D.O.Environmental Consulting David Oldham 01706 226519 david @doec.co.uk

### **Regulations Compliance Report**



**OK** 

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.1.1 *Printed on 22 September 2014 at 09:38:39* 

Project Information:

Assessed By: David Oldham (STRO007778) Building Type: End-terrace House

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 74.46m<sup>2</sup>

Site Reference: Macs Cafe Site

Plot Reference: Plot 1

Address: Plot 1, Macs Cafe Site

Client Details:

Name: Address :

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 18.19 kg/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 18.16 kg/m<sup>2</sup> OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 48.90 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 44.90 kWh/m²

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.41 (max. 2.00)	1.50 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals 4.00 (design value)

Maximum 10.0 **OK** 

4 Heating efficiency

Main Heating system: Database: (rev 360, product index 015425):

Boiler systems with radiators or underfloor heating - mains gas

Brand name: Vaillant Model: ecoTEC plus 837

Model qualifier:

(Combi)

Efficiency 88.8 % SEDBUK2009

Minimum 88.0 %

Secondary heating system: None

OK

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## **Regulations Compliance Report**



5 Cylinder insulation			
Hot water Storage:	No cylinder		
6 Controls			
Space heating controls	Programmer, room thern	nostat and TRVs	OK
Hot water controls:	No cylinder		
Boiler interlock:	Yes		OK
7 Low energy lights			
Percentage of fixed lights wi	th low-energy fittings	100.0%	
Minimum		75.0%	OK
8 Mechanical ventilation			
Not applicable			
9 Summertime temperature			
Overheating risk (South Eas	t England):	Not assessed	?
10 Key features			
Thermal bridging		0 W/m²K	
Floors U-value		0.12 W/m <sup>2</sup> K	

### **Predicted Energy Assessment**

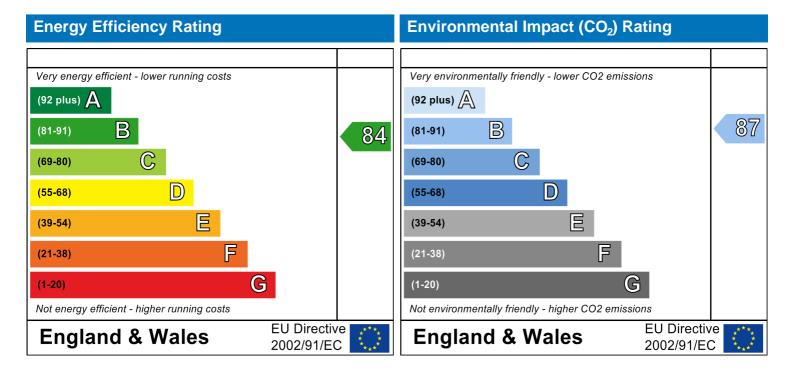


Plot 1 Macs Cafe Site Dwelling type:
Date of assessment:
Produced by:
Total floor area:

End-terrace House 16 September 2014 David Oldham 74.46 m<sup>2</sup>

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

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



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

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

### **SAP Input**



### Property Details: Plot 1

Address: Plot 1, Macs Cafe Site

Located in: England

Region: South East England

**UPRN**:

Date of assessment:

Date of certificate:

Assessment type:

16 September 2014

22 September 2014

New dwelling design stage

Transaction type: Marketed sale
Tenure type: Owner-occupied
Related party disclosure: No related party
Thermal Mass Parameter: Indicative Value Medium

Water use <= 125 litres/person/day: False

PCDF Version: 360

### Property description:

Dwelling type: House
Detachment: End-terrace
Year Completed: 2014

Floor Location: Floor area: Storey height:

Floor 0  $37.23 \text{ m}^2$  2.4 m Floor 1  $37.23 \text{ m}^2$  2.6 m

Living area: 18.74 m<sup>2</sup> (fraction 0.252)

Front of dwelling faces: North West

#### Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Front Door	Manufacturer	Half glazed	low-E, $En = 0.05$ , soft coat	No	Wood
Front Windows	Manufacturer	Windows	low-E, $En = 0.05$ , soft coat	No	Wood
Rear Windows	Manufacturer	Windows	low-E, $En = 0.05$ , soft coat	No	Wood

Name:	Gap:	Frame Fa	actor: g-value:	U-value:	Area:	No. of Openings:
Front Door	16mm or more mm	0.7	0.63	1.5	1.75	1
Front Windows	16mm or more	0.7	0.63	1.4	3.72	1
Rear Windows	16mm or more	0.7	0.63	1.4	7.53	1

Width: Orient: Height: Name: Type-Name: Location: North West Front Door **Exposed Wall** 0 Front Windows **Exposed Wall** North West 0 0 Rear Windows **Exposed Wall** North West 0 0

Overshading: Average or unknown

### Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Element	<u>ts</u>						
Exposed Wall	86.6	13	73.6	0.24	0	False	N/A
Roof	37.23	0	37.23	0.13	0		N/A
Ground Floor	37.23			0.12			N/A
Internal Element	<u>s</u>						

### Thermal bridges

Party Elements

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0005

Length Psi-value

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### **SAP Input**



Ventilation:

Pressure test: Yes (As designed)

Ventilation: Natural ventilation (extract fans)

Number of chimneys:0Number of open flues:0Number of fans:3Number of passive stacks:0Number of sides sheltered:1Pressure test:4

Main heating system

Main heating system: Boiler systems with radiators or underfloor heating

Gas boilers and oil boilers

Fuel: mains gas

Info Source: Boiler Database

Database: (rev 360, product index 015425) Efficiency: Winter 79.6 % Summer: 89.7

Brand name: Vaillant Model: ecoTEC plus 837 Model qualifier: (Combi boiler) Systems with radiators

Central heating pump: 2013 or later Design flow temperature: Unknown

Boiler interlock: Yes

Main heating Control:

Main heating Control: Programmer, room thermostat and TRVs

Control code: 2106

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating: From main heating system

Water code: 901 Fuel :mains gas No hot water cylinder

Flue Gas Heat Recovery System:

Database (rev 360, product index 060010)

Brand name: Zenex Model: SuperFlow SMadelamealifierseSF-50

Others:

Electricity tariff: Standard Tariff
In Smoke Control Area: Unknown
Conservatory: No conservatory

Low energy lights: 100%
Terrain type: Dense urban
EPC language: English
Wind turbine: No
Photovoltaics: None
Assess Zero Carbon Home: No



David Oldham **Assessor Name:** Stroma Number: STRO007778

Assessor Name:	David Oldnam	Stroma N	J007778			
Software Name:	Stroma FSAP 2012	Software		Versic	n: 1.0.1.1	
	Pro	operty Address: Plo	ot 1			
Address :	Plot 1, Macs Cafe Site					
1. Overall dwelling dime	ensions:					
		Area(m²)	Av. Heigl	<u> </u>	Volume(m <sup>3</sup>	<u> </u>
Ground floor		37.23 (1a)	X 2.4	(2a) =	89.35	(3a)
First floor		37.23 (1b)	x 2.6	(2b) =	96.8	(3b)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+(1n)	74.46 (4)				
Dwelling volume		(3a	)+(3b)+(3c)+(3d)+(	(3e)+(3n) =	186.15	(5)
2. Ventilation rate:						
	main secondary heating heating	other	total		m³ per hou	ır
Number of chimneys	0 + 0	+ 0	= 0	x 40 =	0	(6a)
Number of open flues	0 + 0	+ 0	= 0	x 20 =	0	(6b)
Number of intermittent fa	ins		3	x 10 =	30	(7a)
Number of passive vents	3		0	x 10 =	0	(7b)
Number of flueless gas f	ires		0	x 40 =	0	(7c)
				Air ch	anges per ho	our
	ys, flues and fans = $(6a)+(6b)+(7a)$		30	÷ (5) =	0.16	(8)
	peen carried out or is intended, proceed	to (17), otherwise conti	nue from (9) to (16	5)		<b>—</b>
Number of storeys in the Additional infiltration	ne aweiling (ns)			[(0) 4]0 4	0	(9)
	OF for ataal or timber frame or (	) 25 for magazing	anatruation	$[(9)-1]\times 0.1 =$	0	(10)
	0.25 for steel or timber frame or ( resent, use the value corresponding to the	•			0	(11)
deducting areas of openi		ne greater wan area (ar	iei			
If suspended wooden	floor, enter 0.2 (unsealed) or 0.1	(sealed), else ente	er O		0	(12)
If no draught lobby, en	ter 0.05, else enter 0				0	(13)
Percentage of window	s and doors draught stripped				0	(14)
Window infiltration		0.25 - [0.2 x (1	4) ÷ 100] =		0	(15)
Infiltration rate		(8) + (10) + (11	1) + (12) + (13) + (13)	15) =	0	(16)
Air permeability value,	q50, expressed in cubic metres	per hour per squa	re metre of env	elope area	4	(17)
If based on air permeabi	lity value, then $(18) = [(17) \div 20] + (8)$	, otherwise (18) = (16)			0.36	(18)
Air permeability value applie	es if a pressurisation test has been done	or a degree air permea	ability is being used	d		_
Number of sides sheltered	ed				1	(19)
Shelter factor		(20) = 1 - [0.07]			0.92	(20)
Infiltration rate incorpora	ting shelter factor	$(21) = (18) \times (2)$	?O) =		0.33	(21)

minutation rate interperating entered rates	
Infiltration rate modified for monthly wind speed	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthl	Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	



david @doec.co.uk Wind Factor  $(22a)m = (22)m \div 4$ 1.27 0.95 (22a)m: 1.25 1.23 1.08 0.95 0.92 1.08 1.12 1.18 Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m 0.42 0.41 0.37 0.36 0.32 0.32 0.33 0.36 0.38 0.39 Calculate effective air change rate for the applicable case If mechanical ventilation: (23a) 0 If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0 (23b) If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 − (23c) ÷ 100] (24a)m: 0 0 (24a)b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b) (24b)m 0 0 0 (24b)c) If whole house extract ventilation or positive input ventilation from outside if  $(22b)m < 0.5 \times (23b)$ , then (24c) = (23b); otherwise  $(24c) = (22b)m + 0.5 \times (23b)$ (24c)(24c)m =0 0 0 0 0 0 0 0 d) If natural ventilation or whole house positive input ventilation from loft if (22b)m = 1, then (24d)m = (22b)m otherwise  $(24d)m = 0.5 + [(22b)m^2 \times 0.5]$ (24d)m =0.59 0.59 0.58 0.56 0.55 0.56 0.57 0.58 (24d)0.55 0.55 0.56 Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25) 0.58 0.57 0.56 0.55 (25)(25)m =0.56 0.58 3. Heat losses and heat loss parameter: **ELEMENT** Gross Openings Net Area **U-value** AXUk-value AXkkJ/m<sup>2</sup>·K kJ/K area (m²) m<sup>2</sup> A,m<sup>2</sup> W/m2K (W/K) Doors (26)1.5 2.625 1.75 Windows Type 1  $\chi 1/[1/(1.4) + 0.04] =$ 3.72 4.93 (27)Windows Type 2  $\chi 1/[1/(1.4) + 0.04]$ (27)7.53 9.98 Floor 37.23 0.12 4.4676 (28)Walls 86.6 13 0.24 17.66 (29)73.6 Roof (30)37.23 0 37.23 0.13 4.84 Total area of elements, m<sup>2</sup> 161.06 (31)\* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2 \*\* include the areas on both sides of internal walls and partitions (26)...(30) + (32) =Fabric heat loss,  $W/K = S(A \times U)$ (33)44.51 Heat capacity  $Cm = S(A \times k)$ ((28)...(30) + (32) + (32a)...(32e) =(34)6231.67 Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium (35)250 For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation. Thermal bridges: S (L x Y) calculated using Appendix K 0.08 (36)if details of thermal bridging are not known (36) =  $0.15 \times (31)$ Total fabric heat loss (33) + (36) =(37)44.59 Ventilation heat loss calculated monthly (38)m =  $0.33 \times (25)$ m x (5)Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (38)(38)m =36.29 36.07 35.86 34.86 34.68 33.81 33.81 33.65 34.14 34.68 35.05 35.45

80.04

(39)m = (37) + (38)m

79.27

78.73

79.45

79.27

78.4

78.4

78.24

80.45

Heat transfer coefficient, W/K

80.66

80.88

(39)m =



davia	3000.0	o.an												
11(1			II D\ \A/	/ 21 <i>/</i>					(40)	(00)	(1)			
	oss para	•	<del></del>	1	ı	ı	ı	ī	· ` ′	= (39)m ÷	r i		l	
(40)m=	1.09	1.08	1.08	1.07	1.06	1.05	1.05	1.05	1.06	1.06	1.07	1.07		
Numb	or of dov	o in mo	oth /Toh	lo 10)					,	Average =	Sum(40) <sub>1</sub> .	12 /12=	1.07	(40)
Numbe	er of day		· ` `	<u> </u>			<del></del>				<del></del>	_	l	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Wa	ater heat	ing enei	rgy requ	irement:								kWh/ye	ear:	
if TF	ned occu FA > 13.9 FA £ 13.9	0, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9	)2)] + 0.0	0013 x ( <sup>-</sup>	TFA -13.		35		(42)
								(25 x N) to achieve		se target o		.73		(43)
		_			o‰ ii irie d ∕ater use, l	_	-	io acriieve	a water us	se largel o	1			
					1		<u> </u>				Nov	Daa	]	
Hot wat	Jan er usage ir	Feb	Mar day for ea	Apr	May $Vd, m = fa$	Jun	Jul Table 1c x	Aug (43)	Sep	Oct	Nov	Dec	ĺ	
		•		1		1		· <i>′</i>		L 00.00	100.40	404.04	I	
(44)m=	104.21	100.42	96.63	92.84	89.05	85.26	85.26	89.05	92.84	96.63	100.42	104.21	4400.04	(44)
Enerav	content of	hot water	used - cal	culated mo	onthly = $4$ .	190 x Vd.r	m x nm x E	OTm / 3600			m(44) <sub>112</sub> = ables 1b, 1		1136.81	(44)
(45)m=	154.54	135.16	139.47	121.59	116.67	100.68	93.29	107.06	108.34	126.26	137.82	149.66	1	
(40)111=	104.04	100.10	155.47	121.00	110.07	100.00	33.23	107.00			m(45) <sub>112</sub> =		1490.54	(45)
If instan	taneous w	ater heatii	ng at point	of use (no	o hot water	storage),	enter 0 in	boxes (46)		Total = Su	III(43) <sub>112</sub> =		1490.54	(40)
(46)m=	23.18	20.27	20.92	18.24	17.5	15.1	13.99	16.06	16.25	18.94	20.67	22.45	1	(46)
	storage			10.2			1 .0.00	1 .0.00	1	1 .0.0 .			l	, ,
Storag	e volum	e (litres)	includir	ng any so	olar or W	/WHRS	storage	within sa	ame ves	sel	0			(47)
If com	munity h	eating a	nd no ta	ınk in dw	velling, e	nter 110	litres in	(47)					J	
	-	•			_			mbi boil	ers) ente	er '0' in (	47)			
Water	storage	loss:												
a) If m	nanufact	urer's de	eclared I	oss facto	or is kno	wn (kWł	n/day):				0.	54		(48)
Tempe	erature fa	actor fro	m Table	2b								0		(49)
Energy	lost fro	m water	storage	, kWh/ye	ear			(48) x (49)	) =			0		(50)
,				•	loss fact								 	
		_			le 2 (kW	h/litre/da	ay)					0		(51)
	munity h	-		on 4.3									I	
	e factor			2h							<b>—</b>	0		(52)
•	erature fa											0		(53)
٠.	/ lost fro		_	, kWh/ye	ear			(47) x (51)	) x (52) x (	53) =		0		(54)
	(50) or (	, ,	,								0.	59	l	(55)
Water	storage	loss cal	culated	or each	month			((56)m = (	55) × (41)ı	m 			-	
(56)m=	18.41	16.63	18.41	17.82	18.41	17.82	18.41	18.41	17.82	18.41	17.82	18.41		(56)
If cylinde	er contains	dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Append	ix H	
(57)m=	18.41	16.63	18.41	17.82	18.41	17.82	18.41	18.41	17.82	18.41	17.82	18.41		(57)
Primar	y circuit	loss (ar	nual) fro	m Table	e 3							0	ĺ	(58)
	•	•	•			59)m = (	(58) ÷ 36	65 × (41)	m				1	
	•				,	•	` '	ng and a		r thermo	stat)			
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
				Ц	L	<b>L</b>	L	L	L	L	l		i	



0			£		(04)	(00) - 0(	SE (44)	١						
	6.37	5.75	for each 6.16	montn (	5.67	(60) ÷ 36 5.26	5.43	)m 5.67	5.72	6.16	6.16	6.37	1	(61)
(61)m=						<u> </u>			ļ	ļ	<u> </u>		(50) (04)	
	179.32	157.54	water ne	145.14	140.76	123.76	117.14	(62)m 131.1		(45)m + 150.82	<del>ì ´</del>	<del>`</del>	· (59)m + (61)m 1	(62)
(62)m=											161.8	174.44	J	(02)
			USING APPO						r '0' if no sola	ir contribut	ion to wate	er neating)		
(63)m=	0	0	0	0 0	0	o applies	, see Ap	0		0	0	0	1	(63)
FHRS	24.46	20.65	19.4	14.01	9.87	6.89	6.38	7.32		14.4	19.65	24.32	J	(63) (G2)
		ater hea		14.01	9.07	0.09	0.30	7.52	. 7.41	14.4	19.03	24.32		(66) (62)
(64)m=	156.39	138.21	145.94	132.19	131.86	117.63	111.38	124.6	64 125.33	137.52	143.44	151.58	]	
(- 1)										L			1616.11	(64)
Heat o	Output from water heater (annual) 112 Logonity [64] Meat gains from water heating, kWh/month $0.25 \cdot [0.85 \times (45) \text{m} + (61) \text{m}] + 0.8 \times [(46) \text{m} + (57) \text{m} + (59) \text{m}]$													
(65)m=	67.71	59.68	62.64	56.12	54.94	49.05	47.11	51.7	<del></del>	58.25	61.62	66.09	اً	(65)
	ـــــــا اde (57)ا	m in cald	culation o	of (65)m	only if c	vlinder i	s in the o	L dwellir	ng or hot w	ıater is fı	om com	munity h	ı neating	
			Table 5	. ,	•	,								
		,	5), Wat	·	,									
Mictabl	Jan	Feb	Mar	Apr	May	Jun	Jul	Au	g Sep	Oct	Nov	Dec	1	
(66)m=	140.96	140.96	140.96	140.96	140.96	140.96	140.96	140.9	<del>-                                    </del>	140.96	140.96	140.96		(66)
Liahtin	u gains	(calcula	ted in Ar	pendix l	L. equat	ion L9 o	r L9a). a	lso se	e Table 5	!	<u> </u>	<u>I</u>	ı	
(67)m=	47.47	42.16	34.29	25.96	19.4	16.38	17.7	23.0	_	39.21	45.77	48.79	]	(67)
Applia	nces gai	ins (calc	ulated in	Append	dix L. ea	uation L	13 or L1	3а). а	lso see Ta	ble 5	<u> </u>		ı	
(68)m=	309.66	312.88	304.78	287.54	265.78	245.33	231.67	228.4		253.79	275.55	296	]	(68)
Cookir	ng gains	(calcula	ted in Ap	pendix	L, equat	ion L15	or L15a	), also	see Table	5			I	
(69)m=	51.45	51.45	51.45	51.45	51.45	51.45	51.45	51.4		51.45	51.45	51.45	1	(69)
Pumps	and far	ns gains	(Table 5	ia)					<b>!</b>		l		ı	
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	]	(70)
Losses	e.g. ev	aporatio	n (negat	ive valu	es) (Tab	le 5)			<b>!</b>				ı	
(71)m=	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.9	7 -93.97	-93.97	-93.97	-93.97	]	(71)
Water	heating	gains (T	able 5)						<b>!</b>		ı		ı	
(72)m=	91	88.82	84.2	77.94	73.85	68.12	63.32	69.5	5 71.82	78.29	85.59	88.83	1	(72)
Total i	nternal	gains =				(66)	m + (67)m	ı + (68)	m + (69)m +	(70)m + (7	1)m + (72)	m	1	
(73)m=	549.57	545.29	524.7	492.87	460.47	431.26	414.12	422.4	4 440.68	472.73	508.33	535.05	]	(73)
6. So	lar gains	S:						<u> </u>						
Solar g	ains are c	alculated	using sola	r flux from	Table 6a	and assoc	ated equa	itions to	convert to the	ne applicat	ole orientat	ion.		
Orienta		Access Fable 6d		Area m²		Flu Tal	x ole 6a		g_ Table 6b	Т	FF able 6c		Gains (W)	
Northw	_							1 🗆					. ,	7(04)
Northw	L	0.77	x	3.7		-	1.28	] x	0.63		0.7	=	12.83	(81)
Northw	<u> </u>	0.77	x	7.5			1.28	] х <u>[</u> 1 ., Г	0.63		0.7	=	25.97	(81) 
	<u> </u>	0.77	X	3.7		-	2.97	х   Г	0.63		0.7	=	26.11	(81)
INOLUM	est <sub>0.9x</sub>	0.77	X	7.5	53	x 2	2.97	X	0.63	x	0.7	=	52.85	(81)



