	5.00	from Table 6.80	8 8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
. ,				11.70	14.00	16.90	16.90	14.30	10.80	7.00	4.90	] (96)
Heat loss rate for mean int (97)m 1488.2				065.34	586.08	349.29	240.02	610.30	020.47	1240 50	1420.01	7 (07)
	-	1319.37	1139.05	865.24			348.93	610.26	929.47	1248.58	1430.61	(97)
Space heating requirement							0.00	0.00	225.02	454.64	C1445	٦
(98)m 631.49	488.44	411.37	267.96	138.14	0.00	0.00	0.00	0.00	225.03	451.61	614.15	] ¬
						Total per	r year (kWh/y	ear) = ∑(9			3228.19	∐ (98) ¬
Space heating requirement	in kWh/m²/y	year							(98)	÷ (4)	30.31	(99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11)

Fraction of space heating from main system(s) 1 - (201)			1.00	(202)		
Fraction of main heating from main system 2			0.00	(203)		
Fraction of total space heat from main system 1 (202) x [1 - (203)]			1.00	(204)		
Fraction of total space heat from main system 2 (202) x (203)			0.00	(205)		
Efficiency of main space heating system 1 (%)			93.00	(206)		
(from database or Table 4a/4b, adjusted where appropriate by the a	mount shown ir	the 'space e	fficiency adjustmer	nt' column of Table	e 4c)	
Jan Feb Mar Apr Ma	ıy Jun	Jul	Aug Sep	Oct No	ov Dec	
Space heating requirement, kWh/month (as calculated above)						
(98)m 631.49 488.44 411.37 267.96 138.		0.00	0.00 0.00	225.03   451	.61 614.15	
Space heating fuel (main heating system 1), kWh/month = (98)m x (2						1
(211)m 679.02 525.21 442.33 288.13 148.	ļ.	0.00	0.00 0.00	-!	5.60   660.38	1
	7	Total per year	$r (kWh/year) = \sum (22)$	11)15, 1012 =	3471.17	(211)
Water heating:						
Output from water heater, kWh/month (calculated above)						l
(64)m 225.90 199.33 209.88 188.88 185.	63 166.64	160.77	175.40 174.78		5.13   220.71	 
				∑(64)112 =	2309.87	(64)
Efficiency of water heater per month	70.00	70.00	70.20 70.20		25 06.00	I
(217)m 86.91 86.61 86.08 85.24 83.5	79.30	79.30	79.30 79.30	84.68 86	.35 86.90	
Fuel for water heating, kWh/month = $(64)$ m x $100 \div (217)$ m $(219)$ m $259.92$ $230.14$ $243.83$ $221.57$ $222$ .	21 210.13	202.73	221.19 220.40	231.24 238	3.72 253.99	l
(219)111 235.92 230.14 245.05 221.37 222.	21   210.13		1			(240)
		rotarp	er year (kWh/year	) = 2(219)112 =	2756.08	(219)
A				Idalla lugga	Idalle /voor	
Annual Totals Summary:				kWh/year	kWh/year	(244)
Space heating fuel used, main system 1				kWh/year	3471.17	(211)
Space heating fuel used, main system 1 Water heating fuel used				kWh/year		(211) (219)
Space heating fuel used, main system 1 Water heating fuel used Electricity for pumps, fans and electric keep-hot (Table 4f):					3471.17	(219)
Space heating fuel used, main system 1 Water heating fuel used Electricity for pumps, fans and electric keep-hot (Table 4f): mechanical ventilation fans - balanced, extract or positive input from	rom outside			79.05	3471.17	(219) (230a)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input from warm air heating system fans	rom outside			79.05 0.00	3471.17	(219) (230a) (230b)
Space heating fuel used, main system 1 Water heating fuel used Electricity for pumps, fans and electric keep-hot (Table 4f): mechanical ventilation fans - balanced, extract or positive input from warm air heating system fans central heating pump	rom outside			79.05 0.00 130.00	3471.17	(219) (230a) (230b) (230c)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input from warm air heating system fans	rom outside			79.05 0.00	3471.17	(219) (230a) (230b)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input from warm air heating system fans central heating pump oil boiler pump	rom outside			79.05 0.00 130.00 0.00	3471.17	(230a) (230b) (230c) (230d)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input from warm air heating system fans central heating pump oil boiler pump boiler flue fan	rom outside			79.05 0.00 130.00 0.00 45.00	3471.17	(230a) (230b) (230c) (230d) (230e)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input from warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler	rom outside			79.05 0.00 130.00 0.00 45.00 0.00	3471.17	(230a) (230b) (230c) (230d) (230e) (230f)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input from warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating	rom outside			79.05 0.00 130.00 0.00 45.00 0.00	3471.17 2756.08	(230a) (230b) (230c) (230d) (230e) (230f) (230g)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input from warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating	rom outside			79.05 0.00 130.00 0.00 45.00 0.00	3471.17 2756.08	(230a) (230b) (230c) (230d) (230e) (230f) (230g)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input from warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above	rom outside			79.05 0.00 130.00 0.00 45.00 0.00	3471.17 2756.08	(219) (230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input from warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L):	rom outside			79.05 0.00 130.00 0.00 45.00 0.00	3471.17 2756.08	(219) (230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input from warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)				79.05 0.00 130.00 0.00 45.00 0.00	3471.17 2756.08 254.05	(219) (230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (232)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input from warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q):	ing micro-CHP		Emissions	79.05 0.00 130.00 0.00 45.00 0.00	3471.17 2756.08 2756.08 254.05 428.34	(219) (230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (232)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input from warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)			Emissions Factor	79.05 0.00 130.00 0.00 45.00 0.00	3471.17 2756.08 254.05	(219) (230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (232)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input from warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)	ng micro-CHP Energy	x		79.05 0.00 130.00 0.00 45.00 0.00	3471.17 2756.08 2756.08 254.05 428.34 -994.03	(219) (230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (232)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input from warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)  12a. Carbon dioxide emissions - Individual heating systems includi	ng micro-CHP Energy kWh/year	] x	Factor	79.05 0.00 130.00 0.00 45.00 0.00 0.00 Σ(230a)(230g)	3471.17 2756.08 2756.08 254.05 428.34 -994.03	(219) (230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (232)
Space heating fuel used  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input from warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)  12a. Carbon dioxide emissions - Individual heating systems including Space heating - main system 1	ing micro-CHP Energy kWh/year 3471.17	1	0.198 0.198	79.05 0.00 130.00 0.00 45.00 0.00 Σ(230a)(230g)	3471.17 2756.08 2756.08 254.05 428.34 -994.03 Emissions (kgCO2/year) 687.29	(219) (230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (232) (233)

Space heating - main system 1	2474 47				(kgCO2/year)	
	3471.17	Х	0.198	] = [	687.29	(261)
Water heating	2756.08	x	0.198	] = [	545.70	(264)
Space and water heating			(261) + (262)	+ (263) + (264) =	1233.00	(265)
Pumps, fans and electric keep-hot	254.05	x	0.517	] = [	131.34	(267)
ighting	428.34	x	0.517	] = [	221.45	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-994.03	x	0.529	] = [	-525.84	(269)
Total carbon dioxide emissions				∑(261)(271) =	1059.95	(272)

SAP version 9.90

# SAP 2009 Worksheet

## Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P07 4 St Augustines, London, NW1		

1. Overall dwelling dimensi	ions					
		Area (m²)	Average st height (ı		Volume (m³)	
Lowest occupied		106.50 (1a) x	2.60	(2a) =	276.90	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)(1n) =	106.50 (4)				
Dwelling volume			(3a) + (3b)	) + (3c) + (3d)(3n) =	276.90	(5)
2. Ventilation rate						
					m³ per hour	
Number of chimneys			0	x 40 =	0	(6a)
Number of open flues			0	x 20 =	0	(6b)
Number of intermittent fans			0	x 10 =	0	(7a)
Number of passive vents			0	x 10 =	0	(7b)
Number of flueless gas fires			0	x 40 =	0	(7c)
					Air changes pe hour	er
Infiltration due to chimneys,	flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) +	- (7c) = 0	÷ (5) =	0.00	(8)
If a pressurisation test has be	een carried out or is intended, proceed to	o (17), otherwise continu	e from (9) to (16)			
Air permeability value, q50, e	expressed in cubic metres per hour per s	square metre of envelop	e area		5.00	(17)
If based on air permeability v	value, then (18) = $[(17) \div 20] + (8)$ , other	wise (18) = (16)			0.25	(18)
Air permeability value applie	s if a pressurisation test has been done,	or a design or specified o	iir permeability is b	eing used		
Number of sides on which dv	welling is sheltered				1	(19)
Shelter factor				1 - [0.075 x (19)] =	0.92	(20)
Adjusted infiltration rate				(18) x (20) =	0.23	(21)
Infiltration rate modified for	monthly wind speed:					

Infiltration rate m	odified for	monthly wi	nd speed:										_
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average	wind speed	from Table	· 7										
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	]
										∑(22)1	12 =	54.10	(22)
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	1.20	1.27	]
										∑(22a)1	12 =	13.52	(22a)
Adjusted infiltration	on rate (allo	owing for sh	nelter and v	vind speed	) = (21) × (2	2a)m							
(22b)m	0.31	0.29	0.29	0.26	0.24	0.23	0.21	0.21	0.24	0.26	0.28	0.29	]
										Σ(22b)1	12 =	3.13	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system

0.5 (23a)

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

If balanced wi	th heat rec	overy: effici	ency in % all	lowing for	in-use fact	or (from Ta	ble 4h) =							N/A	(23c)
c) If whole hou	use extract	ventilation	or positive i	nput venti	lation from	n outside									
if (22b)m <	0.5 x (23b)	, then (24c)	) = (23b); oth	nerwise (2	4c) = (22b)	m + 0.5 x (23	3b)								
(24c)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	(	0.50	0.50	0.51	0	.53	0.54	(24c
Effective air chan	ge rate - en	iter (24a) oi	r (24b) or (24	1c) or (24c	l) in box (25	5)									_
(25)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	(	0.50	0.50	0.51	0	.53	0.54	(25)
3. Heat losses ar	nd heat los	s paramete	r												
The κ-value is the	heat capa	city per unit	area, see To	able 1e.											
E	lement		Gross Area, m²	-	nings, n²	Net area A, m²		-value, V/m²K		A x U, W/K		-value, J/m².K		Αxκ, kJ/K	
Doors						2.10	х 🗌	1.60	] =	3.36		N/A		N/A	(26)
Window*						8.68	х	1.15	=	9.94		N/A		N/A	(27)
Window*						12.13	х	1.33	=	16.08		N/A		N/A	(27)
External wall						90.01	x	0.20	=	18.00		N/A		N/A	(29a
Party Wall						34.19	x	0.00	=	0.00		N/A		N/A	(32)
Roof						30.00	x	0.15	=	4.50		N/A		N/A	(30)
Total area of exte	rnal eleme	nts ∑A, m²				142.92	(31)								
* for windows and	d roof wind	lows, effect	ive window l	U-value is	calculated	using formu	la 1/[(1/	'UValu	e)+0.04	!] paragraµ	oh 3.2				
Fabric heat loss, \	N/K = ∑(A >	( U)								(2	6)(30)	+ (32) =		51.88	(33)
Heat capacity Cm	$= \sum (A \times \kappa)$								(28)(	(30) + (32)	+ (32a)	.(32e) =		N/A	(34)
Thermal mass par	rameter (TI	MP) in kJ/m	²K							Calcula	ted sepa	rately =	:	100.00	(35)
Thermal bridges: if details of the					5 x (31)									12.17	(36)
Total fabric heat I	oss										(33)	+ (36) =		64.05	(37)
Ventilation heat l	oss calculat	ted monthly	0.33 x (25)	)m x (5)											_
(38)m	51.37	49.79	49.79	46.62	45.69	45.69	45.69	4	5.69	45.69	46.62	2 48	3.20	49.79	(38)
Heat transfer coe	fficient, W	/K (37)m+	(38)m												_
(39)m	115.42	113.84	113.84	110.67	109.74	109.74	109.74	1 10	09.74	109.74	110.6	7 11	2.25	113.84	_
									,	Average =	∑(39)1	12/12 =	:	111.60	(39)
Heat loss parame														1 -	7
(40)m	1.08	1.07	1.07	1.04	1.03	1.03	1.03	_   1	1.03	1.03	1.04		.05	1.07	] 7
									,	Average =	∑(40)1	12/12 =		1.05	(40)
4. Water heating	g energy re	quirement													
													k۷	Wh/year	
Assumed occupar	ncy, N										2.	79	(42)		
If TFA > 13.9, I	N = 1 + 1.76	5 x [1 - exp(-	·0.000349 x (	(TFA - 13.9	9) <sup>2</sup> )] + 0.00	13 x (TFA - 1	3.9)						_		
If TFA ≤ 13.9, I	N = 1														
Annual average h	ot water us	sage in litre	s per day Vd	,average =	(25 x N) +	36					100	0.51	(43)		
Annual average h	ot water us	sage has be	en reduced l	by 5% if th	e dwelling	is designed	to achiev	ve a wa	ater use	target of	not more	e than 1	 25 litr	es	
per person per da	ıy (all wateı	r use, hot ai	nd cold)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	,	Aug	Sep	Oct	N	lov	Dec	
Hot water usage i		-	1			1					1			1	7
(44)m	110.56	106.54	102.52	98.50	94.48	90.46	90.46	9	4.48	98.50	102.5	-	6.54	110.56	_
												112 =	1	.206.15	(44)
Energy content of				-								_		l	7
(45)m	164.36	143.75	148.33	129.32	124.09	107.08	99.22	11	13.86	115.22	134.2		6.57	159.17	] ¬
											∑(45)	112 =	1	.585.24	(45)
											UR	N: 13-01	10-07 I	Planning v	ersion

Distribution loss 0.15 x (45)m

Distribution loss t	7.13 X (43)11	•											
(46)m	24.65	21.56	22.25	19.40	18.61	16.06	14.88	17.08	17.28	20.14	21.99	23.88	(46)
Water storage loss	s:												
a) If manufacturer	's declared	loss factor	is known (k	(Wh/day):					1.85	(47)			
Temperature fa	actor from <sup>-</sup>	Table 2b							0.54	(48)			
Energy lost fro	m water sto	orage, kWl	h/day (47)	x (48)					1.00	(49)			
Enter (49) or (54) i	in (55)								1.00	(55)			

Water storage loss calculated for each month =  $(55) \times (41) \text{m}$ 

27.97

27.62

If cylinder contains	s dedicated	solar stora	ige, = (56)m	า x [(50) - (F	H11)] ÷ (50)	, else = (56	)m where (	H11) is tror	n Appendix	Н			
(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)

29.97

29.59

30.58

Primary circuit loss (annual) from Table 3

30.97

360.00

30.97

30.58

Primary circuit loss for each month (58)  $\div$  365 × (41)m

30.58

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat) 30.58

30.97

Combi loss for eac	h month fr	om Table 3	a, 3b or 3c	(enter '0' if	not a comb	oi boiler)							
(61)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat require	d for water	heating ca	lculated for	each mon	th 0.85 × (4	5)m + (46)r	m + (57)m -	+ (59)m + (6	61)m				_
(62)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	195.82	206.13	220.71	(62)

29.59

30.58

30.58

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

29.59

(63)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
										5/62/1	13	0.00	160

∑(63)1...12 = 0.00

29.97

29.59

30.97

30.58

(56)

Output from water heater for each month, kWh/month (62)m + (63)m

(64)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	195.82	206.13	220.71

 $\Sigma(64)1...12 = 2309.87$  (64)

if (64)m < 0 then set to 0

(59)m

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

(65	i)m	103.88	92.27	98.56	90.65	90.49	83.25	82.23	87.09	85.96	93.88	96.38	102.16	(65)	١
10-	,,,,,,	103.00	J Z . Z /	50.50	50.05	30.73	03.23	02.23	07.03	03.30	23.00	, ,,,,,,,	102.10	1 100/	,

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	Fand Fal					V						
5. Internal gains	Jan	Feb	Mar	Apr	Mav	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (			IVIGI	Дрі	iviay	Juli	Jui	Aug	Зер	Oct	1404	Dec	
	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	7 166
(66)m							107.55	107.55	107.55	107.55	107.55	107.55	<b>[ (66)</b>
Lighting gains (ca	culated in A	ppendix L,	equation L	9 or L9a), a	lso see Tab	le 5							_
(67)m	60.64	53.86	43.80	33.16	24.79	20.93	22.61	29.39	39.45	50.09	58.46	62.32	(67)
Appliances gains	(calculated i	n Appendix	L, equatio	n L13 or L1	3a), also se	e Table 5							
(68)m	397.65	401.78	391.38	369.25	341.30	315.04	297.49	293.37	303.76	325.90	353.85	380.11	(68)
Cooking gains (ca	lculated in A	Appendix L,	equation L	15 or L15a)	, also see T	able 5							
(69)m	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	(69)
Pumps and fans g	ains (Table	5a)											
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evapo	ration (nega	itive values	) (Table 5)										
(71)m	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	(71)
Water heating ga	ins (Table 5)	)											
(72)m	139.63	137.30	132.47	125.90	121.63	115.63	110.52	117.06	119.39	126.19	133.87	137.31	(72)
Total internal gain	ns (66)m + (	67)m + (68	)m + (69)m	+ (70)m +	(71)m + (72	!)m							
(73)m	718.30	713.32	688.04	648.69	608.11	571.98	551.01	560.20	582.98	622.56	666.56	700.13	(73)

