Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.58 *Printed on 21 October 2022 at 12:33:17*

Project Information	on:			
Assessed By:	Ben Marsh (STR	O005374)	Building Type:	Mid-terrace House
Dwelling Details:				
NEW DWELLING	DESIGN STAGE		Total Floor Area: 8	57.9m ²
Site Reference :	New Project		Plot Reference:	Plot 10
Address :	Plot 10			
Client Details:				
Name:				
Address :				
•		vithin the SAP calculations. tions compliance.		
1a TER and DER	2			
	ing system: Mains	jas		
Fuel factor: 1.00 (r	e ,			
•	xide Emission Rate	. ,	17 kg/m²	01/
1b TFEE and DF	Dioxide Emission Ra	ate (DER)	15.86 kg/m²	OK
	rgy Efficiency (TFE	Ε/	47.0 kWh/m ²	
-	nergy Efficiency (DF		42.9 kWh/m ²	
Ewoning Pablic Er)	12.0 1000/000	ОК
2 Fabric U-value	s			
Element		Average	Highest	
External v		0.17 (max. 0.30)	0.17 (max. 0.70)	OK
Party wal	I	0.00 (max. 0.20)	-	OK
Floor		0.14 (max. 0.25)	0.14 (max. 0.70)	OK
Roof		0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings		1.40 (max. 2.00)	1.40 (max. 3.30)	OK
2a Thermal bridg		· · · · · · · · · · · ·	· · · ·	
Thermal a 3 Air permeabilit		from linear thermal transmittan	ces for each junction	
	bility at 50 pascals		E 00 (design vol	uo)
Maximum	Sinty at 50 pascals		5.00 (design val 10.0	OK
4 Heating efficie	nev			-
Main Heatir		Database: (rev 507, produc	t index 017953):	
Main rieati	ig system.	· ·	rs or underfloor heating - ma	ains das
		Brand name: Vaillant		
		Model: ecoTEC exclusive 8	35	
		Model qualifier: VUW 356/5		
		(Combi)		
		Efficiency 89.7 % SEDBUK	2009	
		Minimum 88.0 %		OK
Secondary	heating system:	None		

Regulations Compliance Report

5 Cylinder insulation			
Hot water Storage:	No cylinder		
6 Controls			
Space heating controls	TTZC by plumbing and el	ectrical services	ОК
Hot water controls:	No cylinder thermostat		
	No cylinder		
Boiler interlock:	Yes		OK
7 Low energy lights			
Percentage of fixed lights wit	h low-energy fittings	100.0%	
Minimum		75.0%	OK
8 Mechanical ventilation			
Not applicable			
9 Summertime temperature			
Overheating risk (South East	England):	Not assessed	?
10 Key features			
Roofs U-value		0.11 W/m²K	
Party Walls U-value		0 W/m²K	

Thermal Bridge Report

Droporty Datails, Diat 10					
Property Details: Plot 10					
Address:	Plot 10				
Located in:	England				
Region:	South East Er	ngland			
Thermal bridges:					
Thermal bridges:		User-defined = UD			
5		Default = D			
		Approved $= A$			
		User-defined (individ	ual PSI-values)	Y-Value = 0.1325	
Eutomal Iunationa Dataila					
External Junctions Details:					
Junction Type		PSI-Value	Length	Reference	Туре
Other lintels (including other steel lintels)		0.3	9.83	E2	[A]
Sill		0.04	7	E3	[A]
Jamb		0.05	22.14	E4	[A]
Intermediate floor within a dwelling		0.07	20.16	E6	[A]
Eaves (insulation at ceiling level)		0.06	10.08	E10	[A]
Corner (normal)		0.09	20.12	E16	[A]
Ground floor (normal)		0.16	20.16	E5	[A]
Darty Junctions Dataila					
Party Junctions Details:					
Ground floor		0.16	17.44	P1	[D]
Intermediate floor within a dwelling		0	17.44	P2	[D]
Roof (insulation at ceiling level)		0.24	17.44	P4	[D]



Plot 10

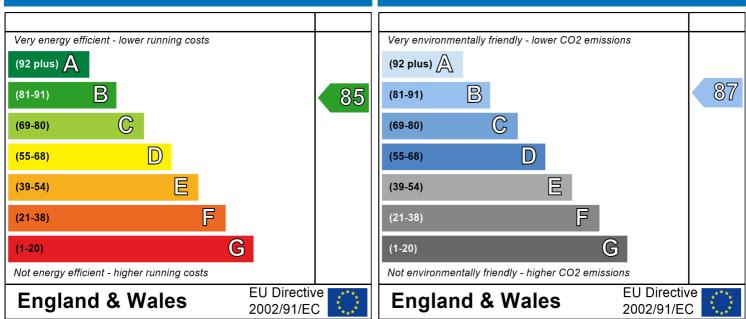
Dwelling type: Date of assessment: Produced by: Total floor area: Mid-terrace House 21 October 2022 Ben Marsh 87.9 m²

Environmental Impact (CO₂) Rating

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

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

Energy Efficiency Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be. The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

SAP Input

Property Details: Pl	ot 10							
Address: Located in: Region: UPRN: Date of assessm Date of certificat Assessment type Transaction type Tenure type: Related party dis Thermal Mass Pa Water use <= 12 PCDF Version:	te: 2: 2: sclosure: arameter:	21 Octo 21 Octo New dv New dv Owner- No rela Indicati	ast England ober 2022 ober 2022 velling design stag	ge				
Property description	ו:							
Dwelling type: Detachment: Year Completed: Floor Location: Floor 0 Floor 1		House Mid-ten 2022 Floor 43.95 n 43.95 n	area: n²	S	itorey height 2.4 m 2.63 m	:		
Living area:			n ² (fraction 0.27	9)				
Front of dwelling fa	aces:	North						
Name: Front Front Rear	Source: Manufacturer SAP 2012 SAP 2012	Sc W	/pe: lid indows indows	Glazing: double-glaze double-glaze		Argon: Yes Yes	Fram PVC-U PVC-U PVC-U	9:
Name: Front Front Rear Name:	Gap: mm 16mm o 16mm o Type-Nam	r more e: Lo	Frame Facto 0.7 0.7 0.7 0.7	or: g-value: 0 0.76 0.76 Orient:	U-value: 1.4 1.4 1.4	Area: 2.14 5.48 8.42 Width:	1 1 1 Heigh	Openings:
Front Front			t Walls t Walls	Unspecified		0 0	0 0	
Rear			t Walls	Unspecified		0	0	
Overshading:		Average	e or unknown					
Opaque Elements:								
External Elements Ext Walls Cold Roof Ground Floor Internal Elements	Gross area: 50.7 43.95 43.95	Openings: 16.04 0	Net area: 34.66 43.95	U-value: 0.17 0.11 0.14	Ru value: 0 0	Curtain False	wall:	Kappa: N/A N/A N/A
<u>Party Elements</u> Party Wall	87.71							N/A
Thermal bridges:								

SAP Input

Thermal bridges:				Y-Value = 0.1325
[Approved] [Approved] [Approved] [Approved] [Approved] [Approved]	Length 9.83 7 22.14 20.16 10.08 20.12 20.16 17.44 17.44 17.44	Psi-value 0.3 0.04 0.05 0.07 0.06 0.09 0.16 0.16 0 0.24	E2 E3 E4 E6 E10 E16 E5 P1 P2 P4	Other lintels (including other steel lintels) Sill Jamb Intermediate floor within a dwelling Eaves (insulation at ceiling level) Corner (normal) Ground floor (normal) Ground floor Intermediate floor within a dwelling Roof (insulation at ceiling level)
Ventilation:				
Pressure test: Ventilation: Number of chimneys: Number of open flues: Number of fans: Number of passive stacks: Number of sides sheltered: Pressure test:	Yes (As des Natural ven O 3 0 2 5	igned) tilation (extra	ct fans)	
Main heating system:				
Main heating system:	Gas boilers Fuel: mains Info Source Database: (Has integra Brand name Model: eco Model quali (Combi boil Systems wi Central hea	and oil boilers gas Boiler Datab (rev 507, prod I PFGHRD e: Vaillant FEC exclusive fier: VUW 356 er) th radiators ting pump : 2 (temperature:	ase uct index C 835 /5-7 (H-GE 013 or late	r
Main heating Control:				
Main heating Control:	Time and te services Control cod		ne control	by suitable arrangement of plumbing and electrical
Secondary heating system:				
Secondary heating system:	None			
Water heating:				
Water heating:	Water code Fuel :mains No hot wate Flue Gas He	gas er cylinder eat Recovery S (rev 507, proc	System:)
Others:				
Electricity tariff: In Smoke Control Area: Conservatory:	Standard Ta No No conserva			

SAP Input

Low energy lights: Terrain type: EPC language: Wind turbine: Photovoltaics: Assess Zero Carbon Home:

100% Low rise urban / suburban English No None No

					User [Details:						
Assessor Name: Software Name:	oftware Name: Stroma FSAP 2012							ber: rsion:			0005374 on: 1.0.5.58	
	DIa			Pi	operty	Address	: Plot 10					
Address : 1. Overall dwelling dim	Plot											
T. Overall dwelling diff	IENSION	5.			Aro	a(m²)		Av. Hei	ight(m)		Volume(m ³)	
Ground floor							(1a) x		2.4	(2a) =	105.48	(3a)
First floor						43.95	(10) x		.63	(2b) =	115.59	(3b)
Total floor area TFA = (1a)+(1t	o)+(1c)+((1d)+(1e	e)+(1n	、 <u> </u>	87.9	(4)	2.	.00	()	110.00	
Dwelling volume			() - (,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	′	01.0)+(3c)+(3d)+(3e)+	.(3n) =	221.07	(5)
2. Ventilation rate:												
		main neating		econdary neating	y	other		total			m ³ per hour	
Number of chimneys	Ĺ	0] + [0] + [0	_ = _	0	x 4	40 =	0	(6a)
Number of open flues		0	+	0] + [0] = [0	x 2	20 =	0	(6b)
Number of intermittent f	ans							3	x 1	10 =	30	(7a)
Number of passive vent	S							0	x 1	10 =	0	(7b)
Number of flueless gas	fires							0	x 4	40 =	0	(7c)
										Air ch	anges per ho	ur
Infiltration due to chimne	eys, flu	es and fa	ans = (6	a)+(6b)+(7	a)+(7b)+	(7c) =	Г	30	<u> </u>	÷ (5) =	0.14	(8)
If a pressurisation test has							continue fr			- (-)	0.11	
Number of storeys in	the dw	elling (ne	s)								0	(9)
Additional infiltration									[(9)-	-1]x0.1 =	0	(10)
Structural infiltration:	0.25 fo	r steel or	timber t	frame or	0.35 fo	r masoni	ry constr	uction			0	(11)
if both types of wall are deducting areas of oper				ponding to	the grea	ter wall are	a (after					
If suspended wooden	0 /	•		ed) or 0.	1 (seal	ed), else	enter 0				0	(12)
If no draught lobby, e	nter 0.0)5, else e	enter 0								0	(13)
Percentage of window	vs and	doors dr	aught st	ripped							0	(14)
Window infiltration						0.25 - [0.2	2 x (14) ÷ 1	= [00			0	(15)
Infiltration rate						(8) + (10)	+ (11) + (1	2) + (13) +	+ (15) =		0	(16)
Air permeability value		•			•	•	•	etre of e	nvelope	area	5	(17)
If based on air permeab	-										0.39	(18)
Air permeability value appl		ressurisatio	on test has	s been don	e or a de	gree air pe	rmeability	is being us	sed			-
Number of sides shelter Shelter factor	ed					(20) - 1 - 1	[0.075 x (1	9)1 -			2	(19)
	oting ob	altar faa	tor					[0]] =			0.85	(20)
Infiltration rate incorpora		(21) = (18) x (20) =				0.33	(21)				
Infiltration rate modified		· · ·			11	A	Sec.	Oct	Nevi	Dee	1	
Jan Feb	Mar	Apr	May -	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind s						1			· -	·	1	
(22)m= 5.1 5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7		