Northwe	est <sub>0.9x</sub>	0.77		x	3.7	2	x	4	1.38	x		0.63	X	0.7		=	47.04	(81)
Northwe	est <sub>0.9x</sub>	0.77		x	7.5	3	x	4	1.38	x		0.63	x	0.7		=	95.22	(81)
Northwe	est <sub>0.9x</sub>	0.77		x	3.7	2	x	6	7.96	x	(	0.63	x	0.7		=	77.26	(81)
Northwe	est <sub>0.9x</sub>	0.77		x	7.5	3	x	6	7.96	x		0.63	x	0.7		=	156.38	(81)
Northwe	est <sub>0.9x</sub>	0.77		x	3.7	2	x	9	1.35	x		0.63	x	0.7		=	103.85	(81)
Northwe	est <sub>0.9x</sub>	0.77		x	7.5	3	x	9	1.35	x	(	0.63	x	0.7		=	210.21	(81)
Northwe	est 0.9x	0.77		x	3.7	2	x	9	7.38	x	(	0.63	×	0.7		=	110.71	(81)
Northwe	est <sub>0.9x</sub>	0.77		x	7.5	3	x	9	7.38	x	(	0.63	x	0.7		=	224.11	(81)
Northwe	est <sub>0.9x</sub>	0.77		x	3.7	2	x	9	91.1	x	(	0.63	x	0.7		=	103.57	(81)
Northwe	est 0.9x	0.77		x	7.5	3	x	9	91.1	x		0.63	x	0.7		=	209.65	(81)
Northwe	est <sub>0.9x</sub>	0.77		x	3.7	2	x	7	2.63	x		0.63	x	0.7		=	82.57	(81)
Northwe	est <sub>0.9x</sub>	0.77		x	7.5	3	x	7	2.63	x		0.63	x	0.7		=	167.13	(81)
Northwe	est <sub>0.9x</sub>	0.77		x	3.7	2	x	5	0.42	x		0.63	x	0.7		=	57.32	(81)
Northwe	est <sub>0.9x</sub>	0.77		x	7.5	3	x	5	0.42	x		0.63	x	0.7		=	116.03	(81)
Northwe	est <sub>0.9x</sub>	0.77		x	3.7	2	x	2	8.07	x	(	0.63	X	0.7		=	31.91	(81)
Northwe	est <sub>0.9x</sub>	0.77		x	7.5	3	x	2	8.07	x		0.63	x	0.7		=	64.59	(81)
Northwe	est <sub>0.9x</sub>	0.77		x	3.7	2	x		14.2	x		0.63	x	0.7		=	16.14	(81)
Northwe	est <sub>0.9x</sub>	0.77		x	7.5	3	x		14.2	x	(	0.63	X	0.7		=	32.67	(81)
Northwe	est <sub>0.9x</sub>	0.77		x	3.7	2	x	9	9.21	x	(	0.63	X	0.7		=	10.48	(81)
Northwe	est <sub>0.9x</sub>	0.77		x	7.5	3	x	9	9.21	x		0.63	×	0.7		=	21.2	(81)
							-			=								
Solar g	ains in v	watts, ca	lculat	ed	for each	n mon	th			(83)m	n = Sun	n(74)m	.(82)m					
(83)m=	38.79	78.96	142.2	$\overline{}$	233.64	314.00	$\neg$	34.82	313.22	249	9.7	173.35	96.5	48.81	31.6	88		(83)
Total g	ains – ir	nternal a	nd so	lar	(84)m =	(73)n	า + (	83)m	, watts			•		•				
(84)m=	588.36	624.25	666.9	7	726.51	774.5	3 7	66.08	727.34	672	.15	614.04	569.22	2 557.14	566.	73		(84)
7. Me:	an interi	nal temp	eratu	re (	heating	seaso	n)											
Temp	erature	during h	eating	g pe	eriods in	the li	ving	area t	from Tab	ole 9	, Th1	(°C)					21	(85)
Utilisa	tion fac	tor for ga	ains fo	or liv	ving are	a, h1,	m (s	ee Ta	ble 9a)									_
	Jan	Feb	Ма	r	Apr	Ma	<i>y</i>	Jun	Jul	Α	ug	Sep	Oct	Nov	De	ЭС		
(86)m=	0.99	0.99	0.98		0.93	0.82		0.63	0.47	0.5	53	0.79	0.95	0.99	0.9	9		(86)
Mean	internal	tempera	ature	in li	ving are	a T1	(follo	w ste	ps 3 to 7	in T	able	9c)		•			•	
(87)m=	20.02	20.13	20.34	_	20.64	20.87	Ì	20.98	21	20.		20.92	20.64	20.29	20	)		(87)
Tamn	aratura	during h	eating		ariode in	rest	of dw	ellina	from Ta	عاما	a Thí	. (°C)			<b>!</b>			
(88)m=	20.01	20.01	20.02	<del></del>	20.03	20.03	_	20.04	20.04	20.	<del></del>	20.04	20.03	20.03	20.0	)2	]	(88)
										<u> </u>								
Г	0.99	tor for ga	0.97	_	0.91	0.77		,m (se 0.55	0.37	9a) 0.4	12	0.71	0.93	0.98	0.9	<u> </u>	]	(89)
(89)m=		!							<u> </u>					0.90	0.9	9		(09)
r		tempera		_	i		Ť	<u> </u>		·				-	<del></del>		1	(0.0)
(90)m=	19.13	19.24	19.45	5	19.74	19.95	2	20.03	20.04	20.	04	20	19.75		19.1	2		(90)
												fL	.A = LI\	ring area ÷ (4	4) =		0.25	(91)
Mean	internal	tempera	ature	(for	the wh	ole dw	/ellin	g) = fl	LA × T1	+ (1	– fLA	) × T2					<u>.</u>	
(92)m=	19.36	19.47	19.68	_	19.97	20.18		20.27	20.28	20.		20.23	19.98		19.3	34		(92)
Apply	adjustm	nent to th	ne me	an	internal	tempe	eratu	ıre fro	m Table	4e,	where	e appro	priate					



aavia	50000.0	O.UIT											_	
(93)m=	19.36	19.47	19.68	19.97	20.18	20.27	20.28	20.28	20.23	19.98	19.63	19.34		(93)
8. Sp	ace hea	ting requ	uirement											
Set T	i to the r	mean int	ernal ter	nperatui	e obtair	ed at ste	ep 11 of	Table 9l	o, so tha	t Ti,m=(	76)m an	d re-calc	ulate	
the ut	ilisation		or gains	using Ta	ble 9a				,				l	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
			ains, hm								·		1	4
(94)m=	0.99	0.98	0.97	0.91	0.78	0.57	0.39	0.45	0.73	0.93	0.98	0.99		(94)
	<u> </u>		, W = (94	<u> </u>	·		1	1	1			1	[	(0.5)
(95)m=	581.68	613.63	644.37	661.63	601.99	434.13	287.28	301.22	446.55	530	545.84	561.34		(95)
	<u> </u>		rnal tem			r e	100	104	444	40.0	7.4	1.0		(06)
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
		1174.97		al tempe 879.49		Lm , VV =	=[(39)m : 288.46	<del>-``</del>	– (96)m		997.91	1211.99		(97)
(97)m=					672.1			303.5	482.58	743.16		1211.99		(97)
Space (98)m=	473.3	g require 377.22	309.31	156.86	52.16	/vn/mon	$\ln = 0.02$	24 X [(97]	)m – (95 0	)mj x (4 158.59	325.49	484.08		
(90)111=	473.3	311.22	309.31	130.00	32.10								2227.04	(98)
								Tota	l per year	(kvvn/year	r) = Sum(9	8)15,912 =	2337.01	╡``
Space	e heatin	g require	ement in	kWh/m²	<sup>2</sup> /year								31.39	(99)
9a. En	ergy rec	luiremer	nts – Indi	vidual h	eating s	ystems i	ncluding	micro-C	CHP)					
Spac	e heatir	ng:												_
Fracti	on of sp	ace hea	at from se	econdar	y/supple	mentary	system						0	(201)
Fracti	on of sp	ace hea	at from m	ain syst	em(s)			(202) = 1	- <b>(201)</b> =				1	(202)
Fracti	on of to	tal heati	ng from i	main sys	stem 1			(204) = (2	02) <b>×</b> [1 –	(203)] =			1	(204)
Efficie	ency of r	main spa	ace heati	ing syste	em 1								89.7	(206)
Efficie	ency of s	seconda	ry/supple	ementar	v heatin	g system	ղ, %						0	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	⊒ ` ar
Snace			ement (c			l	Jui	L Aug	Sep	Oct	INOV	Dec	KVVII/ye	aı
Opao	473.3	377.22	309.31	156.86	52.16	0	0	0	0	158.59	325.49	484.08		
(211)m			)4)] + (21	0)m l v	100 · (2	(06)	l	l			<u> </u>			(211)
(211)11	527.65	420.53	344.83	174.87	58.15	0	0	0	0	176.8	362.87	539.67		(211)
	027.00	420.00	044.00	174.07	00.10				l (kWh/yea				2605.36	(211)
Space	o bootin	a fuel (e	ooondor	ν) ΙΛΛ/h/	month					(	/15,1012		2005.50	(= /
•		•	econdar; 14) m } x											
(215)m=		0	0	0	0	0	0	0	0	0	0	0		
( -/						<u> </u>	<u> </u>		l (kWh/yea	ar) =Sum(2	215), 510 11		0	(215)
Water	heating									,	715,1012			
	_	•	ter (calc	ulated al	hove)									
Catpat	156.39	138.21	145.94	132.19	131.86	117.63	111.38	124.64	125.33	137.52	143.44	151.58		
Efficier	ncy of w	ater hea	ıter			!	!	!			<u> </u>		79.6	(216)
(217)m=	86.96	86.75	86.19	84.78	82.22	79.6	79.6	79.6	79.6	84.71	86.35	87.07		(217)
` '			kWh/mo		<u> </u>	L	L	L		L		<u> </u>		•
		•	) ÷ (217)											
. ,	179.84	159.32	169.32	155.92	160.37	147.77	139.92	156.59	157.45	162.34	166.12	174.1		
								Tota	I = Sum(2	19a) <sub>112</sub> =			1929.06	(219)
Annua	ıl totals									k'	Wh/year	•	kWh/yeaı	-
Space	heating	fuel use	ed, main	system	1								2605.36	
														_



Water heating fuel used 1929.06 Electricity for pumps, fans and electric keep-hot central heating pump: (230c)boiler with a fan-assisted flue (230e)45 sum of (230a)...(230g) = Total electricity for the above, kWh/year (231)Electricity for lighting (232)335.32 10a. Fuel costs - individual heating systems: **Fuel Fuel Price Fuel Cost** kWh/year (Table 12) £/year (211) x x 0.01 =Space heating - main system 1 90.6666762396509 (240) 3.48 Space heating - main system 2 (213) x x 0.01 =0 0 (241)Space heating - secondary (215) x x 0.01 =(242)13.19 0 Water heating cost (other fuel) (219)x 0.01 =3.48 67.13 (247)(231)Pumps, fans and electric keep-hot x 0.01 =13.19 9.89 (249)(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a **Energy for lighting** x = 0.01 =(250)13.19 44.23 Additional standing charges (Table 12) 120 (251)Appendix Q items: repeat lines (253) and (254) as needed (245)...(247) + (250)...(254) =(255)Total energy cost 331.92 11a. SAP rating - individual heating systems Energy cost deflator (Table 12) (256)0.42 Energy cost factor (ECF)  $[(255) \times (256)] \div [(4) + 45.0] =$ (257)1.17 SAP rating (Section 12) 83.72 (258)12a. CO2 emissions – Individual heating systems including micro-CHP **Energy Emission factor Emissions** kg CO2/kWh kg CO2/year kWh/year (211) x Space heating (main system 1) 0.216 562.76 (261)Space heating (secondary) (215) x (263)0.519 0 (219) x Water heating 0.216 416.68 (264)(261) + (262) + (263) + (264) =Space and water heating 979.43 (265)Electricity for pumps, fans and electric keep-hot (231) x (267)38.93 0.519 (232)Electricity for lighting (268)0.519 174.03 sum of (265)...(271) =Total CO2, kg/year (272)1192.39  $(272) \div (4) =$ CO2 emissions per m<sup>2</sup> 16.01 (273)El rating (section 14) (274)87 13a. Primary Energy



	<b>Energy</b> kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) x	1.22	3178.54 (261)
Space heating (secondary)	(215) x	3.07	0 (263)
Energy for water heating	(219) x	1.22 =	2353.45 (264)
Space and water heating	(261) + (262) + (263) + (264) =		5531.99 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	230.25 (267)
Electricity for lighting	(232) x	0 =	1029.44 (268)
'Total Primary Energy	sun	n of (265)(271) =	6791.68 (272)
Primary energy kWh/m²/year	(27	2) ÷ (4) =	91.21 (273)

### David Ochhalling Fabric Energy Efficiency WorkSheet: New dwelling design stage david@doec.co.uk



**Assessor Name:** David Oldham **Stroma Number:** STRO007778

Assessor name:	David Oldriam	Stroma	Num	ber:	SIKO	007776	
Software Name:	Stroma FSAP 2012	Softwai	re Vei	rsion:	Versio	n: 1.0.1.1	
	Pr	operty Address: I	Plot 1				
Address :	Plot 1, Macs Cafe Site						
1. Overall dwelling dime	ensions:						
		Area(m²)		Av. Heigh	t(m)	Volume(m	3)
Ground floor		37.23	1a) x	2.4	(2a) =	89.35	(3a)
First floor		37.23	1b) x	2.6	(2b) =	96.8	(3b)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+(1n)	74.46	4)				
Dwelling volume			(3a)+(3b	)+(3c)+(3d)+(3	se)+(3n) =	186.15	(5)
2. Ventilation rate:							_
	main secondary	y other		total		m³ per hou	ır
Number of chimneys	heating heating  0 + 0	+ 0	= [	0	x 40 =	0	(6a)
Number of open flues	0 + 0	+ 0	= [	0	x 20 =	0	(6b)
Number of intermittent fa	ans		Ē	3	x 10 =	30	(7a)
Number of passive vents	3		Ė	0	x 10 =	0	(7b)
Number of flueless gas f	ires		Ė	0	x 40 =	0	(7c)
			L				
					Air ch	anges per h	our
Infiltration due to chimne	eys, flues and fans = $(6a)+(6b)+(7a)$	a)+(7b)+(7c) =	Γ	30	÷ (5) =	0.16	(8)
If a pressurisation test has l	been carried out or is intended, proceed	l to (17), otherwise co	ntinue fr	om (9) to (16)	<b>-</b>		_
Number of storeys in t	he dwelling (ns)					0	(9)
Additional infiltration					[(9)-1]x0.1 =	0	(10)
	0.25 for steel or timber frame or	•		uction		0	(11)
	present, use the value corresponding to	the greater wall area	(after				
deducting areas of openi	floor, enter 0.2 (unsealed) or 0.3	1 (sealed) else e	nter 0			0	(12)
If no draught lobby, er	, , ,	, (ocaloa), cloc c	11101 0			0	(13)
• ,	s and doors draught stripped						(14)
Window infiltration	s and doors draught simpped	0.25 - [0.2 x	(14) ÷ 1	001 =		0	(15)
Infiltration rate				12) + (13) + (1	5) =	0	(16)
	, q50, expressed in cubic metres					0	(17)
•	ility value, then $(18) = [(17) \div 20] + (8)$			5.1.5 OI 611V6		0.26	(17)
· ·	es if a pressurisation test has been done			is being used		0.36	(10)
Number of sides sheltere		a aug. ou an poin	. Jaamiy		ĺ	1	(19)
Shelter factor		(20) = 1 - [0	.075 x (1	19)] =		0.92	(20)
Infiltration anto income	Carabaltan taatan	(04) (40)	. (00)				≓

Infiltration rate incorporating shelter factor

(20) = 1 - [0.	075 x (19)] =	

 $(21) = (18) \times (20) =$ 

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthl	y avera	ge wind	speed fr	om Tabl	e 7							
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

(21)

0.33

Heat transfer coefficient, W/K

80.66

80.45

Stroma FSAP 2012 Version: 1.0.1.1 (SAP 9.91) - http://www.stroma.com

79.45

79.27

80.88

# David Okham ling Fabric Energy Efficiency WorkSheet: New dwelling design sta



david @doec.co.uk

Wind Factor (	22a)m =	(22)m ÷	4										
(22a)m= 1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18		
Adjusted infilt	ration rat	e (allowi	na for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m	-	-			
0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39		
Calculate effe			rate for t	he appli	cable ca	se	•	•	!	•		,	(220)
If exhaust air I			endix N. (2	3b) = (23a	a) × Fmv (e	eguation (N	N5)) . othe	rwise (23b	) = (23a)			0	(23a) (23b)
If balanced wi		0		, ,	,	. ,	,, .	,	, (===,			0	(23c)
a) If balanc		-	-	_					2b)m + (	23b) <b>x</b> [	1 – (23c)		(200)
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0	]	(24a)
b) If balanc	ed mech	anical ve	entilation	without	heat red	covery (N	лV) (24b	m = (22)	2b)m + (2	23b)			
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If whole	house ex	tract ver	tilation o	or positiv	e input	ventilatio	on from o	outside	-	-		-	
	m < 0.5 >	<del>`                                    </del>	· ` `	ŕ	í –		<del>_``</del>	<del></del>	<u> </u>	<del></del>		1	
(24c)m = 0	0	0	0	0	0	0	0	0	0	0	0	]	(24c)
d) If natural	l ventilation m = 1, th				•				0.51				
(24d)m = 0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	]	(24d)
Effective ai	r change	rate - er	ıter (24a	) or (24b	o) or (24	c) or (24	d) in box	r (25)				J	
(25)m= 0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	]	(25)
3. Heat loss	os and ha	oot loog r	ooromote	or:								1	
0. 1 loat 1000	oo ana m	out 1000 p	Jaiannon										
ELEMENT	Gros area		Openin m	gs	Net Ar A ,r		U-valı W/m2		A X U (W/l	K)	k-value kJ/m²-l		A X k kJ/K
<b>ELEMENT</b> Doors				gs		m²				K)			
	area			gs	A ,r	m² x	W/m2	2K =	(W/I	K)			kJ/K
Doors	area e 1			gs	A ,r	m <sup>2</sup> x x 10	W/m2 1.5	eK =   0.04] =	(W/l	K)			kJ/K (26)
Doors Windows Typ	area e 1			gs	A ,r	m <sup>2</sup> x x10 x10	W/m2 1.5 /[1/( 1.4 )+	eK =   0.04] =	2.625 4.93				kJ/K (26) (27)
Doors Windows Typ Windows Typ	area e 1	(m²)		gs	A ,r 1.75 3.72 7.53	x1. x1. x1. x1.	W/m2 1.5 /[1/( 1.4 )+ /[1/( 1.4 )+	eK =   0.04] =   0.04] =	2.625 4.93 9.98				kJ/K (26) (27) (27)
Doors Windows Typ Windows Typ Floor	area e 1 e 2	(m²)	· m	gs	A ,r 1.75 3.72 7.53 37.23	x1. x1. x1. x1. x1.	W/m2 1.5 /[1/( 1.4 )+ /[1/( 1.4 )+	eK =   0.04] =   0.04] =   = =	(W/l 2.625 4.93 9.98 4.4676				kJ/K (26) (27) (27) (28)
Doors Windows Typ Windows Typ Floor Walls	area e 1 e 2  86.  37.2	(m²) 6	13	gs	A ,r  1.75  3.72  7.53  37.23  73.6	m <sup>2</sup>	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12	0.04] = 0.04] = = = = = = = = = = = = = = = = = = =	(W/l 2.625 4.93 9.98 4.4676 17.66				kJ/K (26) (27) (27) (28) (29)
Doors Windows Typ Windows Typ Floor Walls Roof	area e 1 e 2  86. 37.2 elements d roof wind	6 23 3, m <sup>2</sup> ows, use 6	13 0	gs <sub>1</sub> 2	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calcul	x1 x	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13	2K =   0.04] =   0.04] =   =   =	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84		kJ/m²-l	k 	kJ/K (26) (27) (27) (28) (29)
Doors Windows Typ Windows Typ Floor Walls Roof Total area of * for windows an	area e 1 e 2  86.  37.2 elements d roof wind eas on both	6 23 c, m² ows, use e sides of in	13 0	gs <sub>1</sub> 2	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calcul	x1.	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13	2K =   0.04] =   0.04] =   =   =   =     =	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84		kJ/m²-l	k 	kJ/K (26) (27) (27) (28) (29) (30) (31)
Doors Windows Typ Windows Typ Floor Walls Roof Total area of * for windows an ** include the are	area  e 1  e 2  86.  37.2  elements d roof wind eas on both	6 23 3, m² cows, use 6 sides of ir = S (A x	13 0	gs <sub>1</sub> 2	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calcul	x1.	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13	2K =   0.04] =   0.04] =   =   =   =     =	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84	as given in	kJ/m²-l	K	kJ/K (26) (27) (27) (28) (29) (30) (31)
Doors Windows Typ Windows Typ Floor Walls Roof Total area of * for windows an ** include the are Fabric heat lo	area  e 1  e 2  86.  37.2  elements d roof wind eas on both eas, W/K  r Cm = Si	6 23 5, m <sup>2</sup> ows, use e sides of ir = S (A x (A x k)	13 0	gs <sub>1</sub> 2 ndow U-va ls and pan	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calcultitions	x1 x1 x1 x1 x1 x2 x2 x2 x3 x4	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13	2K =   0.04] =   0.04] =   =   =   =     =	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84	as given in (2) + (32a).	kJ/m²-l	n 3.2	kJ/K (26) (27) (27) (28) (29) (30) (31)
Doors Windows Typ Windows Typ Floor Walls Roof Total area of * for windows an ** include the are Fabric heat lo Heat capacity Thermal mass For design asses	area  e 1  e 2  86.  37.2  elements d roof wind eas on both ess, W/K  Cm = Sesses s parame	6 23 3, m² cows, use esides of ir = S (A x (A x k) eter (TMF)	13 0  iffective winternal wall U)  P = Cm -iffective of the	gs pndow U-va ls and pan	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calculatitions	x1. x1. x1. x1. x1. x2. x3. x4. x4. x4. x4. x4. x4. x4. x4. x4. x4	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13  formula 1 (26)(30)	2K =   0.04] =   0.04] =   =   =   =     =	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84 ue)+0.04] a	as given in (2) + (32a).: Medium	kJ/m²-l paragraph (32e) =	1 3.2 44.5 6231.	kJ/K (26) (27) (27) (28) (29) (30) (31)
Doors Windows Typ Windows Typ Floor Walls Roof Total area of * for windows an ** include the are Fabric heat lo Heat capacity Thermal mass For design asses can be used inst	area  e 1  e 2  86.  37.2 elements d roof wind eas on both ess, W/K  Cm = Se s parame essments wheed of a de	6 23 3, m² cows, use esides of ir = S (A x (A x k) eter (TMF) ere the detailed calculations	13 0 effective winternal walk U) $P = Cm \div tails of the culation.$	gs prodow U-vals and part of TFA) in construction	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calculatitions  n kJ/m²K	x1 x1 x1 x1 x1 xx xx xx xx xx xx xx xx x	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13  formula 1 (26)(30)	2K =   0.04] =   0.04] =   =   =   =     =	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84 ue)+0.04] a	as given in (2) + (32a).: Medium	kJ/m²-l paragraph (32e) =	7 3.2 44.5 6231. 250	kJ/K (26) (27) (27) (28) (29) (30) (31)  1 (33) 67 (34) (35)
Doors Windows Typ Windows Typ Floor Walls Roof Total area of * for windows an ** include the are Fabric heat lo Heat capacity Thermal mass For design asses	area  e 1  e 2  86.  37.2 elements d roof wind eas on both eas, W/K  Cm = Se s parame ssments wheed of a de	6 23 23 25, m² 26 sides of ir 27 s (A x k) 28 seter (TMF) 28 seter the decent tailed calculation (X Y)	13 0 effective winternal wall U) $P = Cm + \frac{1}{2}$ tails of the culation. culated to	gs Indow U-ve Is and pan TFA) in construction	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calculations  a kJ/m²K  pendix kine are not	x1 x1 x1 x1 x1 xx xx xx xx xx xx xx xx x	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13  formula 1 (26)(30)	2K =   0.04] =   0.04] =   =   =   =     =	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84 ue)+0.04] a	as given in (2) + (32a).: Medium	kJ/m²-l paragraph (32e) =	1 3.2 44.5 6231.	kJ/K (26) (27) (27) (28) (29) (30) (31)  1 (33) 67 (34) (35)
Doors Windows Typ Windows Typ Floor Walls Roof Total area of * for windows an ** include the are Fabric heat lo Heat capacity Thermal mass For design asses can be used inst Thermal bridge	area  e 1  e 2  86.  37.2 elements d roof wind eas on both eas, W/K  Cm = Si s parame ssments whe ead of a de ges : S (L nal bridging	6 23 23 25, m² 26 sides of ir 27 s (A x k) 28 seter (TMF) 28 seter the decent tailed calculation (X Y)	13 0 effective winternal wall U) $P = Cm + \frac{1}{2}$ tails of the culation. culated to	gs Indow U-ve Is and pan TFA) in construction	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calculations  a kJ/m²K  pendix kine are not	x1 x1 x1 x1 x1 xx xx xx xx xx xx xx xx x	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13  formula 1 (26)(30)	2K	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84 ue)+0.04] a	as given in (2) + (32a).: Medium	kJ/m²-l paragraph (32e) =	7 3.2 44.5 6231. 250	kJ/K (26) (27) (27) (28) (29) (30) (31)  1 (33) 67 (34) (35)
Doors Windows Typ Windows Typ Floor Walls Roof Total area of * for windows an ** include the are Fabric heat lo Heat capacity Thermal mass For design asses can be used inst Thermal bridg if details of them	area  e 1  e 2  86.  37.2 elements d roof wind eas on both eas, W/K  CCm = Si s parame essments whe ead of a de ges : S (L nal bridging eat loss	(m²)  6  23  a, m²  ows, use e sides of ir  = S (A x (A x k)  eter (TMF)  ere the de tailed calculum (a x Y)	affective winternal walk  U)  P = Cm - tails of the culation.  culated to cown (36) =	gs  ndow U-ve ls and pan  - TFA) ir  construct  using Ap  = 0.15 x (3	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calculations  a kJ/m²K  pendix kine are not	x1 x1 x1 x1 x1 xx xx xx xx xx xx xx xx x	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13  formula 1 (26)(30)	2K	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84 ue)+0.04] a tive Value	as given in (2) + (32a).: Medium	paragraph(32e) =	7 3.2 44.5 6231. 250	kJ/K (26) (27) (27) (28) (29) (30) (31)  1 (33) 67 (34) (35)
Doors Windows Typ Windows Typ Floor Walls Roof Total area of * for windows an ** include the are Fabric heat lo Heat capacity Thermal mass For design asses can be used inst Thermal bridg if details of them Total fabric he	area  e 1  e 2  86.  37.2 elements d roof wind eas on both eas, W/K  CCm = Si s parame essments whe ead of a de ges : S (L nal bridging eat loss	(m²)  6  23  a, m²  ows, use e sides of ir  = S (A x (A x k)  eter (TMF)  ere the de tailed calculum (a x Y)	affective winternal walk  U)  P = Cm - tails of the culation.  culated to cown (36) =	gs  ndow U-ve ls and pan  - TFA) ir  construct  using Ap  = 0.15 x (3	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calculations  a kJ/m²K  pendix kine are not	x1 x1 x1 x1 x1 xx xx xx xx xx xx xx xx x	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13  formula 1 (26)(30)	2K	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84  1e)+0.04] a  tive Value e values of	as given in (2) + (32a).: Medium	paragraph(32e) =	7 3.2 44.5 6231. 250	kJ/K (26) (27) (27) (28) (29) (30) (31)  1 (33) 67 (34) (35)