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

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

Access facto Table 6d	or	Area m²	So	lar flux W/	m² g	Specific dat or Table 6b	a FF	Specific da or Table 6		Gains (W)	
0.54	] x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
0.54	x	12.13	x	47.32	x 0.9 x	0.63	х	0.80	=	140.58	(78)
ated for each	month ∑(74	1)m(82)m	1								
311.17	410.86	506.60	558.92	570.23	557.75	517.02	453.52	353.10	219.09	156.32	(83)
olar (73)m + (	83)m										
3 1024.50	1098.89	1155.28	1167.03	1142.20	1108.76	1077.23	1036.50	975.66	885.64	856.45	(84)
aturo (hoatin)	g coason)										
	-	ea from Ta	hle 9 Th1(°	(C)						21.00	(85)
	_				Jul	Aug	Sep	Oct			] (03)
		•	,			7.00	000			200	
0.90	0.85	0.79	0.69	0.54	0.39	0.40	0.60	0.79	0.90	0.93	(86)
ng area T1 (st	1	n Table 9c)	•							•	
	19.83	20.22	20.61	20.86	20.96	20.96	20.80	20.37	19.65	19.21	(87)
ng periods in t	the living ar	ea from Ta	ble 9, Th2(°	C)				•	•		-
	20.03	20.05	20.06	20.06	20.06	20.06	20.06	20.05	20.04	20.03	(88)
for rest of dw	elling η2,m	(see Table	9a)					•	•		-
0.88	0.83	0.77	0.64	0.48	0.30	0.31	0.54	0.75	0.88	0.92	(89)
e in the rest o	of dwelling 1	T2 (follow s	teps 3 to 7	in Table 9c)				•	•		-
17.99	18.54	19.10	19.63	19.93	20.04	20.03	19.87	19.31	18.31	17.67	(90)
						fLA 2	24.00	÷ (4) =	=	0.23	(91)
e for the who	le dwelling	fLA x T1 +(:	1 - fLA) x T2					-			-
18.32	18.83	19.35	19.85	20.14	20.24	20.24	20.08	19.55	18.61	18.01	(92)
iean internal t	temperatur	e from Tab	le 4e, wher	e appropria	te						
18.17	18.68	19.20	19.70	19.99	20.09	20.09	19.93	19.40	18.46	17.86	(93)
	Mor	Ann	May	lum	11	A	Com	Oct	New	Des	
			•			•	-				. 0.0\
	: Obtained a	it step 11 0	i Table 90,	SO that till	– (33)III a	nu recalculat	e the utilis	Sation facto	i ioi gailis	using rable	: 3a)
	0.80	0.74	0.63	0.47	0.31	0.32	0.53	0.73	0.85	0.89	(94)
	1	0.7.	0.00	0	0.01	0.02	0.00	1 05	0.00	0.03	] (0 .)
1 1		852.49	729.63	541.97	340.86	339.99	549.75	708.79	754.93	762.92	(95)
	1					1		1	, ,		, د د
			11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
			, -								, , , ,
			878.24	591.21	350.55	350.35	618.11	951.93	1286.63	1475.74	(97)
<u> </u>				l					1		, · · · /
2 420.55	349.85	223.26	110.57	0.00	0.00	0.00	0.00	180.89	382.82	530.34	1
											_
	1	•	•		Total ner	vear (kWh/v	ear) = 5(9)	8)15. 10	.12 = 2	745.39	(98)
t in kWh/m²/չ	vear				Total per	year (kWh/y	ear) = ∑(98			745.39 25.78	(98) (99)
3 3 3 r r 6 r 2 r - 1 n 9 r 1 , - ( 7 1 t 3 n 1	0.54  0.54  ated for each 3   311.17  solar (73)m + ( 3   1024.50  ature (heating area of the solar of the so	0.54 x  0.54 x  1 ated for each month Σ(74 3 311.17 410.86 3 311.17 410.86 3 3124.50 1098.89  1 ature (heating season) 1 apperiods in the living are represented in the rest of dwelling π 2 20.03 20.03  1 and periods in the living are represented in the rest of dwelling π 2 20.03 20.03  2 and represented in the rest of dwelling π 2 20.03 20.03  2 and represented in the rest of dwelling π 3 2 20.03  3 and represented in the rest of dwelling π 3 2 20.03  3 and represented in the rest of dwelling π 3 2 20.03  3 and represented in the rest of dwelling π 3 2 20.03  3 and represented in the rest of dwelling π 3 2 20.03  3 and represented in the rest of dwelling π 3 2 20.03  3 and represented in the rest of dwelling π 3 2 20.03  3 and represented in the rest of dwelling π 3 2 20.03  3 and represented in the rest of dwelling π 3 2 20.03  3 and represented in the rest of dwelling π 3 2 20.03  3 and represented in the rest of dwelling π 3 2 20.03  3 and represented in the rest of dwelling π 3 2 20.03  3 and represented in the rest of dwelling π 3 2 20.03  3 and represented in the rest of dwelling π 3 2 20.03  3 and represented in the living are represented in the rest of dwelling π 3 2 20.03  3 and represented in the living are represented in the rest of dwelling π 3 20.03  3 and represented in the living are repr	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11)

					_			
Fraction of space heating from main system(s) 1 - (201)				1.00	(202)			
Fraction of main heating from main system 2				0.00	(203)			
Fraction of total space heat from main system 1 (202) x [1 - (203)]				1.00	(204)			
Fraction of total space heat from main system 2 (202) x (203)				0.00	(205)			
Efficiency of main space heating system 1 (%)				93.00	(206)			
(from database or Table 4a/4b, adjusted where appropriate by the	amount shown in	the 'space	efficiency o	ıdjustment	- :' column of Tab	ole 4c)		
Jan Feb Mar Apr N	lay Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement, kWh/month (as calculated above)								
(98)m 547.12 420.55 349.85 223.26 11	0.57 0.00	0.00	0.00	0.00	180.89 38	82.82	530.34	
Space heating fuel (main heating system 1), kWh/month = (98)m x	(204) x 100 ÷ (200	5)						
(211)m 588.30 452.20 376.18 240.06 11	8.89 0.00	0.00	0.00	0.00	194.51 43	11.63	570.26	
	7	otal per ye	ar (kWh/ye	ar) = ∑(211	1)15, 1012 =	= 2	952.04	(211)
Water heating:								
Output from water heater, kWh/month (calculated above)								
(64)m 225.90 199.33 209.88 188.88 18	5.63 166.64	160.77	175.40	174.78	195.82 20	06.13	220.71	]
					∑(64)112 =	= 2	309.87	(64)
Efficiency of water heater per month								-
	2.98 79.30	79.30	79.30	79.30	84.10 8	5.94	86.57	]
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m								_
(219)m 260.90 231.09 245.00 222.84 22	3.70 210.13	202.73	221.19	220.40	232.84 23	39.85	254.96	]
		Total	per year (k	Wh/year)	= ∑(219)112 =	= 2	765.63	(219)
								_
Annual Totals Summary:					kWh/year	kV	/h/year	
Space heating fuel used, main system 1					.,		952.04	(211)
Water heating fuel used							765.63	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):							703.03	[(213)
					70.05	$\neg$		(220-)
mechanical ventilation fans - balanced, extract or positive input warm air heating system fans	from outside				79.05			(230a) (230b)
central heating system rans					130.00	$\exists$		(230c)
oil boiler pump					0.00	$\exists$		(230d)
boiler flue fan					45.00			(230e)
maintaining electric keep-hot facility for gas combi boiler					0.00	Ħ		(230f)
pump for solar water heating					0.00			(230g)
Total electricity for the above					∑(230a)(230g	) 2	254.05	(231)
Electricity for lighting (calculated in Appendix L):						4	28.34	(232)
Energy saving/generation technologies (Appendices M, N and Q):								
Electricity generated by PVs (Appendix M) (negative quantity)						-6	994.03	(233)
10a. Fuel costs - Individual heating systems including micro-CHP								
	Fuel kWh/year			el price able 12)		Fuel	ost £/yea	r
Space heating - main system 1	2952.04	x		3.10	x 0.01 =		91.51	(240)
Water heating cost (other fuel)	2765.63	×		3.10	x 0.01 =		85.73	(247)
Pumps, fans and electric keep-hot	254.05	×		11.46	x 0.01 =		29.11	(249)
Energy for lighting	428.34	x		11.46	x 0.01 =		49.09	(250)
Additional standing charges (Table 12)				-	1		.06.00	(251)
Energy saving/generation technologies (Appendices M, N and Q):							,	, , _ 5 _ 1
	-994.03			11.46	x 0.01 =		113.92	(252)
PV savings (negative quantity)	-334.03	x			1			3
Total energy cost			()	240)(242	1) + (245)(254	) <u> </u>	247.53	(255)

11a. SAP rating - Individual heating systems including micro-CHP			7
Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.77	(257)
SAP value		89.29	
SAP rating		89	(258)
SAP band		В	]

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	2952.04	x	0.198	=	584.50	(261)
Water heating	2765.63	х	0.198	=	547.60	(264)
Space and water heating			(261) + (262)	+ (263) + (264) =	1132.10	(265)
Pumps, fans and electric keep-hot	254.05	x	0.517	=	131.34	(267)
Lighting	428.34	x	0.517	=	221.45	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-994.03	х	0.529	=	-525.84	(269)
Total carbon dioxide emissions				∑(261)(271) =	959.05	(272)
Dwelling carbon dioxide emissions rate				(272) ÷ (4) =	9.01	(273)
El value					91.52	
El rating (see section 14)					92	(274)
El band					А	7

13a. Primary energy - Individual heating systems including	micro-CHP					
	Energy kWh/year		Primary Energy Factor		Primary Energy	,
Space heating - main system 1	2952.04	х	1.02	=	3011.08	(261*)
Water heating	2765.63	х	1.02	=	2820.95	(264*)
Space and water heating			(261*) + (262*) + (263*)	+ (264*) =	5832.03	(265*)
Pumps, fans and electric keep-hot	254.05	x	2.92	=	741.82	(267*)
Lighting	428.34	x	2.92	=	1250.75	(268*)
Energy saving/generation technologies:						
PV primary energy savings (negative quantity)	-994.03	х	2.92	=	-2902.56	(269*)
Total primary energy kWh/year			∑(261*	)(271*) =	4922.04	(272*)
Primary energy kWh/m2/year			(27	72*) ÷ (4) =	46.22	(273*)

# Code for Sustainable Homes (November 2010) Design - Draft



### This report details the calculations and results for Ene 1, 2 and 7 of the Code For Sustainable Homes.

This Design Assessment has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed. Code calculations are from the Technical Guide (November 2010).

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P08 4 St Augustines, London, NW1		

Building regulation assessment - criterion 1					
				kg/m²/yr	
DER				10.55	
TER				15.26	
Assessment of zero carbon home and low or ze	ero carbon technologies				
			Credits	Level	
Dwelling emission rate (Ene 1)	CO₂ reduction = 30.9 %		3.5	4	
Fabric Energy Efficiency	FEE = 41.3		5.8		
Low or zero carbon technologies (Ene 7)	CO₂ reduction = 14 %		1		
Ene 1 - dwelling emission rate					
		%	kWh/m²	kgCO₂/m²/yr	
Assessment of Ene 1 (level 1-5)					
DER from SAP 2009 DER worksheet				10.55	
Additional allowable generation			0.00		
CO₂ emissions offset from generation				0.00	
CO <sub>2</sub> emissions offset from community b	iofuel CHP systems			0.00	
Total CO <sub>2</sub> emissions offset from SAP section 16 a	llowances			0.00	
DER accounting for SAP section 16 allowances				10.55	
CO₂ reduction compared to TER				4.71	
CO₂ reduction as % of TER		30.9			
Assessment of Ene 1 (level 6)					
DER from SAP 2009 DER worksheet				10.55	(ZC:
CO <sub>2</sub> emissions from appliances (equation L14)					(ZC
CO <sub>2</sub> emissions from cooking (equation L16)					(ZC
Total CO <sub>2</sub> emissions					(ZC
Additional allowable generation and its CO₂ emis			0.00		(ZC
CO₂ emissions offset from additional allo	-				(ZC
CO₂ emissions offset from community b	iofuel CHP systems			0.00	(ZC
Net CO₂ emissions				27.87	(ZC

#### Ene 1 - dwelling emission rate - level 6 There is no Zero Carbon Home definition in the current technical guide Criterion Value Pass/Fail FEE <= 39 41.3 Fail Net CO<sub>2</sub> emissions <= 0.00 27.87 Fail Result: Not level 6 Number of credits for Ene 1 3.5 Ene 2 - Fabric Energy Efficiency FEE 41.3 Number of credits for Ene 2 5.8 Ene 7 - low or zero carbon technologies **Emissions** Reduction kgCO₂/yr kgCO<sub>2</sub>/yr Standard case Space and water heating (265) 1261.52 Mechanical cooling (266) 0.00 Pumps and fans (267) 127.12 Lighting (268) 207.33 Appliances and cooking 1653.87 Total CO₂ 1578.66 **Actual case** Space and water heating (265) or (376) 1261.52 Space and water heating from LZCT considered in SAP 2009 0.00 Pumps and fans (267) or (378) 127.12 Pumps and fans 0.00 Electricity generated by LZCT (269) + (380)) -471.35 Additional allowable electricity generation considered in SAP 2009 section 16 0.00 Offset from biofuel CHP $[-1 \times [(363)..(366) + (368)...(372)]]$ 0.00 LZCT electricity generation -471.35 LZCT thermal generation 0 Total from specified LZCT -471.35 **Emissions** $kgCO_2/m^2/yr$ Reduction in CO<sub>2</sub> Emissions Standard Case CO<sub>2</sub> 34.03

29.10

14

1

Actual Case CO2

% Reduction in CO<sub>2</sub>

Number of credits for Ene 7

# DER 2009 Worksheet

## Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P08 4 St Augustines, London, NW1		

1. Overall dwelling dimen	sions						
		Area (m²)		Average store height (m)	ey	Volume (m³)	
Lowest occupied		95.50	(1a) x	2.60	(2a) =	248.30	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)(1n) = [	95.50	(4)				
Dwelling volume				(3a) + (3b) +	(3c) + (3d)(3n) =	248.30	(5)
2. Ventilation rate							
						m³ per hour	
Number of chimneys				0	x 40 =	0	(6a)
Number of open flues				0	x 20 =	0	(6b)
Number of intermittent fan	ns			0	x 10 =	0	(7a)
Number of passive vents				0	x 10 =	0	(7b)
Number of flueless gas fires	S			0	x 40 =	0	(7c)
						Air changes pe hour	er
Infiltration due to chimneys	s, flues, fans, PSVs	(6a) + (6b) + (	7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)
If a pressurisation test has b	been carried out or is intended, proceed to	o (17), otherw	ise continue from	(9) to (16)			
Air permeability value, q50,	, expressed in cubic metres per hour per	square metre	of envelope area			5.00	(17)
If based on air permeability	value, then (18) = $[(17) \div 20] + (8)$ , other	wise (18) = (16	5)			0.25	(18)
Air permeability value appli	ies if a pressurisation test has been done,	or a design or	specified air perr	meability is bein	g used		
Number of sides on which o	dwelling is sheltered					2	(19)
Shelter factor				1	- [0.075 x (19)] =	0.85	(20)
Adjusted infiltration rate					(18) x (20) =	0.21	(21)
Infiltration rate modified fo	or monthly wind speed:						

Infiltration	rate modified t	or mo	nthly win	d chood.