Wind F	Factor (2	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]	
Adjust	ed infiltr	ation rat	e (allowi	ing for sł	nelter an	d wind s	peed) =	(21a) x	(22a)m					
	0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.39]	
		<i>ctive air</i> al ventila	-	rate for t	he appli	cable ca	se						- 0	(23a)
		eat pump		endix N, (2	:3b) = (23a	a) × Fmv (e	equation (N	N5)) , other	wise (23b) = (23a)			0	(23b)
lf bala	anced with	h heat reco	overy: effic	iency in %	allowing f	or in-use fa	actor (from	n Table 4h)) =				0	(23c)
a) If	balance	ed mecha	anical ve	entilation	with he	at recove	ery (MV⊦	HR) (24a	ı)m = (22	2b)m + (2	23b) × [1	– (23c)) ÷ 100]]、 `
(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) lf	balance	ed mecha	anical ve	entilation	without	heat rec	overy (N	/IV) (24b)m = (22	2b)m + (2	23b)			
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
,		nouse ex m < 0.5 ×			•	•				5 × (23b)			
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
,		ventilation = 1, the				•				0.5]				
(24d)m=	0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57		(24d)
Effe	ctive air	change	rate - er	nter (24a) or (24t	o) or (24	c) or (24	d) in box	(25)				_	
(25)m=	0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57		(25)
3. He	at losse	s and he	eat loss	paramet	er:									
ELEN	IENT	Gros area		Openin rr		Net Ar A ,r		U-valı W/m2		A X U (W/ł	<)	k-value kJ/m²·l		A X k kJ/K
Doors						2.14	x	1.4	=	2.996				(26)
Windo	ws Type	e 1				5.48	x1/	/[1/(1.4)+	0.04] =	7.27				(27)
Windo	ws Type	e 2				8.42	x1/	/[1/(1.4)+	0.04] =	11.16				(27)
Floor						43.95	x	0.14	=	6.153				(28)
Walls		50.	7	16.0	4	34.66	x	0.17	=	5.89				(29)
Roof		43.9	5											
Total a			5	0		43.95	x	0.11	= [4.83				(30)
	area of e	elements		0		43.95 138.6		0.11	= [4.83				(30)
•	wall	elements	, m²			138.6 87.71	; x	0	= [0				
	wall ndows and		, m² ows, use e	L		138.6 87.71 alue calcula	; x	0	= [0	s given in	paragraph	[[13.2	(31)
* for win ** includ	wall ndows and de the area	elements d roof winde	, m² ows, use e sides of ir	effective wi		138.6 87.71 alue calcula	x ated using	0	= [/[(1/U-valu	0	s given in	paragraph] [] .2 [38.	(31)
* for win ** incluc Fabric	wall ndows and de the area heat los	elements I roof winde as on both	, m² ows, use e sides of ir = S (A x	effective wi		138.6 87.71 alue calcula	x ated using	0 formula 1,	= [/[(1/U-valu + (32) =	0	-			(31) (32) 3 (33)
* for win ** incluc Fabric Heat c	wall ndows and de the area heat los capacity	elements I roof winde as on both ss, W/K =	, m² ows, use e sides of ir = S (A x (A x k)	offective wi nternal wal	ls and par	138.6 87.71 alue calcula titions	x x	0 formula 1,	= = = = = = = = = = = = = = = = = = =	0 re)+0.04] a	2) + (32a)		38.	(31) (32) 3 (33) 0.79 (34)
* for win ** incluc Fabric Heat c Therm For desi	wall ndows and de the area heat los capacity nal mass ign asses	elements I roof windo as on both ss, W/K : Cm = S(, m ² sides of ir S (A x (A x k) ter (TMF ere the de	effective wi nternal wal U) P = Cm +	ls and par - TFA) ir	138.6 87.71 alue calcula tititions	x ated using	0 formula 1, (26)(30)	= [/[(1/U-valu + (32) = ((28) Indica	0 re)+0.04] a .(30) + (32 tive Value:	2) + (32a) Low	(32e) =	38. 21329	(31) (32) 3 (33) 0.79 (34)
* for win ** incluc Fabric Heat c Therm For desi can be t Therm	wall dows and the the area heat los capacity hal mass ign assess used inste	elements I roof windd as on both ss, W/K : Cm = S(cm = S(parame sments wh bad of a del es : S (L	, m ² sides of ir S (A x A x k) ter (TMF ere the de tailed calc x Y) cal	effective winternal wal U) P = Cm + etails of the ulation. culated of	ls and par - TFA) ir construct using Ap	138.6 87.71 alue calcula titions kJ/m²K ion are not	ated using	0 formula 1, (26)(30)	= [/[(1/U-valu + (32) = ((28) Indica	0 re)+0.04] a .(30) + (32 tive Value:	2) + (32a) Low	(32e) =	38. 21329	(31) (32) 3 (33) 0.79 (34) 0 (35)
* for win ** incluc Fabric Heat c Therm For desi can be u Therm if details	wall dows and de the area heat los capacity nal mass ign assess used inste nal bridge s of therma	elements I roof windo as on both ss, W/K = Cm = S(cm = S(parame sments wh ead of a de es : S (L al bridging	, m ² sides of ir S (A x A x k) ter (TMF ere the de tailed calc x Y) cal	effective winternal wal U) P = Cm + etails of the ulation. culated of	ls and par - TFA) ir construct using Ap	138.6 87.71 alue calcula titions kJ/m²K ion are not	ated using	0 formula 1, (26)(30)	= = = = = = = = = = = = = = = = = = =	0 .(30) + (32 tive Value: values of	2) + (32a) Low	(32e) =	38. 21329 100	(31) (32) 3 (33) 9.79 (34) 0 (35) 36 (36)
* for win ** incluc Fabric Heat c Therm For desi can be t Therm if details Total f	wall dows and de the area heat los capacity hal mass ign assess used inste hal bridge s of therma fabric he	elements I roof windo as on both ss, W/K = Cm = S(cm = S(parame sments wh ead of a de es : S (L al bridging	, m ² sides of ir S (A x A x k) ter (TMF ere the de tailed calc x Y) cal are not kr	effective winternal wal U) P = Cm + etails of the ulation. culated of hown (36) =	ls and par - TFA) ir - construct using Ap = 0.05 x (3	138.6 87.71 alue calcula titions kJ/m²K ion are not	ated using	0 formula 1, (26)(30)	= = [/[(1/U-valu + (32) = ((28) Indica e indicative (33) +	0 re)+0.04] a .(30) + (32 tive Value:	2) + (32a) Low TMP in Ta	(32e) = able 1f	38. 21329 100	(31) (32) 3 (33) 9.79 (34) 9 (35) 36 (36)

(38)m=	42.85	42.6	42.36	41.22	41.01	40.01	40.01	39.83	40.4	41.01	41.44	41.89		(38)
Heat tr	ansfer o	coefficie	nt, W/K						(39)m	= (37) + (3	38)m			
(39)m=	99.52	99.27	99.03	97.89	97.68	96.68	96.68	96.5	97.07	97.68	98.11	98.56		_
Heat lo	oss para	ameter (H	HLP), W/	/m²K						Average = = (39)m ÷	Sum(39) ₁ .	12 /12=	97.89	(39)
(40)m=	1.13	1.13	1.13	1.11	1.11	1.1	1.1	1.1	1.1	1.11	1.12	1.12		
I		Į		Į				Į	· · · ·	Average =	Sum(40)1.	12 /12=	1.11	(40)
Numbe		<u> </u>	nth (Tab	,		i .					i			
(11)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		(41)
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)
4 \\/-	4 a u a a a	(*												
4. vva	ter nea	ting ene	rgy requi	irement:								kWh/ye	ear:	
		upancy,	N + 1.76 x	[1 ovp	(0 0003		- 12 0	<u>)))] , 0 (</u>	1012 v /	TEA 12		6		(42)
		9, $N = 1$ 9, $N = 1$	+ 1.70 X	li - exp	(-0.0003	949 X (11	-A -13.9)2)] + 0.0	JU13 X (IFA - 13.	.9)			
			ater usag									0.9		(43)
		-	hot water person per			-	-	to achieve	a water us	se target o	T			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot wate			r day for ea	· ·	· ·			<u> </u>	000	000	1101			
(44)m=	110.99	106.95	102.91	98.88	94.84	90.81	90.81	94.84	98.88	102.91	106.95	110.99		
_		•			·	·		•			m(44) ₁₁₂ =	L	1210.76	(44)
Energy o			used - cal		onthly = 4.	190 x Vd,r	n x nm x D	0Tm / 3600		nth (see Ta	ables 1b, 1 I	c, 1d)		
(45)m=	164.59	143.95	148.54	129.5	124.26	107.23	99.36	114.02	115.38	134.47	146.78	159.4		
lf instant	aneous w	vater heati	ng at point	of use (no	o hot water	r storage),	enter 0 in	boxes (46		Total = Su	m(45) ₁₁₂ =	= [1587.5	(45)
(46)m=	24.69	21.59	22.28	19.43	18.64	16.08	14.9	17.1	17.31	20.17	22.02	23.91		(46)
Water	storage	loss:	I	I				I		I	<u> </u>	<u> </u>		
-) includir				-		ame ves	sel		0		(47)
		•	and no ta		•			` '	ara) ant	or (0) in (47)			
	storage		hot wate	er (unis ir	iciudes i	nstantar	ieous co	ווסס ומחו	ers) ente	er U in (47)			
	-		eclared I	oss facto	or is kno	wn (kWł	n/day):					0		(48)
Tempe	rature f	actor fro	m Table	2b								0		(49)
			r storage					(48) x (49)) =			0		(50)
,			eclared of factor fr	•										(51)
		-	see secti			1/1116/06	(y)					0		(31)
Volume	e factor	from Ta	ble 2a									0		(52)
Tempe	rature f	actor fro	m Table	2b								0		(53)
•••			r storage	, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(54)
	. ,	(54) in (8		for an-l	100 c 10 f -			((EC)	EE) / 44)	~		0		(55)
	-		culated f		1			((56)m = (i	1				
(56)m= If cylinde	0 er contain:	0 s dedicate	0 d solar sto	0 rage, (57)	0 m = (56)m	0 x [(50) – (0 H11)] ÷ (5	0), else (5	0 7)m = (56)	0 m where (0 H11) is fro	0 om Appendi	хH	(56)
				- · ·		· ·			· · ·				~	(57)
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

Drima	v circui	loss (ar	nual) fr	om Table	3							0		(58)
	•	loss (al	,			(59)m = ((58) ÷ 36	35 x (41)	m			•	1	()
	•	/ factor fi				· ·	` '	```		r thermo	stat)			
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
Combi		Iculated	for oach	month	(61)m –	(60) · 20	L 65 v (41	l					1	
(61)m=								0	0	0	0	0		(61)
			_										(50)m + (61)m	
(62)m=	164.59	143.95	148.54	129.5	124.26	107.23	99.36	(02)11 =	115.38	134.47	146.78	159.4	(59)m + (61)m 	(62)
		calculated											l	(02)
		I lines if								r contribut	ION IO Walt	er neaung)		
(63)m=					0				0	0	0	0]	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	I	(63) (G2)
				0	0	0	0	0	0	0	0	0		(00) (02)
(64)m=	164.59	ater hea 143.95	148.54	129.5	124.26	107.23	99.36	114.02	115.38	134.47	146.78	159.4	1	
(04)11=	104.59	143.95	140.54	129.5	124.20	107.23	99.30			ater heate			1587.5	(64)
Lloot o	aina fra	mustar	haating	k\//b/m	anth 0.0	E 1 TO DE	(4 E) m							
	54.73	m water 47.86	49.39	43.06	41.32	5 [U.85 35.65	× (45)11 33.04	37.91		44.71	<u>, </u>	r í í	·]]	(65)
(65)m=									38.36		48.81	53	[(03)
	, ,	m in calo		. ,	-	cylinder i	s in the (dwelling	or hot w	ater is fr	om com	munity r	leating	
5. In	ternal g	ains (see	e Table 5	5 and 5a):									
Metab		ns (Table	T i i	T		<u> </u>	<u> </u>			_		_	1	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	155.75	155.75	155.75	155.75	155.75	155.75	155.75	155.75	155.75	155.75	155.75	155.75		(66)
Lightin	ig gains	(calcula	ted in Ap	opendix	L, equat	ion L9 o	r L9a), a	lso see	Table 5				1	
(67)m=	54.81	48.68	39.59	29.97	22.4	18.91	20.44	26.57	35.66	45.27	52.84	56.33		(67)
Applia	nces ga	ins (calc	ulated ir	n Appeno	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5				
(68)m=	350.99	354.63	345.45	325.91	301.25	278.07	262.58	258.94	268.12	287.65	312.32	335.5		(68)
Cookir	ng gains	(calcula	ted in A	ppendix	L, equa	tion L15	or L15a), also se	e Table	5	-	-		
(69)m=	53.17	53.17	53.17	53.17	53.17	53.17	53.17	53.17	53.17	53.17	53.17	53.17		(69)
Pumps	s and fa	ns gains	(Table \$	5a)										
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losse	s e.g. ev	vaporatio	on (nega	tive valu	es) (Tab	ole 5)							-	
(71)m=	-103.83	-103.83	-103.83	-103.83	-103.83	-103.83	-103.83	-103.83	-103.83	-103.83	-103.83	-103.83		(71)
Water	heating	gains (T	able 5)											
(72)m=	73.56	71.23	66.39	59.81	55.53	49.52	44.41	50.96	53.28	60.09	67.78	71.24		(72)
Total i	internal	gains =				(66))m + (67)n	n + (68)m -	+ (69)m + ((70)m + (7	1)m + (72)	m	1	
(73)m=	587.44	582.62	559.51	523.78	487.27	454.59	435.51	444.55	465.14	501.11	541.03	571.16		(73)
6. So	lar gain	s:							1					
Solar g	gains are	calculated	using sola	r flux from	Table 6a	and assoc	iated equa	itions to co	onvert to th	e applicat	ole orientat	ion.		
Orient		Access F		Area		Flu			g_		FF		Gains	
	-	Table 6d		m²		Tal	ble 6a	Т	able 6b	T	able 6c		(W)	
Solar (gains in	watts, ca	alculated	for eac	h month			(83)m = S	um(74)m .	(82)m			1	
(83)m=	0	0	0	0	0	0	0	0	0	0	0	0		(83)