79.64

80.04

(39)m = (37) + (38)m

79.27

78.24

78.73



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Heat loss parameter (H	HLP), W	/m²K					(40)m	= (39)m ÷	· (4)			
(40)m= 1.09 1.08	1.08	1.07	1.06	1.05	1.05	1.05	1.06	1.06	1.07	1.07		
Number of days in mo	nth (Tab	le 1a)					,	Average =	Sum(40) <sub>1.</sub>	12 /12=	1.07	(40)
Jan Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m= 31 28	31	30	31	30	31	31	30	31	30	31		(41)
	•	•							•			
4. Water heating ene	rgy requ	irement:								kWh/ye	ear:	
Assumed occupancy, if TFA > 13.9, N = 1 if TFA £ 13.9, N = 1		: [1 - exp	(-0.0003	349 x (TF	FA -13.9	)2)] + 0.0	0013 x (T	ΓFA -13		35		(42)
Annual average hot wa Reduce the annual average not more that 125 litres per	hot water	usage by	5% if the a	lwelling is	designed t			se target o		.73		(43)
Jan Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per							Oop			200	l	
(44)m= 104.21 100.42	96.63	92.84	89.05	85.26	85.26	89.05	92.84	96.63	100.42	104.21		
									m(44) <sub>112</sub> =		1136.81	(44)
Energy content of hot water	used - cal	culated m	onthly = 4.	190 x Vd,r	n x nm x C	Tm / 3600	) kWh/mon	nth (see Ta	ables 1b, 1	c, 1d)	•	
(45)m= 154.54 135.16	139.47	121.59	116.67	100.68	93.29	107.06	108.34	126.26	137.82	149.66		<b>—</b>
If instantaneous water heati	ng at point	t of use (no	hot water	storage),	enter 0 in	boxes (46 <sub>)</sub>		Total = Su	m(45) <sub>112</sub> =		1490.54	(45)
(46)m= 0 0	0	0	0	0	0	0	0	0	0	0		(46)
Water storage loss:			I.								•	
Storage volume (litres)					•		ame ves	sel	0			(47)
If community heating a Otherwise if no stored			0,			` '	ora) onto	or 'O' in /	( <b>47</b> )			
Water storage loss:	not wate	וו פוווו) וכ	iciuues i	iistaiitai	ieous co	יווטט וטוויוי	ers) erite	51 0 111 (	41)			
a) If manufacturer's de	eclared I	oss facto	or is kno	wn (kWh	n/day):				0.	54		(48)
Temperature factor fro	m Table	2b								0		(49)
Energy lost from water	storage	, kWh/ye	ear			(48) x (49)	) =			0		(50)
b) If manufacturer's de		•									· I	
Hot water storage loss If community heating s			le 2 (KVV	n/litre/da	ıy)				(	0		(51)
Volume factor from Ta		011 4.0								0		(52)
Temperature factor fro	m Table	2b							<b>—</b>	0		(53)
Energy lost from water	storage	, kWh/ye	ear			(47) x (51)	x (52) x (	53) =		0		(54)
Enter (50) or (54) in (5	55)								0.	59		(55)
Water storage loss cal	culated t	for each	month			((56)m = (	55) × (41)r	m				
(56)m= 18.41 16.63	18.41	17.82	18.41	17.82	18.41	18.41	17.82	18.41	17.82	18.41		(56)
If cylinder contains dedicate	d solar sto	rage, (57)	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Append	ix H	
(57)m= 18.41 16.63	18.41	17.82	18.41	17.82	18.41	18.41	17.82	18.41	17.82	18.41		(57)
Primary circuit loss (ar	•									0		(58)
Primary circuit loss cal			,	•	. ,	, ,		v 4h a ==== =	otot\			
(modified by factor f				i	i	<u> </u>		i	<del> </del>	0		(59)
(59)m= 0 0	0	0	0	0	0	0	0	0	0	0		(33)

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david @doec.co.uk

Combi l	oss cal	culated	for each	month (	(61)m =	(60) ÷ 36	65 × (41)	)m						
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
Total he	eat requ	ired for	water he	eating ca	alculated	for eac	n month	(62)m =	0.85 ×	(45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m=	149.77	131.52	136.97	121.18	117.59	103.4	97.71	109.41	109.91	125.73	134.96	145.63		(62)
Solar DH\	W input c	alculated	using Appe	endix G or	Appendix	H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)	•	
(add ad	ditional	lines if	FGHRS	and/or V	WWHRS	applies	, see Ap	pendix (	3)					
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
FHRS	10.57	9.24	9.54	8.32	7.98	6.89	6.38	7.32	7.41	8.64	9.43	10.24		(63) (G2)
Output f	from wa	ater hea	ter											
(64)m=	140.73	123.58	128.73	113.92	110.57	97.27	91.95	102.91	103.35	118.19	126.83	136.84		_
			-		-	-	-	Outp	out from w	ater heate	r (annual)₁	12	1394.89	(64)
Heat ga	ains fror	n water	heating,	kWh/mo	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m	n] + 0.8 x	x [(46)m	+ (57)m	+ (59)m	]	
(65)m=	47.57	42.03	44.37	40.09	39.52	35.65	34.56	37.48	37.28	41.56	43.54	46.53		(65)
includ	de (57)r	n in calc	culation c	of (65)m	only if o	ylinder i	s in the	dwelling	or hot w	ater is f	om com	munity h	eating	
5. Inte	ernal ga	ins (see	Table 5	and 5a)	):									
Metabol	lic gain	s (Table	5), Watt	S										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	117.47	117.47	117.47	117.47	117.47	117.47	117.47	117.47	117.47	117.47	117.47	117.47		(66)
Lighting	gains	(calcula	ted in Ap	pendix l	L, equat	ion L9 o	r L9a), a	lso see	Table 5					
(67)m=	18.99	16.86	13.72	10.38	7.76	6.55	7.08	9.2	12.35	15.68	18.31	19.52		(67)
Appliand	ces gai	ns (calc	ulated in	Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5			•	
(68)m=	207.48	209.63	204.2	192.65	178.07	164.37	155.22	153.06	158.49	170.04	184.62	198.32		(68)
Cooking	g gains	(calcula	ited in Ap	pendix	L, equat	tion L15	or L15a	, also se	ee Table	5				
(69)m=	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.75		(69)
Pumps	and far	ns gains	(Table 5	ia)		-		-	-		-	-		
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0		(70)
Losses	e.g. ev	aporatio	n (negat	ive valu	es) (Tab	le 5)							•	
(71)m=	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97		(71)
Water h	eating	gains (T	able 5)											
(72)m=	63.94	62.54	59.64	55.69	53.12	49.51	46.45	50.38	51.77	55.86	60.48	62.55		(72)
Total in	nternal	gains =				(66)	m + (67)m	ı + (68)m -	+ (69)m +	(70)m + (7	'1)m + (72)	m	•	
(73)m=	348.64	347.27	335.79	316.96	297.2	278.68	266.98	270.88	280.86	299.82	321.64	338.62		(73)
6. Sola	ar gains	:												
Solar ga	ains are c	alculated	using solar	flux from	Table 6a	and assoc	ated equa	tions to co	onvert to th	ne applicat		ion.		
Orientat		ccess Fable 6d		Area m²		Flu Tal	x ole 6a	Т	g_ able 6b	Т	FF able 6c		Gains (W)	
				3.7	′2	x 1	1.28	x	0.63	x	0.7	=	12.83	(81)
Northwes	St 0.9x	0.77	X	3.7									. —	
Northwes	느	0.77	^	7.5			1.28	x	0.63	<b>-</b> x -	0.7	=	25.97	(81)
	st <sub>0.9x</sub>				53	x 1	1.28	x x		x	0.7	= =		(81) (81)

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Northwest 0.9x (81)х x x 0.77 х 3.72 41.38 0.63 0.7 = 47.04 Northwest 0.9x (81)х 0.77 7.53 41.38 х 0.63 0.7 95.22 Northwest 0.9x (81)0.77 3.72 67.96 Х 0.63 Х 0.7 77.26 Northwest 0.9x (81)0.77 7.53 67.96 х 0.63 Х 0.7 156.38 Northwest 0.9x 0.77 3.72 91.35 0.63 0.7 103.85 (81) Northwest 0.9x 210.21 (81)0.77 7.53 91.35 0.63 0.7 Northwest 0.9x 0.77 3.72 97.38 0.63 0.7 110.71 (81)Northwest 0.9x 224.11 (81)0.77 7.53 97.38 0.63 0.7 Northwest 0.9x 0.77 3.72 91.1 0.63 0.7 103.57 (81)Northwest 0.9x (81)0.77 7.53 91.1 0.63 0.7 209.65 Northwest 0.9x (81) 0.77 3.72 72.63 0.63 82.57 0.7 Northwest 0.9x (81)0.77 7.53 72.63 0.63 0.7 167.13 Northwest 0.9x 50.42 0.63 0.7 57.32 (81)0.77 3.72 Х X Northwest 0.9x (81)0.77 7.53 50.42 х 0.63 Х 0.7 116.03 Northwest 0.9x (81)х х 3.72 28.07 0.63 0.7 31 91 0.77 Northwest 0.9x (81)0.77 Х 7.53 Х 28.07 х 0.63 x 0.7 = 64.59 Northwest 0.9x (81)3.72 0.7 16.14 0.77 14.2 х 0.63 X Northwest 0.9x (81)0.77 Х 7.53 14.2 Х 0.63 Х 0.7 = 32.67 Northwest 0.9x (81)0.77 3.72 9.21 Х 0.63 Х 0.7 10.48 Northwest 0.9x 0.77 7.53 9.21 Х 0.63 0.7 21.2 (81)Solar gains in watts, calculated for each month (83)m = Sum(74)m ...(82)m334.82 313.22 (83)(83)m =38.79 78.96 142.27 233.64 314.06 249.7 173.35 48.81 31.68 Total gains – internal and solar (84)m = (73)m + (83)m watts 613.5 (84)387.43 426.24 478.06 550.61 611.26 580.2 520.59 454.21 396.32 370.45 370.3 (84)m =7. Mean internal temperature (heating season) (85)Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 Utilisation factor for gains for living area, h1,m (see Table 9a) Oct Jan Feb Mar May Sep Nov Apr Jun Jul Aug Dec 0.99 0.98 0.58 (86)(86)m =1 0.91 0.75 0.66 0.91 0.99 1 1 Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)19.77 19.89 20.12 20.46 20.77 20.95 20.99 20.98 20.83 20.45 20.06 19.75 (87)m =Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)(88)m =20.01 20.01 20.02 20.03 20.03 20.04 20.04 20.04 20.04 20.03 20.03 20.02 Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)(89)m =0.99 0.97 0.87 0.66 0.46 0.54 0.85 0.98 1 Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m =18.88 19 19.23 19.58 19.87 20.01 20.04 20.03 19.93 19.18 18.88 (90)19.57  $fLA = Living area \div (4) =$ (91)0.25 Mean internal temperature (for the whole dwelling) =  $fLA \times T1 + (1 - fLA) \times T2$ (92)(92)m =19.11 19.22 19.46 19.8 20.09 20.25 20.28 20.27 19.79 19.4 20.16 19.1 Apply adjustment to the mean internal temperature from Table 4e, where appropriate



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(93)m=	19.11	19.22	19.46	19.8	20.09	20.25	20.28	20.27	20.16	19.79	19.4	19.1		(93)
8. Spa	ace hea	ting requ	uirement											
				•		ned at st	ep 11 of	Table 9	o, so tha	t Ti,m=(	76)m an	d re-calc	culate	
tne ut			or gains			lup	1	۸۰۰۵	Con	Oct	Nov	Doo		
l Itilies	Jan	Feb	Mar ains, hm	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(94)m=	1	1	0.99	0.97	0.88	0.68	0.49	0.57	0.86	0.98	1	1		(94)
			W = (94)											. ,
(95)m=	386.74	424.83	473.82	531.66	535.43	418.59	284.85	295.96	392.09	389.21	369.15	369.79		(95)
Month	nly avera	age exte	rnal tem	perature	from T	able 8	<u> </u>	ļ.				ļ		
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat	loss rate	for mea	an intern	al tempe	erature,	Lm , W =	=[(39)m	x [(93)m	– (96)m	]			ı	
(97)m=	1197.59	1155.35	1042.33	866.03	665.39	442.8	288.21	302.96	477.16	728.62	979.72	1192.27		(97)
Space	e heating	g require	ement fo	r each n	nonth, k	Wh/mon	th = 0.02	24 x [(97)	)m – (95	)m] x (4 <sup>-</sup>	1)m			
(98)m=	603.27	490.9	422.97	240.74	96.7	0	0	0	0	252.52	439.61	611.93		
								Tota	l per year	(kWh/year	r) = Sum(9	8)15,912 =	3158.63	(98)
Space	e heating	g require	ement in	kWh/m²	<sup>2</sup> /year								42.42	(99)
8c. Sp	pace co	oling rec	luiremen	nt										
Calcu	lated for	r June, J	July and	August.	See Tal	ble 10b								
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Heat	loss rate	ELm (ca	lculated	using 2	5°C inte	nal tem	perature	and exte	ernal ten	nperatur	e from T	able 10)		
(100)m=	0	0	0	0	0	736.96	580.16	594.62	0	0	0	0		(100)
Utilisa	ation fac	tor for lo	ss hm										•	
(101)m=	0	0	0	0	0	0.88	0.93	0.9	0	0	0	0		(101)
Usefu	l loss, h	mLm (V	/atts) = (	(100)m x	(101)m	<u> </u>	,	,			T	1	Ī	
(102)m=		0	0	0	0	646.01	541.34	535.35	0	0	0	0		(102)
					i e			e Table					1	
(103)m=		0	0	0	0	801.01	760.35	692.13	0	0	0	0		(103)
			ement fo. 104)m <			dwelling,	continu	ous ( kW	h') = 0.0	24 x [(10	03)m – (	102)m ] x	x (41)m	
(104)m=	0	0	0	0	0	111.6	162.94	116.64	0	0	0	0		
'									Total	= Sum(	104)	=	391.18	(104)
	fraction								f C =	cooled	area ÷ (4	4) =	1	(105)
			able 10b										1	
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0		_
0 -					(404)	(405)	(400)		Total	' = Sum(	104)	=	0	(106)
	Ť	<u> </u>	nent for		<del>`                                    </del>	<del>- `                                   </del>	<del></del>	1		0			1	
(107)m=	0	0	0	0	0	27.9	40.74	29.16	0 Total	0 - Sum(	107)	0	07.0	(407)
										= Sum(	IUI )	=	97.8	(107)
•		•	nent in k		•				` ′	÷ (4) =			1.31	(108)
				alculated	only un	der spec	cial conc	litions, s		· ·				
Fabrio	c Energy	/ Efficier	ncy						(99) -	+ (108) =	=		43.73	(109)

### David Ochhalling Fabric Energy Efficiency WorkSheet: New dwelling design stage david@doec.co.uk



**Assessor Name:** David Oldham **Stroma Number:** STRO007778

Assessor name:	David Oldriam	Stroma	Num	ber:	SIKO	007776	
Software Name:	Stroma FSAP 2012	Softwai	re Vei	rsion:	Versio	n: 1.0.1.1	
	Pr	operty Address: I	Plot 1				
Address :	Plot 1, Macs Cafe Site						
1. Overall dwelling dime	ensions:						
		Area(m²)		Av. Heigh	t(m)	Volume(m	3)
Ground floor		37.23	1a) x	2.4	(2a) =	89.35	(3a)
First floor		37.23	1b) x	2.6	(2b) =	96.8	(3b)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+(1n)	74.46	4)				
Dwelling volume			(3a)+(3b	)+(3c)+(3d)+(3	se)+(3n) =	186.15	(5)
2. Ventilation rate:							_
	main secondary	y other		total		m³ per hou	ır
Number of chimneys	heating heating  0 + 0	+ 0	= [	0	x 40 =	0	(6a)
Number of open flues	0 + 0	+ 0	= [	0	x 20 =	0	(6b)
Number of intermittent fa	ans		Ē	3	x 10 =	30	(7a)
Number of passive vents	3		Ė	0	x 10 =	0	(7b)
Number of flueless gas f	ires		Ė	0	x 40 =	0	(7c)
			L				
					Air ch	anges per h	our
Infiltration due to chimne	eys, flues and fans = $(6a)+(6b)+(7a)$	a)+(7b)+(7c) =	Γ	30	÷ (5) =	0.16	(8)
If a pressurisation test has l	been carried out or is intended, proceed	l to (17), otherwise co	ntinue fr	om (9) to (16)	<b>-</b>		_
Number of storeys in t	he dwelling (ns)					0	(9)
Additional infiltration					[(9)-1]x0.1 =	0	(10)
	0.25 for steel or timber frame or	•		uction		0	(11)
	present, use the value corresponding to	the greater wall area	(after				
deducting areas of openi	floor, enter 0.2 (unsealed) or 0.3	1 (sealed) else e	nter 0			0	(12)
If no draught lobby, er	, , ,	, (ocaloa), cloc c	11101 0			0	(13)
• ,	s and doors draught stripped						(14)
Window infiltration	s and doors draught simpped	0.25 - [0.2 x	(14) ÷ 1	001 =		0	(15)
Infiltration rate				12) + (13) + (1	5) =	0	(16)
	, q50, expressed in cubic metres					0	(17)
•	ility value, then $(18) = [(17) \div 20] + (8)$			5.1.5 OI 611V6		0.26	(17)
· ·	es if a pressurisation test has been done			is being used		0.36	(10)
Number of sides sheltere		a aug. ou an poin	. Jaamiy		ĺ	1	(19)
Shelter factor		(20) = 1 - [0	.075 x (1	19)] =		0.92	(20)
Infiltration anto income	Carabaltan taatan	(04) (40)	. (00)				≓