Infiltration rate mo	odified for i	monthly wi	nd speed:										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average v	vind speed	from Table	7										
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1	.12 =	54.10	(22)
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	1.20	1.27	
										∑(22a)1	.12 =	13.52	(22a)
Adjusted infiltration	n rate (allo	wing for sh	elter and v	vind speed	) = (21) × (2	2a)m							
(22b)m	0.29	0.27	0.27	0.24	0.22	0.21	0.20	0.20	0.22	0.24	0.26	0.27	
										∑(22b)1	.12 =	2.87	(22b)

Calculate effective air change rate for the applicable case: If mechanical ventilation: air change rate through system

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

0.5 (23b)

If balanced w	ith heat rec	overy: effic	iency in % all	owing for	in-use fact	or (from Ta	ble 4h) =							N/A	(23c)
c) If whole ho	use extract	ventilation	or positive i	nput venti	lation from	n outside									
if (22b)m ·	< 0.5 x (23b)	), then (24c	) = (23b); oth	erwise (2	4c) = (22b)	m + 0.5 x (23	3b)								
(24c)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	(	0.50	0.50	0.50	0.	50	0.52	(24c)
Effective air char	nge rate - er	nter (24a) o	r (24b) or (24	c) or (24d	l) in box (25	5)									_
(25)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	(	0.50	0.50	0.50	0.	50	0.52	(25)
3. Heat losses a	ınd heat los	s paramete	er												
The κ-value is the	e heat capa	city per unit	t area, see To	ıble 1e.											
E	Element		Gross Area, m²	-	nings, n²	Net area A, m²		-value, V/m²K		A x U, W/K		value, J/m².K		Αxκ, kJ/K	
Doors						2.10	x	1.60	] =	3.36		N/A	] [	N/A	(26)
Window*						8.68	х	1.15	=	9.94		N/A	] [	N/A	(27)
Window*						9.70	х	1.33	=	12.86		N/A	] [	N/A	(27)
External wall						55.08	x	0.20	=	11.02		N/A	] [	N/A	(29a
Party Wall						33.80	x	0.00	=	0.00		N/A	] [	N/A	(32)
Roof						30.00	x	0.15	=	4.50		N/A	] [	N/A	(30)
Total area of ext	ernal eleme	ents ∑A, m²				105.56	(31)								
* for windows ar	nd roof wind	dows, effect	ive window l	J-value is	calculated	using formu	la 1/[(1/	'UValu	e)+0.04	!] paragra <sub>l</sub>	oh 3.2				
Fabric heat loss,	$W/K = \sum (A >$	< U)								(2	6)(30)	+ (32) =	4	1.68	(33)
Heat capacity Cn	n = ∑(A x κ)								(28)	(30) + (32)	+ (32a)	(32e) =		N/A	(34)
Thermal mass pa	rameter (TI	MP) in kJ/m	²K							Calcula	ted sepa	rately =	10	00.00	(35)
Thermal bridges:					5 x (31)									9.73	(36)
Total fabric heat	_			. ,							(33) -	+ (36) =	5	51.41	(37)
Ventilation heat		ted monthly	v 0.33 x (25)	m x (5)							()	()			_ (- /
(38)m	43.99	42.69	42.69	40.97	40.97	40.97	40.97	4	0.97	40.97	40.97	41	.38	42.69	(38)
Heat transfer co	efficient, W,	/K (37)m+	(38)m												
(39)m	95.40	94.09	94.09	92.38	92.38	92.38	92.38	9	2.38	92.38	92.38	92	.79	94.09	
										Average =	∑(39)1:	12/12 =	9	3.09	(39)
Heat loss parame	eter (HLP), \	N/m²K (39	)m ÷ (4)												_
(40)m	1.00	0.99	0.99	0.97	0.97	0.97	0.97	(	0.97	0.97	0.97	0.	97	0.99	
										Average =	∑(40)1:	12/12 =	(	0.97	(40)
4. Water heatir	ng energy re	equirement													
	, g = g,												kW	h/year	
Assumed occupa	incv. N										2.	 69	(42)	,,	
If TFA > 13.9,		5 x [1 - exp(-	-0.000349 x (	TFA - 13.9	9)²)] + 0.00°	13 x (TFA - 1	3.9)						] (/		
If TFA ≤ 13.9,		o x [1 cxp(	0.0003 13 X (	1177 13.3	,,,,, . 0.00.	10 / (11 / 1	3.37								
Annual average I		sage in litre	s ner day Vd	average =	· (25 v N) +	36					98	12	(43)		
Annual average		_					to achiev	ie a wi	ater iise	r taraet of				c	
per person per de		_		, y 370 ij tii	cawening	is acsigned	to deme	ic a we	acci usc	. turget oj	not more	. triair 12	25 mires	,	
	Jan	Feb	Mar	Apr	May	Jun	Jul		Aug	Sep	Oct	N	ov	Dec	
Hot water usage				•	•		-			r				-	
(44)m	108.00	104.07	100.14	96.21	92.29	88.36	88.36	9	2.29	96.21	100.14	104	1.07	108.00	
											∑(44)	112 =	11	.78.13	(44)
Energy content of	of hot water	used - calc	ulated montl	nly = 4.190	0 x Vd,m x	nm x Tm/36	00 kW	h/mon	th (see	Tables 1b	, 1c 1d)				
(45)m	160.54	140.41	144.89	126.32	121.20	104.59	96.92	11	11.21	112.54	131.10	5 143	3.17	155.47	
											∑(45)	112 =	15	48.41	(45)
												1. 40 -	0.00 =		
											URI	v: 13-01	U-U8 PI	anning ve	ersion

,	3					'							
Distribution loss	0.15 x (45)n	n											
(46)m	24.08	21.06	21.73	18.95	18.18	15.69	14.54	16.68	16.88	19.67	21.48	23.32	(4
Water storage los	ss:												
a) If manufacture	r's declared	loss factor	is known (l	«Wh/day):					1.85	(47)			
Temperature	factor from	Table 2b							0.54	(48)			
Energy lost fro	om water sto	orage, kW	h/day (47)	x (48)					1.00	(49)			
Enter (49) or (54)	in (55)								1.00	(55)			
Water storage los	ss calculated	d for each n	nonth = (55	) x (41)m						_			
(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(5
If cylinder contair	ns dedicated	d solar stora	age, = (56)n	n x [(50) - (I	H11)] ÷ (50)	), else = (56	)m where (	H11) is froi	m Appendi	к Н	•		_
(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(5
Primary circuit los	ss (annual) f	rom Table	3						360.00	(58)			
Primary circuit los	ss for each r	month (58)	÷ 365 × (41	)m									
(modified by fact	or from Tab	le H5 if the	re is solar v	vater heatii	ng and a cy	linder ther	nostat)						
(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	(5
Combi loss for ea	ch month fr	om Table 3	a, 3b or 3c	(enter '0' if	not a com	bi boiler)							
(61)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(6
Total heat require	ed for water	heating ca	Iculated fo	r each mon	th 0.85 × (4	15)m + (46)	m + (57)m -	+ (59)m + (	61)m				
(62)m	222.08	195.99	206.43	185.87	182.75	164.15	158.46	172.76	172.10	192.70	202.73	217.02	(6
Solar DHW input	calculated u	ısing Apper	ndix H (nega	ative quant	ity) ('0' ent	ered if no s	olar contrib	oution to w	ater heatin	g)			
(63)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
										∑(63)1	.12 =	0.00	(6
Output from wate	er heater fo	r each mon	th, kWh/m	onth (62)n	n + (63)m								
(64)m	222.08	195.99	206.43	185.87	182.75	164.15	158.46	172.76	172.10	192.70	202.73	217.02	
										∑(64)1	.12 = 2	273.04	(6
													_

if (64)m < 0 then set to 0

Heat gains from wa	ater heating, kWh/month	$0.25 \times [0.85 \times (45)]$ m	$+ (61)mJ + 0.8 \times [(46)m]$	i + (5/)m + (59)m]

(65)m	102.61	91.16	97.41	89.65	89.54	82.42	81.46	86.21	85.07	92.85	95.25	100.93	(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)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	s (Table 5), Wa	atts											
(66)m	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	(66)
Lighting gains (	calculated in A	ppendix L,	equation L	9 or L9a), a	lso see Tab	le 5							
(67)m	22.71	20.17	16.40	12.42	9.28	7.84	8.47	11.01	14.77	18.76	21.89	23.34	(67)
Appliances gain	ıs (calculated i	n Appendix	L, equatio	n L13 or L1	3a), also se	e Table 5							
(68)m	248.84	251.42	244.92	231.06	213.58	197.14	186.16	183.58	190.09	203.94	221.43	237.86	(68)
Cooking gains (	calculated in A	Appendix L,	equation L	15 or L15a)	, also see T	able 5							
(69)m	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	(69)
Pumps and fans	s gains (Table	5a)											
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evap	ooration (nega	itive values	) (Table 5)										
(71)m	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	(71)
Water heating a	gains (Table 5)	)											
(72)m	137.92	135.65	130.93	124.51	120.34	114.48	109.49	115.88	118.15	124.79	132.29	135.66	(72)
Total internal g	ains (66)m + (	67)m + (68	)m + (69)m	+ (70)m +	(71)m + (72	!)m				·	·		
(73)m	482.88	480.65	465.65	441.40	416.61	392.86	377.53	383.87	396.42	420.90	449.02	470.27	(73)

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

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

Total gains - internal and solar (73)m + (83)m (84)m	x 0.80 x 0.80		42.25
Solar gains in watts, calculated for each month Σ(74)m(82)m  (83)m 69.60 137.87 228.63 355.47 449.79 478.45 460.45 387.66 27  Total gains - internal and solar (73)m + (83)m  (84)m 552.48 618.52 694.28 796.86 866.40 871.31 837.98 771.53 67  7. Mean internal temperature (heating season)  Temperature during heating periods in the living area from Table 9, Th1(°C)  Jan Feb Mar Apr May Jun Jul Aug :  Utilisation factor for gains for living area, η1,m (see Table 9a)  (86)m 0.97 0.95 0.92 0.86 0.74 0.59 0.43 0.46 0.88)  Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)  (87)m 18.95 19.18 19.62 20.10 20.57 20.84 20.96 20.95 2  Temperature during heating periods in the living area from Table 9, Th2(°C)  (88)m 20.09 20.10 20.10 20.11 20.1		_	72.23
(83)m 69.60 137.87 228.63 355.47 449.79 478.45 460.45 387.66 27. Total gains - internal and solar (73)m + (83)m (84)m 552.48 618.52 694.28 796.86 866.40 871.31 837.98 771.53 67. Total gains - internal temperature (heating season)  Femperature during heating periods in the living area from Table 9, Th1(°C)  Jan Feb Mar Apr May Jun Jul Aug 5. Mag 18.95 19.18 19.62 20.10 20.57 20.84 20.96 20.95 2. Mag 18.95 19.18 19.62 20.10 20.57 20.84 20.96 20.95 2. Mag 18.95 19.18 19.62 20.10 20.11	78.27 170.0		27.35
Total gains - internal and solar (73)m + (83)m (84)m	78.27 170.0		
Table   Tabl		7 87.05	57.10
7. Mean internal temperature (heating season)  Temperature during heating periods in the living area from Table 9, Th1(°C)    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Statistical Statistics   July   Jun   Jul   Aug   Statistics   July   Jun   July   Aug   Statistics   July   Ju			
Temperature during heating periods in the living area from Table 9, Th1(°C)    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   May	74.69 590.9	536.07	527.36
Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Stillisation factor for gains for living area, η1,m (see Table 9a)			
Utilisation factor for gains for living area, η1,m (see Table 9a)  (86)m 0.97 0.95 0.92 0.86 0.74 0.59 0.43 0.46 0  Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)  (87)m 18.95 19.18 19.62 20.10 20.57 20.84 20.96 20.95 2  Temperature during heating periods in the living area from Table 9, Th2(°C)  (88)m 20.09 20.10 20.10 20.11 20.11 20.11 20.11 20.11 20.11 2  Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)  (89)m 0.96 0.95 0.91 0.84 0.70 0.53 0.34 0.37 0  Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)  (90)m 17.32 17.67 18.30 18.98 19.62 19.96 20.08 20.08 1  Living area fraction flat.  Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2  (92)m 17.86 18.17 18.73 19.35 19.93 20.25 20.37 20.36 2  Apply adjustment to the mean internal temperature from Table 4e, where appropriate  (93)m 17.71 18.02 18.58 19.20 19.78 20.10 20.22 20.21 1   8. Space heating requirement  Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the Utilisation factor for gains, nm  (94)m 0.94 0.93 0.88 0.81 0.69 0.53 0.35 0.38 0  Juseful gains, ηmGm, W = (94)m x (84)m  (95)m 521.68 572.45 613.70 647.39 595.00 458.21 296.14 293.27 43  Monthly average external temperature from Table 8  (96)m 4.50 5.00 6.80 8.70 11.70 14.60 16.90 16.90 1			21.00
tilisation factor for gains for living area, η1,m (see Table 9a) (86)m	Sep Oct	Nov	Dec
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)  (87)m			
(87)m       18.95       19.18       19.62       20.10       20.57       20.84       20.96       20.95       2         Temperature during heating periods in the living area from Table 9, Th2(°C)         (88)m       20.09       20.10       20.10       20.11       20.21       20.08       20.08       20.08       20.08       20.08       20.08       20.08 <td< td=""><td>0.71 0.89</td><td>0.95</td><td>0.97</td></td<>	0.71 0.89	0.95	0.97
Temperature during heating periods in the living area from Table 9, Th2(°C)  (88)m			
20.09   20.10   20.10   20.11   20.1	20.72 20.16	6 19.43	19.01
Ditilisation factor for gains for rest of dwelling n2,m (see Table 9a)			<del>_</del> _
(89)m	20.11 20.11	20.11	20.10
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)			
(90)m       17.32       17.67       18.30       18.98       19.62       19.96       20.08       20.08       1         All siving area fraction         Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2         (92)m       17.86       18.17       18.73       19.35       19.93       20.25       20.37       20.36       2         Apply adjustment to the mean internal temperature from Table 4e, where appropriate         (93)m       17.71       18.02       18.58       19.20       19.78       20.10       20.22       20.21       1         8. Space heating requirement         Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       9         Sepace heating requirement         Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       9         Sepace heating requirement         Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       9         Jan       Feb       Mar       Apr       May       Jun       Jul       Aug </td <td>0.65 0.86</td> <td>0.95</td> <td>0.96</td>	0.65 0.86	0.95	0.96
In the mean internal temperature for the whole dwelling fLA x T1 + (1 - fLA) x T2  (92)m  17.86  18.17  18.73  19.35  19.93  20.25  20.37  20.36  20.36  20.39  20.39  20.30  20.			
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	19.83 19.09	9 18.04	17.42
(92)m 17.86 18.17 18.73 19.35 19.93 20.25 20.37 20.36 2 Apply adjustment to the mean internal temperature from Table 4e, where appropriate (93)m 17.71 18.02 18.58 19.20 19.78 20.10 20.22 20.21 1  8. Space heating requirement  Jan Feb Mar Apr May Jun Jul Aug 5  Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the Utilisation factor for gains, ηm (94)m 0.94 0.93 0.88 0.81 0.69 0.53 0.35 0.38 0  Useful gains, ηmGm, W = (94)m x (84)m (95)m 521.68 572.45 613.70 647.39 595.00 458.21 296.14 293.27 430  Wonthly average external temperature from Table 8 (96)m 4.50 5.00 6.80 8.70 11.70 14.60 16.90 16.90 1	30 ÷ (	(4) =	0.33
Apply adjustment to the mean internal temperature from Table 4e, where appropriate  (93)m  17.71  18.02  18.58  19.20  19.78  20.10  20.22  20.21  1  8. Space heating requirement  Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the Julisation factor for gains, ηm  (94)m  0.94  0.93  0.88  0.81  0.69  0.53  0.35  0.38  0  Jun  Jul  Aug  Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the Julisation factor for gains, ηm  (94)m  0.94  0.93  0.88  0.81  0.69  0.53  0.35  0.38  0  Jun  Jul  Aug  Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the Julisation factor for gains, ηm  (94)m  0.94  0.95  0.95  0.95  0.15			
(93)m 17.71 18.02 18.58 19.20 19.78 20.10 20.22 20.21 1  8. Space heating requirement  Jan Feb Mar Apr May Jun Jul Aug Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the Utilisation factor for gains, ηm  (94)m 0.94 0.93 0.88 0.81 0.69 0.53 0.35 0.38 0  Useful gains, ηmGm, W = (94)m x (84)m  (95)m 521.68 572.45 613.70 647.39 595.00 458.21 296.14 293.27 430  Monthly average external temperature from Table 8  (96)m 4.50 5.00 6.80 8.70 11.70 14.60 16.90 16.90 1	20.12 19.44	4 18.49	17.94
(93)m 17.71 18.02 18.58 19.20 19.78 20.10 20.22 20.21 1  8. Space heating requirement  Jan Feb Mar Apr May Jun Jul Aug Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the Utilisation factor for gains, ηm  (94)m 0.94 0.93 0.88 0.81 0.69 0.53 0.35 0.38 0  Useful gains, ηmGm, W = (94)m x (84)m  (95)m 521.68 572.45 613.70 647.39 595.00 458.21 296.14 293.27 430  Wonthly average external temperature from Table 8  (96)m 4.50 5.00 6.80 8.70 11.70 14.60 16.90 16.90 1		•	
Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the Ditilisation factor for gains, ηm           (94)m         0.94         0.93         0.88         0.81         0.69         0.53         0.35         0.38         0.00           Useful gains, ηmGm, W = (94)m x (84)m         (95)m         521.68         572.45         613.70         647.39         595.00         458.21         296.14         293.27         430           Wonthly average external temperature from Table 8         (96)m         4.50         5.00         6.80         8.70         11.70         14.60         16.90         16.90         1	19.97 19.29	9 18.34	17.79
Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         State Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the Ditilisation factor for gains, ηm           (94)m         0.94         0.93         0.88         0.81         0.69         0.53         0.35         0.38         0.00           Useful gains, ηmGm, W = (94)m x (84)m         (95)m         521.68         572.45         613.70         647.39         595.00         458.21         296.14         293.27         430           Monthly average external temperature from Table 8         (96)m         4.50         5.00         6.80         8.70         11.70         14.60         16.90         16.90         1	<u> </u>		
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the Utilisation factor for gains, ηm  (94)m  0.94  0.93  0.88  0.81  0.69  0.53  0.35  0.38  0  Useful gains, ηmGm, W = (94)m x (84)m  (95)m  521.68  572.45  613.70  647.39  595.00  458.21  296.14  293.27  43  Wonthly average external temperature from Table 8  (96)m  4.50  5.00  6.80  8.70  11.70  14.60  16.90  16.90  1			
Utilisation factor for gains, ηm         (94)m       0.94       0.93       0.88       0.81       0.69       0.53       0.35       0.38       0         Useful gains, ηmGm, W = (94)m x (84)m         (95)m       521.68       572.45       613.70       647.39       595.00       458.21       296.14       293.27       43         Wonthly average external temperature from Table 8         (96)m       4.50       5.00       6.80       8.70       11.70       14.60       16.90       16.90       1	Sep Oct	Nov	Dec
(94)m 0.94 0.93 0.88 0.81 0.69 0.53 0.35 0.38 0  Useful gains, ηmGm, W = (94)m x (84)m  (95)m 521.68 572.45 613.70 647.39 595.00 458.21 296.14 293.27 43  Monthly average external temperature from Table 8  (96)m 4.50 5.00 6.80 8.70 11.70 14.60 16.90 16.90 1	the utilisation fa	ictor for gains	using Table
Useful gains, ηmGm, W = (94)m x (84)m       (95)m     521.68     572.45     613.70     647.39     595.00     458.21     296.14     293.27     43.20       Wonthly average external temperature from Table 8       (96)m     4.50     5.00     6.80     8.70     11.70     14.60     16.90     16.90     1			
(95)m     521.68     572.45     613.70     647.39     595.00     458.21     296.14     293.27     43       Monthly average external temperature from Table 8       (96)m     4.50     5.00     6.80     8.70     11.70     14.60     16.90     16.90     1	0.64 0.84	0.93	0.95
Monthly average external temperature from Table 8 (96)m 4.50 5.00 6.80 8.70 11.70 14.60 16.90 16.90 1			
(96)m 4.50 5.00 6.80 8.70 11.70 14.60 16.90 16.90 1	34.94 495.6	6 496.18	499.16
	14.30 10.80	7.00	4.90
Heat loss rate for mean internal temperature, Lm, W			
(97)m 1259.78 1224.70 1108.30 969.67 746.45 508.32 306.74 306.10 52	24.22 784.4	1 1052.54	1212.79
space heating requirement for each month, $kWh/month = 0.024 x [(97)m - (95)m] x (41)m$			
(98)m 549.15 438.31 367.98 232.04 112.68 0.00 0.00 0.00 0	0.00 214.8	3 400.58	530.94
Total per year (kWh/year	r) = ∑(98)15, 1	012 =	2846.51
Space heating requirement in kWh/m²/year		98) ÷ (4)	29.81