(84)m=	587.44	582.62	559.51	523.78	487.27	454.59	435.51	444.55	465.14	501.11	541.03	571.16		(84)
7. Me	an inter	nal temp	erature	(heating	season)								
Temp	erature	during h	eating p	eriods ir	n the livir	ng area	from Tab	ole 9, Th	1 (°C)				21	(85)
Utilisa	ation fac	tor for g	ains for	living are	ea, h1,m	(see Ta	ble 9a)					I		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(86)m=	0.96	0.95	0.95	0.93	0.9	0.83	0.72	0.73	0.84	0.92	0.95	0.96		(86)
Mean	interna	l temper	ature in	living are	ea T1 (fo	ullow ste	ns 3 to 7	r in Tabl	e 9c)					
(87)m=	18.75	18.87	19.14	19.57	20.03	20.5	20.77	20.75	20.43	19.85	19.25	18.73		(87)
		during h		l oriodo ir	root of	l dwolling			h2 (°C)					
(88)m=	19.97	19.98	19.98	eriods ir 19.99	19.99	20	20	20	20	19.99	19.99	19.98		(88)
									20	10.00	10.00	10.00		()
			1	rest of d		· · · ·	i	i	0.0		0.04	0.05		(90)
(89)m=	0.95	0.95	0.94	0.92	0.88	0.78	0.62	0.63	0.8	0.9	0.94	0.95		(89)
		· ·		the rest		r ě (1	ri — — — — — — — — — — — — — — — — — — —	7 in Tabl	e 9c)	i			
(90)m=	16.98	17.14	17.55	18.17	18.84	19.49	19.82	19.8	19.39	18.58	17.71	16.95		(90)
									f	'LA = Livin	g area ÷ (4	4) =	0.28	(91)
Mean	interna	l temper	ature (fo	or the wh	ole dwe	lling) = fl	LA × T1	+ (1 – fL	A) × T2	-				
(92)m=	17.47	17.63	18	18.56	19.17	19.77	20.09	20.07	19.68	18.94	18.14	17.44		(92)
Apply	adjustn	nent to t	he mear	n internal	temper	ature fro	m Table	4e, whe	ere appro	opriate				
(93)m=	17.47	17.63	18	18.56	19.17	19.77	20.09	20.07	19.68	18.94	18.14	17.44		(93)
		ting requ												
Set T														
				•		ned at ste	ep 11 of	Table 9	o, so tha	t Ti,m=(76)m an	d re-calc	ulate	
	ilisation	factor fo	or gains	using Ta	ble 9a		r				,		ulate	
the ut	ilisation Jan	factor fo Feb	or gains Mar	using Ta Apr		led at ste	ep 11 of Jul	Table 9l Aug	o, so tha Sep	t Ti,m=(Oct	76)m an Nov	d re-calc Dec	ulate	
the ut	ilisation Jan	factor fo	or gains Mar	using Ta Apr	ble 9a		r				,		ulate	(94)
the ut Utilisa (94)m=	ilisation Jan ation fac	factor fo Feb tor for ga	or gains Mar ains, hm 0.92	using Ta Apr : 0.9	ble 9a May 0.85	Jun	Jul	Aug	Sep	Oct	Nov	Dec	ulate	(94)
the ut Utilisa (94)m=	ilisation Jan ation fac	factor fo Feb tor for ga	or gains Mar ains, hm 0.92	using Ta Apr I:	ble 9a May 0.85	Jun	Jul	Aug	Sep	Oct	Nov	Dec	ulate	(94) (95)
the ut Utilisa (94)m= Usefu (95)m=	ilisation Jan ation fac 0.93 Il gains, 546.12	factor for Feb tor for g 0.93 hmGm 539.34	or gains Mar ains, hm 0.92 , W = (94 512.47	using Ta Apr 1: 0.9 4)m x (84	ble 9a May 0.85 4)m 415.91	Jun 0.76 346.48	Jul 0.63	Aug 0.64	Sep 0.78	Oct 0.87	0.91	Dec 0.93	ulate	. ,
the ut Utilisa (94)m= Usefu (95)m=	ilisation Jan ation fac 0.93 Il gains, 546.12	factor for Feb tor for g 0.93 hmGm 539.34	or gains Mar ains, hm 0.92 , W = (94 512.47	using Ta Apr 1: 0.9 4)m x (84 469.03	ble 9a May 0.85 4)m 415.91	Jun 0.76 346.48	Jul 0.63	Aug 0.64	Sep 0.78	Oct 0.87	0.91	Dec 0.93	ulate	. ,
the ut Utilisa (94)m= Usefu (95)m= Montł (96)m=	ilisation Jan ation fac 0.93 ul gains, 546.12 nly avera 4.3	factor for Feb tor for g 0.93 hmGm 539.34 age exte 4.9	or gains Mar ains, hm 0.92 , W = (94 512.47 ornal tem 6.5 an intern	using Ta Apr 0.9 4)m x (84 469.03 perature 8.9 nal tempe	ble 9a May 0.85 4)m 415.91 e from Ta 11.7	Jun 0.76 346.48 able 8 14.6 Lm , W =	Jul 0.63 274.4 16.6	Aug 0.64 285.17 16.4	Sep 0.78 363.18 14.1	Oct 0.87 437.6 10.6	Nov 0.91 494.59	Dec 0.93 533.41	ulate	(95)
the ut Utilisa (94)m= Usefu (95)m= Montł (96)m=	ilisation Jan ation fac 0.93 ul gains, 546.12 nly avera 4.3	factor for Feb tor for g 0.93 hmGm 539.34 age exte 4.9	or gains Mar ains, hm 0.92 W = (94 512.47 ornal tem 6.5	using Ta Apr 0.9 4)m x (84 469.03 perature 8.9 nal tempe	ble 9a May 0.85 4)m 415.91 e from Ta 11.7	Jun 0.76 346.48 able 8 14.6	Jul 0.63 274.4 16.6	Aug 0.64 285.17 16.4	Sep 0.78 363.18 14.1	Oct 0.87 437.6 10.6	Nov 0.91 494.59	Dec 0.93 533.41	ulate	(95)
the ut Utilisa (94)m= Usefu (95)m= Month (96)m= Heat (97)m= Space	ilisation Jan ation fac 0.93 Il gains, 546.12 nly avera 4.3 loss rate 1310.8 e heatin	factor for Feb tor for ga 0.93 hmGm 539.34 age exte 4.9 e for mea 1263.29 g require	or gains Mar ains, hm 0.92 W = (94) 512.47 crnal tem $6.5an intern1138.36ement fo$	using Ta Apr 0.9 4)m x (84 469.03 perature 8.9 nal tempe 945.64 or each n	ble 9a May 0.85 4)m 415.91 e from Ta 11.7 erature, 729.93 nonth, k\	Jun 0.76 346.48 able 8 14.6 Lm , W = 499.96 Wh/mont	Jul 0.63 274.4 16.6 =[(39)m 337.13 th = 0.02	Aug 0.64 285.17 16.4 x [(93)m 353.98 24 x [(97	Sep 0.78 363.18 14.1 - (96)m 541.56)m - (95	Oct 0.87 437.6 10.6] 814.35)m] x (4	Nov 0.91 494.59 7.1 1082.84 1)m	Dec 0.93 533.41 4.2 1305.17	ulate	(95) (96)
the ut Utilisa (94)m= Usefu (95)m= Month (96)m= Heat (97)m=	ilisation Jan ation fac 0.93 ul gains, 546.12 hly avera 4.3 loss rate 1310.8	factor for Feb tor for g 0.93 hmGm 539.34 age exte 4.9 e for mea 1263.29	or gains Mar ains, hm 0.92 , W = (94 512.47 crnal tem 6.5 an intern 1138.36	using Ta Apr 0.9 4)m x (84 469.03 perature 8.9 nal tempe 945.64	ble 9a May 0.85 4)m 415.91 e from Ta 11.7 erature, 729.93	Jun 0.76 346.48 able 8 14.6 Lm , W = 499.96	Jul 0.63 274.4 16.6 =[(39)m 1 337.13	Aug 0.64 285.17 16.4 x [(93)m 353.98 24 x [(97 0	Sep 0.78 363.18 14.1 - (96)m 541.56)m - (95 0	Oct 0.87 437.6 10.6] 814.35)m] x (4 280.3	Nov 0.91 494.59 7.1 1082.84 1)m 423.53	Dec 0.93 533.41 4.2 1305.17 574.19	ulate	(95) (96) (97)
the ut Utilisa (94)m= Usefu (95)m= Month (96)m= Heat (97)m= Space	ilisation Jan ation fac 0.93 Il gains, 546.12 nly avera 4.3 loss rate 1310.8 e heatin	factor for Feb tor for ga 0.93 hmGm 539.34 age exte 4.9 e for mea 1263.29 g require	or gains Mar ains, hm 0.92 W = (94 512.47 rnal tem 6.5 an intern 1138.36 ement fo	using Ta Apr 0.9 4)m x (84 469.03 perature 8.9 nal tempe 945.64 or each n	ble 9a May 0.85 4)m 415.91 e from Ta 11.7 erature, 729.93 nonth, k\	Jun 0.76 346.48 able 8 14.6 Lm , W = 499.96 Wh/mont	Jul 0.63 274.4 16.6 =[(39)m 337.13 th = 0.02	Aug 0.64 285.17 16.4 x [(93)m 353.98 24 x [(97 0	Sep 0.78 363.18 14.1 - (96)m 541.56)m - (95 0	Oct 0.87 437.6 10.6] 814.35)m] x (4 280.3	Nov 0.91 494.59 7.1 1082.84 1)m	Dec 0.93 533.41 4.2 1305.17 574.19	ulate 3375.9	(95) (96)
the ut Utilisa (94)m= Usefu (95)m= Month (96)m= Heat (97)m= Space (98)m=	ilisation Jan ation fac 0.93 Il gains, 546.12 hly avera 4.3 loss rate 1310.8 e heatin 568.93	factor for Feb tor for g 0.93 hmGm 539.34 age exte 4.9 e for mea 1263.29 g require 486.5	or gains Mar ains, hm 0.92 , W = (94 512.47 rnal tem 6.5 an intern 1138.36 ement fo 465.66	using Ta Apr 0.9 4)m x (84 469.03 perature 8.9 nal tempe 945.64 or each n	ble 9a May 0.85 4)m 415.91 e from Ta 11.7 erature, 1 729.93 nonth, k\ 233.62	Jun 0.76 346.48 able 8 14.6 Lm , W = 499.96 Wh/mont	Jul 0.63 274.4 16.6 =[(39)m 337.13 th = 0.02	Aug 0.64 285.17 16.4 x [(93)m 353.98 24 x [(97 0	Sep 0.78 363.18 14.1 - (96)m 541.56)m - (95 0	Oct 0.87 437.6 10.6] 814.35)m] x (4 280.3	Nov 0.91 494.59 7.1 1082.84 1)m 423.53	Dec 0.93 533.41 4.2 1305.17 574.19		(95) (96) (97)
the ut Utilisa (94)m= Usefu (95)m= Month (96)m= Heat (97)m= Space (98)m=	ilisation Jan ation fac 0.93 Il gains, 546.12 nly avera 4.3 loss rate 1310.8 e heatin 568.93	factor for Feb tor for g 0.93 hmGm 539.34 age exte 4.9 e for mea 1263.29 g require 486.5	or gains Mar ains, hm 0.92 , W = (94 512.47 rnal tem 6.5 an intern 1138.36 ement fo 465.66	using Ta Apr 0.9 4)m x (84 469.03 perature 8.9 nal tempe 945.64 or each n 343.16	ble 9a May 0.85 4)m 415.91 e from Ta 11.7 erature, 729.93 nonth, kV 233.62	Jun 0.76 346.48 able 8 14.6 Lm , W = 499.96 Wh/mont 0	Jul 0.63 274.4 16.6 =[(39)m : 337.13 th = 0.02 0	Aug 0.64 285.17 16.4 x [(93)m 353.98 24 x [(97 0 Tota	Sep 0.78 363.18 14.1 - (96)m 541.56)m - (95 0 1 per year	Oct 0.87 437.6 10.6] 814.35)m] x (4 280.3	Nov 0.91 494.59 7.1 1082.84 1)m 423.53	Dec 0.93 533.41 4.2 1305.17 574.19	3375.9	(95) (96) (97) (98)
the ut Utilisa (94)m= Usefu (95)m= Month (96)m= Heat (97)m= Space (98)m= Space 9a. En	ilisation Jan ation fac 0.93 Il gains, 546.12 nly avera 4.3 loss rate 1310.8 e heatin 568.93	factor for Feb tor for gi 0.93 hmGm 539.34 age exte 4.9 e for mea 1263.29 g require 486.5 g require	or gains Mar ains, hm 0.92 , W = (94 512.47 rnal tem 6.5 an intern 1138.36 ement fo 465.66	using Ta Apr 1: 0.9 4)m x (84 469.03 perature 8.9 nal tempe 945.64 r each n 343.16	ble 9a May 0.85 4)m 415.91 e from Ta 11.7 erature, 729.93 nonth, kV 233.62	Jun 0.76 346.48 able 8 14.6 Lm , W = 499.96 Wh/mont 0	Jul 0.63 274.4 16.6 =[(39)m : 337.13 th = 0.02 0	Aug 0.64 285.17 16.4 x [(93)m 353.98 24 x [(97 0 Tota	Sep 0.78 363.18 14.1 - (96)m 541.56)m - (95 0 1 per year	Oct 0.87 437.6 10.6] 814.35)m] x (4 280.3	Nov 0.91 494.59 7.1 1082.84 1)m 423.53	Dec 0.93 533.41 4.2 1305.17 574.19	3375.9	(95) (96) (97) (98)
the ut Utilisa (94)m= Usefu (95)m= Month (96)m= Heat (97)m= Space (98)m= Space 9a. En Space	ilisation Jan ation fac 0.93 I gains, 546.12 hly avera 4.3 loss rate 1310.8 e heatin 568.93 e heatin ergy rec e heatir	factor for Feb tor for gi 0.93 hmGm 539.34 age exte 4.9 e for mea 1263.29 g require 486.5 g require quiremen ng:	or gains Mar ains, hm 0.92 , W = (94 512.47 rnal tem 6.5 an intern 1138.36 ement fo 465.66 ement in an t = 1nd	using Ta Apr 1: 0.9 4)m x (84 469.03 perature 8.9 nal tempe 945.64 r each n 343.16	ble 9a May 0.85 4)m 415.91 e from Ta 11.7 erature, 729.93 nonth, kk 233.62 2/year eating sy	Jun 0.76 346.48 able 8 14.6 Lm , W = 499.96 Wh/mont 0	Jul 0.63 274.4 16.6 =[(39)m = 337.13 th = 0.02 0 ncluding	Aug 0.64 285.17 16.4 x [(93)m 353.98 24 x [(97) 0 Tota micro-C	Sep 0.78 363.18 14.1 - (96)m 541.56)m - (95 0 1 per year	Oct 0.87 437.6 10.6] 814.35)m] x (4 280.3	Nov 0.91 494.59 7.1 1082.84 1)m 423.53	Dec 0.93 533.41 4.2 1305.17 574.19	3375.9	(95) (96) (97) (98)
the ut Utilisa (94)m= Usefu (95)m= Month (96)m= Heat (97)m= Space (98)m= Space 9a. En Space Fracti	ilisation Jan ation fac 0.93 Il gains, 546.12 nly avera 4.3 loss rate 1310.8 e heatin 568.93 e heatin ergy rec e heatir	factor for Feb tor for gi 0.93 hmGm 539.34 age exte 4.9 e for mea 1263.29 g require 486.5 g require quiremen ng: bace hea	or gains Mar ains, hm 0.92 W = (94) 512.47 rnal tem 6.5 an intern 1138.36 ement fo 465.66 ement in ts - Ind	using Ta Apr 1: 0.9 4)m x (84 469.03 perature 8.9 nal tempe 945.64 or each n 343.16 kWh/m ² ividual h	ble 9a May 0.85 4)m 415.91 e from Ta 11.7 erature, 729.93 nonth, k\ 233.62 k/year eating sy y/supple	Jun 0.76 346.48 able 8 14.6 Lm , W = 499.96 Wh/mont 0	Jul 0.63 274.4 16.6 =[(39)m 2 337.13 th = 0.02 0 ncluding	Aug 0.64 285.17 16.4 x [(93)m 353.98 24 x [(97) 0 Tota micro-C	Sep 0.78 363.18 14.1 - (96)m 541.56)m - (95 0 I per year CHP)	Oct 0.87 437.6 10.6] 814.35)m] x (4 280.3	Nov 0.91 494.59 7.1 1082.84 1)m 423.53	Dec 0.93 533.41 4.2 1305.17 574.19	<u>3375.9</u> <u>38.41</u>	(95) (96) (97) (98) (99)
the ut Utilisa (94)m= Usefu (95)m= Month (96)m= Heat (97)m= Space (98)m= Space 9a. En Space Fracti	ilisation Jan ation fac 0.93 Il gains, 546.12 hly avera 4.3 loss rate 1310.8 e heatin 568.93 e heatin ergy rec e heatir ion of sp	factor for Feb tor for g: 0.93 hmGm 539.34 age exte 4.9 e for mea 1263.29 g require 486.5 g require quiremen ng: pace hea pace hea	or gains Mar ains, hm 0.92 W = (94) 512.47 ornal tem 6.5 an intern 1138.36 ement fo 465.66 ement in ts - Ind at from so	using Ta Apr 0.9 4)m x (84 469.03 perature 8.9 nal tempe 945.64 or each n 343.16 kWh/m ² ividual h	ble 9a May 0.85 4)m 415.91 e from Ta 11.7 erature, 1 729.93 nonth, k\ 233.62 2 /year eating sy y/supple em(s)	Jun 0.76 346.48 able 8 14.6 Lm , W = 499.96 Wh/mont 0	Jul 0.63 274.4 16.6 =[(39)m : 337.13 th = 0.02 0 ncluding	Aug 0.64 285.17 16.4 x [(93)m 353.98 24 x [(97 0 Tota micro-C	Sep 0.78 363.18 14.1 - (96)m 541.56)m - (95 0 I per year CHP) - (201) =	Oct 0.87 437.6 10.6] 814.35)m] x (4 280.3 (kWh/year	Nov 0.91 494.59 7.1 1082.84 1)m 423.53	Dec 0.93 533.41 4.2 1305.17 574.19	3375.9 38.41 0	(95) (96) (97) (98) (99)