Infiltration rate incorporating shelter factor

(20) = 1 - [0.	075 x (19)] =	

 $(21) = (18) \times (20) =$ 

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthl	y avera	ge wind	speed fr	om Tabl	e 7							
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

(21)

0.33

Heat transfer coefficient, W/K

80.66

80.45

Stroma FSAP 2012 Version: 1.0.1.1 (SAP 9.91) - http://www.stroma.com

79.45

79.27

80.88

# David Okham ling Fabric Energy Efficiency WorkSheet: New dwelling design sta



david @doec.co.uk

Wind Factor (	22a)m =	(22)m ÷	4										
(22a)m= 1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18		
Adjusted infilt	ration rat	e (allowi	na for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m	-	-			
0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39		
Calculate effe			rate for t	he appli	cable ca	se	•	•	!	•		,	(220)
If exhaust air I			endix N. (2	3b) = (23a	a) × Fmv (e	eguation (N	N5)) . othe	rwise (23b	) = (23a)			0	(23a) (23b)
If balanced wi		0		, ,	,	. ,	,, .	,	, (===,			0	(23c)
a) If balanc		-	-	_					2b)m + (	23b) <b>x</b> [	1 – (23c)		(200)
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0	]	(24a)
b) If balanc	ed mech	anical ve	entilation	without	heat red	covery (N	лV) (24b	m = (22)	2b)m + (2	23b)			
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If whole	house ex	tract ver	tilation o	or positiv	e input	ventilatio	on from o	outside	-	-		-	
	m < 0.5 >	<del>`                                    </del>	· ` `	ŕ	í –		<del>_``</del>	<del></del>	<u> </u>	<del></del>		1	
(24c)m = 0	0	0	0	0	0	0	0	0	0	0	0	]	(24c)
d) If natural	l ventilation m = 1, th				•				0.51				
(24d)m = 0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	]	(24d)
Effective ai	r change	rate - er	iter (24a	) or (24b	o) or (24	c) or (24	d) in box	r (25)				J	
(25)m= 0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	]	(25)
3. Heat loss	os and ha	oot loog r	ocromote	or:								1	
0. 1 loat 1000	oo ana m	out 1000 p	Jaiannon										
ELEMENT	Gros area		Openin m	gs	Net Ar A ,r		U-valı W/m2		A X U (W/l	K)	k-value kJ/m²-l		A X k kJ/K
<b>ELEMENT</b> Doors				gs		m²				K)			
	area			gs	A ,r	m² x	W/m2	2K =	(W/I	K)			kJ/K
Doors	area e 1			gs	A ,r	m <sup>2</sup> x x 10	W/m2 1.5	eK =   0.04] =	(W/l	K)			kJ/K (26)
Doors Windows Typ	area e 1			gs	A ,r	m <sup>2</sup> x x10 x10	W/m2 1.5 /[1/( 1.4 )+	eK =   0.04] =	2.625 4.93				kJ/K (26) (27)
Doors Windows Typ Windows Typ	area e 1	(m²)		gs	A ,r 1.75 3.72 7.53	x1. x1. x1. x1.	W/m2 1.5 /[1/( 1.4 )+ /[1/( 1.4 )+	eK =   0.04] =   0.04] =	2.625 4.93 9.98				kJ/K (26) (27) (27)
Doors Windows Typ Windows Typ Floor	area e 1 e 2	(m²)	· m	gs	A ,r 1.75 3.72 7.53 37.23	x1. x1. x1. x1. x1.	W/m2 1.5 /[1/( 1.4 )+ /[1/( 1.4 )+	eK =   0.04] =   0.04] =   = =	(W/l 2.625 4.93 9.98 4.4676				kJ/K (26) (27) (27) (28)
Doors Windows Typ Windows Typ Floor Walls	area e 1 e 2  86.  37.2	(m²) 6	13	gs	A ,r  1.75  3.72  7.53  37.23  73.6	m <sup>2</sup>	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12	0.04] = 0.04] = = = = = = = = = = = = = = = = = = =	(W/l 2.625 4.93 9.98 4.4676 17.66				kJ/K (26) (27) (27) (28) (29)
Doors Windows Typ Windows Typ Floor Walls Roof	area e 1 e 2  86. 37.2 elements d roof wind	6 23 3, m <sup>2</sup> ows, use 6	13 0	gs <sub>1</sub> 2	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calcul	x1 x	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13	2K =   0.04] =   0.04] =   =   =	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84		kJ/m²-l	k 	kJ/K (26) (27) (27) (28) (29)
Doors Windows Typ Windows Typ Floor Walls Roof Total area of * for windows an	area e 1 e 2  86.  37.2 elements d roof wind eas on both	6 23 c, m² ows, use e sides of in	13 0	gs <sub>1</sub> 2	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calcul	x1.	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13	2K =   0.04] =   0.04] =   =   =   =     =	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84		kJ/m²-l	k 	kJ/K (26) (27) (27) (28) (29) (30) (31)
Doors Windows Typ Windows Typ Floor Walls Roof Total area of * for windows an ** include the are	area  e 1  e 2  86.  37.2  elements d roof wind eas on both	6 23 3, m² cows, use 6 sides of ir = S (A x	13 0 effective winternal wall	gs <sub>1</sub> 2	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calcul	x1.	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13	2K =   0.04] =   0.04] =   =   =   =     =	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84	as given in	kJ/m²-l	K	kJ/K (26) (27) (27) (28) (29) (30) (31)
Doors Windows Typ Windows Typ Floor Walls Roof Total area of * for windows an ** include the are Fabric heat lo	area  e 1  e 2  86.  37.2  elements d roof wind eas on both eas, W/K  r Cm = Si	6 23 5, m <sup>2</sup> ows, use e sides of ir = S (A x (A x k)	13 0	gs <sub>1</sub> 2 ndow U-va ls and pan	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calcultitions	x1 x1 x1 x1 x1 x2 x2 x2 x3 x4	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13	2K =   0.04] =   0.04] =   =   =   =     =	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84	as given in (2) + (32a).	kJ/m²-l	n 3.2	kJ/K (26) (27) (27) (28) (29) (30) (31)
Doors Windows Typ Windows Typ Floor Walls Roof Total area of * for windows an ** include the are Fabric heat lo Heat capacity Thermal mass For design asses	area  e 1  e 2  86.  37.2  elements d roof wind eas on both ess, W/K  Cm = Sesses s parame	6 23 3, m² cows, use esides of ir = S (A x (A x k) eter (TMF)	13 0  iffective winternal wall U)  P = Cm -iffective of the	gs pndow U-va ls and pan	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calculatitions	x1. x1. x1. x1. x1. x2. x3. x4. x4. x4. x4. x4. x4. x4. x4. x4. x4	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13  formula 1 (26)(30)	2K =   0.04] =   0.04] =   =   =   =     =	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84 ue)+0.04] a	as given in (2) + (32a).: Medium	kJ/m²-l paragraph (32e) =	1 3.2 44.5 6231.	kJ/K (26) (27) (27) (28) (29) (30) (31)
Doors Windows Typ Windows Typ Floor Walls Roof Total area of * for windows an ** include the are Fabric heat lo Heat capacity Thermal mass For design asses can be used inst	area  e 1  e 2  86.  37.2 elements d roof wind eas on both ess, W/K  Cm = Se s parame essments wheed of a de	6 23 3, m² cows, use esides of ir = S (A x (A x k) eter (TMF) ere the detailed calculations	13 0 effective winternal walk U) $P = Cm \div tails of the culation.$	gs prodow U-vals and part of TFA) in construction	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calculatitions  n kJ/m²K	x1 x1 x1 x1 x1 xx xx xx xx xx xx xx xx x	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13  formula 1 (26)(30)	2K =   0.04] =   0.04] =   =   =   =     =	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84 ue)+0.04] a	as given in (2) + (32a).: Medium	kJ/m²-l paragraph (32e) =	7 3.2 44.5 6231. 250	kJ/K (26) (27) (27) (28) (29) (30) (31)  1 (33) 67 (34) (35)
Doors Windows Typ Windows Typ Floor Walls Roof Total area of * for windows an ** include the are Fabric heat lo Heat capacity Thermal mass For design asses	area  e 1  e 2  86.  37.2 elements d roof wind eas on both eas, W/K  Cm = Se s parame ssments wheed of a de	6 23 23 25, m² 26 sides of ir 27 s (A x k) 28 seter (TMF) 28 seter the decent tailed calculation (X Y)	13 0 effective winternal wall U) $P = Cm + \frac{1}{2}$ tails of the culation. culated to	gs Indow U-ve Is and pan TFA) in construction	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calculations  a kJ/m²K  pendix kine are not	x1 x1 x1 x1 x1 xx xx xx xx xx xx xx xx x	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13  formula 1 (26)(30)	2K =   0.04] =   0.04] =   =   =   =     =	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84 ue)+0.04] a	as given in (2) + (32a).: Medium	kJ/m²-l paragraph (32e) =	1 3.2 44.5 6231.	kJ/K (26) (27) (27) (28) (29) (30) (31)  1 (33) 67 (34) (35)
Doors Windows Typ Windows Typ Floor Walls Roof Total area of * for windows an ** include the are Fabric heat lo Heat capacity Thermal mass For design asses can be used inst Thermal bridge	area  e 1  e 2  86.  37.2 elements d roof wind eas on both eas, W/K  Cm = Si s parame ssments whe ead of a de ges : S (L nal bridging	6 23 23 25, m² 26 sides of ir 27 s (A x k) 28 seter (TMF) 28 seter the decent tailed calculation (X Y)	13 0 effective winternal wall U) $P = Cm + \frac{1}{2}$ tails of the culation. culated to	gs Indow U-ve Is and pan TFA) in construction	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calculations  a kJ/m²K  pendix kine are not	x1 x1 x1 x1 x1 xx xx xx xx xx xx xx xx x	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13  formula 1 (26)(30)	2K	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84 ue)+0.04] a	as given in (2) + (32a).: Medium	kJ/m²-l paragraph (32e) =	7 3.2 44.5 6231. 250	kJ/K (26) (27) (27) (28) (29) (30) (31)  1 (33) 67 (34) (35)
Doors Windows Typ Windows Typ Floor Walls Roof Total area of * for windows an ** include the are Fabric heat lo Heat capacity Thermal mass For design asses can be used inst Thermal bridg if details of them	area  e 1  e 2  86.  37.2 elements d roof wind eas on both eas, W/K  CCm = Si s parame essments whe ead of a de ges : S (L nal bridging eat loss	(m²)  6  23  a, m²  ows, use e sides of ir  = S (A x (A x k)  eter (TMF)  ere the de tailed calculum (a x Y)	affective winternal walk  U)  P = Cm - tails of the culation.  culated to cown (36) =	gs  ndow U-ve ls and pan  - TFA) ir  construct  using Ap  = 0.15 x (3	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calculations  a kJ/m²K  pendix kine are not	x1 x1 x1 x1 x1 xx xx xx xx xx xx xx xx x	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13  formula 1 (26)(30)	2K	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84 ue)+0.04] a tive Value	as given in (2) + (32a).: Medium	paragraph(32e) =	7 3.2 44.5 6231. 250	kJ/K (26) (27) (27) (28) (29) (30) (31)  1 (33) 67 (34) (35)
Doors Windows Typ Windows Typ Floor Walls Roof Total area of * for windows an ** include the are Fabric heat lo Heat capacity Thermal mass For design asses can be used inst Thermal bridg if details of them Total fabric he	area  e 1  e 2  86.  37.2 elements d roof wind eas on both eas, W/K  CCm = Si s parame essments whe ead of a de ges : S (L nal bridging eat loss	(m²)  6  23  a, m²  ows, use e sides of ir  = S (A x (A x k)  eter (TMF)  ere the de tailed calculum (a x Y)	affective winternal walk  U)  P = Cm - tails of the culation.  culated to cown (36) =	gs  ndow U-ve ls and pan  - TFA) ir  construct  using Ap  = 0.15 x (3	A ,r  1.75  3.72  7.53  37.23  73.6  37.23  161.0  alue calculations  a kJ/m²K  pendix kine are not	x1 x1 x1 x1 x1 xx xx xx xx xx xx xx xx x	W/m2  1.5 /[1/( 1.4 )+ /[1/( 1.4 )+  0.12  0.24  0.13  formula 1 (26)(30)	2K	(W/l 2.625 4.93 9.98 4.4676 17.66 4.84  1e)+0.04] a  tive Value e values of	as given in (2) + (32a).: Medium	paragraph(32e) =	7 3.2 44.5 6231. 250	kJ/K (26) (27) (27) (28) (29) (30) (31)  1 (33) 67 (34) (35)

79.64

80.04

(39)m = (37) + (38)m

79.27

78.24

78.73



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Heat loss parameter (H	HLP), W	/m²K					(40)m	= (39)m ÷	· (4)			
(40)m= 1.09 1.08	1.08	1.07	1.06	1.05	1.05	1.05	1.06	1.06	1.07	1.07		
Number of days in mo	nth (Tab	le 1a)					,	Average =	Sum(40) <sub>1.</sub>	12 /12=	1.07	(40)
Jan Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m= 31 28	31	30	31	30	31	31	30	31	30	31		(41)
	•	•							•			
4. Water heating ene	rgy requ	irement:								kWh/ye	ear:	
Assumed occupancy, if TFA > 13.9, N = 1 if TFA £ 13.9, N = 1		: [1 - exp	(-0.0003	349 x (TF	FA -13.9	)2)] + 0.0	0013 x (T	ΓFA -13		35		(42)
Annual average hot wa Reduce the annual average not more that 125 litres per	hot water	usage by	5% if the a	lwelling is	designed t			se target o		.73		(43)
Jan Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per							Oop			200	l	
(44)m= 104.21 100.42	96.63	92.84	89.05	85.26	85.26	89.05	92.84	96.63	100.42	104.21		
									m(44) <sub>112</sub> =		1136.81	(44)
Energy content of hot water	used - cal	culated m	onthly = 4.	190 x Vd,r	n x nm x C	Tm / 3600	) kWh/mon	nth (see Ta	ables 1b, 1	c, 1d)	•	
(45)m= 154.54 135.16	139.47	121.59	116.67	100.68	93.29	107.06	108.34	126.26	137.82	149.66		<b>—</b>
If instantaneous water heati	ng at point	t of use (no	hot water	storage),	enter 0 in	boxes (46 <sub>)</sub>		Total = Su	m(45) <sub>112</sub> =		1490.54	(45)
(46)m= 0 0	0	0	0	0	0	0	0	0	0	0		(46)
Water storage loss:			I.								•	
Storage volume (litres)					•		ame ves	sel	0			(47)
If community heating a Otherwise if no stored			0,			` '	ora) onto	or 'O' in /	( <b>47</b> )			
Water storage loss:	not wate	וו פוווו) וכ	iciuues i	iistaiitai	ieous co	יווטט וטוויוי	ers) erite	51 0 111 (	41)			
a) If manufacturer's de	eclared I	oss facto	or is kno	wn (kWh	n/day):				0.	54		(48)
Temperature factor fro	m Table	2b								0		(49)
Energy lost from water	storage	, kWh/ye	ear			(48) x (49)	) =			0		(50)
b) If manufacturer's de		•									i İ	
Hot water storage loss If community heating s			le 2 (KVV	n/litre/da	ıy)					0		(51)
Volume factor from Ta		011 4.0								0		(52)
Temperature factor fro	m Table	2b							<b>—</b>	0		(53)
Energy lost from water	storage	, kWh/ye	ear			(47) x (51)	x (52) x (	53) =		0		(54)
Enter (50) or (54) in (5	55)								0.	59		(55)
Water storage loss cal	culated t	for each	month			((56)m = (	55) × (41)r	m				
(56)m= 18.41 16.63	18.41	17.82	18.41	17.82	18.41	18.41	17.82	18.41	17.82	18.41		(56)
If cylinder contains dedicate	d solar sto	rage, (57)	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Append	ix H	
(57)m= 18.41 16.63	18.41	17.82	18.41	17.82	18.41	18.41	17.82	18.41	17.82	18.41		(57)
Primary circuit loss (ar	•									0		(58)
Primary circuit loss cal			,	•	. ,	, ,		v 4h a ==== =	otot\			
(modified by factor f				i	i	<u> </u>		i	<del> </del>	0		(59)
(59)m= 0 0	0	0	0	0	0	0	0	0	0	0		(33)

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Combi l	oss cal	culated	for each	month (	(61)m =	(60) ÷ 36	65 × (41)	)m						
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
Total he	eat requ	ired for	water he	eating ca	alculated	for eac	n month	(62)m =	0.85 ×	(45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m=	149.77	131.52	136.97	121.18	117.59	103.4	97.71	109.41	109.91	125.73	134.96	145.63		(62)
Solar DH\	W input c	alculated	using Appe	endix G or	Appendix	H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)	•	
(add ad	ditional	lines if	FGHRS	and/or V	WWHRS	applies	, see Ap	pendix (	3)					
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
FHRS	10.57	9.24	9.54	8.32	7.98	6.89	6.38	7.32	7.41	8.64	9.43	10.24		(63) (G2)
Output f	from wa	ater hea	ter											
(64)m=	140.73	123.58	128.73	113.92	110.57	97.27	91.95	102.91	103.35	118.19	126.83	136.84		_
			-		-	-	-	Outp	out from w	ater heate	r (annual)₁	12	1394.89	(64)
Heat ga	ains fror	n water	heating,	kWh/mo	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m	n] + 0.8 x	x [(46)m	+ (57)m	+ (59)m	]	
(65)m=	47.57	42.03	44.37	40.09	39.52	35.65	34.56	37.48	37.28	41.56	43.54	46.53		(65)
includ	de (57)r	n in calc	culation c	of (65)m	only if o	ylinder i	s in the	dwelling	or hot w	ater is f	om com	munity h	eating	
5. Inte	ernal ga	ins (see	Table 5	and 5a)	):									
Metabol	lic gain	s (Table	5), Watt	S										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	117.47	117.47	117.47	117.47	117.47	117.47	117.47	117.47	117.47	117.47	117.47	117.47		(66)
Lighting	gains	(calcula	ted in Ap	pendix l	L, equat	ion L9 o	r L9a), a	lso see	Table 5					
(67)m=	18.99	16.86	13.72	10.38	7.76	6.55	7.08	9.2	12.35	15.68	18.31	19.52		(67)
Appliand	ces gai	ns (calc	ulated in	Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5			•	
(68)m=	207.48	209.63	204.2	192.65	178.07	164.37	155.22	153.06	158.49	170.04	184.62	198.32		(68)
Cooking	g gains	(calcula	ited in Ap	pendix	L, equat	tion L15	or L15a	, also se	ee Table	5				
(69)m=	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.75		(69)
Pumps	and far	ns gains	(Table 5	ia)		-		-	-		-	-		
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0		(70)
Losses	e.g. ev	aporatio	n (negat	ive valu	es) (Tab	le 5)							•	
(71)m=	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97		(71)
Water h	eating	gains (T	able 5)											
(72)m=	63.94	62.54	59.64	55.69	53.12	49.51	46.45	50.38	51.77	55.86	60.48	62.55		(72)
Total in	nternal	gains =				(66)	m + (67)m	ı + (68)m -	+ (69)m +	(70)m + (7	'1)m + (72)	m	•	
(73)m=	348.64	347.27	335.79	316.96	297.2	278.68	266.98	270.88	280.86	299.82	321.64	338.62		(73)
6. Sola	ar gains	:												
Solar ga	ains are c	alculated	using solar	flux from	Table 6a	and assoc	ated equa	tions to co	onvert to th	ne applicat		ion.		
Orientat		ccess Fable 6d		Area m²		Flu Tal	x ole 6a	Т	g_ able 6b	Т	FF able 6c		Gains (W)	
				3.7	′2	x 1	1.28	x	0.63	x	0.7	=	12.83	(81)
Northwes	St 0.9x	0.77	X	3.7									. —	
Northwes	느	0.77	^	7.5			1.28	x	0.63	<b>-</b> x -	0.7	=	25.97	(81)
	st <sub>0.9x</sub>				53	x 1	1.28	x x		x	0.7	= =		(81) (81)