### 9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11)

Fraction of space heating from main system(s) 1 - (201)					1.00	(202)		
Fraction of main heating from main system 2					0.00	(203)		
Fraction of total space heat from main system 1 (202) x [1 - (203)]					1.00	(204)		
Fraction of total space heat from main system 2 (202) x (203)					0.00	(205)		
Efficiency of main space heating system 1 (%)					93.00	(206)		
(from database or Table 4a/4b, adjusted where appropriate by the	amount sho	own in th	e 'space	efficiency o	ndjustment	t' column of Tabl	e 4c)	
Jan Feb Mar Apr M	May Ju	ın	Jul	Aug	Sep	Oct N	ov Dec	
Space heating requirement, kWh/month (as calculated above)								1
` '	ļ.	00	0.00	0.00	0.00	214.83 400	0.58 530.94	
Space heating fuel (main heating system 1), kWh/month = (98)m x						1		1
(211)m 590.48 471.31 395.68 249.51 12	21.16 0.	00	0.00	0.00	0.00	!	0.73   570.90	1
		Tot	al per ye	ar (kWh/ye	ar) = ∑(21:	1)15, 1012 =	3060.77	(211)
Water heating:								
Output from water heater, kWh/month (calculated above)								1
(64)m 222.08 195.99 206.43 185.87 18	32.75   164	1.15	158.46	172.76	172.10		2.73 217.02	1
						∑(64)112 =	2273.04	(64)
Efficiency of water heater per month							1	1
	3.07 79	.30	79.30	79.30	79.30	84.60 86	5.10 86.61	
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m	20.00 20	7.00	100.02	247.05	247.02		5 47 250 57	1
(219)m 256.34 226.85 240.49 218.92 22	20.00 207	7.00	199.83	217.85	217.03	!	5.47   250.57	] ] (240)
			Total	per year (k	(Wh/year)	= ∑(219)112 =	2718.12	(219)
						1.34/1- /	LAMIL L	
Annual Totals Summary:						kWh/year	kWh/year	
						,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	-	1
Space heating fuel used, main system 1						, ,	3060.77	(211)
Space heating fuel used, main system 1 Water heating fuel used						, ,	-	(211)
Space heating fuel used, main system 1 Water heating fuel used Electricity for pumps, fans and electric keep-hot (Table 4f):							3060.77	1
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input	t from outsid	de				70.88	3060.77	(219) (230a)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans	t from outsid	de				70.88	3060.77	(219) (230a) (230b)
Space heating fuel used, main system 1 Water heating fuel used Electricity for pumps, fans and electric keep-hot (Table 4f): mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump	t from outsid	de				70.88 0.00 130.00	3060.77	(219) (230a) (230b) (230c)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump	t from outsid	de				70.88 0.00 130.00 0.00	3060.77	(230a) (230b) (230c) (230d)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan	t from outsid	de				70.88 0.00 130.00	3060.77	(230a) (230b) (230c) (230d) (230e)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump	t from outsid	de				70.88 0.00 130.00 0.00 45.00	3060.77	(230a) (230b) (230c) (230d)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler	t from outsid	de				70.88 0.00 130.00 0.00 45.00 0.00	3060.77	(230a) (230b) (230c) (230d) (230e) (230f)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating	t from outsid	de				70.88 0.00 130.00 0.00 45.00 0.00 0.00	3060.77 2718.12	(230a) (230b) (230c) (230d) (230e) (230f) (230g)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating	t from outsid	de				70.88 0.00 130.00 0.00 45.00 0.00 0.00	3060.77 2718.12	(230a) (230b) (230c) (230d) (230e) (230f) (230g)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above		de				70.88 0.00 130.00 0.00 45.00 0.00 0.00	3060.77 2718.12	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L):		de				70.88 0.00 130.00 0.00 45.00 0.00 0.00	3060.77 2718.12	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)						70.88 0.00 130.00 0.00 45.00 0.00 0.00	3060.77 2718.12	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q):	uding micro-	СНР				70.88 0.00 130.00 0.00 45.00 0.00 0.00	3060.77 2718.12 ] ] 245.88 401.03	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)		СНР			nissions Factor	70.88 0.00 130.00 0.00 45.00 0.00 0.00	3060.77 2718.12	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)  12a. Carbon dioxide emissions - Individual heating systems inclu	: uding micro- Energ kWh/ye	CHP y ear	X	F	nissions Factor	70.88 0.00 130.00 0.00 45.00 0.00 0.00	3060.77  2718.12  245.88  401.03  -891.02  Emissions (kgCO2/year)	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (232)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)  12a. Carbon dioxide emissions - Individual heating systems inclu  Space heating - main system 1	: Energ kWh/ye 3060.7	CHP y ear	X X	F	nissions Factor	70.88 0.00 130.00 0.00 45.00 0.00 0.00 Σ(230a)(230g)	3060.77  2718.12  ]  [ ]  [ ]  [ ]  [ ]  [ ]  [ ]  [ ]	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (232) (233)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)  12a. Carbon dioxide emissions - Individual heating systems inclu  Space heating - main system 1  Water heating	: uding micro- Energ kWh/ye	CHP y ear	x x	F	nissions Factor 0.198	70.88 0.00 130.00 0.00 45.00 0.00 0.00 Σ(230a)(230g)	3060.77  2718.12  245.88  401.03  -891.02  Emissions (kgCO2/year)  606.03  538.19	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (232) (233)
Space heating fuel used, main system 1  Water heating fuel used  Electricity for pumps, fans and electric keep-hot (Table 4f):  mechanical ventilation fans - balanced, extract or positive input warm air heating system fans central heating pump oil boiler pump boiler flue fan maintaining electric keep-hot facility for gas combi boiler pump for solar water heating  Total electricity for the above  Electricity for lighting (calculated in Appendix L): Energy saving/generation technologies (Appendices M, N and Q): Electricity generated by PVs (Appendix M) (negative quantity)  12a. Carbon dioxide emissions - Individual heating systems inclu  Space heating - main system 1	: Energ kWh/ye 3060.7	CHP y ear 7		(26:	nissions Factor 0.198	70.88 0.00 130.00 0.00 45.00 0.00  (230a)(230g)	3060.77  2718.12  ]  [ ]  [ ]  [ ]  [ ]  [ ]  [ ]  [ ]	(230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (232) (233)

Space heating - main system 1			Factor		(kgCO2/year)	
space fleating - filani system 1	3060.77	x	0.198	=	606.03	(261)
Water heating	2718.12	x	0.198	=	538.19	(264)
Space and water heating			(261) + (262)	+ (263) + (264) =	1144.22	(265)
Pumps, fans and electric keep-hot	245.88	x	0.517	=	127.12	(267)
Lighting	401.03	x	0.517	=	207.33	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-891.02	x	0.529	=	-471.35	(269)
Total carbon dioxide emissions				∑(261)(271) =	1007.33	(272)

SAP version 9.90

# SAP 2009 Worksheet

## Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P08 4 St Augustines, London, NW1		

1. Overall dwelling dimensio	ns						
		Area (m²)		Average stor height (m)	•	Volume (m³)	
Lowest occupied		95.50	(1a) x	2.60	(2a) =	248.30	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)(1n) = [	95.50	(4)				
Dwelling volume				(3a) + (3b) +	(3c) + (3d)(3n) =	248.30	(5)
2. Ventilation rate							
						m³ per hour	
Number of chimneys				0	x 40 =	0	(6a)
Number of open flues				0	x 20 =	0	(6b)
Number of intermittent fans				0	x 10 =	0	(7a)
Number of passive vents				0	x 10 =	0	(7b)
Number of flueless gas fires				0	x 40 =	0	(7c)
						Air changes pe hour	er
Infiltration due to chimneys, fl	ues, fans, PSVs	(6a) + (6b) + (	7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)
If a pressurisation test has bee	en carried out or is intended, proceed to	o (17), otherw	ise continue from	(9) to (16)			
Air permeability value, q50, ex	pressed in cubic metres per hour per	square metre	of envelope area			5.00	(17)
If based on air permeability va	lue, then (18) = $[(17) \div 20] + (8)$ , other	wise (18) = (16	5)			0.25	(18)
Air permeability value applies	if a pressurisation test has been done,	or a design or	specified air pern	neability is beir	ng used		
Number of sides on which dwe	elling is sheltered					2	(19)
Shelter factor					1 - [0.075 x (19)] =	0.85	(20)
Adjusted infiltration rate					(18) x (20) =	0.21	(21)
Infiltration rate modified for m	nonthly wind speed:						

Infiltration rate modified for monthly wind speed:													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average v	vind speed	from Table	· 7										
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	]
										∑(22)1	.12 =	54.10	(22)
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	1.20	1.27	]
										∑(22a)1	.12 =	13.52	(22a)
Adjusted infiltration	n rate (allo	owing for sh	nelter and v	vind speed)	) = (21) × (2	2a)m							
(22b)m	0.29	0.27	0.27	0.24	0.22	0.21	0.20	0.20	0.22	0.24	0.26	0.27	]
										∑(22b)1	.12 =	2.87	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system

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

If balanced w	ith heat rec	overy: effic	iency in % all	owing for	in-use fact	or (from Ta	ble 4h) =							N/A	(23c)
c) If whole ho	use extract	ventilation	or positive i	nput venti	lation from	n outside									
if (22b)m ·	< 0.5 x (23b)	), then (24c	) = (23b); oth	erwise (2	4c) = (22b)	m + 0.5 x (23	3b)								
(24c)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	(	0.50	0.50	0.50	0.	50	0.52	(24c)
Effective air char	nge rate - er	nter (24a) o	r (24b) or (24	c) or (24d	l) in box (25	5)									_
(25)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	(	0.50	0.50	0.50	0.	50	0.52	(25)
3. Heat losses a	ınd heat los	s paramete	r												
The κ-value is the	e heat capa	city per unit	area, see To	ıble 1e.											
E	Element		Gross Area, m²	-	nings, n²	Net area A, m²		-value, V/m²K		A x U, W/K		value, J/m².K		Αxκ, kJ/K	
Doors						2.10	x	1.60	] =	3.36		N/A	] [	N/A	(26)
Window*						8.68	х	1.15	=	9.94		N/A	] [	N/A	(27)
Window*						9.70	х	1.33	=	12.86		N/A	] [	N/A	(27)
External wall						55.08	x	0.20	=	11.02		N/A	] [	N/A	(29a
Party Wall						33.80	x	0.00	=	0.00		N/A	] [	N/A	(32)
Roof						30.00	x	0.15	=	4.50		N/A	] [	N/A	(30)
Total area of ext	ernal eleme	ents ∑A, m²				105.56	(31)								
* for windows ar	nd roof wind	dows, effect	ive window l	J-value is	calculated	using formu	la 1/[(1/	'UValu	e)+0.04	!] paragra <sub>l</sub>	oh 3.2				
Fabric heat loss,	$W/K = \sum (A >$	< U)								(2	6)(30)	+ (32) =	4	1.68	(33)
Heat capacity Cn	n = ∑(A x κ)								(28)	(30) + (32)	+ (32a)	(32e) =		N/A	(34)
Thermal mass pa	rameter (TI	MP) in kJ/m	²K							Calcula	ted sepa	rately =	10	00.00	(35)
Thermal bridges:					5 x (31)									9.73	(36)
Total fabric heat	_			. ,							(33) -	+ (36) =	5	51.41	(37)
Ventilation heat		ted monthly	v 0.33 x (25)	m x (5)							(,	()			_ (- /
(38)m	43.99	42.69	42.69	40.97	40.97	40.97	40.97	4	0.97	40.97	40.97	41	.38	42.69	(38)
Heat transfer co	efficient, W,	/K (37)m+	(38)m												
(39)m	95.40	94.09	94.09	92.38	92.38	92.38	92.38	9	2.38	92.38	92.38	92	.79	94.09	
										Average =	∑(39)1:	12/12 =	9	3.09	(39)
Heat loss parame	eter (HLP), \	N/m²K (39	)m ÷ (4)												_
(40)m	1.00	0.99	0.99	0.97	0.97	0.97	0.97	(	0.97	0.97	0.97	0.	97	0.99	
										Average =	∑(40)1:	12/12 =	(	0.97	(40)
4. Water heatir	ng energy re	equirement													
	, g = g,												kW	h/year	
Assumed occupa	incv. N										2.	 69	(42)	,,	
If TFA > 13.9,		5 x [1 - exp(-	-0.000349 x (	TFA - 13.9	9)²)] + 0.00°	13 x (TFA - 1	3.9)						] (/		
If TFA ≤ 13.9,		o x [1 cxp(	0.0003 13 X (	1177 13.3	,,,,, . 0.00.	10 / (11 / 1	3.37								
Annual average I		sage in litre	s ner day Vd	average =	· (25 v N) +	36					98	12	(43)		
Annual average		_					to achiev	ie a wi	ater iise	e taraet of				c	
per person per de		_		, y 370 ij tii	cawening	is acsigned	to deme	ic a we	acci usc	. turget oj	not more	. triair 12	25 mires	,	
	Jan	Feb	Mar	Apr	May	Jun	Jul		Aug	Sep	Oct	N	ov	Dec	
Hot water usage				•	•		-			r				-	
(44)m	108.00	104.07	100.14	96.21	92.29	88.36	88.36	9	2.29	96.21	100.14	104	1.07	108.00	
											∑(44)	112 =	11	.78.13	(44)
Energy content of	of hot water	used - calc	ulated montl	nly = 4.190	0 x Vd,m x	nm x Tm/36	00 kW	h/mon	th (see	Tables 1b	, 1c 1d)				
(45)m	160.54	140.41	144.89	126.32	121.20	104.59	96.92	11	11.21	112.54	131.10	5 143	3.17	155.47	
											∑(45)	112 =	15	48.41	(45)
												1. 40 -	0.00 =		
											URI	v: 13-01	U-U8 PI	anning ve	ersion