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

Efficie	ency of I	main spa	ace heat	ing syste	em 1								90.6	(206)
Efficie	ency of s	seconda	ry/suppl	ementar	y heating	g system	ח, %						0	(208)
[Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar
Space	e heatin	g require	· · · ·	alculate	d above))								
	568.93	486.5	465.66	343.16	233.62	0	0	0	0	280.3	423.53	574.19		
(211)m	= {[(98)m x (20	4)] } x 1	00 ÷ (20)6)									(211)
	627.95	536.97	513.98	378.76	257.86	0	0	0	0	309.39	467.48	633.77		_
								Tota	l (kWh/yea	ar) =Sum(2	211) _{15,1012}		3726.16	(211)
•				y), kWh/	month									
r)1)]}x1		İ									1	
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		٦
								Tota	l (kWh/yea	ar) =Sum(2	2 15) _{15,1012}		0	(215)
	heating													
Output	from w 164.59	ater hea 143.95	ter (calc 148.54	ulated a	00VE) 124.26	107.23	99.36	114.02	115.38	134.47	146.78	159.4	1	
Efficion		ater hea		129.5	124.20	107.23	99.30	114.02	115.56	134.47	140.78	159.4		(216)
(217)m=	89.28	89.26	89.18	88.99	88.57	85	85	85	85	88.71	89.09	89.32	85	(217)
· · ·					00.37	00	00	00	65	00.71	89.09	09.32		(217)
		heating, m x 100												
(<u>-</u> 19)m=		161.28	166.57	145.52	140.29	126.15	116.9	134.14	135.75	151.59	164.76	178.45		
L								Tota	I = Sum(2'	19a) ₁₁₂ =			1805.75	(219)
Annua	l totals									k	Wh/year	,	kWh/year	_
Space	heating	fuel use	ed, main	system	1								3726.16	
Water I	neating	fuel use	d										1805.75	1
Electric	ity for p	oumps, fa	ans and	electric	keep-ho	t								-
centra	l heatir	ig pump	:									30		(230c)
boiler	with a f	an-assis	sted flue									45		(230e)
Total e	lectricity	y for the	above, l	kWh/yea	r			sum	of (230a).	(230g) =			75	(231)
Electric	ity for li	ighting											387.17	(232)
Total d	elivered	l energy	for all u	ses (211)(221)	+ (231)	+ (232).	(237b)	=				5994.08	(338)
10a. F	uel cos	sts - indiv	/idual he	eating sy	stems:									-
						Fu	el			Fuel P	rice		Fuel Cost	
						kW	/h/year			(Table	12)		£/year	
Space	heating	- main s	system 1	l		(21	1) x			3.4	.8	x 0.01 =	129.67	(240)
Space	heating	- main s	system 2	2		(213	3) x			0		x 0.01 =	0	(241)
Space	heating	- secon	dary			(218	5) x			13.7	19	x 0.01 =	0	(242)
Water I	neating	cost (otl	her fuel)			(219	9)			3.4	.8	x 0.01 =	62.84	(247)
Pumps	, fans a	nd elect	ric keep	-hot		(231	1)			13.	19	x 0.01 =	9.89	(249)
			ch of (2	30a) to (230g) se			licable a	nd apply			-	Table 12a	٦.
⊢nergy	for ligh	ting				(232	<u><)</u>			13.1	19	x 0.01 =	51.07	(250)

Additional standing charges (Table 12)			120 (251)
Appendix Q items: repeat lines (253) and (254) Total energy cost (245).	4) as needed (247) + (250)(254) =		373.47 (255)
11a. SAP rating - individual heating systems			373.47
Energy cost deflator (Table 12) Energy cost factor (ECF) [(255)	x (256)] ÷ [(4) + 45.0] =		0.42 (256)
SAP rating (Section 12)	x (100)] : [(i) : ioio]		1.18 (257) 83.54 (258)
12a. CO2 emissions – Individual heating sys	tems including micro-CHF)	
			Fusia siana
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	804.85 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	390.04 (264)
Space and water heating	(261) + (262) + (263) + (264) =	1194.89 (265)
Electricity for pumps, fans and electric keep-h	ot (231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	200.94 (268)
Total CO2, kg/year		sum of (265)(271) =	1434.76 (272)
CO2 emissions per m ²		(272) ÷ (4) =	16.32 (273)
El rating (section 14)			86 (274)
13a. Primary Energy			
	Energy kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) x	1.22 =	4545.91 (261)
Space heating (secondary)	(215) x	3.07 =	0 (263)
Energy for water heating	(219) x	1.22 =	2203.02 (264)
Space and water heating	(261) + (262) + (263) + (264) =	6748.93 (265)
Electricity for pumps, fans and electric keep-h	ot (231) x	3.07 =	230.25 (267)
Electricity for lighting	(232) x	0 =	1188.61 (268)
'Total Primary Energy		sum of (265)(271) =	8167.79 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =	92.92 (273)