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Northwest 0.9x (81)х x x 0.77 х 3.72 41.38 0.63 0.7 = 47.04 Northwest 0.9x (81)х 0.77 7.53 41.38 х 0.63 0.7 95.22 Northwest 0.9x (81)0.77 3.72 67.96 Х 0.63 Х 0.7 77.26 Northwest 0.9x (81)0.77 7.53 67.96 х 0.63 Х 0.7 156.38 Northwest 0.9x 0.77 3.72 91.35 0.63 0.7 103.85 (81) Northwest 0.9x 210.21 (81)0.77 7.53 91.35 0.63 0.7 Northwest 0.9x 0.77 3.72 97.38 0.63 0.7 110.71 (81)Northwest 0.9x 224.11 (81)0.77 7.53 97.38 0.63 0.7 Northwest 0.9x 0.77 3.72 91.1 0.63 0.7 103.57 (81)Northwest 0.9x (81)0.77 7.53 91.1 0.63 0.7 209.65 Northwest 0.9x (81) 0.77 3.72 72.63 0.63 82.57 0.7 Northwest 0.9x (81)0.77 7.53 72.63 0.63 0.7 167.13 Northwest 0.9x 50.42 0.63 0.7 57.32 (81)0.77 3.72 Х X Northwest 0.9x (81)0.77 7.53 50.42 х 0.63 Х 0.7 116.03 Northwest 0.9x (81)х х 3.72 28.07 0.63 0.7 31 91 0.77 Northwest 0.9x (81)0.77 Х 7.53 Х 28.07 х 0.63 x 0.7 = 64.59 Northwest 0.9x (81)3.72 0.7 16.14 0.77 14.2 х 0.63 X Northwest 0.9x (81)0.77 Х 7.53 14.2 Х 0.63 Х 0.7 = 32.67 Northwest 0.9x (81)0.77 3.72 9.21 Х 0.63 Х 0.7 10.48 Northwest 0.9x 0.77 7.53 9.21 Х 0.63 0.7 21.2 (81)Solar gains in watts, calculated for each month (83)m = Sum(74)m ...(82)m334.82 313.22 (83)(83)m =38.79 78.96 142.27 233.64 314.06 249.7 173.35 48.81 31.68 Total gains – internal and solar (84)m = (73)m + (83)m watts 613.5 (84)387.43 426.24 478.06 550.61 611.26 580.2 520.59 454.21 396.32 370.45 370.3 (84)m =7. Mean internal temperature (heating season) (85)Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 Utilisation factor for gains for living area, h1,m (see Table 9a) Oct Jan Feb Mar May Sep Nov Apr Jun Jul Aug Dec 0.99 0.98 0.58 (86)(86)m =1 0.91 0.75 0.66 0.91 0.99 1 1 Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)19.77 19.89 20.12 20.46 20.77 20.95 20.99 20.98 20.83 20.45 20.06 19.75 (87)m =Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)(88)m =20.01 20.01 20.02 20.03 20.03 20.04 20.04 20.04 20.04 20.03 20.03 20.02 Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)(89)m =0.99 0.97 0.87 0.66 0.46 0.54 0.85 0.98 1 Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m =18.88 19 19.23 19.58 19.87 20.01 20.04 20.03 19.93 19.18 18.88 (90)19.57  $fLA = Living area \div (4) =$ (91)0.25 Mean internal temperature (for the whole dwelling) =  $fLA \times T1 + (1 - fLA) \times T2$ (92)(92)m =19.11 19.22 19.46 19.8 20.09 20.25 20.28 20.27 19.79 19.4 20.16 19.1 Apply adjustment to the mean internal temperature from Table 4e, where appropriate



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(93)m=	19.11	19.22	19.46	19.8	20.09	20.25	20.28	20.27	20.16	19.79	19.4	19.1		(93)
8. Spa	ace hea	ting requ	uirement											
				•		ned at st	ep 11 of	Table 9	o, so tha	t Ti,m=(	76)m an	d re-calc	culate	
tne ut			or gains			lup	1	۸۰۰۵	Con	Oct	Nov	Doo		
l Itilies	Jan	Feb	Mar ains, hm	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(94)m=	1	1	0.99	0.97	0.88	0.68	0.49	0.57	0.86	0.98	1	1		(94)
			W = (94)											. ,
(95)m=	386.74	424.83	473.82	531.66	535.43	418.59	284.85	295.96	392.09	389.21	369.15	369.79		(95)
Month	nly avera	age exte	rnal tem	perature	from T	able 8	<u> </u>	ļ.				ļ		
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat	loss rate	for mea	an intern	al tempe	erature,	Lm , W =	=[(39)m	x [(93)m	– (96)m	]			ı	
(97)m=	1197.59	1155.35	1042.33	866.03	665.39	442.8	288.21	302.96	477.16	728.62	979.72	1192.27		(97)
Space	e heating	g require	ement fo	r each n	nonth, k	Wh/mon	th = 0.02	24 x [(97)	)m – (95	)m] x (4 <sup>-</sup>	1)m			
(98)m=	603.27	490.9	422.97	240.74	96.7	0	0	0	0	252.52	439.61	611.93		
								Tota	l per year	(kWh/year	r) = Sum(9	8)15,912 =	3158.63	(98)
Space	e heating	g require	ement in	kWh/m²	<sup>2</sup> /year								42.42	(99)
8c. Sp	pace co	oling rec	luiremen	nt										
Calcu	lated for	r June, J	July and	August.	See Tal	ble 10b								
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Heat	loss rate	ELm (ca	lculated	using 2	5°C inte	nal tem	perature	and exte	ernal ten	nperatur	e from T	able 10)		
(100)m=	0	0	0	0	0	736.96	580.16	594.62	0	0	0	0		(100)
Utilisa	ation fac	tor for lo	ss hm										•	
(101)m=	0	0	0	0	0	0.88	0.93	0.9	0	0	0	0		(101)
Usefu	l loss, h	mLm (V	/atts) = (	(100)m x	(101)m	<u> </u>	,	,			T	1	Ī	
(102)m=		0	0	0	0	646.01	541.34	535.35	0	0	0	0		(102)
					i e			e Table					1	
(103)m=		0	0	0	0	801.01	760.35	692.13	0	0	0	0		(103)
			ement fo. 104)m <			dwelling,	continu	ous ( kW	h') = 0.0	24 x [(10	03)m – (	102)m ] x	x (41)m	
(104)m=	0	0	0	0	0	111.6	162.94	116.64	0	0	0	0		
'									Total	= Sum(	104)	=	391.18	(104)
	fraction								f C =	cooled	area ÷ (4	4) =	1	(105)
			able 10b										1	
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0		_
0 -					(404)	(405)	(400)		Total	' = Sum(	104)	=	0	(106)
	Ť	<u> </u>	nent for		<del>`                                    </del>	<del>- `                                   </del>	<del></del>	1		0			1	
(107)m=	0	0	0	0	0	27.9	40.74	29.16	0 Total	0 - Sum(	107)	0	07.0	(407)
										= Sum(	IUI )	=	97.8	(107)
•		•	nent in k		•				` ′	÷ (4) =			1.31	(108)
				alculated	Tonly un	der spec	cial conc	litions, s		· ·				
Fabrio	c Energy	/ Efficier	ncy						(99) -	+ (108) =	=		43.73	(109)



David Oldham **Assessor Name: Stroma Number:** STRO007778

Assessor Name:	David Oldham	Stron	na Num	ber:		007778	
Software Name:	Stroma FSAP 2012	Softw	are Ve	sion:	Versio	n: 1.0.1.1	
	Pro	operty Addres	s: Plot 1				
Address :	Plot 1, Macs Cafe Site						
1. Overall dwelling dime	nsions:						
		Area(m²)	_	Av. Heigh	<del>``</del>	Volume(m <sup>3</sup>	<u> </u>
Ground floor		37.23	(1a) x	2.4	(2a) =	89.35	(3a)
First floor		37.23	(1b) x	2.6	(2b) =	96.8	(3b)
Total floor area TFA = (1a	a)+(1b)+(1c)+(1d)+(1e)+(1n)	74.46	(4)				
Dwelling volume			(3a)+(3b	)+(3c)+(3d)+(3	3e)+(3n) =	186.15	(5)
2. Ventilation rate:							
	main secondary heating heating	other		total		m³ per hou	r
Number of chimneys	0 + 0	+ 0	=	0	x 40 =	0	(6a)
Number of open flues	0 + 0	+ 0	=	0	x 20 =	0	(6b)
Number of intermittent fa	ns			3	x 10 =	30	(7a)
Number of passive vents				0	x 10 =	0	(7b)
Number of flueless gas fi	res			0	x 40 =	0	(7c)
					Air ch	anges per ho	our
Infiltration due to chimne	ys, flues and fans = $(6a)+(6b)+(7a)$	(7b)+(7c) =	Γ	30	÷ (5) =	0.16	(8)
If a pressurisation test has b	een carried out or is intended, proceed	to (17), otherwise	continue fr	om (9) to (16)			
Number of storeys in the	ne dwelling (ns)					0	(9)
Additional infiltration					[(9)-1]x0.1 =	0	(10)
	.25 for steel or timber frame or (		•	uction		0	(11)
if both types of wall are pu deducting areas of openir	resent, use the value corresponding to t	the greater wall ar	rea (after				
	loor, enter 0.2 (unsealed) or 0.1	(sealed), else	e enter 0			0	(12)
If no draught lobby, en		,,,				0	(13)
•	s and doors draught stripped					0	(14)
Window infiltration	0 11	0.25 - [0	.2 x (14) ÷ 1	00] =		0	(15)
Infiltration rate		(8) + (10	) + (11) + (1	2) + (13) + (1	5) =	0	(16)
Air permeability value,	q50, expressed in cubic metres	per hour per	square m	etre of enve	elope area	4	(17)
•	ity value, then $(18) = [(17) \div 20] + (8)$	•	•		·	0.36	(18)
Air permeability value applie	s if a pressurisation test has been done	or a degree air p	ermeability	is being used			
Number of sides sheltere	d					1	(19)
Shelter factor		(20) = 1	- [0.075 x (1	9)] =		0.92	(20)
Infiltration rate incorporat	ing shelter factor	(21) = (1	8) x (20) =			0.33	(21)
Infiltration rate modified f	or monthly wind speed						

Infiltra	tion rate	modified	d for mo	nthly wir	nd speed	]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthl	y avera	ge wind	speed fr	om Tabl	e 7							
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Heat transfer coefficient, W/K

80.66

80.45

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79.45

79.27

78.4

78.4

78.24

80.88

(39)m =

### DER WorkSheet: New dwelling design stage



david @doec.co.uk Wind Factor  $(22a)m = (22)m \div 4$ 1.27 0.95 (22a)m: 1.25 1.23 1.08 0.95 0.92 1.08 1.12 1.18 Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m 0.42 0.41 0.37 0.36 0.32 0.32 0.33 0.36 0.38 0.39 Calculate effective air change rate for the applicable case If mechanical ventilation: (23a) 0 If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0 (23b) If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 − (23c) ÷ 100] (24a)m: 0 0 (24a)b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b) (24b)m 0 0 0 (24b)c) If whole house extract ventilation or positive input ventilation from outside if  $(22b)m < 0.5 \times (23b)$ , then (24c) = (23b); otherwise  $(24c) = (22b)m + 0.5 \times (23b)$ (24c)(24c)m =0 0 0 0 0 0 0 0 d) If natural ventilation or whole house positive input ventilation from loft if (22b)m = 1, then (24d)m = (22b)m otherwise  $(24d)m = 0.5 + [(22b)m^2 \times 0.5]$ (24d)m =0.59 0.59 0.58 0.56 0.55 0.55 0.55 0.56 0.57 0.58 (24d)0.56 Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25) (25)m =0.58 0.57 0.56 0.55 (25)0.56 0.58 3. Heat losses and heat loss parameter: **ELEMENT** Gross Openings Net Area **U-value** AXUk-value AXkkJ/m<sup>2</sup>·K kJ/K area (m²) m<sup>2</sup> A,m<sup>2</sup> W/m2K (W/K) Doors (26)1.5 2.625 1.75 Windows Type 1  $\chi 1/[1/(1.4) + 0.04] =$ 3.72 4.93 (27)Windows Type 2  $\chi 1/[1/(1.4) + 0.04]$ (27)7.53 9.98 Floor 37.23 0.12 4.4676 (28)Walls 86.6 13 73.6 0.24 17.66 (29)Roof (30)37.23 0 37.23 0.13 4.84 Total area of elements, m<sup>2</sup> 161.06 (31)\* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2 \*\* include the areas on both sides of internal walls and partitions (26)...(30) + (32) =Fabric heat loss,  $W/K = S(A \times U)$ (33)44.51 Heat capacity  $Cm = S(A \times k)$ ((28)...(30) + (32) + (32a)...(32e) =(34)6231.67 Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium (35)250 For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation. Thermal bridges: S (L x Y) calculated using Appendix K 0.08 (36)if details of thermal bridging are not known (36) =  $0.15 \times (31)$ Total fabric heat loss (33) + (36) =(37)44.59 Ventilation heat loss calculated monthly (38)m =  $0.33 \times (25)$ m x (5)Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (38)(38)m =36.29 36.07 35.86 34.86 34.68 33.81 33.81 33.65 34.14 34.68 35.05 35.45

79.64

80.04

(39)m = (37) + (38)m

79.27

78.73



Heat los	ss parar	meter (H	HLP), W/	′m²K					(40)m	= (39)m ÷	- (4)			
(40)m=	1.09	1.08	1.08	1.07	1.06	1.05	1.05	1.05	1.06	1.06	1.07	1.07		
Number	r of days	s in mor	nth (Tabl	le 1a)	•	•	•	•	,	Average =	Sum(40) <sub>1</sub> .	12 /12=	1.07	(40)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)
_	•									•	•			
4. Wat	er heati	ng ener	gy requi	rement:								kWh/ye	ear:	
if TFA	ed occup A > 13.9 A £ 13.9	, N = 1	N + 1.76 x	[1 - exp	(-0.0003	349 x (TF	FA -13.9	)2)] + 0.0	0013 x (¯	TFA -13		35		(42)
Reduce th	he annual	l average	ater usag hot water person per	usage by	5% if the a	lwelling is	designed t			se target o		.73		(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water	r usage in	litres per	day for ea	ach month	Vd,m = fa	ctor from T	Table 1c x	(43)		_				
(44)m=	104.21	100.42	96.63	92.84	89.05	85.26	85.26	89.05	92.84	96.63	100.42	104.21		_
Energy co	ontent of I	hot water	used - cal	culated m	onthly = $4$ .	190 x Vd,r	n x nm x D	)Tm / 3600			m(44) <sub>112</sub> = ables 1b, 1		1136.81	(44)
	154.54	135.16	139.47	121.59	116.67	100.68	93.29	107.06	108.34	126.26	137.82	149.66		
( · · · / · · · L				1-11-1					l		m(45) <sub>112</sub> =		1490.54	(45)
lf instanta _	aneous wa	ater heatii	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46	) to (61)			, '		
	23.18	20.27	20.92	18.24	17.5	15.1	13.99	16.06	16.25	18.94	20.67	22.45		(46)
	torage l		includin	na anv so	olar or W	/WHRS	storage	within sa	ame ves	sel	0			(47)
Ū		` ,	nd no ta	•			Ū							()
		-	hot wate		-			' '	ers) ente	er '0' in (	(47)			
	torage l													
			eclared l		or is kno	wn (kWh	n/day):				0.	54		(48)
•			m Table									0		(49)
• • •			storage clared o	-		or ic not		(48) x (49)	) =			0		(50)
•			factor fr	-								0		(51)
	-	-	ee section	on 4.3										
Volume				2h								0		(52)
•			m Table					(47) (54)	· · · (EQ) · · · (	50)		0		(53)
٠.	10st from 50) or (8		storage	, KVVN/ye	ear			(47) x (51)	) X (52) X (	53) =		0 59		(54) (55)
,	, ,	, ,	culated f	or each	month			((56)m = (	55) × (41):	m	0.	39		(00)
	18.41	16.63	18.41	17.82	18.41	17.82	18.41	18.41	17.82	18.41	17.82	18.41		(56)
(56)m= f cylinder												m Append	x H	(50)
(57)m=	18.41	16.63	18.41	17.82	18.41	17.82	18.41	18.41	17.82	18.41	17.82	18.41		(57)
	circuit	lose (an	nual) fro	m Table	. 3					ı		0		(58)
•		•	culated f			59)m = (	(58) ÷ 36	65 × (41)	m		<u> </u>	~		(30)
•			om Tabl		,	•	. ,	, ,		r thermo	stat)			
(	,													



Combi loss calculated for each month (61)m = (60) + 365 x (41)m (61)m = (837	0 1.					(0.4)	(00)	05 (44)							
Total heat required for water heating calculated for each month (62)m = 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m (62)m    (62)m   179.32   157.54   164.04   145.14   140.76   123.76   117.14   131.14   131.88   150.82   161.8   174.44    (62)  Solar DHW input calculated using Appendix Or Appendix H (regardive quantity) (enter 0' if no solar contribution to water heating) (add additional lines if FCHFRS and/or WH/RS applies, see Appendix O)    (63)m   0   0   0   0   0   0   0   0   0			r			<u> </u>	<del>`</del>	<del>``</del>		F 70	L c 46	C 40	0.07	1	(61)
(62)ms 179.32 157.54 164.04 145.14 140.76 123.76 117.14 131.14 131.88 150.82 161.8 174.44 (62)  Solar DPW injout calculated using Appendux G or Appendix H (negative quantity) (enter "0" if no solar contribution to water heating)  (63)ms 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			<u> </u>	<u> </u>		<u> </u>		<u> </u>	ļ	<u> </u>		<u> </u>		(F0)m + (61)m	(01)
Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter "0" if no solar contribution to water heating) (add additional lines if FGHRS and/or WWHRS applies, see Appendix G) (63)ms    0						·			<del>`</del>		<del>`                                    </del>	<del>`                                    </del>	<del>`</del>	(59)III + (61)III ]	(62)
California			l	L			l	<u> </u>			l			]	(02)
(63)me											i continua	ion to wate	or neating)		
Output from water heater (64)ms   153.76   135.98   143.7   130.01   130.54   117.63   111.38   124.64   125.33   135.17   141.2   149  Output from water heater (annual)	`						<del></del>	· ·	<del></del>	ŕ	0	0	0	]	(63)
	FHRS	27.09	22.88	21.65	16.19	11.19	6.89	6.38	7.32	7.41	16.76	21.89	26.89	I	(63) (G2)
	Output	from w	ater hea	ter											
Heat gains from water heating, kWh/month 0.25 * [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]   (65)m	-				130.01	130.54	117.63	111.38	124.64	125.33	135.17	141.2	149	]	
(65)me 67.71 59.68 62.64 56.12 54.94 49.05 47.11 51.75 51.71 58.25 61.62 66.09 (65) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating  5. Internal gains (see Table 5 and 5a):  Metabolic gains (Table 5), Watts    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec									Out	out from w	ater heate	r (annual) <sub>1</sub>	12	1598.33	(64)
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating  5. Internal gains (see Table 5 and 5a):  Metabolic gains (Table 5), Watts    May	Heat g	ains froi	m water	heating,	kWh/m	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m	n] + 0.8 x	k [(46)m	+ (57)m	+ (59)m	1]	_
Metabolic gains (rable 5), Watts    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec	(65)m=	67.71	59.68	62.64	56.12	54.94	49.05	47.11	51.75	51.71	58.25	61.62	66.09		(65)
Metabolic qains (Table 5), Watts    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec	inclu	ıde (57)ı	m in cal	culation of	of (65)m	only if c	ylinder i	s in the o	dwelling	or hot w	ater is fr	om com	munity h	neating	
Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec   117.47   1	5. Int	ternal ga	ains (see	Table 5	and 5a	):									
Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec   117.47   1	Metabo	olic gain	s (Table	5). Wat	ts										
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 (67)m=						May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(67)me	(66)m=	117.47	117.47	117.47	117.47	117.47	117.47	117.47	117.47	117.47	117.47	117.47	117.47		(66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5  (88)m= 207.48   209.63   204.2   192.65   178.07   164.37   155.22   153.06   158.49   170.04   184.62   198.32   (68)  Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5  (89)m= 34.75   34.75	Lightin	g gains	(calcula	ted in Ap	pendix	L, equat	ion L9 o	r L9a), a	lso see	Table 5	•		•	•	
(68)m= 207.48	(67)m=	18.99	16.86	13.72	10.38	7.76	6.55	7.08	9.2	12.35	15.68	18.31	19.52		(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 (69)m= 34.75  34.75	Applia	nces ga	ins (calc	ulated in	Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5			•	
(69)m= 34.75 34.75 34.75 34.75 34.75 34.75 34.75 34.75 34.75 34.75 34.75 34.75 34.75 34.75 34.75 34.75 34.75 (69)  Pumps and fans gains (Table 5a)  (70)m= 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	(68)m=	207.48	209.63	204.2	192.65	178.07	164.37	155.22	153.06	158.49	170.04	184.62	198.32		(68)
Pumps and fans gains (Table 5a) (70)m= 3	Cookir	ng gains	(calcula	ted in A	ppendix	L, equa	tion L15	or L15a)	, also se	ee Table	5		•	•	
(70)m= 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	(69)m=	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.75		(69)
Losses e.g. evaporation (negative values) (Table 5) (71)m=	Pumps	and far	ns gains	(Table 5	 5a)										
(71)m=	(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Water heating gains (Table 5)  (72)m= 91 88.82 84.2 77.94 73.85 68.12 63.32 69.55 71.82 78.29 85.59 88.83  (72)  Total internal gains =	Losses	e.g. ev	aporatio	n (nega	tive valu	es) (Tab	le 5)								
(72)m=       91       88.82       84.2       77.94       73.85       68.12       63.32       69.55       71.82       78.29       85.59       88.83       (72)         Total internal gains =       (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m         (73)m=       378.71       376.55       363.36       342.22       320.92       300.28       286.86       293.06       303.9       325.26       349.75       367.9       (73)         6. Solar gains:         Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.         Orientation: Access Factor Table 6d       Area Flux g_ FF Gains Table 6c       FF Gains (W)         Northwest 0.9x	(71)m=	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97	-93.97		(71)
Total internal gains =	Water	heating	gains (T	able 5)							-	-	-		
(73)m= 378.71 376.55 363.36 342.22 320.92 300.28 286.86 293.06 303.9 325.26 349.75 367.9 (73)  6. Solar gains:  Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.  Orientation: Access Factor Area Flux g_ FF Gains Table 6d Table 6c (W)  Northwest 0.9x 0.77 x 3.72 x 11.28 x 0.63 x 0.7 = 12.83 (81)  Northwest 0.9x 0.77 x 7.53 x 11.28 x 0.63 x 0.7 = 25.97 (81)  Northwest 0.9x 0.77 x 3.72 x 22.97 x 0.63 x 0.7 = 26.11 (81)	(72)m=	91	88.82	84.2	77.94	73.85	68.12	63.32	69.55	71.82	78.29	85.59	88.83		(72)
Solar gains:  Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.  Orientation: Access Factor Table 6d $m^2$ Flux $g_{-}$ FF Gains Table 6b Table 6c $(W)$ Northwest $0.9x$ $0.77$ $\times$ $3.72$ $\times$ $11.28$ $\times$ $0.63$ $\times$ $0.7$ $=$ $12.83$ $(81)$ Northwest $0.9x$ $0.77$ $\times$ $7.53$ $\times$ $11.28$ $\times$ $0.63$ $\times$ $0.7$ $=$ $25.97$ $(81)$ Northwest $0.9x$ $0.77$ $\times$ $3.72$	Total i	nternal	gains =	:		-	(66)	m + (67)m	ı + (68)m -	+ (69)m +	(70)m + (7	1)m + (72)	)m		
Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.  Orientation: Access Factor Area Flux $g_{-}$ FF Gains Table 6d $m^2$ Table 6a Table 6b Table 6c (W)  Northwest $0.9x$ 0.77 × 3.72 × 11.28 × 0.63 × 0.7 = 12.83 (81)  Northwest $0.9x$ 0.77 × 7.53 × 11.28 × 0.63 × 0.7 = 25.97 (81)  Northwest $0.9x$ 0.77 × 3.72 × 22.97 × 0.63 × 0.7 = 26.11 (81)	(73)m=	378.71	376.55	363.36	342.22	320.92	300.28	286.86	293.06	303.9	325.26	349.75	367.9		(73)
Orientation:         Access Factor Table 6d         Area m²         Flux Table 6a $g_{-}$ Table 6b         FF Table 6c         Gains (W)           Northwest $0.9x$ $0.77$ $\times$ 3.72 $\times$ 11.28 $\times$ 0.63 $\times$ 0.7 $=$ 12.83         (81)           Northwest $0.9x$ $0.77$ $\times$ 7.53 $\times$ 11.28 $\times$ 0.63 $\times$ 0.7 $=$ 25.97         (81)           Northwest $0.9x$ $0.77$ $\times$ 3.72 $\times$ 22.97 $\times$ 0.63 $\times$ 0.7 $=$ 26.11         (81)	6. So	lar gains	S:												
Table 6d $m^2$ Table 6a Table 6b Table 6c (W)  Northwest $0.9x$ 0.77 $\times$ 3.72 $\times$ 11.28 $\times$ 0.63 $\times$ 0.7 $=$ 12.83 (81)  Northwest $0.9x$ 0.77 $\times$ 7.53 $\times$ 11.28 $\times$ 0.63 $\times$ 0.7 $=$ 25.97 (81)  Northwest $0.9x$ 0.77 $\times$ 3.72 $\times$ 22.97 $\times$ 0.63 $\times$ 0.7 $=$ 26.11 (81)	_			•	r flux from	Table 6a		•	tions to co	onvert to th	ne applicat		tion.		
Northwest 0.9x	Orienta			actor					Т		T				
Northwest 0.9x 0.77 x 7.53 x 11.28 x 0.63 x 0.7 = 25.97 (81)  Northwest 0.9x 0.77 x 3.72 x 22.97 x 0.63 x 0.7 = 26.11 (81)	Northw	est <sub>0.9x</sub>	0.77	x	3.7	72	x 1	1.28	x	0.63	x	0.7	=	12.83	(81)
	Northw	est <sub>0.9x</sub>	0.77	X	7.5	53	x 1	1.28	x	0.63	T x F	0.7	=	25.97	(81)
Northwest 0.9x 0.77 x 7.53 x 22.07 x 0.63 x 0.7 = 52.95 (81)	Northw	est <sub>0.9x</sub>	0.77	X	3.7	72	x 2	22.97	×	0.63	T x F	0.7	<del>-</del>	26.11	(81)
7.55	Northw	est <sub>0.9x</sub>	0.77	x	7.5	53	x 2	22.97	x	0.63	x	0.7		52.85	(81)