Distribution loss 0.15 x (45)m 21.06 18.95 16.68 19.67 21.48 (46)m 24.08 21.73 18.18 15.69 14.54 16.88 23.32 Water storage loss: a) If manufacturer's declared loss factor is known (kWh/day): 1.85 (47)Temperature factor from Table 2b 0.54 (48)Energy lost from water storage, kWh/day (47) x (48) 1.00 (49)Enter (49) or (54) in (55) 1.00 (55)Water storage loss calculated for each month = (55) x (41)m 29.97 30.97 30.97 27.97 30.97 29.97 30.97 29.97 30.97 30.97 29.97 30.97 (56)m(56)If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H 30.97 30.97 30.97 29.97 30.97 30.97 30.97 29.97 30.97 (57)m27.97 29.97 29.97 (57)Primary circuit loss (annual) from Table 3 360.00 (58)Primary circuit loss for each month (58) ÷ 365 × (41)m (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat) 27.62 30.58 29.59 30.58 29.59 30.58 30.58 29.59 30.58 29.59 30.58 (59)m 30.58 (59)Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 (61)m(61)Total heat required for water heating calculated for each month  $0.85 \times (45)$ m + (46)m + (57)m + (59)m + (61)m 222.08 195.99 206.43 185.87 182.75 164.15 158.46 172.76 172.10 192.70 202.73 217.02 (62)mSolar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating) 0.00 0.00 0.00 0.00 (63)m0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00  $\Sigma$ (63)1...12 = (63)Output from water heater for each month, kWh/month (62)m + (63)m (64)m 222.08 195.99 206.43 185.87 182.75 164.15 158.46 172.76 172.10 192.70 202.73 217.02  $\Sigma(64)1...12 =$ 2273.04 (64)

if (64)m < 0 then set to 0

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

(65)m 102.61 91.16 97.41 89.65 89.54 82.42 81.46 86.21 85.07 92.85 95.25 100.93 (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)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (	Table 5), Wa	atts											
(66)m	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	(66)
Lighting gains (cal	culated in A	Appendix L,	equation L	9 or L9a), a	lso see Tab	le 5							
(67)m	56.77	50.42	41.01	31.04	23.21	19.59	21.17	27.52	36.93	46.90	54.73	58.35	(67)
Appliances gains	(calculated i	n Appendix	L, equatio	n L13 or L1	3a), also se	e Table 5							
(68)m	371.40	375.26	365.55	344.87	318.77	294.24	277.85	274.00	283.71	304.39	330.49	355.02	(68)
Cooking gains (ca	lculated in A	Appendix L,	equation L	15 or L15a)	, also see T	able 5							
(69)m	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	(69)
Pumps and fans g	ains (Table	5a)											
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evapo	ration (nega	ntive values	) (Table 5)										
(71)m	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	(71)
Water heating ga	ins (Table 5)	)											
(72)m	137.92	135.65	130.93	124.51	120.34	114.48	109.49	115.88	118.15	124.79	132.29	135.66	(72)
Total internal gair	Total internal gains (66)m + (67)m + (69)m + (70)m + (71)m + (72)m												
(73)m	683.83	679.06	655.21	618.16	580.05	546.04	526.25	535.13	556.53	593.81	635.25	666.76	(73)

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

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Δ	Access facto Table 6d	ır	Area m²	So	lar flux W/ı	n² į	g Specific dat or Table 6b	a FI	Specific da or Table 60		Gains (W)	)
West		0.54	x	8.68	х	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80
Northwest		0.54	x	9.70	x	11.51	x 0.9 x	0.63	x	0.80	] =	27.35	(81
Solar gains in watts	, calculate	ed for each i	month ∑(7	4)m(82)m									
(83)m	69.60	137.87	228.63	355.47	449.79	478.45	460.45	387.66	278.27	170.07	87.05	57.10	(83
– Total gains - interna	al and sola	ar (73)m + (8	83)m										
(84)m	753.43	816.93	883.84	973.62	1029.84	1024.49	986.69	922.79	834.80	763.88	722.29	723.85	(84
7. Mean internal t	temperatu	re (heating	season)										
Temperature durin		_		rea from Ta	ble 9, Th1(°	(C)						21.00	(85
·	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	٠, ٦
Utilisation factor fo	r gains for	r living area	, η1,m (see	e Table 9a)	•								
(86)m	0.93	0.91	0.87	0.80	0.67	0.52	0.37	0.39	0.63	0.82	0.91	0.93	(86
ے Mean internal tem <sub>ا</sub>	o of living	area T1 (ste	eps 3 to 7 ii	n Table 9c)									
(87)m	19.28	19.49	19.88	20.28	20.67	20.89	20.97	20.97	20.81	20.36	19.72	19.34	(87
- Temperature durin	g heating	periods in t	he living ar	rea from Ta	ble 9, Th2(°	C)							
(88)m	20.09	20.10	20.10	20.11	20.11	20.11	20.11	20.11	20.11	20.11	20.11	20.10	(88
- Jtilisation factor fo	r gains for	r rest of dw	elling η2,m	(see Table	9a)								
(89)m	0.92	0.90	0.85	0.77	0.63	0.46	0.29	0.31	0.57	0.79	0.90	0.93	(8
ے Nean internal tem¡	perature ii	n the rest o	f dwelling	T2 (follow s	teps 3 to 7	in Table 9c)							
(90)m	17.80	18.11	18.66	19.23	19.74	20.01	20.09	20.09	19.92	19.35	18.45	17.89	(9
iving area fraction								fLA 3	31.30	÷ (4) =	=	0.33	(9
/lean internal temp	perature f	or the whol	e dwelling	fLA x T1 +(2	L - fLA) x T2								
(92)m	18.28	18.56	19.06	19.58	20.05	20.30	20.38	20.38	20.21	19.69	18.87	18.36	(92
apply adjustment t	o the mea	n internal t	emperatur	e from Tab	le 4e, wher	e appropria	te						
(93)m	18.13	18.41	18.91	19.43	19.90	20.15	20.23	20.23	20.06	19.54	18.72	18.21	(93
8. Space heating r	equireme	nt											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
et Ti to the mean i			obtained a	at step 11 o	f Table 9b,	so that tim	= (93)m a	and recalculat	e the utili	sation facto	or for gains	using Table	e 9a)
Jtilisation factor fo			0.00		0.50			1		1 0 = 0		T	٦,,
(94)m	0.90	0.88	0.83	0.75	0.62	0.46	0.30	0.32	0.56	0.76	0.87	0.90	(94
Jseful gains, ηmGn		, , ,	1							T =0.1.0=		T === = .	٦ ,,
(95)m	677.43	715.91	731.52	731.22	640.38	475.90	300.55	298.93	469.60	584.05	629.65	652.34	(9!
Monthly average ex					44 = 2	14.55	46.00	16.00	4400	10.00	<b>—</b> ••	1.00	٦,,
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(9
leat loss rate for m							0.0-	1 0	-0		1.0=	.a== -:	٦,,
	1300.66	1262.16	1139.05	990.85	757.29	512.29	307.72	307.36	532.38	806.93	1087.08	1252.60	(9
pace heating requ								<u> </u>		T	1	T	7
4 4	463.68	367.08	303.20	186.93	86.98	0.00	0.00	0.00	0.00	165.83	329.35	446.59	
(98)m	403.00	307.06	303.20	100.55	00.50					•		1	_
(98)m	403.08	307.08	303.20	100.55	00.50			year (kWh/y		•		2349.65	(9

### 9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11)

Fraction of space h	eating fro	m main syst	tem(s) 1 -	(201)					1.00	(202)			
Fraction of main he	eating fror	n main syste	em 2						0.00	(203)			
Fraction of total sp	ace heat f	rom main sy	ystem 1 (2	02) x [1 - (2	(03)				1.00	(204)			
Fraction of total sp	ace heat f	rom main sy	ystem 2 (2	02) x (203)					0.00	(205)			
Efficiency of main s	space heat	ting system	1 (%)						93.00	(206)			
(from database or	Table 4a/4	4b, adjusted	where app	propriate by	y the amou	ınt shown iı	n the 'space	efficiency	adjustmen	- t' column of To	able 4c)		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requ	uirement, l	kWh/month	(as calcula	ited above)	)								_
(98)m	463.68	367.08	303.20	186.93	86.98	0.00	0.00	0.00	0.00	165.83	329.35	446.59	
Space heating fuel	(main hea	iting system	1), kWh/m	nonth = (98	)m x (204)	x 100 ÷ (20	6)						_
(211)m	498.58	394.71	326.02	201.00	93.53	0.00	0.00	0.00	0.00	178.31	354.14	480.21	
						•	Total per ye	ar (kWh/ye	ear) = ∑(21	1)15, 1012	= 2	2526.50	(211)
Water heating:													
Output from water	heater, k	Wh/month	(calculated	d above)									
(64)m	222.08	195.99	206.43	185.87	182.75	164.15	158.46	172.76	172.10	192.70	202.73	217.02	
										∑(64)112	= 2	2273.04	(64)
Efficiency of water	heater pe	r month											
(217)m	86.23	85.96	85.34	84.33	82.46	79.30	79.30	79.30	79.30	83.91	85.60	86.20	
Fuel for water heat	ting, kWh/	/month = (64	4)m x 100 ÷	÷ (217)m									
(219)m	257.54	228.00	241.90	220.42	221.62	207.00	199.83	217.85	217.03	229.64	236.83	251.77	
							Total	per year (l	kWh/year)	= ∑(219)112	= 2	2729.42	(219)
Annual Totals Sum	nmary:									kWh/year	k۱	Wh/year	
Space heating fuel	-	in system 1										2526.50	(211)
Water heating fue		.,										2729.42	(219)
Electricity for pum		nd electric k	ceen-hot (1	able 4f)·								.,	] (=15)
mechanical ven	-				input from	outsido				70.88	$\neg$		(230a)
warm air heatin			u, extract t	positive i	iiiput ii oiii	outside				0.00	$\dashv$		(230a)
central heating		14115								130.00			(230c)
oil boiler pump										0.00			(230d)
boiler flue fan										45.00			(230e)
maintaining ele	ctric keep	-hot facility	for gas con	nbi boiler						0.00			(230f)
pump for solar	water hea	ting								0.00			(230g)
Total electricity for	the above	e								∑(230a)(230	g)	245.88	(231)
													_
Electricity for light	ing (calcul	lated in App	endix L):									401.03	(232)
Energy saving/gen	eration te	chnologies	(Appendic	es M, N and	d Q):								
Electricity generate	ed by PVs (	(Appendix N	Л) (negativ	e quantity)							-	891.02	(233)
10a. Fuel costs - I	ndividual	heating sys	tems includ	ding micro-									
					Fuel	l kWh/year			uel price able 12)		Fuel	cost £/yea	r
Space heating - ma	in system	1				2526.50	x		3.10	x 0.01 =		78.32	(240)
Water heating cost	t (other fu	el)			2	2729.42	x		3.10	x 0.01 =		84.61	(247)
Pumps, fans and el	lectric kee	p-hot				245.88	x		11.46	x 0.01 =		28.18	(249)
Energy for lighting						401.03	×		11.46	x 0.01 =		45.96	(250)
Additional standing		(Table 12)					_			-		106.00	(251)
Energy saving/gen			(Appendic	es M, N and	d Q):								
PV savings (neg		_		,		-891.02	x		11.46	x 0.01 =		102.11	(252)
Total energy cost	, quui					22 2. <b>02</b>	_ ^			2) + (245)(25		240.96	(255)
Total chergy cost								,	(=+0)(Z42	-, · (~75)(~5	7	_+0.50	J (233)

ergy cost deflator (Table 12) ergy cost factor (ECF) [(	· · · · · · · · · · · · · · · · · · ·	0.47	(256)
ergy cost factor (ECF)			
	$(255) \times (256)] \div [(4) + 45.0] =$	0.81	(257)
P value		88.76	
P rating		89	(258)
P band		В	

	Energy		Emissions		Emissions		
	kWh/year		Factor		(kgCO2/year)		
Space heating - main system 1	2526.50	x	0.198	=	500.25	(261)	
Water heating	2729.42	x	0.198	=	540.43	(264)	
Space and water heating			(261) + (262)	+ (263) + (264) =	1040.67	(265)	
Pumps, fans and electric keep-hot	245.88	x	0.517	=	127.12	(267)	
Lighting	401.03	x	0.517	=	207.33	(268)	
Energy saving/generation technologies:							
PV emission savings (negative quantity)	-891.02	x	0.529	=	-471.35	(269)	
Total carbon dioxide emissions				∑(261)(271) =	903.78	(272)	
Dwelling carbon dioxide emissions rate				(272) ÷ (4) =	9.46	(273)	
El value					91.38		
El rating (see section 14)					91	(274)	
EI band					В	٦	

13a. Primary energy - Individual heating systems including	g micro-CHP					
	Energy kWh/year		Primary Energy Factor	P	Primary Energy	,
Space heating - main system 1	2526.50	х	1.02	=	2577.03	(261*)
Water heating	2729.42	х	1.02	=	2784.01	(264*)
Space and water heating			(261*) + (262*) + (263*) +	(264*) = [	5361.05	(265*)
Pumps, fans and electric keep-hot	245.88	х	2.92	=	717.98	(267*)
Lighting	401.03	х	2.92	=	1171.02	(268*)
Energy saving/generation technologies:						
PV primary energy savings (negative quantity)	-891.02	х	2.92	=	-2601.78	(269*)
Total primary energy kWh/year			∑(261*)	(271*) =	4648.27	(272*)
Primary energy kWh/m2/year			(272*	*) ÷ (4) =	48.67	(273*)

# Code for Sustainable Homes (November 2010) Design - Draft

Mr Stuart Searle



2435

#### This report details the calculations and results for Ene 1, 2 and 7 of the Code For Sustainable Homes.

This Design Assessment has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed. Code calculations are from the Technical Guide (November 2010).

Assessor number

32.6

7.55C5501 Harrie	Will Studie Scuric		713303301 11411	ibei	2-133
Client			Last modified		01/02/2013
Address	P09 4 St Augustines	s, London, NW1			
Building regulation asses	ssment - criterion 1				
					kg/m²/yr
ER					11.93
ER					17.69
Assessment of zero carbo	on home and low or ze	ro carbon technologies			
				Credits	Level
welling emission rate (Er	ne 1)	CO <sub>2</sub> reduction = 32.6 %		3.6	4
abric Energy Efficiency		FEE = 60.8		No credits	
ow or zero carbon techno	ologies (Ene 7)	CO₂ reduction = 14 %		1	
Ene 1 - dwelling emission	n rate				
			%	kWh/m²	kgCO₂/m²/yr
assessment of Ene 1 (leve	el 1-5)				
ER from SAP 2009 DER w	orksheet				11.93
additional allowable gene	ration			0.00	
CO <sub>2</sub> emissions off	fset from generation				0.00
CO <sub>2</sub> emissions off	fset from community bi	ofuel CHP systems			0.00
otal CO₂ emissions offset	from SAP section 16 al	lowances			0.00
DER accounting for SAP se	ection 16 allowances				11.93

CO<sub>2</sub> emissions offset from additional allowable generation

CO<sub>2</sub> emissions offset from community biofuel CHP systems

Net CO₂ emissions

CO₂ reduction compared to TER

Assessment of Ene 1 (level 6)
DER from SAP 2009 DER worksheet

CO<sub>2</sub> emissions from appliances (equation L14)

CO<sub>2</sub> emissions from cooking (equation L16)

CO₂ reduction as % of TER

Assessor name

5.76

11.93

13.08

1.35

26.37

0.00

0.00

(ZC1)

(ZC2)

(ZC3)

(ZC4)

(ZC5)

#### Ene 1 - dwelling emission rate - level 6 There is no Zero Carbon Home definition in the current technical guide Criterion Value Pass/Fail FEE <= 39 60.8 Fail 26.37 Net CO<sub>2</sub> emissions <= 0.00 Fail Result: Not level 6 Number of credits for Ene 1 3.6 Ene 2 - Fabric Energy Efficiency 60.8 FEE Number of credits for Ene 2 No credits Ene 7 - low or zero carbon technologies **Emissions** Reduction kgCO₂/yr kgCO<sub>2</sub>/yr Standard case 2216.91 Space and water heating (265) Mechanical cooling (266) 0.00 Pumps and fans (267) 152.24 Lighting (268) 251.39 2013.72 Appliances and cooking Total CO₂ 2606.11 **Actual case** Space and water heating (265) or (376) 2216.91 Space and water heating from LZCT considered in SAP 2009 0.00 Pumps and fans (267) or (378) 152.24 Pumps and fans 0.00 Electricity generated by LZCT (269) + (380)) -688.41 Additional allowable electricity generation considered in SAP 2009 section 16 0.00 Offset from biofuel CHP $[-1 \times [(363)..(366) + (368)...(372)]]$ 0.00 LZCT electricity generation -688.41 LZCT thermal generation 0 Total from specified LZCT -688.41 **Emissions** $kgCO_2/m^2/yr$ Reduction in CO<sub>2</sub> Emissions Standard Case CO<sub>2</sub> 33.23

28.29

14

1

Actual Case CO2

% Reduction in CO<sub>2</sub>

Number of credits for Ene 7

# DER 2009 Worksheet

## Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P09 4 St Augustines, London, NW1		

1. Overall dwelling dimension	ons						
		Area (m²)		Average s height (		Volume (m³)	
Lowest occupied		139.50	(1a) x	3.00	(2a) =	418.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)(1n) =	139.50	(4)				
Dwelling volume				(3a) + (3b	o) + (3c) + (3d)(3n) =	418.50	(5)
2. Ventilation rate							
						m³ per hour	
Number of chimneys				0	x 40 =	0	(6a)
Number of open flues				0	x 20 =	0	(6b)
Number of intermittent fans				0	x 10 =	0	(7a)
Number of passive vents				0	x 10 =	0	(7b)
Number of flueless gas fires				0	x 40 =	0	(7c)
						Air changes pe hour	er
Infiltration due to chimneys, f	flues, fans, PSVs	(6a) + (6b) + (7	7a) + (7b) + (7d	:) = 0	÷ (5) =	0.00	(8)
If a pressurisation test has be	en carried out or is intended, proceed t	o (17), otherwi	se continue fro	om (9) to (16)			
Air permeability value, q50, e	xpressed in cubic metres per hour per	square metre o	of envelope are	ea		5.00	(17)
If based on air permeability va	alue, then (18) = $[(17) \div 20] + (8)$ , other	wise (18) = (16	5)			0.25	(18)
Air permeability value applies	s if a pressurisation test has been done,	or a design or	specified air p	ermeability is b	being used		
Number of sides on which dw	velling is sheltered					0	(19)
Shelter factor					1 - [0.075 x (19)] =	1.00	(20)
Adjusted infiltration rate					(18) x (20) =	0.25	(21)
Infiltration rate modified for r	monthly wind speed:						