				User [Details:						
Assessor Name: Software Name:	Ben Marsh Stroma FS				Softwa	a Num are Vei	sion:			005374 n: 1.0.5.58	
			Pi	roperty	Address	: Plot 10					
Address :	Plot 10										
1. Overall dwelling dime	ensions:			•	- (2)		A) (- I	
Ground floor					a(m²)	(10) ×	Av. Hei			Volume(m ³)	-
					43.95	(1a) x		2.4	(2a) =	105.48	(3a)
First floor				4	43.95	(1b) x	2.	.63	(2b) =	115.59	(3b)
Total floor area TFA = (1	a)+(1b)+(1c)+	(1d)+(1e	e)+(1n)	87.9	(4)					
Dwelling volume				L		(3a)+(3b))+(3c)+(3d)+(3e)+	.(3n) =	221.07	(5)
2. Ventilation rate:											
	main heating		econdar heating	у	other		total			m ³ per hour	
Number of chimneys		_ + [0] + [0] = [0	x 4	40 =	0	(6a)
Number of open flues	0	i + F	0] + [0	」 = [0	x 2	20 =	0] (6b)
Number of intermittent fa	ans						3	x 1	0 =	30](7a)
Number of passive vents							0	x 1	0 =	0](⁷ b)
Number of flueless gas f								x4	40 =	-	<u> </u>
Number of fideless gas i	lles					L	0		- 10	0	(7c)
									Air ch	anges per ho	ur
Infiltration due to chimne	vs. flues and f	ans = (6	a)+(6b)+(7	a)+(7b)+	(7c) =	Г	30	<u> </u>	÷ (5) =	0.14	(8)
If a pressurisation test has I	-					continue fr			. (0) –	0.14	
Number of storeys in t	he dwelling (n	s)								0	(9)
Additional infiltration								[(9)-	1]x0.1 =	0	(10)
Structural infiltration: (.25 for steel o	r timber i	frame or	0.35 fo	r masoni	ry constr	uction			0	(11)
if both types of wall are p deducting areas of open			ponding to	the grea	ter wall are	a (after					
If suspended wooden	0 // 1		ed) or 0.	1 (seal	ed). else	enter 0				0	(12)
If no draught lobby, er			,	(,,					0	(13)
Percentage of window			ripped						·	0	(14)
Window infiltration		-			0.25 - [0.2	2 x (14) ÷ 1	= [00			0	(15)
Infiltration rate					(8) + (10)	+ (11) + (1	2) + (13) +	+ (15) =		0	(16)
Air permeability value,	q50, express	ed in cub	oic metre	s per h	our per s	quare m	etre of e	nvelope	area	5	(17)
If based on air permeabi	lity value, ther	(18) = [(1	7) ÷ 20]+(8	8), otherw	vise (18) = ((16)				0.39	(18)
Air permeability value applie		ion test has	s been don	e or a de	gree air pe	rmeability	is being us	sed			_
Number of sides sheltere Shelter factor	ed				(20) = 1 -	[0 075 x (1	0)1 -			2	(19)
	ting chalter for	otor					5)] –			0.85	(20)
Infiltration rate incorpora	•		J		(21) = (18	,				0.33	(21)
Infiltration rate modified	·	· ·	<u> </u>	11	A	Sec.	Oct	Nevi	Dee		
Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp		1		0.0	07	4	4.0	4.5	4 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		

Wind F	Factor (2	2a)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]	
Adjust	ed infiltra	ation rat	e (allowi	ing for sh	nelter ar	nd wind s	peed) =	(21a) x	(22a)m		-			
0.1.1	0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.39		
	ate ettec echanica		-	rate for t	ne appli	icable ca	se						0	(23a)
				endix N, (2	3b) = (23a	a) × Fmv (e	equation (I	N5)) , othei	wise (23b	o) = (23a)			0	(23b)
			• • •		, ,	for in-use f	•		,	, , ,			0	(23c)
			-	-	-	at recove				2b)m + (23b) x [1	1 – (23c)		(200)
(24a)m=		0	0	0	0	0	0	0	0	0	0	0]	(24a)
b) If	balance	d mecha	anical ve	entilation	without	heat rec	: overy (N	и VV) (24b)m = (22	1 2b)m + (;	23b)		1	
, (24b)m=		0	0	0	0	0	0	0	0	0	0	0]	(24b)
,					•	ve input v				- (0.0)	``````````````````````````````````````		1	
	r í		, ,	· ·	<i>,</i> ,	o); otherv		, <u>,</u>	,	<u> </u>	í Í		1	(24a)
(24c)m=		0	0	0	0	0	0	0	0	0	0	0	J	(24c)
,					•	ve input [,] erwise (2				0.51				
(24d)m=	<u> </u>	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	1	(24d)
Effe	ctive air	change	rate - er	nter (24a) or (24	b) or (24	c) or (24	d) in boy	(25)	ļ		1	1	
(25)m=	0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57]	(25)
2 1 10	otlogge			paramete		1							1	
ELEN		Gros	s	Openin m	gs	Net Ar A ,r		U-valı W/m2		A X U (W/I	K)	k-value kJ/m²·l		A X k kJ/K
Doors			()			2.14	x	1.4	=	2.996	<i>,</i>			(26)
Windo	ws Type	1				5.48		/[1/(1.4)+	0.04] =	7.27				(27)
Windo	ws Type	2				8.42		/[1/(1.4)+	0.04] =	11.16	=			(27)
Floor						43.95	, x	0.14		6.153	Ξ r			(28)
Walls		50.	7	16.04	4	34.66	x	0.17		5.89	\dashv		\dashv	(29)
Roof		43.9		0		43.95	_	0.11		4.83	\dashv		\dashv	(30)
Total a	area of e					138.6	_				L			(31)
Party v						87.71	_	0		0				(32)
* for win	ndows and			effective wi		alue calcul					as given in	paragraph	L h 3.2	
	heat los				io una par			(26)(30)	+ (32) =				38.3	(33)
	apacity			,					((28).	(30) + (32	2) + (32a).	(32e) =	21329.	
Therm	al mass	parame	ter (TMI	⊃ = Cm ÷	- TFA) iı	n kJ/m²K			Indica	ative Value	: Low		100	
	ign assess used instea				construct	tion are not	t known pi	recisely the	e indicative	e values of	TMP in Ta	able 1f		
					using Ap	opendix ł	<						18.3	6 (36)
	-	l bridging			• •	•								1`` ′
Total f					0.00 / 10	,								
	abric he			(00)	0.00 / (0				(33) +	- (36) =			56.6	7 (37)
	abric he	at loss		d monthly		1		i		- (36) = = 0.33 × (25)m x (5)		56.6	7 (37)

(38)m=	42.85	42.6	42.36	41.22	41.01	40.01	40.01	39.83	40.4	41.01	41.44	41.89		(38)
Heat tr	ansfer o	coefficie	nt, W/K						(39)m	= (37) + (38)m			
(39)m=	99.52	99.27	99.03	97.89	97.68	96.68	96.68	96.5	97.07	97.68	98.11	98.56		
Heat lo	oss para	meter (H	HLP), W/	/m²K						Average = = (39)m ÷	Sum(39)₁. · (4)	12 /12=	97.89	(39)
(40)m=	1.13	1.13	1.13	1.11	1.11	1.1	1.1	1.1	1.1	1.11	1.12	1.12		
										Average =	Sum(40)1	12 /12=	1.11	(40)
Numbe		i	nth (Tab	, ,	Mov	lun	11	<u> </u>	San	Oct	Nev	Deal		
(41)m=	Jan 31	Feb 28	Mar 31	Apr 30	May 31	Jun 30	Jul 31	Aug 31	Sep 30	Oct 31	Nov 30	Dec 31		(41)
(+1)11-	51	20	01		51		01	51		51		51		(,
4 Wa	iter heat	tina ene	rgy requi	irement [.]								kWh/ye	ar:	
				irement.								Kvvn/yc		
if TF	A > 13.9		N + 1.76 x	[1 - exp	(-0.0003	849 x (TF	-13.9)2)] + 0.0	0013 x (⁻	ΓFA -13.		.6		(42)
	A £ 13.9 Laverao		ater usag	ne in litre	es per da	av Vd.av	erage =	(25 x N)	+ 36		10	0.9		(43)
Reduce	the annua	al average	hot water person per	usage by	5% if the c	lwelling is	designed t			se target o		.0.0		()
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot wate	er usage i	n litres per	day for ea	ach month	Vd,m = fa	ctor from	Table 1c x	(43)						
(44)m=	110.99	106.95	102.91	98.88	94.84	90.81	90.81	94.84	98.88	102.91	106.95	110.99		_
Energy o	content of	hot water	used - cal	culated m	onthly $= 4$.	190 x Vd,r	n x nm x D	0Tm / 3600			m(44) ₁₁₂ = ables 1b, 1	L	1210.76	(44)
(45)m=	164.59	143.95	148.54	129.5	124.26	107.23	99.36	114.02	115.38	134.47	146.78	159.4		
lf instant	aneous w	ater heati	ng at point	of use (no	hot wate	r storage),	enter 0 in	boxes (46		Fotal = Su	m(45) ₁₁₂ =	-	1587.5	(45)
(46)m=	24.69	21.59	22.28	19.43	18.64	16.08	14.9	17.1	17.31	20.17	22.02	23.91		(46)
Water	storage	loss:												
			includir						ame ves	sel		0		(47)
		•	ind no ta hot wate		•			• •	ers) ente	er 'O' in <i>(</i>	47)			
	storage		not wate			notantai								
a) If m	anufact	urer's de	eclared I	oss facto	or is kno	wn (kWł	n/day):					0		(48)
Tempe	rature f	actor fro	m Table	2b								0		(49)
•••			storage	•				(48) x (49)	=			0		(50)
			eclared of factor fr	•								0		(51)
		-	ee secti		(.,,					•		()
		from Ta										0		(52)
•			m Table									0		(53)
			storage	e, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(54)
	. ,	(54) in (5 loss cal	culated f	for each	month			((56)m = (55) × (41)	m		0		(55)
(56)m=	0	0				0	0	0	0	0	0	0		(56)
	-	-		-				-	-		-	m Appendi	ix H	(00)
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
· · · · ·	-	-			-	-	-		-	-				