Northwest 0.9x		_		$\neg$			1						_
	0.77	×	3.72	×	4	1.38	X	0.63	×	0.7	=	47.04	(81)
Northwest 0.9x	0.77	X	7.53	X	4	1.38	X	0.63	X	0.7	=	95.22	(81)
Northwest <sub>0.9x</sub>	0.77	X	3.72	X	6	7.96	X	0.63	X	0.7	=	77.26	(81)
Northwest <sub>0.9x</sub>	0.77	X	7.53	X	6	7.96	X	0.63	X	0.7	=	156.38	(81)
Northwest <sub>0.9x</sub>	0.77	X	3.72	X	9	1.35	X	0.63	x	0.7	=	103.85	(81)
Northwest 0.9x	0.77	X	7.53	X	9	1.35	X	0.63	x	0.7	=	210.21	(81)
Northwest 0.9x	0.77	X	3.72	X	9	7.38	x	0.63	x	0.7	=	110.71	(81)
Northwest 0.9x	0.77	x	7.53	X	9	7.38	X	0.63	x	0.7	=	224.11	(81)
Northwest 0.9x	0.77	x	3.72	X	9	91.1	x	0.63	x	0.7	=	103.57	(81)
Northwest 0.9x	0.77	X	7.53	x	9	91.1	X	0.63	x	0.7	=	209.65	(81)
Northwest 0.9x	0.77	x	3.72	x	7	2.63	x	0.63	x	0.7	=	82.57	(81)
Northwest 0.9x	0.77	x	7.53	x	7	2.63	X	0.63	x	0.7	=	167.13	(81)
Northwest 0.9x	0.77	x	3.72	x	5	0.42	x	0.63	×	0.7	=	57.32	(81)
Northwest 0.9x	0.77	x	7.53	x	5	0.42	x	0.63	x	0.7	=	116.03	(81)
Northwest 0.9x	0.77	×	3.72	×	2	8.07	x	0.63	×	0.7	_ =	31.91	(81)
Northwest 0.9x	0.77	×	7.53	×	2	8.07	x	0.63	x	0.7		64.59	(81)
Northwest 0.9x	0.77	×	3.72	×	1	14.2	x	0.63	x	0.7	=	16.14	(81)
Northwest 0.9x	0.77	x	7.53	×	1	14.2	x	0.63	x	0.7	=	32.67	(81)
Northwest 0.9x	0.77	x	3.72	×	9	9.21	х	0.63	×	0.7	=	10.48	(81)
Northwest 0.9x	0.77	x	7.53	×		9.21	х	0.63	×	0.7	=	21.2	(81)
•									_				
		1-1-1	fa., a.a.a.b	nth			(93)m	ı = Sum(74)m	(92)m				
Solar gains in	watts, caici	ılated	for each mo	ווווו			(03)11	i = Suiii(74)iii	.(02)111				
Solar gains in $(83)m = 38.79$	<del> </del>	42.27	233.64 314	-	34.82	313.22	249	<del></del>	96.5	48.81	31.68	]	(83)
Ţ	78.96	42.27	233.64 314	.06 3		313.22	ÈΈ	<del></del>		48.81	31.68	]	(83)
(83)m= 38.79	78.96 14	42.27	233.64 314	.06 3 3)m + (		313.22	ÈΈ	0.7 173.35			31.68	] ]	(83)
(83)m= 38.79 Total gains – i	78.96 14 internal and 455.51 50	42.27 solar 05.62	233.64 314 (84)m = (73 575.86 634	.06 3 3)m + (	83)m ,	313.22 , watts	249	0.7 173.35	96.5		<u> </u>	]	, ,
(83)m= 38.79 Total gains – i (84)m= 417.5	78.96 14 internal and 455.51 50 rnal tempera	solar 05.62	233.64 314 (84)m = (73 575.86 634 heating sea	.06 3 3)m + ( .98 6	83)m , 635.1	313.22 , watts 600.08	542	.76 477.25	96.5		<u> </u>	21	, ,
(83)m= 38.79  Total gains – i (84)m= 417.5  7. Mean interest	78.96 14 internal and 455.51 50 rnal tempera during hea	solar 05.62 ature (	233.64 314 (84)m = (73 575.86 634 heating sea eriods in the	.06 3 e)m + ( 98 6 son)	83)m , 635.1 area f	313.22 , watts 600.08	542	.76 477.25	96.5		<u> </u>	21	(84)
(83)m= 38.79 Total gains – i (84)m= 417.5  7. Mean inter Temperature	78.96 14 internal and 455.51 50 rnal tempera during hea ctor for gain	solar 05.62 ature (	233.64 314 (84)m = (73 575.86 634 heating sea eriods in the ving area, h	.06 3 e)m + ( 98 6 son)	83)m , 635.1 area f	313.22 , watts 600.08	542 ble 9,	.76 477.25	96.5	5 398.56	<u> </u>	21	(84)
(83)m= 38.79 Total gains – i (84)m= 417.5  7. Mean inter Temperature Utilisation fac	78.96 14 Internal and 455.51 50 Internal temperate during headotr for gain Feb	solar 05.62 ature ( ting pe	233.64 314 (84)m = (73 575.86 634 heating sea eriods in the ving area, h	.06 3 .08 (c) m + (c) .98 (c)	83)m 635.1 area f	313.22 , watts 600.08 From Tab	542 ble 9,	7.7 173.35 7.76 477.25 Th1 (°C)	96.5	5 398.56	399.58	21	(84)
(83)m= 38.79 Total gains – i (84)m= 417.5  7. Mean inte Temperature Utilisation face Jan (86)m= 1	78.96 14 Internal and 455.51 50 Internal temperate during headeter for gain Feb 1 0	solar 05.62 ature ( ting personal time of the solution of the	233.64 314 (84)m = (73 575.86 634 heating sea eriods in the ving area, h Apr M 0.97 0.	.06 3 .08 (son) .98 (son) .1,m (solution)	83)m , 635.1 area f see Ta Jun 0.73	313.22 , watts 600.08 From Tab ble 9a) Jul 0.56	542 542 ole 9,	7.7 173.35 7.76 477.25 Th1 (°C) 1.76 Sep 1.76 0.89	96.5 421.75	5 398.56 Nov	399.58	21	(84)
(83)m= 38.79 Total gains – i (84)m= 417.5  7. Mean inter Temperature Utilisation face Jan	78.96 14 Internal and 455.51 50 Internal temperate during heat actor for gain Feb 1 (all temperature)	solar 05.62 ature ( ting personal time of the solution of the	233.64 314 (84)m = (73 575.86 634 heating sea eriods in the ving area, h Apr M 0.97 0.	.06 3 .0m + ( .98 6 son) living 1,m (s lay 9	83)m , 635.1 area f see Ta Jun 0.73	313.22 , watts 600.08 From Tab ble 9a) Jul 0.56	542 542 ole 9,	7.7 173.35  7.76 477.25  Th1 (°C)  1.79 Sep 14 0.89  Table 9c)	96.5 421.75	5 398.56 Nov	399.58	21	(84)
(83)m= 38.79 Total gains – i (84)m= 417.5  7. Mean interpreture Utilisation fact  Jan (86)m= 1  Mean internations (87)m= 19.81	78.96 14 internal and 455.51 56 rnal temperate during heater for gain Feb 1 (a) 1 temperate 19.92 2	solar 05.62 ature ( ting pe s for li Mar 0.99 ure in li 0.15	233.64 314 (84)m = (73 575.86 634 heating sea eriods in the ving area, h Apr M 0.97 0. iving area T 20.49 20.	.06 3 .08 ( .98 (	83)m , 635.1 area f see Ta Jun 0.73 ow ste 20.95	313.22 , watts 600.08 From Tak ble 9a) Jul 0.56 ps 3 to 7 20.99	249 542 ole 9, 0.6 7 in T	.76 477.25  Th1 (°C)  ug Sep 4 0.89  Table 9c)  98 20.85	96.5 421.75 Oct 0.99	5 398.56 Nov	399.58  Dec 1	21	(84)
(83)m= 38.79 Total gains – i (84)m= 417.5  7. Mean inte Temperature Utilisation fac  Jan (86)m= 1  Mean interna (87)m= 19.81  Temperature	78.96 14 Internal and 455.51 50 Internal temperate during head temperature for gain 1 00 Internal temperature for gain 1	solar 05.62 ature ( ting persons for limited for limit	233.64 314 (84)m = (73 575.86 634 heating sea eriods in the ving area, h Apr M 0.97 0. iving area T 20.49 20. eriods in res	.06 3 )m + ( .98 0 son) living 1,m (s lay 9 1 (folic) 79 2	area f see Ta Jun 0.73 ow ste 20.95	313.22 , watts 600.08 From Tab ble 9a) Jul 0.56 ps 3 to 7 20.99 from Ta	249 542 542 0le 9, 0.6 7 in T 20.9	.76 477.25  .76 477.25  .Th1 (°C)  ug Sep 4 0.89  .able 9c) 98 20.85  9, Th2 (°C)	96.5 421.75 Oct 0.99	Nov 1 20.09	Dec 1	21	(84) (85) (86) (87)
(83)m= 38.79 Total gains – i (84)m= 417.5  7. Mean interpreture Utilisation fact  Jan (86)m= 1  Mean internation (87)m= 19.81  Temperature (88)m= 20.01	78.96 14 internal and 455.51 50 rnal temperate during head temperature 19.92 2 during head 20.01 2	solar 05.62 ature ( ting persons for limited for limit	233.64 314 (84)m = (73 575.86 634 heating sea eriods in the ving area, h Apr M 0.97 0. iving area T 20.49 20. eriods in res 20.03 20.	son) living 1,m (s lay 9 1 (follo	area f see Ta Jun 0.73 ow ste 20.95 velling	313.22 , watts 600.08 From Tab ble 9a) Jul 0.56 ps 3 to 7 20.99 from Ta	249 542 542 0le 9, 0.6 7 in T 20.9 able 9	.76 477.25  .76 477.25  .Th1 (°C)  .ug Sep .4 0.89  .able 9c) .98 20.85  .Th2 (°C)	96.5 421.75 Oct 0.99	Nov 1 20.09	399.58  Dec 1	21	(84)
Total gains — i (84)m= 417.5  7. Mean interpretature Utilisation fact (86)m= 1  Mean internation (87)m= 19.81  Temperature (88)m= 20.01  Utilisation fact	78.96 14 internal and 455.51 50 rnal temperate during hea ctor for gain Feb 1 ( al temperatu 19.92 2 during hea 20.01 2 ctor for gain	solar 05.62 ature ( ting pe s for li Mar 0.99 are in li 0.15 ting pe	233.64 314 (84)m = (73 575.86 634 heating sea eriods in the ving area, h Apr M 0.97 0. iving area T 20.49 20. eriods in res 20.03 20. est of dwelli	son) living 1,m (s lay 9 1 (follo 79 2 t of dv 03 2 ng, h2	83)m , 635.1 area f see Ta Jun 0.73 ow ste 20.95 velling 20.04	313.22 , watts 600.08 From Table 9a) Jul 0.56 ps 3 to 7 20.99 from Table	249 542 542 ole 9, 0.6 7 in T 20.9 able 9 20.9	.76 477.25  .76 477.25  .Th1 (°C)  .ug Sep .44 0.89  .able 9c) .98 20.85  .7 Th2 (°C) .04 20.04	96.5 421.75 Oct 0.99 20.48	Nov 1 20.09	Dec 1 19.79 20.02	21	(84) (85) (86) (87) (88)
(83)m= 38.79 Total gains – i (84)m= 417.5  7. Mean interpreture Utilisation fact  Jan (86)m= 1  Mean internation (87)m= 19.81  Temperature (88)m= 20.01	78.96 14 internal and 455.51 50 rnal temperate during hea ctor for gain Feb 1 ( al temperatu 19.92 2 during hea 20.01 2 ctor for gain	solar 05.62 ature ( ting persons for limited for limit	233.64 314 (84)m = (73 575.86 634 heating sea eriods in the ving area, h Apr M 0.97 0. iving area T 20.49 20. eriods in res 20.03 20.	son) living 1,m (s lay 9 1 (follo 79 2 t of dv 03 2 ng, h2	area f see Ta Jun 0.73 ow ste 20.95 velling	313.22 , watts 600.08 From Tab ble 9a) Jul 0.56 ps 3 to 7 20.99 from Ta	249 542 542 0le 9, 0.6 7 in T 20.9 able 9	.76 477.25  .76 477.25  .Th1 (°C)  .ug Sep .4 0.89  .able 9c) .98 20.85  .9, Th2 (°C) .04 20.04	96.5 421.75 Oct 0.99	Nov 1 20.09	Dec 1		(84) (85) (86) (87)
(83)m= 38.79  Total gains – i (84)m= 417.5  7. Mean intermediation factors (86)m= 1  Mean internation (87)m= 19.81  Temperature (88)m= 20.01  Utilisation factors (89)m= 1  Mean internation factors (89)m= 1	78.96 14 internal and 455.51 50 rnal temperate during head temperature 19.92 2 during head 20.01 2 ctor for gain 1 0 al temperature 19.92 1 ctor for gain 1 0 al temperature 1 1 0 al temperature 1 1 0 al temperature 1 1 0	solar 05.62 ature ( ting persons for li Mar 0.99 ure in li 0.15 s for re 0.99	233.64 314 (84)m = (73 575.86 634 heating sea eriods in the ving area, h Apr M 0.97 0. iving area T 20.49 20. eriods in res 20.03 20. est of dwelli 0.96 0.8	.06   3 )m + ( .98   0 son) living 1,m (s lay   9   1 (follo 79   2 t of dv 03   2 ng, h2 welling	area f see Ta Jun 0.73  ow ste 20.95  velling 20.04  ,m (se 0.64	313.22 , watts 600.08  From Table 9a) Jul 0.56 ps 3 to 7 20.99  from Ta 20.04 pe Table 0.45 pllow ste	249 542 542 0le 9, 0.6 7 in T 20.9 able 9 0.5	.76 477.25  .76 477.25  .Th1 (°C)  ug Sep .4 0.89  .able 9c) .98 20.85  .7 Th2 (°C) .04 20.04  .20.04  .32 0.83  to 7 in Table	96.5 421.75 Oct 0.99 20.48 20.03	Nov 1 20.09 20.03	Dec 1 19.79 20.02		(84) (85) (86) (87) (88) (89)
(83)m= 38.79 Total gains – i (84)m= 417.5  7. Mean interpretature Utilisation fact  (86)m= 1  Mean internation (87)m= 19.81  Temperature (88)m= 20.01  Utilisation fact (89)m= 1	78.96 14 internal and 455.51 50 rnal temperate during head temperature 19.92 2 ctor for gain 20.01 2 ctor for gain 1 00 al temperature 19.92 1 ctor for gain 1 00 al temperature 1 1 1 00 al temperature 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	solar 05.62 ature ( ting pe s for li Mar 0.99 tre in li 0.15 ting pe 0.02 s for re 0.99	233.64 314 (84)m = (73 575.86 634 heating sea eriods in the ving area, h Apr M 0.97 0. iving area T 20.49 20. eriods in res 20.03 20. est of dwelli 0.96 0.8	.06   3 )m + ( .98   0 son) living 1,m (s lay   9   1 (follo 79   2 t of dv 03   2 ng, h2 welling	area f see Ta Jun 0.73 ow ste 20.95 velling 20.04	313.22 , watts 600.08 From Table 9a) Jul 0.56 ps 3 to 7 20.99 from Ta 20.04 ee Table 0.45	249 542 542 ole 9, 0.6 7 in T 20.9 able 9 20.0 9a) 0.5	.76 477.25  .76 477.25  .Th1 (°C)  .ug Sep .4 0.89  .able 9c) .98 20.85  .7 Th2 (°C) .04 20.04  .2 0.83  .4 to 7 in Table .04 19.95	96.5  421.75  Oct 0.99  20.48  20.03  0.98  9c) 19.6	Nov 1 20.09 20.03 1 1 19.22	399.58  Dec 1 19.79 20.02 1 18.91	21	(84) (85) (86) (87) (88) (89)
(83)m= 38.79  Total gains – i (84)m= 417.5  7. Mean interpreture Utilisation fact  (86)m= 1  Mean internation (87)m= 19.81  Temperature (88)m= 20.01  Utilisation fact (89)m= 1  Mean internation	78.96 14 internal and 455.51 50 rnal temperate during head temperature 19.92 2 during head 20.01 2 ctor for gain 1 0 al temperature 19.92 1 ctor for gain 1 0 al temperature 1 1 0 al temperature 1 1 0 al temperature 1 1 0	solar 05.62 ature ( ting persons for li Mar 0.99 ure in li 0.15 s for re 0.99	233.64 314 (84)m = (73 575.86 634 heating sea eriods in the ving area, h Apr M 0.97 0. iving area T 20.49 20. eriods in res 20.03 20. est of dwelli 0.96 0.8	.06   3 )m + ( .98   0 son) living 1,m (s lay   9   1 (follo 79   2 t of dv 03   2 ng, h2 welling	area f see Ta Jun 0.73  ow ste 20.95  velling 20.04  ,m (se 0.64	313.22 , watts 600.08 From Table 9a) Jul 0.56 ps 3 to 7 20.99 from Ta 20.04 ee Table 0.45	249 542 542 0le 9, 0.6 7 in T 20.9 able 9 0.5	.76 477.25  .76 477.25  .Th1 (°C)  .ug Sep .4 0.89  .able 9c) .98 20.85  .7 Th2 (°C) .04 20.04  .2 0.83  .4 to 7 in Table .04 19.95	96.5  421.75  Oct 0.99  20.48  20.03  0.98  9c) 19.6	Nov 1 20.09 20.03	399.58  Dec 1 19.79 20.02 1 18.91	21	(84) (85) (86) (87) (88) (89)
(83)m= 38.79 Total gains – i (84)m= 417.5  7. Mean intermediation factors (86)m= 1  Mean internation (87)m= 19.81  Temperature (88)m= 20.01  Utilisation factors (89)m= 1  Mean internation factors (89)m= 1	78.96 14 internal and 455.51 56 mal temperate during heat ctor for gain 19.92 2 during heat 20.01 2 ctor for gain 1 (0) al temperatu 19.92 1 during heat 20.01 2 ctor for gain 1 (0) al temperatu 19.04 1	solar 05.62 ature ( ting persons for limited of the color	233.64 314 (84)m = (73 575.86 634 heating sea eriods in the ving area, h Apr N 0.97 0. iving area T 20.49 20. eriods in res 20.03 20. est of dwelli 0.96 0.8 he rest of dv 19.61 19.	.06 3 )m + ( .98 6 son) living 1,m (s lay 9 1 (follo 79 2 t of dv 03 2 mg, h2 36	83)m , 635.1 area f see Ta Jun 0.73 ow ste 20.95 velling 20.04 ,m (se 0.64 g T2 (fo	313.22 , watts 600.08 From Take ble 9a) Jul 0.56 ps 3 to 7 20.99 from Take 20.04 ee Table 0.45 pollow ster 20.04	249 542 542 5le 9, 0.6 7 in T 20.4 able 9 20.4 9a) 0.5 eps 3	0.7   173.35   0.7   173.35   0.76   477.25   0.76   477.25   0.89   0.89   0.89   20.85   0.98   20.85   0.99   20.04   0.99   20.04   0.99   20.04   0.99   0.83   0.99   0.85   0.99	96.5  421.75  Oct 0.99  20.48  20.03  0.98  9c) 19.6	Nov 1 20.09 20.03 1 1 19.22	399.58  Dec 1 19.79 20.02 1 18.91		(84) (85) (86) (87) (88) (89)
(83)m=	78.96 14 internal and 455.51 50 rnal temperate during head temperate 19.92 2 during head 20.01 2 ctor for gain 1 0 al temperate 19.04 1 al temperate 19.04 1	solar 05.62 ature ( ting persons for limited of the color	233.64 314 (84)m = (73 575.86 634 heating sea eriods in the ving area, h Apr N 0.97 0. iving area T 20.49 20. eriods in res 20.03 20. est of dwelli 0.96 0.8 he rest of dv 19.61 19.	.06   3 )m + ( .98   0 .88   0 .88   0 .88   0 .88   0 .88   0 .88   0 .88   0	83)m , 635.1 area f see Ta Jun 0.73 ow ste 20.95 velling 20.04 ,m (se 0.64 g T2 (fo	313.22 , watts 600.08 From Take ble 9a) Jul 0.56 ps 3 to 7 20.99 from Take 20.04 ee Table 0.45 pollow ster 20.04	249 542 542 5le 9, 0.6 7 in T 20.4 able 9 20.4 9a) 0.5 eps 3	2.7 173.35  2.76 477.25  2.76 477.25  2.76 0.89  2.76 0.89  2.76 0.89  2.76 0.89  2.76 0.89  2.76 0.83  2.76 0.83  2.76 0.83  2.76 0.83  2.76 0.83  2.76 0.83  2.76 0.83  2.76 0.83  2.76 0.83  3.76 0.83  4.77 0.83  4.77 0.83  5.77 0.83  5.77 0.83	96.5  421.75  Oct 0.99  20.48  20.03  0.98  9c) 19.6	Nov 1 20.09 20.03 1 19.22 ring area ÷ (-	399.58  Dec 1 19.79 20.02 1 18.91		(84) (85) (86) (87) (88) (89)