Shelter factor		1 - [0.075 x (19)] =	1.00	(20)
Adjusted infiltration rate		(18) x (20) =	0.25	(21)
nfiltration rate modified for month	ly wind speed:			

Infiltration rate mo	odified for i	monthly wi	nd speed:										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average v	wind speed	from Table	7										
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1	.12 =	54.10	(22)
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	1.20	1.27	
										∑(22a)1	.12 =	13.52	(22a)
Adjusted infiltration	on rate (allo	wing for sh	elter and v	vind speed)	) = (21) × (2	2a)m							
(22b)m	0.34	0.32	0.32	0.28	0.26	0.24	0.23	0.23	0.26	0.28	0.30	0.32	
										∑(22b)1	.12 =	3.38	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system

0.5 (23a) 0.5 (23b)

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

If balanced with	n heat reco	overy: effici	ency in % a	llowing for	in-use fact	or (from Ta	ble 4h) =					N/A	(23c)
c) If whole hous if (22b)m < 0			•	•			3h)						
(24c)m	0.59	0.57	0.57	0.53	0.51	0.50	0.50	0.50	0.51	0.53	0.55	0.57	(24c)
Effective air change			I.		I	Į.	0.50	1 0.50	0.51	0.55	0.55	0.57	(2 10)
(25)m	0.59	0.57	0.57	0.53	0.51	0.50	0.50	0.50	0.51	0.53	0.55	0.57	(25)
		<b>'</b>											
3. Heat losses and													
The κ-value is the h		ity per unit										_	
Ele	ment		Gross Area, m <sup>2</sup>	•	nings, 1²	Net area A, m²		/alue, /m²K	A x U, W/K	к-va kJ/r	n².K	Αxκ, kJ/K	
Doors						2.10	x 1	60 =	3.36	N	/A	N/A	(26)
Window*						57.73	x 1	15 =	66.10	N	/A	N/A	(27)
Exposed floor						10.00	x 0	0.15 =	1.50	N	/A	N/A	(28b)
External wall						75.17	x 0	0.20 =	15.03	N	/A	N/A	(29a)
Roof						177.00	x 0	0.15 =	26.55	N	/A	N/A	(30)
Total area of extern	nal elemer	nts ∑A, m²				322.00	(31)						
* for windows and	roof wind	ows, effecti	ve window	U-value is a	calculated		, ,	IValue)+0.0	4] paragrap	h 3.2			
Fabric heat loss, W	/K = Σ(A ×	U)							(2	6)(30) + (3	32) =	112.55	(33)
Heat capacity Cm =		-						(28)	(30) + (32)			N/A	(34)
Thermal mass para		ЛР) in kJ/m²	·K					` '		ted separat		100.00	(35)
Thermal bridges: ∑	,	•		x K						·	, <u> </u>	25.76	(36)
if details of ther					5 x (31)								
Total fabric heat lo		3		(/	( )					(33) + (3	36) =	138.31	(37)
Ventilation heat los		ed monthly	0 33 x (25	5)m x (5)						(33) . (.		130.31	(3,)
(38)m	81.14	78.55	78.55	73.37	69.92	69.05	69.05	69.05	70.78	73.37	75.96	78.55	(38)
Heat transfer coeff	icient, W/	K (37)m+	(38)m					1	1	1		<u>'</u>	_ ` `
(39)m	219.44	216.85	216.85	211.68	208.22	207.36	207.36	207.36	209.09	211.68	214.26	216.85	
									Average = 2	∑(39)112 <i>/</i>	′12 = <u> </u>	212.25	(39)
Heat loss paramete	er (HLP), W	V/m²K (39)	m ÷ (4)										
(40)m	1.57	1.55	1.55	1.52	1.49	1.49	1.49	1.49	1.50	1.52	1.54	1.55	
									Average = 2	∑(40)112 <i>/</i>	12 =	1.52	(40)
4. Water heating	anargy ra	quirement											
4. Water heating	chergy re	quirement									k	:Wh/year	
Assumed occupanc	rv N									2.92	(42	-	
If TFA > 13.9, N		x [1 - exn(-	n nnn349 x	(TFΔ - 13 9	)²)] + 0 00°	13 χ (TFΔ - 1	3 9)			2.32	(	•1	
If TFA ≤ 13.9, N		X [I CXP(	0.000343 X	(117, 15.5	, ,, , 0.00.	13 X (11 A 1	.5.5)						
Annual average ho		age in litres	ner day Vo	l average -	(25 v N) ±	36				103.4	6 (43	4	
Annual average ho		_		-			to achieve	o a water us	e target of				
per person per day		_		by 570 ij tin	caweiling	is acsigned	to demeve	. a water as	c target of	not more tr	iuii 125 iit	763	
, , , , , , , , , , , , , , , , , , ,	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in					•								
(44)m	113.80	109.67	105.53	101.39	97.25	93.11	93.11	97.25	101.39	105.53	109.67	113.80	
_										∑(44)1	.12 =	1241.50	(44)
Energy content of h	not water	used - calcu	lated mon	thly = 4.190	) x Vd,m x i	nm x Tm/36	00 kWh	/month (see	Tables 1b,	1c 1d)			_
(45)m	169.17	147.96	152.68	133.11	127.72	110.21	102.13	117.20	118.60	138.21	150.87	163.83	
										∑(45)1	.12 =	1631.69	(45)
If instantaneous wo	ater heatir	ng at point (	of use (no h	ot water st	orage), en	ter 0 in box	es (46) to (	(61)					
For community hea	ating inclu	de distribut	ion loss wh	ether or no	t hot wate	r tank is pre	sent						
											12 010 00		

Distribution loss	0.15 x (45)r	n											_
(46)m	25.38	22.19	22.90	19.97	19.16	16.53	15.32	17.58	17.79	20.73	22.63	24.58	(46)
Water storage lo	ss:									_			
a) If manufacture	er's declared	loss factor	is known (I	kWh/day):					1.85	(47)			
Temperature	factor from	Table 2b							0.54	(48)			
Energy lost fr	om water st	orage, kW	h/day (47)	) x (48)					1.00	(49)			
Enter (49) or (54	) in (55)								1.00	(55)			
Water storage lo	ss calculated	d for each n	nonth = (55	) x (41)m									
(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)
If cylinder contai	ns dedicated	d solar stora	nge, = (56)n	n x [(50) - (H	H11)] ÷ (50)	), else = (56	)m where (	H11) is fror	n Appendi	хН			
(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)
Primary circuit lo	ss (annual) t	from Table	3					3	360.00	(58)			
Primary circuit lo	ss for each i	month (58)	÷ 365 × (41	.)m									
(modified by fact	or from Tab	le H5 if the	re is solar v	vater heatir	ng and a cy	linder therr	nostat)						
(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 for ea	ach month fr	om Table 3	a, 3b or 3c	(enter '0' if	not a com	bi boiler)							
(61)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requir	ed for water	heating ca	lculated fo	r each mon	th 0.85 × (4	15)m + (46)	m + (57)m -	+ (59)m + (6	61)m				
(62)m	230.72	203.55	214.22	192.67	189.27	169.77	163.67	178.74	178.15	199.76	210.43	225.38	(62)
Solar DHW input	calculated u	ising Appen	dix H (nega	ative quant	ity) ('0' ent	ered if no s	olar contrib	oution to w	ater heatin	g)			
(63)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	]
										∑(63)1	.12 =	0.00	(63)
Output from wat	er heater fo	r each mon	th, kWh/m	onth (62)m	n + (63)m								
(64)m	230.72	203.55	214.22	192.67	189.27	169.77	163.67	178.74	178.15	199.76	210.43	225.38	
										∑(64)1	.12 = 2	356.33	(64)
if (64)m < 0 then	set to 0												
Heat gains from	water heatir	ng, kWh/mc	onth 0.25 ×	[0.85 × (45	5)m + (61)m	n] + 0.8 × [(4	46)m + (57)	m + (59)m]					
(65)m	105.49	93.67	100.00	91.91	91.70	84.29	83.19	88.20	87.08	95.19	97.81	103.71	(65)
include (5	7)m in calcui	ation of (65	m only if o	cylinder is in	the dwelli	ing or hot w	vater is fron	n communi	ty heating				

				_				_	_			_	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (	Table 5), Wa	atts											_
(66)m	145.81	145.81	145.81	145.81	145.81	145.81	145.81	145.81	145.81	145.81	145.81	145.81	(66)
Lighting gains (ca	Iculated in A	ppendix L,	equation L	9 or L9a), a	lso see Tab	le 5							
(67)m	27.53	24.46	19.89	15.06	11.26	9.50	10.27	13.35	17.91	22.74	26.55	28.30	(67)
Appliances gains	(calculated i	n Appendix	L, equatio	n L13 or L1	3a), also se	e Table 5							
(68)m	308.84	312.05	303.97	286.78	265.08	244.68	231.05	227.85	235.92	253.12	274.82	295.22	(68)
Cooking gains (ca	lculated in A	Appendix L,	equation L	15 or L15a)	, also see T	able 5							
(69)m	37.58	37.58	37.58	37.58	37.58	37.58	37.58	37.58	37.58	37.58	37.58	37.58	(69)
Pumps and fans g	gains (Table	5a)											
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evapo	ration (nega	itive values	) (Table 5)										
(71)m	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	(71)
Water heating ga	ins (Table 5)	)											
(72)m	141.78	139.39	134.41	127.65	123.26	117.07	111.82	118.55	120.94	127.94	135.85	139.40	(72)
Total internal gai	ns (66)m + (	67)m + (68	)m + (69)m	+ (70)m +	(71)m + (72	!)m							
(73)m	554.90	552.63	535.01	506.22	476.33	448.00	429.88	436.49	451.52	480.55	513.95	539.65	(73)

## 6. Solar gains

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

Details for month o	f January	and annual	totals are	shown belo	iw:	-			,,				
	ļ	Access facto	or	Area m²	So	lar flux W/	m² g	Specific da		Specific da		Gains (W)	)
		Table 6d	1		1		1	or Table 6b	<b>)</b> 1	or Table 60	1		٦
West		0.54	] x	15.10	] x	19.87	x 0.9 x	0.63	] x	0.80	=	73.50	<u> </u> (80)
North		0.54	x	17.26	x	10.73	x 0.9 x	0.63	x	0.80	=	45.34	(74)
South		0.54	x	25.37	x	47.32	x 0.9 x	0.63	x	0.80	=	294.14	(78)
Solar gains in watts	, calculate	ed for each	month ∑(7	4)m(82)m	<u> </u>			_	•				_
(83)m	412.97	708.24	954.27	1222.36	1403.95	1461.49	1416.93	1268.48	1067.37	808.50	495.74	352.59	(83)
Total gains - interna	al and sola	ar (73)m + (	83)m	_						_		_	_
(84)m	967.87	1260.87	1489.28	1728.59	1880.28	1909.49	1846.81	1704.96	1518.89	1289.05	1009.70	892.24	(84)
7 Manu internal		wa (baatin											
7. Mean internal t				_									7
Temperature durin			_	rea from Ta	ble 9, Th1(`	(C)						21.00	(85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor fo								1				T	7 ()
(86)m	0.96	0.93	0.88	0.82	0.70	0.56	0.41	0.44	0.66	0.84	0.94	0.96	(86)
Mean internal tem			·	1									7
(87)m	17.99	18.42	19.02	19.64	20.29	20.70	20.90	20.89	20.55	19.78	18.68	18.04	(87)
Temperature durin									T		·		7
(88)m	19.64	19.65	19.65	19.68	19.70	19.70	19.70	19.70	19.69	19.68	19.66	19.65	(88)
Utilisation factor fo							1		ı		ı	1	7
(89)m	0.95	0.92	0.86	0.78	0.65	0.48	0.30	0.32	0.58	0.81	0.93	0.96	(89)
Mean internal tem	perature i	n the rest o	f dwelling	T2 (follow s	teps 3 to 7	in Table 9c	)						7
(90)m	15.72	16.33	17.19	18.07	18.95	19.45	19.65	19.64	19.29	18.28	16.73	15.80	(90)
Living area fraction								fLA	45.00	÷ (4) =	=	0.32	(91)
Mean internal tem	perature f	or the whol	e dwelling	fLA x T1 +(:	1 - fLA) x T2	2						_	_
(92)m	16.45	17.00	17.78	18.58	19.38	19.86	20.05	20.04	19.70	18.77	17.36	16.52	(92)
Apply adjustment t	o the mea	ın internal t	emperatu	re from Tab	le 4e, wher	e appropri	ate						_
(93)m	16.30	16.85	17.63	18.43	19.23	19.71	19.90	19.89	19.55	18.62	17.21	16.37	(93)
O Constanting													
8. Space heating r									_	_			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean			obtained a	at step 11 o	f Table 9b,	so that tim	= (93)m ar	nd recalcula	te the utili	sation facto	r for gains	using Table	e 9a)
Utilisation factor fo			0.02	0.75	0.62	0.40	0.22	0.24	0.57	0.77	0.00	0.02	7 (0.4)
(94)m	0.92	0.88	0.82	0.75	0.63	0.48	0.32	0.34	0.57	0.77	0.89	0.93	(94)
Useful gains, ηmGr	<u> </u>	, , ,		1201 75	1170 50	044.07	F05 77	F70.00	070.75	002.00	004.04	020.26	7 (05)
(95)m	893.49	1110.51	1227.13	1291.75	1178.59	911.87	585.77	578.30	870.75	992.88	901.81	829.36	(95)
Monthly average ex					4	1	40.00	40.55	4	40.55			7 (25)
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for m						1 -	I	1		_		1	7
(97)m	2589.66	2570.50	2348.07	2058.81	1568.59	1059.17	622.79	620.70	1096.75	1654.42	2187.01	2487.78	(97)
Space heating requ								1	ı		ı	ı	7
(98)m	1261.95	981.11	833.98	552.28	290.16	0.00	0.00	0.00	0.00	492.18	925.34	1233.86	
							Total per	year (kWh/\	/ear) = ∑(9	8)15, 10	12 = [	5570.86	(98)

### 9a. Energy Requirements - Individual heating systems including micro-CHP

### Space heating:

Fraction of space heating from secondary/supplementary system (Table 11)

Fraction of space heating from main system(s) 1 - (201)

Space heating requirement in kWh/m²/year

(201) 0.00 1.00 (202) 47.10

 $(98) \div (4)$ 

Fraction of main he	eating fron	n main syst	em 2						0.00	(203)			
Fraction of total sp	oace heat f	rom main s	ystem 1 (2	02) x [1 - (2	203)]				1.00	(204)			
Fraction of total sp	oace heat f	rom main s	ystem 2 (2	02) x (203)					0.00	(205)			
Efficiency of main	space heat	ing system	1 (%)						93.00	(206)			
(from database or	Table 4a/4	lb, adjusted	d where app	propriate by	y the amou	nt shown ii	n the 'space	efficiency (	adjustment	' column of	Table 4c)		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requ			·			1				1		_	1
(98)m	1261.95	981.11	833.98	552.28	290.16	0.00	0.00	0.00	0.00	492.18	925.34	1233.86	
Space heating fuel					1					T	Т		1
(211)m	1356.93	1054.96	896.75	593.85	312.00	0.00	0.00	0.00	0.00	529.23	994.99	1326.73	]
						•	Total per ye	ar (kWh/ye	ear) = ∑(21:	1)15, 10	.12 =	7065.44	(211)
Water heating:													
Output from water	r heater, k	Wh/month	(calculated	d above)									,
(64)m	230.72	203.55	214.22	192.67	189.27	169.77	163.67	178.74	178.15	199.76	210.43	225.38	
										∑(64)1	.12 =	2356.33	(64)
Efficiency of water	heater pe	r month											_
(217)m	88.16	87.96	87.58	86.97	85.45	79.30	79.30	79.30	79.30	86.63	87.80	88.16	
Fuel for water hea	ting, kWh/	month = (6	4)m x 100 -	÷ (217)m	,								,
(219)m	261.70	231.41	244.59	221.55	221.50	214.09	206.40	225.40	224.66	230.60	239.65	255.64	
							Total	per year (k	(Wh/year)	= <u>∑</u> (219)1	.12 =	2777.17	(219)
Annual Totals Sum	nmary:									kWh/ye	ear k	Wh/year	
Space heating fuel	l used, mai	in system 1										7065.44	(211)
Water heating fue	el used											2777.17	(219)
Electricity for pum	nps, fans aı	nd electric l	keep-hot (1	Table 4f):									
mechanical ven	ntilation far	ns - balance	ed, extract o	or positive i	input from	outside				119.4	7		(230a)
warm air heatir	ng system 1	fans								0.00			(230b)
central heating	pump									130.00	0		(230c)
oil boiler pump	)									0.00			(230d)
boiler flue fan										45.00	)		(230e)
maintaining ele		-	for gas cor	nbi boiler						0.00			(230f)
pump for solar		-								0.00	\		(230g)
Total electricity for	r the above	9								∑(230a)(2	30g) [	294.47	(231)
=1												406.25	] (222)
Electricity for light												486.25	(232)
Energy saving/gen													1
Electricity generate	ed by PVs (	Appendix N	И) (negativ	e quantity)								1301.33	(233)
12a. Carbon diox	ide emissi	ons - Indivi	dual heatin	g systems i	including m	nicro-CHP							
				<b>5</b> • <b>7</b> • • • •		Energy		En	nissions		F	missions	
						Vh/year			Factor			(CO2/year)	
Space heating - ma	ain system	1			7	065.44	x		0.198	] =		1398.96	(261)
Water heating	,					777.17	] x		0.198	] =		549.88	(264)
Space and water h	eating						٠.			」 - (263) + (26	64) =	1948.84	(265)
Pumps, fans and el	_	n-hot				294.47	x		0.517	=	- ·,	152.24	(267)
Lighting	icea ie kee	, 1101				486.25	]		0.517	] - ] =		251.39	(268)
	oration to	chnologie-				-50.23	_ ^		0.51/	_		£J1.JJ	(200)
Energy saving/gen		_				1201 22	<b>1</b>		0.520	1		600 44	1200
PV emission sav			ιy)		-1	1301.33	x		0.529	= =	74\	-688.41	(269)
Total carbon dioxid	ae emissioi	ns								∑(261)(2	/1) = [	1664.07	(272)