Primar	y circui	t loss (ar	nual) fro	om Table	e 3							0]	(58)
	•	t loss cal				,	· ·	. ,						
	dified by	/ factor f	rom Tab	le H5 if t	here is s	solar wat	ter heati	ng and a	a cylinde	r thermo	stat)		1	
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
Combi	loss ca	lculated	for each	month ((61)m =	(60) ÷ 30	65 × (41)m			_		_	
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
Total h	neat req	uired for	water h	eating ca	alculated	l for eac	h month	(62)m =	0.85 ×	(45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m=	164.59	143.95	148.54	129.5	124.26	107.23	99.36	114.02	115.38	134.47	146.78	159.4		(62)
Solar DI	HW input	calculated	using App	endix G or	Appendix	H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)	-	
(add a	dditiona	l lines if	FGHRS	and/or \	WWHRS	applies	, see Ap	pendix (G)					
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0		(63) (G2)
Output	t from w	ater hea	ter				_	_			_	_	_	
(64)m=	164.59	143.95	148.54	129.5	124.26	107.23	99.36	114.02	115.38	134.47	146.78	159.4		_
								Out	out from w	ater heate	r (annual)₁	12	1587.5	(64)
Heat g	ains fro	m water	heating,	, kWh/m	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m	n] + 0.8 x	x [(46)m	+ (57)m	+ (59)m]	
(65)m=	54.73	47.86	49.39	43.06	41.32	35.65	33.04	37.91	38.36	44.71	48.81	53		(65)
inclu	ude (57)	m in calo	culation	of (65)m	only if c	ylinder i	s in the o	dwelling	or hot w	vater is fr	om com	munity h	eating	
5. Int	ternal g	ains (see	e Table 5	5 and 5a):									
Metab	olic aair	ns (Table	e 5). Wat	ts										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	129.79	129.79	129.79	129.79	129.79	129.79	129.79	129.79	129.79	129.79	129.79	129.79		(66)
Lightin	g gains	(calcula	ted in Ap	pendix	L, equat	ion L9 o	r L9a), a	lso see	Table 5	Į			1	
(67)m=	21.92	19.47	15.84	11.99	8.96	7.57	8.18	10.63	14.26	18.11	21.14	22.53		(67)
Applia	nces ga	ins (calc	ulated ir	n Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5			1	
(68)m=	235.16	237.6	231.45	218.36	201.84	186.3	175.93	173.49	179.64	192.73	209.25	224.78		(68)
Cookir	ng gains	i (calcula	ted in A	ppendix	L, equat	tion L15	or L15a), also se	e Table	9 5			1	
(69)m=	35.98	35.98	35.98	35.98	35.98	35.98	35.98	35.98	35.98	35.98	35.98	35.98		(69)
Pumps	s and fa	ns gains	(Table {	5a)	1	1	1	1	Į	Į	1	1	1	
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losses	se.a. ev	ı /aporatic	n (nega	ı tive valu	es) (Tab	le 5)							1	
	<u> </u>	-103.83	-103.83	-103.83	-103.83	-103.83	-103.83	-103.83	-103.83	-103.83	-103.83	-103.83]	(71)
		ı gains (T	able 5)										1	
(72)m=	73.56	71.23	66.39	59.81	55.53	49.52	44.41	50.96	53.28	60.09	67.78	71.24		(72)
		gains =								(70)m + (7			I	
(73)m=	395.58	393.24	378.61	355.09	331.27	308.33	293.45	300.01	312.12	335.87	363.11	383.49]	(73)
. ,	lar gain									1				
		calculated	using sola	r flux from	Table 6a	and assoc	iated equa	itions to co	onvert to th	ne applicat	ole orientat	ion.		
-		Access F	-	Area		Flu			g_		FF		Gains	
	-	Table 6d		m²		Tal	ble 6a	Т	able 6b	Т	able 6c		(W)	
Solar g	gains in	watts, ca	alculated	<u>l for eac</u>	<u>h month</u>			(83)m = S	um(74)m	(82)m				
(83)m=	0	0	0	0	0	0	0	0	0	0	0	0		(83)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (67) (87)m= 18.4 18.52 18.82 19.27 19.78 20.3 20.63 20.61 20.21 19.57 18.93 18.38 (67) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (86) (86) 19.97 19.98 19.99 19.99 20 20 20 19.99 19.99 19.98 (88) (89)m= 0.98 0.98 0.97 0.97 0.94 0.88 0.77 0.78 0.9 0.96 0.97 0.98 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90) (16.46 16.64 17.08 17.75 18.49 19.24 19.69 19.66 19.12 18.19 17.24 16.44 (90) Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2 (92) (92) 19.42 18.58 17.71 16.98 (92) Apply adjustment to the mean internal temperature from Table 4e, where appropriate (93) 17 17.17 17.56 18.18 18.85 19.92 </th <th>(84)m=</th> <th>395.58</th> <th>393.24</th> <th>378.61</th> <th>355.09</th> <th>331.27</th> <th>308.33</th> <th>293.45</th> <th>300.01</th> <th>312.12</th> <th>335.87</th> <th>363.11</th> <th>383.49</th> <th></th> <th>(84)</th>	(84)m=	395.58	393.24	378.61	355.09	331.27	308.33	293.45	300.01	312.12	335.87	363.11	383.49		(84)
Utilisation factor for gains for living area, h1,m (see Table 9a) Image: Sep Oct Nov Dec Oct Nov Dec Oct Nov Dec Oct Oct Oct Oct Oct Oct Oct Oct Oct Oc	7. Me	an inter	nal temp	erature	(heating	season)								
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$, J			from Tab	ole 9, Th	1 (°C)				21	(85)
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Utilisa	ation fac	tor for g	ains for	living are	ea, h1,m	(see Ta	ble 9a)							
Instrume									Aug	Sep	Oct	Nov	Dec		
(87)m 18.4 18.52 19.27 19.78 20.3 20.63 20.21 19.57 18.33 18.38 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (89)m= 19.97 19.98 19.98 19.99 19.99 19.99 19.99 19.99 19.99 19.99 19.98 (86) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m= 0.98 0.98 0.97 0.9 0.96 0.97 0.98 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 16.46 16.64 17.05 17.75 18.49 19.24 19.86 19.12 18.10 17.24 16.44 (90) Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2 (92)m= 17 17.17 17.66 18.18 19.54 19.92 19.42 18.58 17.71 16.98 (93) S. Space heating requirement Set Ti to the mean internal temperature from Table 4e, where appropriate (93)me 17.71 16.98 (93) (94) Useful gains, hmGm, W = (94)m x (84)m (96)m (93)	(86)m=	0.98	0.98	0.98	0.97	0.96	0.92	0.85	0.85	0.93	0.96	0.98	0.98		(86)
(87)m 18.4 18.52 19.27 19.78 20.3 20.63 20.21 19.57 18.33 18.38 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (89)m= 19.97 19.98 19.98 19.99 19.99 19.99 19.99 19.99 19.99 19.99 19.98 (86) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m= 0.98 0.98 0.97 0.9 0.96 0.97 0.98 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 16.46 16.64 17.05 17.75 18.49 19.24 19.86 19.12 18.10 17.24 16.44 (90) Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2 (92)m= 17 17.17 17.66 18.18 19.54 19.92 19.42 18.58 17.71 16.98 (93) S. Space heating requirement Set Ti to the mean internal temperature from Table 4e, where appropriate (93)me 17.71 16.98 (93) (94) Useful gains, hmGm, W = (94)m x (84)m (96)m (93)	Mean	interna	l temper	ature in	living are	ea T1 (fo	ollow ste	ps 3 to 7	in Tabl	e 9c)					
(88)m 19.97 19.98 19.98 19.99 <td< td=""><td>(87)m=</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>19.57</td><td>18.93</td><td>18.38</td><td></td><td>(87)</td></td<>	(87)m=										19.57	18.93	18.38		(87)
(88)m 19.97 19.98 19.98 19.99 <td< td=""><td>Temp</td><td>erature</td><td>durina h</td><td>eating p</td><td>eriods ir</td><td>n rest of</td><td>dwellina</td><td>from Ta</td><td>ble 9. Ti</td><td>h2 (°C)</td><td></td><td></td><td></td><td></td><td></td></td<>	Temp	erature	durina h	eating p	eriods ir	n rest of	dwellina	from Ta	ble 9. Ti	h2 (°C)					
(89)m= 0.98 0.97 0.97 0.94 0.88 0.77 0.78 0.9 0.96 0.97 0.98 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 16.46 17.08 17.75 18.49 19.24 19.66 19.12 18.19 17.24 16.44 (90) (11) 16.46 16.64 17.08 17.75 18.49 19.24 19.66 19.12 18.19 17.24 16.44 (90) (12) Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2 (92)m= 17 17.17 17.56 18.18 18.55 19.54 19.92 19.42 18.58 17.71 16.98 (92) Apply adjustment to the mean internal temperature from Table 4e, where appropriate (93)m= 17 17.17 17.56 18.18 18.85 19.54 19.92 19.42 18.58 17.71 16.98 (93) 8. Space heating requirement Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains, hm: (94) Utilisation factor for gains, hm? (94) Ma	(88)m=				1		ĭ				19.99	19.99	19.98		(88)
(89)m= 0.98 0.97 0.97 0.94 0.88 0.77 0.78 0.9 0.96 0.97 0.98 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 16.46 17.08 17.75 18.49 19.24 19.66 19.12 18.19 17.24 16.44 (90) (11) 16.46 16.64 17.08 17.75 18.49 19.24 19.66 19.12 18.19 17.24 16.44 (90) (12) Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2 (92)m= 17 17.17 17.56 18.18 18.55 19.54 19.92 19.42 18.58 17.71 16.98 (92) Apply adjustment to the mean internal temperature from Table 4e, where appropriate (93)m= 17 17.17 17.56 18.18 18.85 19.54 19.92 19.42 18.58 17.71 16.98 (93) 8. Space heating requirement Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains, hm: (94) Utilisation factor for gains, hm? (94) Ma	Utilisa	ation fac	tor for a	ains for	rest of d	welling	h2 m (se	e Table	9a)						
(90)m= 16.46 17.08 17.75 18.49 19.24 19.69 19.66 19.12 18.19 17.24 16.44 (90) ILA = Living area + (4) = 0.28 (91) (92)m 17 17.17 17.56 18.18 18.55 19.54 19.92 19.42 18.58 17.71 16.98 (92) Apply adjustment to the mean internal temperature from Table 4e, where appropriate (93)m 17 17.17 17.56 18.18 18.51 19.54 19.92 19.42 18.58 17.71 16.98 (92) Apply adjustment to the mean internal temperature from Table 4e, where appropriate (93)m (93) 8. Space heating requirement (93) Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains, hm: (94)m (95)m (94) Useful gains, hmGm, W = (94)m X (84)m (96)m 48.67 379.54 38.37 36.75 305.79 26.15 224.09 231.81 274.09 314.64 348.44 371.95 (95) Monthly average external temperature, Lm , W = ((39)m X (19)m (96)m (96)m 43.4.9 65	(89)m=				i		,		<i>,</i>	0.9	0.96	0.97	0.98		(89)
(90)m= 16.46 17.08 17.75 18.49 19.24 19.69 19.66 19.12 18.19 17.24 16.44 (90) ILA = Living area + (4) = 0.28 (91) (92)m 17 17.17 17.56 18.18 18.55 19.54 19.92 19.42 18.58 17.71 16.98 (92) Apply adjustment to the mean internal temperature from Table 4e, where appropriate (93)m 17 17.17 17.56 18.18 18.51 19.54 19.92 19.42 18.58 17.71 16.98 (92) Apply adjustment to the mean internal temperature from Table 4e, where appropriate (93)m (93) 8. Space heating requirement (93) Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains, hm: (94)m (95)m (94) Useful gains, hmGm, W = (94)m X (84)m (96)m 48.67 379.54 38.37 36.75 305.79 26.15 224.09 231.81 274.09 314.64 348.44 371.95 (95) Monthly average external temperature, Lm , W = ((39)m X (19)m (96)m (96)m 43.4.9 65	Moon	interna	l tompor	atura in	the rest	of dwelli	na T2 (f	ollow ste	ne 3 to -	T in Tahl	e 9c)				
ILA = Living area \div (4) = (91) ILA = Living area \div (4) = (91) Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2 (92)m= 17 17.17 17.56 18.18 18.85 19.54 19.92 19.42 18.58 17.71 16.98 (92) Apply adjustment to the mean internal temperature from Table 4e, where appropriate (93) (93) 8. Space heating requirement (93) Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a (94) (94) Utilisation factor for gains, hm: (94) (95) (94) (95) Useful gains, hmGm, W = (94)m x (84)m (95) (96)m= 332.67 379.54 363.75 305.79 266.15 224.09 231.81 274.09 314.64 348.44 371.95 (95) Monthly average external temperature, Lm, W = ((39)m X ((39)m (96)m) (97) (97) 5pace heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m (96) (97) (97) Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m (98) (98)<			· · ·	1	1		т `				,	17.24	16.44		(90)
(92)m= 17 17.17 17.56 18.18 19.54 19.92 19.42 18.58 17.71 16.98 (92) Apply adjustment to the mean internal temperature from Table 4e, where appropriate (93)m= 17 17.17 17.56 18.18 18.55 19.92 19.92 19.42 18.58 17.71 16.98 (93) 8. Space heating requirement Sep to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains, hm: (94) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, hm: (94)m= 0.97 0.96 0.95 0.92 0.86 0.77 0.88 0.94 0.96 0.97 (94) Useful gains, hmGm, W = (94)m x (84)m (95) Monthly average external temperature, from Table 8 (96)m= 34.3 4.9 6.5 8.9 11.7 14.6 16.6 16.4 14.1 10.6 7.1 4.2 (96) Monthly average external temperature, Lm , W =[(39)m x [(93)m - (96)m] (97)m - (1264.17 127.7 10.5.7										f	LA = Livin	g area ÷ (4	4) =	0.28	(91)
(92)m= 17 17.17 17.56 18.18 19.54 19.92 19.42 18.58 17.71 16.98 (92) Apply adjustment to the mean internal temperature from Table 4e, where appropriate (93)m= 17 17.17 17.56 18.18 18.55 19.92 19.92 19.42 18.58 17.71 16.98 (93) 8. Space heating requirement Sep to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains, hm: (94) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, hm: (94)m= 0.97 0.96 0.95 0.92 0.86 0.77 0.88 0.94 0.96 0.97 (94) Useful gains, hmGm, W = (94)m x (84)m (95) Monthly average external temperature, from Table 8 (96)m= 4.3 4.9 6.5 8.9 11.7 14.6 16.6 16.4 14.1 10.6 7.1 4.2 (96) Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m - (96)m] (97)m - (1264.17 127.7 <td< td=""><td>Moon</td><td>intorno</td><td>ltompor</td><td>atura (fa</td><td>r tho wh</td><td>olo dwol</td><td>lling) – fl</td><td>Λ 🗸 Τ1</td><td>ı (1 fl</td><td>۸) v T2</td><td></td><td></td><td></td><td></td><td></td></td<>	Moon	intorno	ltompor	atura (fa	r tho wh	olo dwol	lling) – fl	Λ 🗸 Τ1	ı (1 fl	۸) v T2					
Apply adjustment to the mean internal temperature from Table 4e, where appropriate (93)m= 17 17.17 17.56 18.18 18.85 19.92 19.92 19.42 18.58 17.71 16.98 (93) 8. Space heating requirement Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a Image: Content of the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains, hm: (94)m Oct Nov Dec Utilisation factor for gains, hm: (94)m 0.97 0.96 0.97 (94) Useful gains, hmGm, W = (94)m x (84)m (95)m 382.67 379.54 363.37 386.75 266.15 224.09 231.81 274.09 314.64 348.44 371.95 (95) Monthly average external temperature from Table 8 (96)m= 4.3 4.9 6.5 8.9 11.7 14.6 16.6 16.4 14.1 10.6 7.1 4.2 (96) Heat loss rate for mean internal temperature, Lm , W =[(39)m × [(93)m – (95)m] × (141)m (97)m 582.6 563.2 563.2 563.2 564.89 411.24 292.17 </td <td></td> <td></td> <td>· ·</td> <td>· · ·</td> <td>ì</td> <td></td> <td></td> <td></td> <td>``</td> <td>, </td> <td>18.58</td> <td>17.71</td> <td>16.98</td> <td></td> <td>(92)</td>			· ·	· · ·	ì				``	, 	18.58	17.71	16.98		(92)
(93)me 17 17.17 17.56 18.18 18.55 19.54 19.95 19.92 19.42 18.58 17.71 16.98 (93) 8. Space heating requirement Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, hm: (94)m 0.97 0.97 0.96 0.95 0.92 0.86 0.76 0.77 0.88 0.94 0.96 0.97 (94) Useful gains, hmGm, W = (94)m x (84)m (95)m= 382.67 379.54 363.37 367.5 305.79 266.15 224.09 231.81 274.09 314.64 348.44 371.95 (95) Monthly average external temperature from Table 8 (96)m= (96)m= 1264.17 121.7 1095.74 907.93 698.49 477.66 324.1 340.06 516.85 779.26 1041.3 1259.47 (97) Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m (9															(-)
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, hm: (94)m= 0.97 0.97 0.96 0.95 0.92 0.86 0.76 0.77 0.88 0.94 0.96 0.97 (94) Useful gains, hmGm, W = (94)m x (84)m (95)m= 382.67 379.54 363.37 336.75 305.79 266.15 224.09 231.81 274.09 314.64 348.44 371.95 (95) Monthly average external temperature from Table 8 (96)m= 4.3 4.9 6.5 8.9 11.7 14.6 16.6 16.4 14.1 10.6 $71.4.2$ (96) Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m - (96)m] (97)m = (264.17 1217.7 1095.74 907.93 698.49 477.66 324.1 340.06 516.58 779.26 1041.3 1259.47 (97) Space heating requirement for each month, kWh/month = $0.024 x [(97)m - (95)m] x (41)m$ (98) $55.83 563.24 544.89 411.24 292.17 0 0 0 0 0 345.68 498.86 660.32$ $3972.$	(93)m=	-			1						·	17.71	16.98		(93)
the utilisation factor for gains using Table 9a Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, hm: (94)m= 0.97 0.97 0.96 0.95 0.92 0.86 0.76 0.77 0.88 0.94 0.96 0.97 $(94)Useful gains, hmGm, W = (94)m \times (84)m(95)m= 382.67 379.54 363.37 365.75 305.79 266.15 224.09 231.81 274.09 314.64 348.44 371.95 (95)m= 4.3 4.9 6.5 8.9 11.7 14.6 16.6 16.4 14.1 10.6 7.1 4.2 (96)m= 4.3 4.9 6.5 8.9 11.7 14.6 16.6 16.4 14.1 10.6 7.1 4.2 (96)m= 1264.17 1217.7 1095.74 907.93 698.49 477.66 324.1 340.06 516.58 792.6 1041.3 1259.47 (97)m= 1264.17 1217.7 1095.74 907.93 698.49 477.66 324.1 340.06 516.58 792.6 1041.3 1259.47 (97) Space heating requirement for each month, kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m (98)m= 655.83 563.24 544.89 411.24 292.17 0 0 0 0 345.68 498.86 660.32 Total per year (kWh/year) = Sum(98)0.58.12 = 3972.22 (98) Space heating requirement in kWh/m²/year 45.19 (99) 9a. Energy requirement in kWh/m²/year (202) = 1 - (201) = 0 (201) Fraction of space heat from main system(s) (202) = 1 - (201) = (0.560.58 10.58$	8. Spa	ace hea	ting requ	uirement											
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, hm: (94)m= 0.97 0.97 0.96 0.95 0.92 0.86 0.76 0.77 0.88 0.94 0.96 0.97 (94) Useful gains, hmGm, W = (94)m x (84)m (95)m= 382.67 379.54 363.37 336.75 305.79 266.15 224.09 231.81 274.09 314.64 348.44 371.95 (95) Monthly average external temperature from Table 8 (96)m= 4.3 4.9 6.5 8.9 11.7 14.6 16.6 16.4 14.1 10.6 7.1 4.2 (96) Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m - (96)m] (97)m = 1264.17 1217.7 1095.74 907.93 698.49 477.66 324.1 340.06 516.58 779.26 1041.3 1259.47 (97) Space heating requirement	Set T	i to the r	mean int	ernal ter	mperatui	re obtain	ed at ste	ep 11 of	Table 9	o, so tha	t Ti,m=(76)m an	d re-calc	culate	
Utilisation factor for gains, hm: (94)m= 0.97 0.97 0.96 0.95 0.92 0.86 0.76 0.77 0.88 0.94 0.96 0.97 (94) Useful gains, hmGm, W = (94)m x (84)m (95)m= 382.67 379.54 363.37 336.75 305.79 266.15 224.09 231.81 274.09 314.64 348.44 371.95 (95) Monthly average external temperature from Table 8 (96)m= 4.3 4.9 6.5 8.9 11.7 14.6 16.6 16.4 14.1 10.6 7.1 4.2 (96) Heat loss rate for mean internal temperature, Lm, W =[(39)m x [(93)m - (96)m] (97)m = (1264.17) 1217.7 1095.74 907.93 698.49 477.66 324.1 340.06 516.58 779.26 1041.3 1259.47 (97) Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$ (98) 99 $92.58.53$ 563.24 544.89 411.24 292.17 0 0	the ut				<u> </u>									I	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	L LCP -					May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(1) (1)					1	0.02	0.86	0.76	0.77	0.88	0.04	0.06	0.07		(94)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$							0.00	0.70	0.77	0.00	0.94	0.90	0.97		(04)
Monthly average external temperature from Table 8 (96)m= 4.3 4.9 6.5 8.9 11.7 14.6 16.6 16.4 14.1 10.6 7.1 4.2 (96) Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m- (96)m] (97)m= 1264.17 1217.7 1095.74 907.93 698.49 477.66 324.1 340.06 516.58 779.26 1041.3 1259.47 (97) Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m (98)m= 655.83 563.24 544.89 411.24 292.17 0 0 0 345.68 498.86 660.32 Total per year (kWh/year) = Sum(98)s.9.12 3972.22 (98) Space heating requirement in kWh/m²/year 45.19 (99) 94. Energy requirements - Individual heating systems including micro-CHP) Space heating: (201) Fraction of space heat from secondary/supplementary system 0 (201) Fraction of space heat from main system(s) (202) = 1 - (201) = 1 (202)				````	ŕ	ŕ	266.15	224.09	231.81	274.09	314.64	348.44	371.95		(95)
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$															
	(96)m=	<u> </u>	<u> </u>		i i			16.6	16.4	14.1	10.6	7.1	4.2		(96)
Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$ (98)m= 655.83 563.24 544.89 411.24 292.17 0 0 0 0 345.68 498.86 660.32 Total per year (kWh/year) = Sum(98) ₁₅₉₁₂ = 3972.22 (98) Space heating requirement in kWh/m ² /year 45.19 (99) 9a. Energy requirements – Individual heating systems including micro-CHP) Space heating: Fraction of space heat from secondary/supplementary system 0 (201) Fraction of space heat from main system(s) $(202) = 1 - (201) = 1$ (202)	Heat	loss rate	e for mea	an intern	al tempe	erature,	Lm , W =	=[(39)m :	x [(93)m	– (96)m]				
$(98) \text{m} = \underbrace{655.83}_{563.24} \underbrace{544.89}_{411.24} \underbrace{292.17}_{0} \underbrace{0}_{0} \underbrace{0}_{0} \underbrace{0}_{345.68} \underbrace{498.86}_{498.86} \underbrace{660.32}_{660.32}$ $Total \text{ per year } (kWh/year) = Sum(98)_{15912} = \underbrace{3972.22}_{(98)} (98)$ Space heating requirement in kWh/m ² /year $\underbrace{45.19}_{99} (99)$ 9a. Energy requirements – Individual heating systems including micro-CHP) Space heating: Fraction of space heat from secondary/supplementary system $\underbrace{0}_{(202)} = 1 - (201) = \underbrace{1}_{(202)} (202) = 1 - (202) = \underbrace{1}_{(202)} (202) = 1 - (202) = \underbrace{1}_{(202)} ($	(97)m=	1264.17	1217.7	1095.74	907.93	698.49	477.66	324.1	340.06	516.58	779.26	1041.3	1259.47		(97)
Total per year (kWh/year) = Sum(98)15.912 = 3972.22 (98) Space heating requirement in kWh/m²/year 9a. Energy requirements – Individual heating systems including micro-CHP) Space heating: Fraction of space heat from secondary/supplementary system 0 (201) Fraction of space heat from main system(s) (202) = 1 - (201) =	Space	e heatin	g require	ement fo	r each n	nonth, k\	Nh/mont	th = 0.02	24 x [(97))m – (95)m] x (4′	1)m			
Space heating requirement in kWh/m²/year 45.19 (99) 9a. Energy requirements – Individual heating systems including micro-CHP) 5 Space heating: Fraction of space heat from secondary/supplementary system 0 (201) Fraction of space heat from main system(s) (202) = 1 - (201) = 1 (202)	(98)m=	655.83	563.24	544.89	411.24	292.17	0	0	0	0	345.68	498.86	660.32		_
9a. Energy requirements – Individual heating systems including micro-CHP) Space heating: Fraction of space heat from secondary/supplementary system 0 (201) Fraction of space heat from main system(s) (202) = 1 - (201) = 1 (202)									Tota	l per year	(kWh/year) = Sum(9	8)15,912 =	3972.22	(98)
Space heating: Fraction of space heat from secondary/supplementary system 0 (201) Fraction of space heat from main system(s) (202) = 1 - (201) =	Space	e heatin	g require	ement in	kWh/m²	/year								45.19	(99)
Fraction of space heat from secondary/supplementary system0(201)Fraction of space heat from main system(s)(202) = 1 - (201) =1(202)	9a. En	ergy rec	luiremer	nts – Indi	ividual h	eating sy	ystems i	ncluding	micro-C	CHP)					
Fraction of space heat from main system(s) $(202) = 1 - (201) =$ 1(202)	•		•												_
	Fracti	on of sp	ace hea	it from s	econdar	y/supple	mentary	system						0	(201)
Fraction of total heating from main system 1 $(204) = (202) \times [1 - (203)] =$ 1(204)	Fracti	on of sp	ace hea	it from m	nain syst	em(s)			(202) = 1 -	- (201) =				1	(202)
	Fracti	on of to	tal heatii	ng from	main sys	stem 1			(204) = (2	02) × [1 –	(203)] =			1	(204)