	19.15	19.26	19.49	19.83	20.11	20.25	20.28	20.27	20.17	19.82	19.44	19.13		(93)
(93)m=			uirement		20.11	20.23	20.20	20.21	20.17	13.02	10.44	13.13		(00)
					ro obtoir	and at et	on 11 of	Table 0	o co tha	t Ti m_/	76\m an	d ro colo	ulato	
				inperaturus using Ta		ned at ste	ер птог	rable 9	o, so ma	ıt 11,111=(	rojili ali	u re-caic	uiate	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisa	ation fac	tor for g	ains, hm	):										
(94)m=	1	1	0.99	0.96	0.86	0.66	0.48	0.55	0.84	0.98	1	1		(94)
Usefu	ll gains,	hmGm	, W = (94	4)m x (8	4)m	,	T	T	T	T			l	
(95)m=	416.45	453.49	499.94	552.46	547.5	421.78	285.37	297.21	402.84	412.04	396.62	398.79		(95)
			r	perature		1							1	(00)
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
		1158.31	an intern 1045.04	<del></del>	666.62	Lm , W =	=[(39)m : 288.26	x [(93)m 303.09	- (96)m 478.24	730.97	982.53	1195.25		(97)
(97)m=			<u> </u>		<u> </u>	Wh/mon			<u> </u>	l		1195.25		(91)
(98)m=	583.45	473.64	405.56	227.32	88.62	0	0.02	0	0	237.28	421.86	592.57		
(00)=	000.10	17 0.0 1	100.00		00.02					(kWh/year			3030.3	(98)
Space	a haatin	a roquir	omant in	. le\A/b/m2	2/voor			1010	i per year	(KVVIII) your	) = Odin(o	0)15,912		╡``
·	·	•		kWh/m²									40.7	(99)
			nts – Indi	ividual h	eating s	ystems i	ncluding	micro-C	CHP)					
•	e heatir	•	at from s	ocondar	v/eunnle	ementary	evetam						0	(201)
	-					incinary	-	(202) = 1 -	_ (201) _					╡
	-			nain syst	. ,			` ,	` '	(000)]			1	(202)
			_	main sys				(204) = (2	02) <b>x</b> [1 –	(203)] =			1	(204)
Efficie	ency of r	nain spa	ace heat	ing syste	em 1								89.7	(206)
														≓ .
Efficie	ency of s	seconda	ry/suppl	ementar	y heatin	g system	າ, %						0	(208)
	Jan	Feb	Mar	Apr	Мау	Jun	n, % Jul	Aug	Sep	Oct	Nov	Dec	o kWh/ye	
	Jan e heatin	Feb g require	Mar ement (c	Apr	May d above	Jun	Jul				_		-	
	Jan	Feb	Mar	Apr	Мау	Jun	1	Aug 0	Sep 0	Oct 237.28	Nov 421.86	Dec 592.57	-	
Space	Jan e heating 583.45 n = {[(98)	Feb g require 473.64 )m x (20	Mar ement (c 405.56 (4)] + (21	Apr calculate 227.32	May d above 88.62 100 ÷ (2	Jun ) 0	Jul 0	0	0	237.28	421.86	592.57	-	
Space	Jan e heating 583.45	Feb g require 473.64	Mar ement (c 405.56	Apr calculate	May d above 88.62	Jun ) 0	Jul	0	0	237.28	421.86 470.3	592.57	kWh/ye	ar (211)
Space (211)m	Jan e heating 583.45 n = {[(98) 650.45	Feb g require 473.64 )m x (20 528.03	Mar ement (c 405.56 (4)] + (21 452.13	Apr calculate 227.32 10)m } x 253.42	May d above 88.62 100 ÷ (2	Jun ) 0	Jul 0	0	0	237.28	421.86 470.3	592.57	-	ar
Space (211)m	Jan 2 heating 583.45 1 = {[(98) 650.45	Feb g require 473.64 )m x (20 528.03	Mar ement (c 405.56 (4)] + (21 452.13	Apr calculate 227.32 10)m } x 253.42 y), kWh/	May d above 88.62 100 ÷ (2 98.8	Jun ) 0	Jul 0	0	0	237.28	421.86 470.3	592.57	kWh/ye	ar (211)
Space (211)m Space = {[(98	Jan = heating = 583.45 = {[(98] = 650.45 = heating = heating = m x (20	Feb g require 473.64 )m x (20 528.03 g fuel (s	Mar ement (c 405.56 (4)] + (21 452.13 econdar 14) m } x	Apr calculate 227.32 10)m } x 253.42 y), kWh/ < 100 ÷ (	May d above 88.62 100 ÷ (2 98.8 month 208)	Jun ) 0 206) 0	Jul 0	0 0 Tota	0 0 I (kWh/yea	237.28 264.53 ar) =Sum(2	421.86 470.3 211) <sub>15,1012</sub>	592.57 660.61	kWh/ye	ar (211)
Space (211)m	Jan = heating = 583.45 = {[(98] = 650.45 = heating = heating = m x (20	Feb g require 473.64 )m x (20 528.03	Mar ement (c 405.56 (4)] + (21 452.13	Apr calculate 227.32 10)m } x 253.42 y), kWh/	May d above 88.62 100 ÷ (2 98.8	Jun ) 0	Jul 0	0 Tota	0 0 I (kWh/yea	237.28 264.53 264.53 0	421.86 470.3 211) <sub>15,1012</sub>	592.57	kWh/ye	(211) (211)
Space (211)m Space = {[(98 (215)m=	Jan = heating = 583.45 = [[(98) = 650.45 = heating ]m x (20) = 0	Feb g require 473.64 )m x (20 528.03 g fuel (s 01)] + (21	Mar ement (c 405.56 (4)] + (21 452.13 econdar 14) m } x	Apr calculate 227.32 10)m } x 253.42 y), kWh/ < 100 ÷ (	May d above 88.62 100 ÷ (2 98.8 month 208)	Jun ) 0 206) 0	Jul 0	0 Tota	0 0 I (kWh/yea	237.28 264.53 ar) =Sum(2	421.86 470.3 211) <sub>15,1012</sub>	592.57	kWh/ye	ar (211)
Space (211)m Space = {[(98 (215)m=	Jan 2 heating 583.45 1 = {[(98) 650.45 2 heating 0 heating	Feb g require 473.64 )m x (20 528.03  g fuel (s 0) 1)] + (20	Mar ement (c 405.56 (4)] + (21 452.13 econdar 14) m } x	Apr calculate 227.32 10)m } x 253.42 y), kWh/ < 100 ÷ (	May d above 88.62 100 ÷ (2 98.8 month 208) 0	Jun ) 0 206) 0	Jul 0	0 Tota	0 0 I (kWh/yea	237.28 264.53 264.53 0	421.86 470.3 211) <sub>15,1012</sub>	592.57	kWh/ye	(211) (211)
Space (211)m Space = {[(98 (215)m=	Jan 2 heating 583.45 1 = {[(98) 650.45 2 heating 0 heating	Feb g require 473.64 )m x (20 528.03  g fuel (s 0) 1)] + (20	Mar ement (c 405.56 (4)] + (21 452.13 econdar 14) m } x	Apr calculate 227.32 10)m } x 253.42 y), kWh/ < 100 ÷ (	May d above 88.62 100 ÷ (2 98.8 month 208) 0	Jun ) 0 206) 0	Jul 0	0 Tota	0 0 I (kWh/yea	237.28 264.53 264.53 0	421.86 470.3 211) <sub>15,1012</sub>	592.57	kWh/ye	(211) (211)
Space (211)m  Space = {[(98 (215)m=	Jan  9 heating  583.45  1 = {[(98)  650.45  9 heating  from wa  153.76	Feb g require 473.64 )m x (20 528.03  g fuel (s 01)] + (20 0	Mar ement (c 405.56 (4)] + (21 452.13 econdar 14) m } x 0	Apr calculated 227.32 10)m } x 253.42 y), kWh/ < 100 ÷ ( 0	May d above 88.62 100 ÷ (2 98.8 month 208) 0	Jun ) 0 206) 0	0 0	0 Tota	0 I (kWh/yea	237.28 264.53 ar) =Sum(2 0 ar) =Sum(2	421.86 470.3 211) <sub>15,1012</sub>	592.57	kWh/ye	(211) (211)
Space (211)m  Space = {[(98 (215)m=	Jan 2 heating 583.45 n = {[(98) 650.45  e heating m x (20) n heating from wa 153.76 ncy of wa	Feb g require 473.64 )m x (20 528.03  g fuel (s 0) 1 + (20 0  ater hea 135.98	Mar ement (c 405.56 (4)] + (21 452.13 econdar 14) m } x 0	Apr calculated 227.32 10)m } x 253.42 y), kWh/ < 100 ÷ ( 0	May d above 88.62 100 ÷ (2 98.8 month 208) 0	Jun ) 0 206) 0	0 0	0 Tota	0 I (kWh/yea	237.28 264.53 ar) =Sum(2 0 ar) =Sum(2	421.86 470.3 211) <sub>15,1012</sub>	592.57	kWh/ye	(211) (211) (215)
Space (211)m  Space = {[(98 (215)m=  Water Output  Efficier (217)m=	Jan 2 heating 583.45 a = {[(98) 650.45 b heating m x (20) n from wa 153.76 n cy of w 87.39	Feb g require 473.64 )m x (20 528.03  g fuel (s 01)] + (20 0  ater hea 135.98 ater hea 87.23	Mar ement (c 405.56 4)] + (21 452.13 econdar 14) m } x 0	Apr calculated 227.32 10)m } x 253.42 y), kWh/ c 100 ÷ ( 0	May d above 88.62 100 ÷ (2 98.8  month 208) 0	Jun ) 0 206) 0 117.63	Jul 0 0 0 111.38	0 Tota  0 Tota	0 0 I (kWh/yea 0 I (kWh/yea	237.28 264.53 264.53 0 0 ar) =Sum(2 135.17	421.86 470.3 211) <sub>15,1012</sub> 0 215) <sub>15,1012</sub>	592.57 660.61 = 0	kWh/ye	(211) (211) (215)
Space (211)m  Space = {[(98 (215)m=  Water Output  Efficier (217)m=  Fuel for (219)m	Jan  = heating = 583.45  = {[(98) = 650.45  = heating = 0  heating = from wa = 153.76  ncy of water = (64)	Feb g require 473.64 )m x (20 528.03  g fuel (s 0) 1 + (2) 0  ater hea 135.98 ater hea 87.23 heating, m x 100	Mar ement (c 405.56 (4)] + (21 452.13 econdar 14) m } x 0 ter (calc 143.7 tter 86.82 kWh/mc 0 ÷ (217)	Apr calculate 227.32  10)m } x 253.42  y), kWh/ c 100 ÷ (  0  ulated a 130.01  85.74  onth	May d above 88.62 100 ÷ (2 98.8  month 208) 0 bove) 130.54	Jun ) 0 206) 0 117.63	Jul 0 0 0 111.38 79.6	0 Tota  0 Tota  124.64	0 0 I (kWh/yea 125.33	237.28 264.53 ar) =Sum(2 0 ar) =Sum(2 135.17	421.86 470.3 211) <sub>15,1012</sub> 0 215) <sub>15,1012</sub> 141.2	592.57 660.61 = 0 =	kWh/ye	(211) (211) (215)
Space (211)m  Space = {[(98 (215)m=  Water Output  Efficier (217)m=  Fuel for (219)m	Jan e heating 583.45 n = {[(98) 650.45 e heating m x (20) n from wa 153.76 ncy of wa 87.39 or water	Feb g require 473.64 )m x (20 528.03  g fuel (s 01)] + (20 0  atter hea 135.98 atter hea 87.23 heating,	Mar ement (c 405.56 4)] + (21 452.13 econdar 14) m } x 0 ter (calc 143.7 tter 86.82 kWh/mc	Apr calculated 227.32 10)m } x 253.42  y), kWh/ c 100 ÷ (  0  ulated at 130.01  85.74  onth	May d above 88.62 100 ÷ (2 98.8  month 208) 0	Jun ) 0 206) 0 117.63	Jul 0 0 0 111.38	0 Tota  124.64  79.6	0 0 I (kWh/yea 125.33 79.6 157.45	237.28  264.53  ar) =Sum(2  0  135.17  85.75	421.86 470.3 211) <sub>15,1012</sub> 0 215) <sub>15,1012</sub>	592.57 660.61 = 0	kWh/ye	(211) (211) (215) (216) (217)
Space (211)m  Space = {[(98 (215)m=  Water Output  Efficier (217)m= Fuel fo (219)m (219)m=	Jan 2 heating 583.45  a = {[(98) 650.45  b heating 153.76 acy of w 87.39  br water 1 = (64) 175.95	Feb g require 473.64 )m x (20 528.03  g fuel (s 0) 1 + (2) 0  ater hea 135.98 ater hea 87.23 heating, m x 100	Mar ement (c 405.56 (4)] + (21 452.13 econdar 14) m } x 0 ter (calc 143.7 tter 86.82 kWh/mc 0 ÷ (217)	Apr calculate 227.32  10)m } x 253.42  y), kWh/ c 100 ÷ (  0  ulated a 130.01  85.74  onth	May d above 88.62 100 ÷ (2 98.8  month 208) 0 bove) 130.54	Jun ) 0 206) 0 117.63	Jul 0 0 0 111.38 79.6	0 Tota  124.64  79.6	0 0 I (kWh/yea 125.33	237.28 264.53 ar) =Sum(2 0 135.17 85.75 157.63 19a) <sub>112</sub> =	421.86 470.3 211) <sub>15,1012</sub> 0 215) <sub>15,1012</sub> 141.2 86.93	592.57  660.61  0  149  87.47	8Wh/ye	(211) (211) (215) (216) (217)
Space (211)m  Space = {[(98 (215)m=  Water Output  Efficier (217)m= Fuel fo (219)m (219)m=	Jan e heating 583.45  a = {[(98) 650.45  b heating m x (20)  n heating from wa 153.76  ncy of wa 87.39  r water n = (64) 175.95	Feb g require 473.64 )m x (20 528.03  g fuel (s 1)] + (20 0  ater hea 135.98 ater hea 87.23 heating, m x 100 155.88	Mar ement (c 405.56 4)] + (21 452.13 econdar 14) m } x 0 ter (calc 143.7 ter 86.82 kWh/mc 0 ÷ (217) 165.51	Apr calculate 227.32  10)m } x 253.42  y), kWh/ (100 ÷ (  0  ulated al 130.01  85.74  onth m 151.63	May d above 88.62 100 ÷ (2 98.8  month 208) 0  bove) 130.54  83.4	Jun ) 0 206) 0 117.63	Jul 0 0 0 111.38 79.6	0 Tota  124.64  79.6	0 0 I (kWh/yea 125.33 79.6 157.45	237.28 264.53 ar) =Sum(2 0 135.17 85.75 157.63 19a) <sub>112</sub> =	421.86 470.3 211) <sub>15,1012</sub> 0 215) <sub>15,1012</sub> 141.2	592.57  660.61  0  149  87.47	3378.26 0 79.6 1897.63 kWh/year	(211) (211) (215) (216) (217)
Space (211)m  Space = {[(98 (215)m=  Water Output  Efficier (217)m= Fuel fo (219)m (219)m=	Jan e heating 583.45  a = {[(98) 650.45  b heating m x (20)  n heating from wa 153.76  ncy of wa 87.39  r water n = (64) 175.95	Feb g require 473.64 )m x (20 528.03  g fuel (s 1)] + (20 0  ater hea 135.98 ater hea 87.23 heating, m x 100 155.88	Mar ement (c 405.56 4)] + (21 452.13 econdar 14) m } x 0 ter (calc 143.7 ter 86.82 kWh/mc 0 ÷ (217) 165.51	Apr calculate 227.32  10)m } x 253.42  y), kWh/ c 100 ÷ (  0  ulated a 130.01  85.74  onth	May d above 88.62 100 ÷ (2 98.8  month 208) 0  bove) 130.54  83.4	Jun ) 0 206) 0 117.63	Jul 0 0 0 111.38 79.6	0 Tota  124.64  79.6	0 0 I (kWh/yea 125.33 79.6 157.45	237.28 264.53 ar) =Sum(2 0 135.17 85.75 157.63 19a) <sub>112</sub> =	421.86 470.3 211) <sub>15,1012</sub> 0 215) <sub>15,1012</sub> 141.2 86.93	592.57  660.61  0  149  87.47	8Wh/ye	(211) (211) (215) (216) (217)

D.O.Environmental Consulting
David Oldham
01706 226519
david @doec.co.uk

### **DER WorkSheet: New dwelling design stage**



Water heating fuel used

Electricity for pumps, fans and electric keep-hot

central heating pump:

boiler with a fan-assisted flue

Total electricity for the above, kWh/year

Electricity for lighting

1897.63

(230c)

45

(230e)

75

(231)

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

12a. CO2 emissions – Individual heating systems	s including micro-CHP		
12a. 002 emissions – muividual neating systems	Energy	Emission factor	Emissions
	kWh/year	kg CO2/kWh	kg CO2/year
Space heating (main system 1)	(211) x	0.216	729.7 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216	409.89 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1139.59 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	174.03 (268)
Total CO2, kg/year	sum	of (265)(271) =	1352.55 (272)
Dwelling CO2 Emission Rate	(272	?) ÷ (4) =	18.16 (273)
El rating (section 14)			85 (274)

Number of flueless gas fires

### TER WorkSheet: New dwelling design stage



### User Details:

**Assessor Name:** David Oldham **Stroma Number:** STRO007778 Stroma FSAP 2012 **Software Name: Software Version:** Version: 1.0.1.1

Property Address: Plot 1

Address:	lot 1, Macs Cafe	Site						
1. Overall dwelling dimension	ons:							
			Area(m²)		Av. Height	(m)	Volume(m³)	)
Ground floor			37.23	(1a) x	2.4	(2a) =	89.35	(3a)
First floor		[	37.23	(1b) x	2.6	(2b) =	96.8	(3b)
Total floor area TFA = (1a)+(	(1b)+(1c)+(1d)+(1	e)+(1n)	74.46	(4)				
Dwelling volume				(3a)+(3b	)+(3c)+(3d)+(3e	e)+(3n) =	186.15	(5)
2. Ventilation rate:								
		secondary heating	other		total		m³ per hou	r
Number of chimneys	0 +	0	+ 0	] = [	0	x 40 =	0	(6a)
Number of open flues	0 +	0	+ 0	= [	0	x 20 =	0	(6b)
Number of intermittent fans					3	x 10 =	30	(7a)
Number of passive vents					0	x 10 =	0	(7b)

(7c)

x 40 =

0

			Air cha	nges per h	our
Infiltration due to chimneys, flues and fans = (6a	)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.16	(8)
If a pressurisation test has been carried out or is intended	d, proceed to (17), otherwise contin	ue from (9) to (16)	_		
Number of storeys in the dwelling (ns)				0	(9)
Additional infiltration			[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber fr	Ī	0	(11)		
if both types of wall are present, use the value corresp deducting areas of openings); if equal user 0.35	onding to the greater wall area (afte	er			
If suspended wooden floor, enter 0.2 (unseale		0	(12)		
If no draught lobby, enter 0.05, else enter 0		0	(13)		
Percentage of windows and doors draught str	ipped		Ī	0	(14)
Window infiltration	0.25 - [0.2 x (14	1) ÷ 100] =	Ī	0	(15)
Infiltration rate	-	0	(16)		
Air permeability value, q50, expressed in cubi	c metres per hour per squar	e metre of envelo	pe area	5	(17)
If based on air permeability value, then (18) = [(17	$(2) \div 20] + (8)$ , otherwise $(18) = (16)$		Ī	0.41	(18)
			<u> </u>		