11.93

(273)

Dwelling Carbon Dioxide Emissions Rate (DER)

# SAP 2009 Worksheet

## Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P09 4 St Augustines, London, NW1		

1. Overall dwelling dimensions								
		Area (m²)			Average store height (m)	ey	Volume (m³)	
Lowest occupied		139.50	(1a)	x	3.00	(2a) =	418.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)(1n) = [	139.50	(4)					
Dwelling volume					(3a) + (3b) +	(3c) + (3d)(3n) =	418.50	(5)
2. Ventilation rate								
							m³ per hour	
Number of chimneys					0	x 40 =	0	(6a)
Number of open flues					0	x 20 =	0	(6b)
Number of intermittent fans					0	x 10 =	0	(7a)
Number of passive vents					0	x 10 =	0	(7b)
Number of flueless gas fires					0	x 40 =	0	(7c)
							Air changes pe hour	er
Infiltration due to chimneys, flues,	fans, PSVs	(6a) + (6b) + (	7a) + (7b	) + (7c) =	0	÷ (5) =	0.00	(8)
If a pressurisation test has been co	arried out or is intended, proceed to	o (17), otherw	ise conti	nue from	(9) to (16)			
Air permeability value, q50, expres	ssed in cubic metres per hour per	square metre	of envelo	pe area			5.00	(17)
If based on air permeability value,	then (18) = $[(17) \div 20] + (8)$ , other	wise (18) = (16	5)				0.25	(18)
Air permeability value applies if a p	oressurisation test has been done,	or a design or	specifie	l air pern	neability is bein	g used		
Number of sides on which dwelling	g is sheltered						0	(19)
Shelter factor					2	- [0.075 x (19)] =	1.00	(20)
Adjusted infiltration rate						(18) x (20) =	0.25	(21)
Infiltration rate modified for mont	hly wind speed:							

Infiltration rate m	odified for	monthly wi	nd speed:										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average	wind speed	from Table	· 7										
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1	.12 =	54.10	(22)
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	1.20	1.27	
										∑(22a)1	.12 =	13.52	(22a)
Adjusted infiltration	on rate (allo	owing for sh	nelter and v	wind speed	) = (21) × (2	!2a)m							
(22b)m	0.34	0.32	0.32	0.28	0.26	0.24	0.23	0.23	0.26	0.28	0.30	0.32	
										∑(22b)1	.12 =	3.38	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system

0.5 (23a)

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

If balanced with	n heat reco	overy: effici	ency in % a	llowing for	in-use fact	or (from Ta	ble 4h) =					N/A	(23c)
c) If whole hous if (22b)m < 0			•	•			3h)						
(24c)m	0.59	0.57	0.57	0.53	0.51	0.50	0.50	0.50	0.51	0.53	0.55	0.57	(24c)
Effective air change			I.		I	Į.	0.50	1 0.50	0.51	0.55	0.55	0.57	(2 10)
(25)m	0.59	0.57	0.57	0.53	0.51	0.50	0.50	0.50	0.51	0.53	0.55	0.57	(25)
		<u>'</u>											
3. Heat losses and													
The κ-value is the h		ity per unit										_	
Ele	ment		Gross Area, m <sup>2</sup>	•	nings, 1²	Net area A, m²		/alue, /m²K	A x U, W/K	к-va kJ/r	n².K	Αxκ, kJ/K	
Doors						2.10	x 1	60 =	3.36	N	/A	N/A	(26)
Window*						57.73	x 1	15 =	66.10	N	/A	N/A	(27)
Exposed floor						10.00	x 0	0.15 =	1.50	N	/A	N/A	(28b)
External wall						75.17	x 0	0.20 =	15.03	N	/A	N/A	(29a)
Roof						177.00	x 0	0.15 =	26.55	N	/A	N/A	(30)
Total area of extern	nal elemer	nts ∑A, m²				322.00	(31)						
* for windows and	roof wind	ows, effecti	ve window	U-value is a	calculated		, ,	IValue)+0.0	4] paragrap	h 3.2			
Fabric heat loss, W	/K = Σ(A ×	U)							(2	6)(30) + (3	32) =	112.55	(33)
Heat capacity Cm =		-						(28)	(30) + (32)			N/A	(34)
Thermal mass para		ЛР) in kJ/m²	·K					` '		ted separat		100.00	(35)
Thermal bridges: ∑	,	•		x K						·	, <u> </u>	25.76	(36)
if details of ther					5 x (31)								
Total fabric heat lo		3		(/	( )					(33) + (3	36) =	138.31	(37)
Ventilation heat los		ed monthly	0 33 x (25	5)m x (5)						(33) . (.		130.31	(3,)
(38)m	81.14	78.55	78.55	73.37	69.92	69.05	69.05	69.05	70.78	73.37	75.96	78.55	(38)
Heat transfer coeff	icient, W/	K (37)m+	(38)m					1	1	1		<u>'</u>	_ ` `
(39)m	219.44	216.85	216.85	211.68	208.22	207.36	207.36	207.36	209.09	211.68	214.26	216.85	
									Average = 2	∑(39)112 <i>/</i>	′12 = <u> </u>	212.25	(39)
Heat loss paramete	er (HLP), W	V/m²K (39)	m ÷ (4)										
(40)m	1.57	1.55	1.55	1.52	1.49	1.49	1.49	1.49	1.50	1.52	1.54	1.55	
									Average = 2	∑(40)112 <i>/</i>	12 =	1.52	(40)
4. Water heating	anargy ra	quirement											
4. Water heating	chergy re	quirement									k	:Wh/year	
Assumed occupanc	rv N									2.92	(42	-	
If TFA > 13.9, N		x [1 - exn(-	n nnn349 x	(TFΔ - 13 9	)²)] + 0 00°	13 χ (TFΔ - 1	3 9)			2.32		•1	
If TFA ≤ 13.9, N		X [I CXP(	0.000343 X	(117, 15.5	, ,, , 0.00.	13 X (11 A 1	.5.5)						
Annual average ho		age in litres	ner day Vo	l average -	(25 v N) ±	36				103.4	6 (43	4	
Annual average ho		_		-			to achieve	o a water us	e target of				
per person per day		_		by 570 ij tin	caweiling	is acsigned	to demeve	. a water as	c target of	not more tr	iuii 125 iit	763	
, , , , , , , , , , , , , , , , , , ,	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in					•								
(44)m	113.80	109.67	105.53	101.39	97.25	93.11	93.11	97.25	101.39	105.53	109.67	113.80	
_										∑(44)1	.12 =	1241.50	(44)
Energy content of h	not water	used - calcu	lated mon	thly = 4.190	) x Vd,m x i	nm x Tm/36	00 kWh	/month (see	Tables 1b,	1c 1d)			_
(45)m	169.17	147.96	152.68	133.11	127.72	110.21	102.13	117.20	118.60	138.21	150.87	163.83	
										∑(45)1	.12 =	1631.69	(45)
If instantaneous wo	ater heatir	ng at point (	of use (no h	ot water st	orage), en	ter 0 in box	es (46) to (	(61)					
For community hea	ating inclu	de distribut	ion loss wh	ether or no	t hot wate	r tank is pre	sent						
											12 010 00		

Distribution loss			1	1		1	1		1	1	ı	1	7
(46)m	25.38	22.19	22.90	19.97	19.16	16.53	15.32	17.58	17.79	20.73	22.63	24.58	(46)
Water storage los	ss:									,			
a) If manufacture	r's declared	loss factor	is known (l	(Wh/day):					1.85	(47)			
Temperature	factor from	Table 2b							0.54	(48)			
Energy lost fro	om water sto	orage, kW	h/day (47)	x (48)					1.00	(49)			
Enter (49) or (54)	in (55)								1.00	(55)			
Water storage los	ss calculated	d for each n	nonth = (55	) x (41)m									
(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)
If cylinder contain	ns dedicated	l solar stora	nge, = (56)n	n x [(50) - (H	H11)] ÷ (50)	), else = (56	)m where (	H11) is from	n Appendi	ĸН			
(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)
Primary circuit lo	ss (annual) f	rom Table	3						360.00	(58)			
Primary circuit lo	ss for each r	month (58)	÷ 365 × (41	)m									
(modified by fact	or from Tab	le H5 if the	re is solar v	vater heatir	ng and a cy	linder therr	nostat)						
(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 for ea	ch month fr	om Table 3	a, 3b or 3c	(enter '0' if	not a com	bi boiler)							
(61)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat require	ed for water	heating ca	lculated fo	r each mon	th 0.85 × (4	15)m + (46)	m + (57)m -	+ (59)m + (6	51)m				
(62)m	230.72	203.55	214.22	192.67	189.27	169.77	163.67	178.74	178.15	199.76	210.43	225.38	(62)
Solar DHW input	calculated u	ising Appen	dix H (nega	ative quant	ity) ('0' ent	ered if no s	olar contrib	oution to w	ater heatin	g)			
(63)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
										∑(63)1	.12 =	0.00	(63)
Output from wat	er heater fo	r each mon	th, kWh/m	onth (62)m	n + (63)m								
(64)m	230.72	203.55	214.22	192.67	189.27	169.77	163.67	178.74	178.15	199.76	210.43	225.38	
										∑(64)1	.12 = 2	356.33	(64)
if (64)m < 0 then	set to 0												
Heat gains from v	vater heatin	ıg, kWh/mo	onth 0.25 ×	[0.85 × (45	5)m + (61)m	n] + 0.8 × [(4	46)m + (57)	m + (59)m]					
(65)m	105.49	93.67	100.00	91.91	91.70	84.29	83.19	88.20	87.08	95.19	97.81	103.71	(65)
include (57	m in calcul	ation of (65	m only if o	cylinder is in	n the dwelli	ing or hot w	vater is fron	n communi	ty heating				_

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
NA stale all a series	-		IVIAI	Дрі	iviay	Juli	Jui	Aug	Зер	Oct	1404	Dec	
Metabolic gains	`									1			٦
(66)m	174.97	174.97	174.97	174.97	174.97	174.97	174.97	174.97	174.97	174.97	174.97	174.97	J (66)
Lighting gains (ca	alculated in A	Appendix L,	equation L	9 or L9a), a	lso see Tab	le 5							
(67)m	68.83	61.14	49.72	37.64	28.14	23.75	25.67	33.36	44.78	56.86	66.36	70.75	(67)
Appliances gains	(calculated i	n Appendix	L, equatio	n L13 or L1	3a), also se	e Table 5							
(68)m	460.96	465.74	453.69	428.03	395.64	365.19	344.85	340.07	352.12	377.78	410.18	440.62	(68)
Cooking gains (c	alculated in A	Appendix L,	equation L	15 or L15a)	, also see T	able 5							
(69)m	55.41	55.41	55.41	55.41	55.41	55.41	55.41	55.41	55.41	55.41	55.41	55.41	(69)
Pumps and fans	gains (Table	5a)											
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evap	oration (nega	ntive values	) (Table 5)										
(71)m	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	(71)
Water heating g	ains (Table 5)	)											
(72)m	141.78	139.39	134.41	127.65	123.26	117.07	111.82	118.55	120.94	127.94	135.85	139.40	(72)
Total internal ga	ins (66)m + (	(67)m + (68	)m + (69)m	+ (70)m +	(71)m + (72	!)m							
Total litternal ga	- (/	. , .											

### 6. Solar gains

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

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month	of January	and annual	totals are	shown belo	w:								
	A	Access facto Table 6d	or	Area m²	So	lar flux W/	_	Specific da or Table 6b		Specific da or Table 60		Gains (W)	
West		0.54	] x	15.10	×	19.87	x 0.9 x	0.63	x	0.80	=	73.50	(80)
North		0.54	] x	17.26	×	10.73	x 0.9 x	0.63	x	0.80	=	45.34	(74)
South		0.54	] x	25.37	x	47.32	x 0.9 x	0.63	] x	0.80	=	294.14	(78)
Solar gains in wat	ts, calculate	ed for each	month ∑(7	4)m(82)m	l								
(83)m	412.97	708.24	954.27	1222.36	1403.95	1461.49	1416.93	1268.48	1067.37	808.50	495.74	352.59	(83)
Total gains - inter	nal and sola	ar (73)m + (	83)m										
(84)m	1208.28	1498.24	1715.83	1939.41	2074.72	2091.25	2023.00	1884.20	1708.96	1494.83	1231.87	1127.09	(84)
7.00.00.00.00.00		one the extra											
7. Mean interna			-										1
Temperature duri	_		_									21.00	(85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor f				1	0.67	0.53	0.20	0.44	0.62	0.00	0.04	0.04	7 (06)
(86)m	0.94	0.90	0.85	0.78	0.67	0.53	0.38	0.41	0.62	0.80	0.91	0.94	(86)
Mean internal ten	·				20.27	20.74	20.01	20.00	20.61	10.01	10.00	10.27	7 (07)
(87)m	18.22	18.62	19.19	19.77	20.37	20.74	20.91	20.90	20.61	19.91	18.88	18.27	(87)
Temperature duri				1			10.70	10.70	10.60	10.69	10.66	10.65	7 (00)
(88)m	19.64	19.65	19.65	19.68	19.70	19.70	19.70	19.70	19.69	19.68	19.66	19.65	(88)
Utilisation factor f				1		0.45	0.27	0.20	0.54	0.70	0.00	0.02	7 (00)
(89)m	0.93	0.89	0.83	0.75	0.61	0.45	0.27	0.29	0.54	0.76	0.90	0.93	(89)
Mean internal ten				1				10.65	10.25	10.45	17.01	16.13	7 (00)
(90)m	16.04	16.62	17.42	18.23	19.04	19.49	19.66	19.65	19.35	18.45		16.12	] (90)
Living area fractio  Mean internal ten		or the whol	le dwelling	fLA x T1 +(:	L - fLA) x T2			fLA	45.00	÷ (4) =	=	0.32	<u>  (91)</u>
(92)m	16.75	17.27	17.99	18.73	19.47	19.89	20.06	20.06	19.76	18.92	17.61	16.82	(92)
Apply adjustment		1				e appropri							_ , ,
(93)m	16.60	17.12	17.84	18.58	19.32	19.74	19.91	19.91	19.61	18.77	17.46	16.67	(93)
. ,		<u>'</u>						'		1	1	<u> </u>	
8. Space heating	requireme	ent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mear	n internal te	emperature	obtained a	at step 11 o	f Table 9b,	so that tim	= (93)m an	nd recalcula	te the utili	sation facto	or for gains	using Table	e 9a)
Utilisation factor						1	1	1	ı		1		7
(94)m	0.89	0.85	0.79	0.71	0.59	0.45	0.29	0.31	0.53	0.73	0.86	0.90	(94)
Useful gains, ηmG		, , ,					l	T _2		T	I	T	٦,
(95)m	1079.03	1272.60	1357.87	1386.59	1233.83	936.56	593.31	587.52	912.68	1091.54	1058.19	1013.71	(95)
Monthly average			1			T	ı	1	ı		1		٦.
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for						1	ı	1	T		1		٦.
(97)m	2654.28	2627.24	2393.75	2090.70	1585.84	1066.26	624.88	623.27	1109.49	1687.88	2241.30	2551.41	(97)
Space heating req								1	T		1		7
(98)m	1171.99	910.31	770.70	506.96	261.90	0.00	0.00	0.00	0.00	443.67	851.84	1144.05	
							Total per y	/ear (kWh/y	/ear) = ∑(9	8)15, 10	.12 = 6	6061.43	(98)

### 9a. Energy Requirements - Individual heating systems including micro-CHP

### Space heating:

Fraction of space heating from secondary/supplementary system (Table 11)

Fraction of space heating from main system(s) 1 - (201)

Space heating requirement in kWh/m²/year

(201) 0.00 1.00 (202)