Efficie	ency of	main spa	ace heat	ting syste	em 1								90.6	(206)
Efficie	ency of	seconda	ry/suppl	ementar	y heating	g systen	n, %						0	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ar
Space	e heatin	g requir	ement (c	calculate	d above)									
	655.83	563.24	544.89	411.24	292.17	0	0	0	0	345.68	498.86	660.32		
(211)m		i	04)] } x 1	100 ÷ (20	<u> </u>			-					1	(211)
	723.88	621.68	601.42	453.91	322.48	0	0	0	0	381.54	550.61	728.83		-
				、 .				lota	ll (kWh/yea	ar) = Sum(2)	211) _{15,1012}	7	4384.35	(211)
•		•	econdar 00 ÷ (20	ˈy), kWh/ ນອນ	month									
= {[(90) (215)m=	0		00 ÷ (20		0	0	0	0	0	0	0	0]	
									l Il (kWh/yea	ar) =Sum(2			0	(215)
Water	heating	3												
		-	ter (calc	ulated a	bove)			-					•	
	164.59	143.95	148.54	129.5	124.26	107.23	99.36	114.02	115.38	134.47	146.78	159.4		-
	-	ater hea	i					1					85	(216)
(217)m=	89.42	89.4	89.34	89.19	88.85	85	85	85	85	88.96	89.26	89.45		(217)
			kWh/m) ÷ (217)											
(219)m=		161.02	166.27	145.2	139.85	126.15	116.9	134.14	135.75	151.16	164.44	178.19		
								Tota	I = Sum(2	19a) ₁₁₂ =			1803.13	(219)
	l totals									k	Wh/year		kWh/year	
Space	heating	fuel use	ed, main	system	1								4384.35	
Water	heating	fuel use	d										1803.13	
Electric	city for p	oumps, f	ans and	electric	keep-ho	t								
centra	al heatir	ng pump	:									30		(230c)
boiler	with a f	ian-assis	sted flue									45	ĺ	(230e)
Total e	lectricit	y for the	above,	kWh/yea	ır			sum	of (230a).	(230g) =			75	(231)
Electric	city for I	ighting											387.17	(232)
Total d	elivered	d energy	for all u	ses (211)(221)	+ (231)	+ (232))(237b)	=				6649.65	(338)
12a. (CO2 em	nissions ·	– Individ	lual heat	ing syste	ems inclu	uding m	icro-CHF	þ					
						Г.,					ion foo	4	Emissions	
							i ergy /h/year			kg CO	ion fac 2/kWh		kg CO2/yea	
Space	heating	ı (main s	ystem 1)		(21	1) x			0.2	16	=	947.02	(261)
Space	heating	(second	dary)			(21	5) x			0.5	19	=	0	(263)
Water	heating					(219	9) x			0.2		=	389.48	(264)
Space	and wa	ter heati	ng			(26	1) + (262)) + (263) + ((264) =				1336.5	(265)
•			•	electric	keep-ho	t (23 ⁻	1) x			0.5	19	=	38.93	(267)
	city for I				-		2) x			0.5		=	200.94	(268)
	O2, kg								sum o	f (265)(2			1576.36	(272)