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered

 $(20) = 1 - [0.075 \times (19)] =$ Shelter factor

Infiltration rate incorporating shelter factor  $(21) = (18) \times (20) =$ 

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthl	Monthly average wind speed from Table 7											
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

(19)

(20)

(21)

0.92

0.38

Heat transfer coefficient, W/K

77.6

77.33

76.03

75.79

74.67

74.67

74.46

77.88

(39)m =

### TER WorkSheet: New dwelling design stage



Wind Factor  $(22a)m = (22)m \div 4$ 1.27 0.95 (22a)m: 1.25 1.23 1.08 0.95 0.92 1.08 1.12 1.18 Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m 0.48 0.47 0.42 0.41 0.36 0.36 0.35 0.38 0.41 0.43 0.45 Calculate effective air change rate for the applicable case If mechanical ventilation: (23a) 0 If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0 (23b) If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 − (23c) ÷ 100] (24a)m: 0 0 (24a)b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b) (24b)m 0 0 0 (24b)c) If whole house extract ventilation or positive input ventilation from outside if  $(22b)m < 0.5 \times (23b)$ , then (24c) = (23b); otherwise  $(24c) = (22b)m + 0.5 \times (23b)$ (24c)(24c)m =0 0 0 0 0 0 0 0 d) If natural ventilation or whole house positive input ventilation from loft if (22b)m = 1, then (24d)m = (22b)m otherwise  $(24d)m = 0.5 + [(22b)m^2 \times 0.5]$ (24d)m =0.62 0.61 0.61 0.58 0.56 0.58 0.59 0.6 (24d)0.57 Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25) 0.62 0.61 0.58 (25)(25)m =0.58 3. Heat losses and heat loss parameter: **ELEMENT** Gross Openings Net Area **U-value** AXUk-value AXkkJ/m<sup>2</sup>·K kJ/K area (m²) m<sup>2</sup> A,m<sup>2</sup> W/m2K (W/K) Doors (26)1.2 1.75 2.1 Windows Type 1  $\chi 1/[1/(1.4) + 0.04] =$ 3.72 4.93 (27)Windows Type 2  $\chi 1/[1/(1.4) + 0.04]$ (27)7.53 9.98 Floor 37.23 0.13 4.8399 (28)Walls 86.6 13 73.6 0.18 13.25 (29)Roof (30)37.23 0 37.23 0.13 4.84 Total area of elements, m<sup>2</sup> 161.06 (31)\* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2 \*\* include the areas on both sides of internal walls and partitions (26)...(30) + (32) =Fabric heat loss,  $W/K = S(A \times U)$ (33)39.94 Heat capacity  $Cm = S(A \times k)$ ((28)...(30) + (32) + (32a)...(32e) =(34)6231.67 Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium (35)250 For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation. Thermal bridges: S (L x Y) calculated using Appendix K (36)0 if details of thermal bridging are not known (36) =  $0.15 \times (31)$ Total fabric heat loss (33) + (36) =(37)39.94 Ventilation heat loss calculated monthly (38)m =  $0.33 \times (25)$ m x (5)Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (38)37.94 37.66 (38)m =37.39 36.09 35.85 34.73 34.73 34.52 35.16 35.85 36.34 36.85

75.1

(39)m = (37) + (38)m

75.79

76.28

76.79

76.03 age 2 of 39)



eat lo	ss para	meter (H	HLP), W	′m²K					(40)m	= (39)m ÷	· (4)			
0)m=	1.05	1.04	1.04	1.02	1.02	1	1	1	1.01	1.02	1.02	1.03		
umba	ar of day	e in moi	nth (Tab	la 1a)					,	Average =	Sum(40) <sub>1</sub> .	12 /12=	1.02	(40
umbe	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
1)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41
1. Wa	iter heat	ing ener	gy requi	rement:								kWh/yea	ar:	
if TF	ied occu A > 13.9 A £ 13.9	N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9	)2)] + 0.0	0013 x ( <sup>-</sup>	ΓFA -13.		35		(42
educe	the annua	l average	hot water	usage by		welling is	designed	(25 x N) to achieve		se target o		90		(43
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
ot wate	er usage ir	litres per	day for ea	ach month	Vd,m = fa	ctor from	Table 1c x	(43)						
4)m=	99	95.4	91.8	88.2	84.6	81	81	84.6	88.2	91.8	95.4	99		_
nerav (	content of	hot water	used - cal	culated mo	onthly = $4$ .	190 x Vd.r	n x nm x F.	OTm / 3600			m(44) <sub>112</sub> = ables 1b, 1		1079.98	(44
5)m=	146.81	128.4	132.5	115.52	110.84	95.65	88.63	101.71	102.92	119.94	130.93	142.18		
<b>0</b> ,–	110.01	120.1	102.0	110.02	110.01	00.00	00.00	1011			m(45) <sub>112</sub> =		1416.02	(4
instan	taneous w	ater heatii	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46			,	L		
6)m=	22.02	19.26	19.87	17.33	16.63	14.35	13.29	15.26	15.44	17.99	19.64	21.33		(4
	storage		inaludin	.a opv o	olor or M	WALDO	otorogo	within sa	ama vaa	n o l				(4
		, ,		•	velling, e		_		airie ves	5 <b>C</b> I		0		(4
	-	_			•			mbi boil	ers) ente	er '0' in (	47)			
/ater	storage	loss:												
) If m	anufact	urer's de	eclared l	oss facto	or is kno	wn (kWł	n/day):					0		(4
empe	erature fa	actor fro	m Table	2b								0		(4
•			storage	-				(48) x (49)	) =			0		(5
•				-	oss facte e 2 (kWl							0		(5
		-	ee secti		<b>-</b> (	., 0, 0.0	.,,					<u> </u>		(0
olum	e factor	from Tal	ble 2a									0		(5
empe	erature fa	actor fro	m Table	2b								0		(5
nergy	lost fro	m water	storage	, kWh/ye	ear			(47) x (51)	) x (52) x (	53) =		0		(5
nter	(50) or (	54) in (5	55)									0		(5
/ater	storage	loss cal	culated f	or each	month			((56)m = (	55) × (41)ı	m				
6)m=	0	0	0	0	0	0	0	0	0	0	0	0		(5
cylinde	er contains	dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Appendix	Н	
7)m=	0	0	0	0	0	0	0	0	0	0	0	0		(5
rimar	v circuit	loss (an	nual) fro	m Table	 e 3							0		(5
	-	•	•				(50) 00	SE (44)						
	y circuit	1055 Cai	cuialeu i	or each	month (	59)m = 0	(58) ÷ 36	55 × (41)	m					
rimar	-				•	•	. ,	55 × (41) ng and a		r thermo	stat)			



1	1		for each			<del>`</del>	· ` `							Ì	
(61)m=	50.45	43.91	46.78	43.5	43.11	39.94	41.28	43.1		43.5	46.78	47.05	50.45		(61)
Total h		uired for						<del>`</del>	_	i	45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m=	197.26	172.31	179.28	159.01	153.95	135.59	129.91	144.8	82	146.41	166.72	177.97	192.63		(62)
	Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating) (add additional lines if FGHRS and/or WWHRS applies, see Appendix G)														
`							· ·	<u> </u>	ix G)					I	
(63)m=	0	0	0	0	0	0	0	0		0	0	0	0		(63)
FHRS															(63) (G2)
•	Output from water heater  (64)m= 197.26 172.31 179.28 159.01 153.95 135.59 129.91 144.82 146.41 166.72 177.97 192.63														
(64)m=	197.26	172.31	179.28	159.01	153.95	135.59	129.91	<u> </u>		146.41	166.72	177.97	192.63		1
									Output	t from wa	ater heate	r (annual)₁	12	1955.86	(64)
Heat g	ains fror	m water	heating,	kWh/m	onth 0.2	5 ´ [0.85	× (45)m	+ (61	1)m]	+ 0.8 x	(46)m	+ (57)m	+ (59)m	.]	
(65)m=	61.43	53.67	55.75	49.28	47.63	41.79	39.79	44.5	59	45.09	51.58	55.29	59.89		(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):															
Metabo	olic gain	s (Table	5), Wat	ts											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Au	ıg	Sep	Oct	Nov	Dec		
(66)m=	117.47	117.47	117.47	117.47	117.47	117.47	117.47	117.4	47	117.47	117.47	117.47	117.47		(66)
Lightin	g gains	(calcula	ted in Ap	pendix	L, equat	ion L9 o	r L9a), a	lso se	ee Ta	able 5					
(67)m=	18.99	16.87	13.72	10.38	7.76	6.55	7.08	9.2	!	12.35	15.69	18.31	19.52		(67)
Appliar	Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5														
(68)m=	207.48	209.63	204.2	192.65	178.07	164.37	155.22	153.0	06	158.49	170.04	184.62	198.32		(68)
Cookin	g gains	(calcula	ted in Ap	pendix	L, equat	tion L15	or L15a	, alsc	see	Table	5	•		ı	
(69)m=	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.7	<b>'</b> 5	34.75	34.75	34.75	34.75		(69)
Pumps	and far	ns gains	(Table 5	ia)						-				I	
(70)m=	3	3	3	3	3	3	3	3		3	3	3	3		(70)
Losses	e.g. ev	aporatio	n (negat	ive valu	es) (Tab	le 5)								I	
(71)m=	-93.98	-93.98	-93.98	-93.98	-93.98	-93.98	-93.98	-93.9	98	-93.98	-93.98	-93.98	-93.98		(71)
Water	Leating	gains (T	able 5)			!	ļ.	!				<u>!</u>	ı	J	
(72)m=	82.56	79.87	74.93	68.45	64.02	58.04	53.48	59.9	94	62.63	69.32	76.8	80.49		(72)
Total i	nternal	gains =				(66)	m + (67)m	ı + (68)	)m + (	(69)m + (	70)m + (7	1)m + (72)	m	ļ	
(73)m=	370.27	367.6	354.1	332.73	311.1	290.21	277.02	283.4	45 2	294.72	316.29	340.97	359.57		(73)
6. Sol	ar gains	S:													
			using sola	r flux from	Table 6a	and assoc	iated equa	tions to	o conv	vert to th	e applicat	ole orientat	ion.		
Orienta	ation: A	Access F	actor	Area		Flu	Х			g_		FF		Gains	
	T	able 6d		m²		Tal	ole 6a		Tal	ble 6b	Т	able 6c		(W)	
Northwe	est <sub>0.9x</sub>	0.77	x	3.7	'2	x 1	1.28	x	(	0.63	х	0.7	=	12.83	(81)
Northwe	est <sub>0.9x</sub>	0.77	х	7.5	3	x 1	1.28	х	(	0.63	_ x [	0.7	=	25.97	(81)
Northwe	est <sub>0.9x</sub>	0.77	х	3.7	2	x 2	2.97	x	(	0.63	_ x [	0.7	=	26.11	(81)
Northwe	est <sub>0.9x</sub>	0.77	x	7.5	3	x 2	2.97	х	(	0.63	x	0.7	=	52.85	(81)
	L							. L						<b>L</b>	_



Northwe	est <sub>0.9x</sub>	0.77		x	3.7	2	x	4	1.38	x	0.63	x		0.7		=	47.04	(81)
Northwe	st <sub>0.9x</sub>	0.77		x	7.5	3	x	4	1.38	x	0.63	X		0.7		=	95.22	(81)
Northwe	st <sub>0.9x</sub>	0.77		x	3.7	2	x	6	7.96	x	0.63	X		0.7		=	77.26	(81)
Northwe	st <sub>0.9x</sub>	0.77		x	7.5	3	x	6	7.96	x	0.63	x		0.7		=	156.38	(81)
Northwe	st <sub>0.9x</sub>	0.77		x	3.7	2	x	9	1.35	x	0.63	X		0.7		=	103.85	(81)
Northwe	st <sub>0.9x</sub>	0.77		x	7.5	3	x	9	1.35	x	0.63	X		0.7		=	210.21	(81)
Northwe	st 0.9x	0.77		x	3.7	2	x	9	7.38	x	0.63	X	Ē	0.7		=	110.71	(81)
Northwe	st <sub>0.9x</sub>	0.77		x	7.5	3	x	9	7.38	x	0.63	×	Ē	0.7		=	224.11	(81)
Northwe	st <sub>0.9x</sub>	0.77		x	3.7	2	x	9	91.1	x	0.63	X		0.7		=	103.57	(81)
Northwe	st 0.9x	0.77		x	7.5	3	х	9	91.1	x	0.63	x		0.7		=	209.65	(81)
Northwe	st <sub>0.9x</sub>	0.77		x	3.7	2	x	7	2.63	x	0.63	X		0.7		=	82.57	(81)
Northwe	st <sub>0.9x</sub>	0.77		x	7.5	3	x	7	2.63	x	0.63	X	Ē	0.7		=	167.13	(81)
Northwe	st <sub>0.9x</sub>	0.77		x	3.7	2	x	5	0.42	x	0.63	×	Ē	0.7		=	57.32	(81)
Northwe	st <sub>0.9x</sub>	0.77		x	7.5	3	x	5	0.42	x	0.63	×	Ē	0.7		=	116.03	(81)
Northwe	st 0.9x	0.77		x	3.7	2	x	2	8.07	x	0.63	×	Ē	0.7		=	31.91	(81)
Northwe	st <sub>0.9x</sub>	0.77		x	7.5	3	x	2	8.07	x	0.63	×	Ē	0.7		=	64.59	(81)
Northwe	st <sub>0.9x</sub>	0.77		x	3.7	2	x		14.2	x	0.63	X	Ē	0.7		=	16.14	(81)
Northwe	st 0.9x	0.77		x	7.5	3	x		14.2	x	0.63	×	Ē	0.7		=	32.67	(81)
Northwe	st <sub>0.9x</sub>	0.77		x	3.72		х	,	9.21	x	0.63	×	Ē	0.7		=	10.48	(81)
Northwe	st <sub>0.9x</sub>	0.77		x	7.5	3	х	,	9.21	x	0.63	x	Ē	0.7		=	21.2	(81)
Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m																		
(83)m=	38.79	78.96	142.2		233.64	314.06		34.82	313.22	249	9.7 173.3	5 96.	.5	48.81	31.0	86		(83)
Ī		nternal a			<u>`                                    </u>	• •	$\overline{}$		1	l		_		T			Ī	(0.4)
(84)m=	409.06	446.57	496.3	6	566.37	625.16	5 6	25.03	590.24	533	.15   468.0	7 412	.79	389.78	391	.25		(84)
		nal temp		•	- U													_
Tempe	erature	during h	eating	g pe	eriods in	the liv	ving	area	from Tab	ole 9	, Th1 (°C)						21	(85)
Utilisa <sup>.</sup>		tor for ga		$\overline{}$			Ť			г -							1	
	Jan	Feb	Ma	$\dashv$	Apr	May	_	Jun	Jul		ug Ser	_		Nov		ec		(0.0)
(86)m=	1	1	0.99		0.97	0.89		0.72	0.55	0.6	0.89	0.9	9	1	1			(86)
Mean		<del></del> -	ature	in li	ving are	a T1	(follo	w ste	ps 3 to 7	in T	able 9c)						1	
(87)m=	19.85	19.97	20.19	)	20.52	20.81	2	20.96	20.99	20.	99 20.87	20.	51	20.13	19.8	84		(87)
Tempe	erature	during h	eating	g pe	eriods in	rest c	of dw	elling	from Ta	able 9	9, Th2 (°C	)						
(88)m=	20.05	20.05	20.05	5	20.07	20.07	2	20.08	20.08	20.	08 20.08	3 20.0	07	20.06	20.0	06		(88)
Utilisa	tion fac	tor for ga	ains fo	or re	est of du	velling	, h2	,m (se	e Table	9a)								
(89)m=	1	1	0.99	_	0.96	0.85	_	0.63	0.44	0.5	0.83	0.9	8	1	1			(89)
Mean	interna	temper	ature	in th	he rest (	of dwe	lling	T2 (f	ollow ste	ns 3	to 7 in Ta	hle 9c	١	•			•	
(90)m=	18.5	18.67	19	T	19.49	19.88	Ť	20.05	20.08	20.	1	<del>-                                    </del>		18.93	18.	.5		(90)
· ' L										<u> </u>		fLA = I	Livii	ng area ÷ (4			0.25	(91)
14000	intoras	tomes	O #1 . P =	/f ~	the wife	مام طب	رماا:∽	۵) ا	Λ	. /4	fl ^\	<del>-</del> 0						
(92)m=	18.84	tempera 19	19.3	Ì	19.75	20.11	$\neg$	g) = 11 20.28	_A × 11	+ (1	– fLA) × T 31	$\neg$	7 <i>4</i>	19.23	18.8	83	]	(92)
L				_							where app			19.23	10.0		I	(02)
Apply	aujusiii	ioni io ii	10 1110	un	micinal	cript	Jiall		iii rabib	<b>т</b> С,	whole app	oropiia	·					



(00)	40.04	40	40.0	40.75	00.44	00.00	00.04	00.04	00.40	40.74	40.00	40.00		(02)
(93)m=	18.84	19	19.3	19.75	20.11	20.28	20.31	20.31	20.19	19.74	19.23	18.83		(93)
			uirement				44 -£	Table O	41	4 T: /	70)	-11-	ulata	
			ternai ter or gains	•		ied at ste	ер 11 от	i abie 9i	o, so tna	t 11,m=(	76)m an	d re-calc	culate	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisa	ation fac	tor for g	ains, hm	•		<u> </u>	<u> </u>		'	<u> </u>				
(94)m=	1	1	0.99	0.96	0.86	0.65	0.47	0.54	0.84	0.98	1	1		(94)
Usefu	ıl gains,	hmGm	, W = (94	4)m x (84	4)m		•	•			•			
(95)m=	408.04	444.56	490.56	542.13	534.82	407.58	274.81	286.41	392.38	403.01	387.87	390.47		(95)
Month	nly avera	age exte	rnal tem	perature	from Ta	able 8								
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
			an intern			i	=[(39)m :	<del>- `                                   </del>	<u> </u>					
(- /	1132.73		989.97	824.98	637.61	424.33	276.9	290.84	457.35	692.39	925.41	1123.83		(97)
		•	ement fo		i	T	I		i i	<del>í - `</del>	<del> </del>			
(98)m=	539.17	436.45	371.56	203.65	76.47	0	0	0	0	215.3	387.03	545.62		<b>¬</b>
								Tota	ıl per year	(kWh/yeai	r) = Sum(9	8) <sub>15,912</sub> =	2775.26	(98)
Space	Space heating requirement in kWh/m²/year													
9a. En	ergy red	uiremer	nts – Indi	vidual h	eating s	ystems i	ncluding	micro-C	CHP)					
Space	e heatir	ıg:												_
Fraction of space heat from secondary/supplementary system													0	(201)
Fraction of space heat from main system(s) (202) = 1 - (201) =													1	(202)
Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] =													1	(204)
Efficiency of main space heating system 1														(206)
Efficie	Efficiency of secondary/supplementary heating system, %													(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	-d ear
Space	e heatin	g require	ement (c	alculate	d above	)								
	539.17	436.45	371.56	203.65	76.47	0	0	0	0	215.3	387.03	545.62		
(211)m	n = {[(98]	)m x (20	)4)] + (21	0)m } x	100 ÷ (2	206)								(211)
	577.27	467.29	397.82	218.04	81.87	0	0	0	0	230.52	414.38	584.17		
								Tota	l (kWh/yea	ar) =Sum(2	211) <sub>15,1012</sub>	į=	2971.37	(211)
Space	e heating	g fuel (s	econdar	y), kWh/	month							·		_
= {[(98]	)m x (20	1)] + (2	14) m } x	100 ÷ (	208)					Г				
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		_
								Tota	ıl (kWh/yea	ar) =Sum(2	215) <sub>15,1012</sub>	<u></u>	0	(215)
	heating													
Output			ter (calc			105.50	100.04	144.00	140.44	400.70	177.07	400.00		
⊏#ioior	197.26	172.31	179.28	159.01	153.95	135.59	129.91	144.82	146.41	166.72	177.97	192.63	00.0	7(246)
l	ncy of w			05.00	00.00					05.7	L 00.05	07.50	80.3	(216)
(217)m=		87.29	86.84	85.68	83.39	80.3	80.3	80.3	80.3	85.7	86.95	87.53		(217)
		•	kWh/mo ) ÷ (217)											
, ,	225.56	197.4	206.44	185.6	184.61	168.86	161.78	180.34	182.33	194.55	204.67	220.08		
								Tota	I = Sum(2	19a) <sub>112</sub> =	!		2312.21	(219)
Annual totals kWh/year												•	kWh/yea	<u> </u>
Space	heating	fuel use	ed, main	system	1						-		2971.37	
												!		_

D.O.Environmental Consulting
David Oldham
01706 226519
david @doec.co.uk

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### TER WorkSheet: New dwelling design stage



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18.19

Water heating fuel used 2312.21 Electricity for pumps, fans and electric keep-hot central heating pump: (230c)boiler with a fan-assisted flue (230e)45 sum of (230a)...(230g) = Total electricity for the above, kWh/year (231)Electricity for lighting (232)335.37 12a. CO2 emissions – Individual heating systems including micro-CHP **Energy Emission factor Emissions** kWh/year kg CO2/kWh kg CO2/year (211) x Space heating (main system 1) (261)0.216 641.82 (215) x Space heating (secondary) 0.519 0 (263)(219) x Water heating (264)0.216 499.44 (261) + (262) + (263) + (264) =Space and water heating 1141.25 (265)Electricity for pumps, fans and electric keep-hot (231) x 38.93 (267)0.519 (232) x Electricity for lighting (268)0.519 174.06 sum of (265)...(271) =Total CO2, kg/year (272)1354.24