43.45

(98) ÷ (4)

	n heating from	main syste	am 2						0.00	(203)			
Fraction of total	I space heat from			02) v [1 <sub>-</sub> /2	U3/J				1.00	(204)			
	•				03)]					1			
Fraction of total				02) X (203)					0.00	(205)			
Efficiency of mai	•	• .			. */	at ala accession	+h = l=====		93.00	(206)	Table 4a)		
(from database	Jan	o, aajustea <b>Feb</b>	wnere app <b>Mar</b>	Apr	May	ut snown in Jun	tne space Jul	Aug	Sep	Oct	Nov	Dec	
Space heating re				•	•	Juli	Jui	Aug	Зер	Oct	NOV	Dec	
(98)m	1171.99	910.31	770.70	506.96	261.90	0.00	0.00	0.00	0.00	443.67	851.84	1144.05	7
Space heating fu								0.00				1	_
(211)m	1260.21	978.83	828.71	545.12	281.61	0.00	0.00	0.00	0.00	477.07	915.96	1230.16	7
(===,										1)15, 10		6517.66	(211)
Water heating:							otal pel ye	ar (KVVII) ye	.ur) – <u>Z</u> (21	1,15, 10		0317.00	] (211)
Output from wa	torboator k\A	uh/manth	/calculates	l abovo)									
(64)m	230.72	203.55	214.22	192.67	189.27	169.77	163.67	178.74	178.15	199.76	210.43	225.38	7
(04)111	230.72	203.33	214.22	192.07	189.27	109.77	103.07	176.74	178.13	Σ(64)1		2356.33	」 ີ (64)
F4f; =: = = = = = f= f										2(04)1	12	2330.33	] (04)
Efficiency of wat (217)m	88.05	87.83	87.43	86.78	85.18	79.30	79.30	79.30	79.30	86.38	87.66	88.04	٦
Fuel for water h	L				65.16	79.30	79.30	79.30	79.30	80.38	87.00	88.04	J
(219)m	262.04	231.74	245.01	222.03	222.20	214.09	206.40	225.40	224.66	231.25	240.06	255.98	7
(215)111	202.04	231.74	243.01	222.03	222.20	214.03				= Σ(219)1		2780.86	」 ີ (210)
							TOtal	i pei yeai (r	(vvii) year)	- 2(219)1	12	2780.80	(219)
A										مرا طافات	a lei	Mh/waa	
Annual Totals S	-									kWh/ye	_	Wh/year	7 (244)
Space heating for		n system 1										6517.66	<u>  (211)</u>
Water heating f												2780.86	(219)
Electricity for pu	• •		• •	-									
	entilation fan		d, extract o	or positive i	nput from o	outside				119.47	7		(230a)
	ating system fa	ans								0.00			(230b)
central heati	•									130.00	)		(230c) (230d)
oil boiler pun	пр									0.00			(230u)
hailar tlua ta	n									45.00			
boiler flue fa		not facility	for gas con	nbi boiler						45.00			(230e)
maintaining o	electric keep-h	•	for gas con	nbi boiler						0.00			(230e) (230f)
maintaining of pump for sol	electric keep-h ar water heati	•	for gas con	nbi boiler						0.00		294.47	(230e) (230f) (230g)
maintaining o	electric keep-h ar water heati	•	for gas con	nbi boiler					:	0.00		294.47	(230e) (230f)
maintaining of pump for sol	electric keep-l ar water heati for the above	ing		nbi boiler					:	0.00	30g)	294.47 486.25	(230e) (230f) (230g)
maintaining of pump for sol	electric keep-har water heati for the above	ing ated in App	endix L):		d Q):					0.00	30g)		(230e) (230f) (230g) (231)
maintaining of pump for sol Total electricity	electric keep-har water heating for the above ghting (calcular generation tec	ing nted in App hnologies	endix L): (Appendico	es M, N and	1 Q):				:	0.00	30g)		(230e) (230f) (230g) (231)
maintaining of pump for sol.  Total electricity  Electricity for lig Energy saving/g	electric keep-har water heating for the above ghting (calculageneration tectated by PVs (A	ing Ited in App Innologies Appendix N	pendix L): (Appendica И) (negative	<b>es M, N and</b> e quantity)						0.00	30g)	486.25	(230e) (230f) (230g) (231) (232)
maintaining of pump for sol.  Total electricity  Electricity for light Energy saving/g  Electricity gener	electric keep-har water heating for the above ghting (calculageneration tectated by PVs (A	ing Ited in App Innologies Appendix N	pendix L): (Appendica И) (negative	<b>es M, N and</b> e quantity)	СНР	kWh/year			el price	0.00	30g)	486.25	(230e) (230f) (230g) (231) (232) (233)
maintaining of pump for sol.  Total electricity  Electricity for light Energy saving/g  Electricity generation. Fuel costs	electric keep-har water heati for the above ghting (calcula generation tec rated by PVs (A	ing  Inted in App  Inhnologies  Appendix N  Ineating systems	pendix L): (Appendica И) (negative	<b>es M, N and</b> e quantity)	CHP Fuel				el price able 12)	0.00 0.00 Σ(230a)(2	30g)	486.25 1301.33 cost £/yea	(230e) (230f) (230g) (231) (232) (233)
maintaining of pump for sol.  Total electricity  Electricity for lighter saving/g  Electricity generation. Fuel costs  Space heating - 1	electric keep-har water heating for the above ghting (calcular generation tect rated by PVs (Assert Individual harmain system 1	ing  Appendix N  eating sys	pendix L): (Appendica И) (negative	<b>es M, N and</b> e quantity)	CHP Fuel 6:	517.66	x		sel price able 12)	0.00 0.00 ∑(230a)(2	30g)	486.25  1301.33  cost £/yea  202.05	(230e) (230f) (230g) (231) (232) (233)
maintaining of pump for soll Total electricity  Electricity for light Energy saving/g  Electricity generation and the same saving of the saving of th	electric keep-har water heatifor the above  ghting (calcular generation tectrated by PVs (Arrandom Individual harmain system 1 cost (other fuel	ing  Appendix N  eating system  (1)	pendix L): (Appendica И) (negative	<b>es M, N and</b> e quantity)	CHP Fuel  6:	517.66 780.86	x x	(Та	atel price able 12) 3.10 3.10	0.00 0.00 Σ(230a)(2 x 0.01 = 200 =	Fuel	486.25  1301.33  cost £/yea  202.05  86.21	(230e) (230f) (230g) (231) (232) (233) (240) (240) (247)
maintaining of pump for sol.  Total electricity  Electricity for light Energy saving/g  Electricity generation. Fuel costs  Space heating - Water heating of Pumps, fans and	electric keep-har water heati for the above ghting (calcular generation tector rated by PVs (A s - Individual har main system 1 cost (other fuel d electric keep	ing  Appendix N  eating system  (1)	pendix L): (Appendica И) (negative	<b>es M, N and</b> e quantity)	CHP Fuel 6.2 2.2	517.66 780.86		(T:	3.10 3.10 11.46	0.00 0.00 Σ(230a)(2 x 0.01 = 1 x 0.01 = 1	Fuel =	486.25  1301.33  cost £/yea  202.05  86.21  33.75	(230e) (230f) (230g) (231) (232) (233) (240) (247) (249)
maintaining of pump for soll Total electricity  Electricity for light Energy saving/g  Electricity generation of the pumps of the pump of the	electric keep-har water heatifor the above ghting (calcular generation tectrated by PVs (Arrandom Individual harmain system 1) cost (other fueld electric keeping	ing  hted in App hnologies Appendix N eating syst	pendix L): (Appendica И) (negative	es <b>M, N and</b> e quantity)	CHP Fuel 6.2 2.2	517.66 780.86	x	(T:	atel price able 12) 3.10 3.10	0.00 0.00 Σ(230a)(2 x 0.01 = 200 =	Fuel = =	486.25  1301.33  cost £/yea  202.05  86.21  33.75  55.72	(230e) (230f) (230g) (231) (232) (233) (240) (247) (249) (250)
maintaining of pump for sol.  Total electricity  Electricity for light Energy saving/g  Electricity generation. Fuel costs  Space heating - Water heating of Pumps, fans and	electric keep-har water heatifor the above ghting (calcular generation tectrated by PVs (Arrandom Individual harmain system 1) cost (other fueld electric keeping	ing  hted in App hnologies Appendix N eating syst	pendix L): (Appendica И) (negative	es <b>M, N and</b> e quantity)	CHP Fuel 6.2 2.2	517.66 780.86	x x	(T:	3.10 3.10 11.46	0.00 0.00 Σ(230a)(2 x 0.01 = 1 x 0.01 = 1	Fuel = =	486.25  1301.33  cost £/yea  202.05  86.21  33.75	(230e) (230f) (230g) (231) (232) (233) (240) (247) (249)
maintaining of pump for soll Total electricity  Electricity for light Energy saving/g  Electricity generation of the pumps of the pump of the	electric keep-har water heating for the above ghting (calcular generation tector ated by PVs (Assert Individual harmain system 1 toost (other fuer delectric keeping	ing  Inted in App Inted in App Inted in App Intel in App	endix L): (Appendica (I) (negative	es M, N and e quantity) ding micro-	CHP  Fuel  60  22  4	517.66 780.86	x x	(T:	3.10 3.10 11.46	0.00 0.00 Σ(230a)(2 x 0.01 = 1 x 0.01 = 1	Fuel = =	486.25  1301.33  cost £/yea  202.05  86.21  33.75  55.72	(230e) (230f) (230g) (231) (232) (233) (240) (247) (249) (250)
maintaining of pump for sol.  Total electricity  Electricity for lighter saving/g  Electricity gener  10a. Fuel costs  Space heating - water heating compumps, fans and Energy for lighting Additional standard Energy saving/g	electric keep-har water heating for the above ghting (calcular generation tector ated by PVs (Assert Individual harmain system 1 toost (other fuer delectric keeping	ing  Appendix N  eating system  -hot  Table 12)  chnologies	endix L): (Appendica (I) (negative	es M, N and e quantity) ding micro-	6: 2 2 4	517.66 780.86	x x	(T:	3.10 3.10 11.46	0.00 0.00 Σ(230a)(2 x 0.01 = 1 x 0.01 = 1	Fuel = =	486.25  1301.33  cost £/yea  202.05  86.21  33.75  55.72	(230e) (230f) (230g) (231) (232) (233) (240) (247) (249) (250)
maintaining of pump for sol.  Total electricity  Electricity for lighter saving/g  Electricity gener  10a. Fuel costs  Space heating - water heating compumps, fans and Energy for lighting Additional standard Energy saving/g	electric keep-har water heatifor the above  ghting (calcular generation tector ated by PVs (A  - Individual har main system 1 cost (other fuel d electric keep ng ding charges (T  generation tector negative quant	ing  Appendix N  eating system  -hot  Table 12)  chnologies	endix L): (Appendica (I) (negative	es M, N and e quantity) ding micro-	6: 2 2 4	517.66 780.86 294.47 186.25	x x x	(T:	atel price able 12) 3.10 3.10 11.46 11.46	0.00 0.00 Σ(230a)(2 x 0.01 = 1 x 0.01 = 1 x 0.01 = 1	Fuel = = = = = = = = = = = = = = = = = = =	486.25  1301.33  cost f/yea  202.05  86.21  33.75  55.72  106.00	(230e) (230f) (230g) (231) (232) (233) (233) (240) (247) (249) (250) (251)
maintaining of pump for sol.  Total electricity  Electricity for lighter saving/g  Electricity gener.  10a. Fuel costs  Space heating of Pumps, fans and Energy for lighting Additional stand.  Energy saving/g  PV savings (no Total energy costs)	electric keep-har water heatifor the above  ghting (calcular generation tectrated by PVs (Armonius of the seep of	ing  Inted in App Inted in App Inted in App Inted in App Inter in App	endix L): (Appendication) (negative	es M, N and e quantity) ding micro-	CHP  Fuel    6: 2: 4  d Q): -1	517.66 780.86 294.47 186.25	x x x	(T:	atel price able 12) 3.10 3.10 11.46 11.46	0.00 0.00 Σ(230a)(2 x 0.01 = x 0	Fuel = = = = = = = = = = = = = = = = = = =	486.25  1301.33  cost £/yea  202.05  86.21  33.75  55.72  106.00	(230e) (230f) (230g) (231) (232) (233) (233) (240) (247) (249) (250) (251)
maintaining of pump for sol.  Total electricity:  Electricity for light in the pump for sol.  Energy saving/g  Electricity gener.  10a. Fuel costs  Space heating of Pumps, fans and Energy for lightin Additional stand.  Energy saving/g  PV savings (no.)	electric keep-har water heatifor the above  ghting (calcular generation tectrated by PVs (Armonius of the seep of	ing  Inted in App Inted in App Inted in App Inted in App Inter in App	endix L): (Appendication) (negative	es M, N and e quantity) ding micro-	CHP  Fuel    6: 2: 4  d Q): -1	517.66 780.86 294.47 186.25	x x x	(T:	atel price able 12) 3.10 3.10 11.46 11.46	0.00 0.00 Σ(230a)(2 x 0.01 = x 0	Fuel = = = = = = = = = = = = = = = = = = =	486.25  1301.33  cost £/yea  202.05  86.21  33.75  55.72  106.00	(230e) (230f) (230g) (231) (232) (233) (233) (240) (247) (249) (250) (251)

				_
Energy cost deflator (Table 12)			0.47	(256)
Energy cost factor (ECF)		$[(255) \times (256)] \div [(4) + 45.0] = [$	0.85	(257)
SAP value			88.11	]
SAP rating			88	(258)
SAP band			В	]
12a. Carbon dioxide emissions - Individual heating systems including	g micro-CHP			
	Energy	Emissions	Emissions	

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	6517.66	х	0.198	=	1290.50	(261)
Water heating	2780.86	х	0.198	=	550.61	(264)
Space and water heating			(261) + (262)	+ (263) + (264) =	1841.11	(265)
Pumps, fans and electric keep-hot	294.47	x	0.517	=	152.24	(267)
Lighting	486.25	x	0.517	=	251.39	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-1301.33	x	0.529	=	-688.41	(269)
Total carbon dioxide emissions				∑(261)(271) =	1556.34	(272)
Dwelling carbon dioxide emissions rate				(272) ÷ (4) =	11.16	(273)
El value					88.70	
El rating (see section 14)					89	(274)
EI band					В	

13a. Primary energy - Individual heating systems including	g micro-CHP					
	Energy kWh/year		Primary Energy Factor		Primary Energy	/
Space heating - main system 1	6517.66	x	1.02	=	6648.02	(261*)
Water heating	2780.86	x	1.02	=	2836.47	(264*)
Space and water heating			(261*) + (262*) + (26	53*) + (264*) =	9484.49	(265*)
Pumps, fans and electric keep-hot	294.47	х	2.92	=	859.86	(267*)
Lighting	486.25	х	2.92	=	1419.85	(268*)
Energy saving/generation technologies:						
PV primary energy savings (negative quantity)	-1301.33	х	2.92	=	-3799.90	(269*)
Total primary energy kWh/year			∑(2	61*)(271*) =	7964.31	(272*)
Primary energy kWh/m2/year				(272*) ÷ (4) =	57.09	(273*)

# Code for Sustainable Homes for Multiple Dwellings



Energy averaging for the Code for Sustainable Homes Ene 1 and Ene 2 is permitted where a building contains multiple dwellings. For Ene 1 the area weighted average DER and TER must be calculated in accordance with the block averaging methodology defined in clauses 4.6 and 4.14 of the ADL1A. For apartment blocks it is acceptable to assess Ene 2 based on area weighted average FEE. The area weighted FEE must be calculated in accordance with the methodology defined in clause 4.6 of ADL1A. The use of energy averaging to assess performance against Ene 2 is at the discretion of the developer and Assessor.

Assessor name Mr Stuart Searle Assessor number 2435

Created 01/02/2013

Energy Averaging									
URN	Vrs	Address	Built Form	DER	TER	FEE	Floor Area (m²)	DER x Floor Area	TER x Floor Area
13-010-09 Planning	1	P09 4 St Augustines	Flat	11.93	17.69	60.8	139.50	1664.24	2467.76
13-010-08 Planning	1	P08 4 St Augustines	Flat	10.55	15.26	41.3	95.50	1007.53	1457.33
13-010-07 Planning	1	P07 4 St Augustines	Flat	9.95	15.66	42.0	106.50	1059.68	1667.79
13-010-06 Planning	1	P06 4 St Augustines	Flat	10.53	15.03	41.7	95.50	1005.61	1435.37
13-010-05 Planning	1	P05 4 St Augustines	Flat	9.58	15.02	40.4	106.50	1020.27	1599.63
13-010-04 Planning	1	P04 4 St Augustines	Flat	12.12	15.73	45.6	80.00	969.60	1258.40
13-010-03 Planning	1	P03 4 St Augustines	Flat	9.57	14.98	40.8	107.00	1023.99	1602.86
13-010-02 Planning	1	P02 4 St Augustines	Flat	13.69	18.82	53.8	80.00	1095.20	1505.60
13-010-01 Planning	1	P01 4 St Augustines	Flat	10.82	17.77	48.1	109.50	1184.79	1945.82
						Total	920.00	10030.91	14940.56

Multiple dwelling DER = 10.90

Multiple dwelling TER = 16.24

Multiple dwelling FEE = 46.5

#### Ene 1 Results

Ene 1 using energy averaging = 32.9 % improvement\*

3.7 credits

\*100 x (1 - (DER/TER))

#### Ene 2 Results

#### Mid terrace and apartment blocks

Number of dwellings of this type = 9

FEE using energy averaging = 46.5

credits = 3.5

#### End terrace, semi-detached and detached

Number of dwellings of this type = 0

Ene 2 credits using energy averaging for all dwelling types = 3.5

(Flats-MidTerrace-TFA x Flats-MidTerrace-Credits) + (Detached-Semi-TFA x Detached-Semi-Credits) / (TFA-All-Dwellings)

(920 x 3.5) + (0 x 0) / (920)