Dwelling CO2 Emission Rate

EI rating (section 14)

(272) ÷ (4) =

17.93	(273)
84	(274)

					User [Details:						
Assessor Name: Software Name:		n Marsh oma FS				Softwa	a Num are Vei	rsion:			0005374 on: 1.0.5.58	
	DIa			Pi	operty	Address	: Plot 10					
Address : 1. Overall dwelling dim	Plot											
T. Overall dwelling diff	IENSION	5.			Aro	a(m²)		Av. Hei	ight(m)		Volume(m ³)	
Ground floor							(1a) x		.4	(2a) =	105.48	(3a)
First floor						43.95	(10) x		.63	(2b) =	115.59	(3b)
Total floor area TFA = (1a)+(1t	o)+(1c)+((1d)+(1e	e)+(1n	、 <u> </u>	87.9	(4)	2.	.00	()	110.00	
Dwelling volume			(,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	′	01.0)+(3c)+(3d)+(3e)+	.(3n) =	221.07	(5)
2. Ventilation rate:												
		main neating		econdary neating	y	other		total			m ³ per hour	
Number of chimneys	Ĺ	0] + [0] + [0	_ = _	0	x 4	40 =	0	(6a)
Number of open flues		0	+	0] + [0] = [0	x 2	20 =	0	(6b)
Number of intermittent f	ans							3	x 1	10 =	30	(7a)
Number of passive vent	S							0	x 1	10 =	0	(7b)
Number of flueless gas	fires							0	x 4	40 =	0	(7c)
										Air ch	anges per ho	ur
Infiltration due to chimne	eys, flu	es and fa	ans = (6	a)+(6b)+(7	a)+(7b)+	(7c) =	Г	30	<u> </u>	÷ (5) =	0.14	(8)
If a pressurisation test has							continue fr			- (-)	0.11	
Number of storeys in	the dw	elling (ne	s)								0	(9)
Additional infiltration									[(9)-	-1]x0.1 =	0	(10)
Structural infiltration:	0.25 fo	r steel or	timber t	frame or	0.35 fo	r masoni	ry constr	uction			0	(11)
if both types of wall are deducting areas of oper				ponding to	the grea	ter wall are	a (after					
If suspended wooden	0 /	•		ed) or 0.	1 (seal	ed), else	enter 0				0	(12)
If no draught lobby, e	nter 0.0)5, else e	enter 0								0	(13)
Percentage of window	vs and	doors dr	aught st	ripped							0	(14)
Window infiltration						0.25 - [0.2	2 x (14) ÷ 1	= [00			0	(15)
Infiltration rate						(8) + (10)	+ (11) + (1	2) + (13) +	+ (15) =		0	(16)
Air permeability value		•			•	•	•	etre of e	nvelope	area	5	(17)
If based on air permeab	-										0.39	(18)
Air permeability value appl		ressurisatio	on test has	s been don	e or a de	gree air pe	rmeability	is being us	sed			-
Number of sides shelter Shelter factor	ed					(20) - 1 - 1	[0.075 x (1	9)1 -			2	(19)
	oting ob	altar faa	tor					[0]] =			0.85	(20)
Infiltration rate incorpora	-			J		(21) = (18) x (20) =				0.33	(21)
Infiltration rate modified		· · ·			11	A	Sec.	Oct	Nevi	Dee	1	
Jan Feb	Mar	Apr	May -	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind s		i				1				·	1	
(22)m= 5.1 5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7		

Wind F	actor (2	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]	
Adjust	ed infiltr	ation rat	e (allowi	ng for sł	nelter ar	id wind s	peed) =	(21a) x	(22a)m					
~ ' '	0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.39		
		c <i>tive air</i> al ventila	-	rate for t	ne appli	cable ca	se						0	(23a)
				endix N. (2	(23a) = (23a	a) × Fmv (e	equation (1	N5)) . othei	wise (23b) = (23a)			0	
						for in-use f				, (,			0	
			-	-	-	at recove				2h)m + ('	23h) y [1	l – (23c)	_	(200)
(24a)m=				0	0				0		0	0]	(24a)
		d mech	I anical ve	ntilation	ı without	heat rec	L coverv (N	I //V) (24b)m = (22	1 2b)m + (;	23b)		1	
(24b)m=		0	0	0	0	0	0	0	0	0	0	0]	(24b)
c) If	whole h	use ex	ract ver	ntilation of	r positiv	/e input v	r ventilatio	n from c	outside				J	
,					•	o); otherv				5 × (23b)			
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
,					•	ve input erwise (2				0.5]				
(24d)m=	0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57		(24d)
Effe	ctive air	change	rate - er	nter (24a) or (24	o) or (24	c) or (24	d) in boy	(25)				•	
(25)m=	0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57]	(25)
3 He	at losse	s and he	at loss i	paramet	er.								-	
ELEN		Gros area	s	Openin rr	gs	Net Ar A ,r		U-valı W/m2		A X U (W/ł	<)	k-value kJ/m²·l		A X k kJ/K
Doors						2.14	x	1	=	2.14				(26)
Windo	ws Type	e 1				5.48	x1	/[1/(1.4)+	0.04] =	7.27				(27)
Windo	ws Type	2				8.42	x1	/[1/(1.4)+	0.04] =	11.16				(27)
Floor						43.95	5 X	0.13		5.7135	Ξr			(28)
Walls		50.	7	16.0	4	34.66	3 X	0.18	=	6.24	Ξ ř		Ξ F	(29)
Roof		43.9	95	0		43.95	5 X	0.13		5.71				(30)
Total a	area of e	lements	, m²			138.6	3							(31)
Party v	wall					87.71	x	0	=	0				(32)
				effective wi nternal wal		alue calcul titions	ated using	formula 1,	/[(1/U-valu	ıe)+0.04] a	ns given in	paragraph	1 3.2	
Fabric	heat los	s, W/K :	= S (A x	U)				(26)(30)	+ (32) =				38.2	23 (33)
Heat c	apacity	Cm = S((Axk)						((28).	(30) + (32	2) + (32a).	(32e) =	21329	9.79 (34)
Therm	al mass	parame	ter (TMI	- = Cm -	- TFA) ii	א kJ/m²K			Indica	tive Value:	Medium		25	0 (35)
	-	sments wh ad of a de			construct	ion are not	t known pr	ecisely the	indicative	e values of	TMP in Te	able 1f		
Therm	al bridg	əs : S (L	x Y) cal	culated	using Ap	pendix ł	<						11.0	08 <mark>(36)</mark>
			are not kr	own (36) =	= 0.05 x (3	81)								
	abric he									(36) =			49.3	31 (37)
Ventila	ation hea	at loss ca Feb	alculateo Mar	monthl Apr	í	. .			(38)m Sep	= 0.33 × (- · · ·		1	
	Jan				May	Jun	Jul	Aug	Son	Oct	Nov	Dec		

(38)m=	42.85	42.6	42.36	41.22	41.01	40.01	40.01	39.83	40.4	41.01	41.44	41.89		(38)
Heat tr	ansfer o	coefficie	nt. W/K						(39)m	= (37) + (38)m			
(39)m=	92.16	91.91	91.67	90.53	90.32	89.33	89.33	89.14	89.71	90.32	90.75	91.2		
I										-	Sum(39)1.	12 /12=	90.53	(39)
1		· · · ·	HLP), W/	· · · · · ·						= (39)m ÷	r			
(40)m=	1.05	1.05	1.04	1.03	1.03	1.02	1.02	1.01	1.02	1.03	1.03	1.04	1.02	(40)
Numbe	r of day	s in mo	nth (Tab	le 1a)					,	Average =	Sum(40)₁.	12 / 12=	1.03	(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. Wa	ter heat	ting ene	rgy requi	irement:								kWh/ye	ar:	
if TF. if TF. Annual	A > 13.9 A £ 13.9 averag	9, N = 1 je hot wa	+ 1.76 x ater usaç	ge in litre	es per da	ay Vd,av	erage =)2)] + 0.((25 x N) to achieve	+ 36		.9) 95	6 5.85		(42) (43)
		-	person per	• •		-	-		a water ut	se larger o	I			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot wate	er usage i	n litres per	day for ea	ach month	Vd,m = fa	ctor from	Table 1c x	(43)						
(44)m=	105.44	101.6	97.77	93.93	90.1	86.27	86.27	90.1	93.93	97.77	101.6	105.44		
Energy o	content of	hot water	used - cal	culated mo	onthly $= 4$.	190 x Vd,r	n x nm x D)))))))))))))))))))			m(44) ₁₁₂ = ables 1b, 1		1150.22	(44)
(45)m=	156.36	136.75	141.12	123.03	118.05	101.87	94.4	108.32	109.61	127.74	139.44	151.43		
										Total = Su	m(45) ₁₁₂ =	=	1508.12	(45)
If instant		·	,	· · · ·		,		boxes (46)				·1		
(46)m= Water	23.45 storage	20.51	21.17	18.45	17.71	15.28	14.16	16.25	16.44	19.16	20.92	22.71		(46)
	•		includir	ng any so	olar or W	/WHRS	storage	within sa	ame ves	sel		0		(47)
	-	-	ind no ta		-									
			hot wate	er (this ir	icludes i	nstantar	neous co	ombi boil	ers) ente	er '0' in (47)			
	storage anufact		eclared I	oss facto	or is kno	wn (kWł	n/dav):					0		(48)
			m Table			(" a a j / .					0		(49)
			storage		ear			(48) x (49)) =			0		(50)
b) If m	anufact	urer's de	eclared o	cylinder l	oss fact		known:							()
			factor fr		e 2 (kW	h/litre/da	ıy)					0		(51)
		from Ta	ee secti ble 2a	on 4.3								0		(52)
			m Table	2b								0 0		(52)
-			· storage		ear			(47) x (51)	x (52) x (53) =		0		(54)
		(54) in (5	-									0		(55)
Water	storage	loss cal	culated f	for each	month			((56)m = (55) × (41)	m				
(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
If cylinde	r contains	s 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 Appendi	хH	
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)

		•	,	om Table for each		59)m – ((58) ± 36	\$5 v (11)	m			0]	(58)
	•			le H5 if t			. ,	. ,		r thermo	stat)			
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
Combi	loss cal	culated	for each	month ((61)m =	(60) ÷ 30	65 × (41))m					I	
(61)m=	50.96	46.03	49.82	46.32	45.91	42.54	43.96	45.91	46.32	49.82	49.32	50.96		(61)
Total h	eat requ	ired for	water h	eating ca	alculated	for eac	h month	(62)m =	0.85 × ((45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m=	207.32	182.78	190.94	169.35	163.96	144.41	138.36	154.23	155.94	177.57	188.76	202.39		(62)
Solar DH	IW input c	alculated	using App	endix G or	r Appendix	H (negati	ve quantity	/) (enter '0	if no sola	r contribut	ion to wate	er heating)		
(add ad	dditional	lines if	FGHRS	and/or \	NWHRS	applies	, see Ap	pendix (G)	-	-	-		
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0		(63) (G2)
Output	from wa	ater hea	ter											
(64)m=	207.32	182.78	190.94	169.35	163.96	144.41	138.36	154.23	155.94	177.57	188.76	202.39		
-	-				-	-	-	Outp	out from w	ater heate	r (annual)₁	12	2076.01	(64)
Heat g	ains fror	n water	heating	, kWh/m	onth 0.2	5 ´ [0.85	× (45)m	ı + (61)m	n] + 0.8 x	k [(46)m	+ (57)m	+ (59)m]	
(65)m=	64.73	56.98	59.38	52.49	50.73	44.51	42.38	47.5	48.03	54.93	58.69	63.09		(65)
inclu	de (57)r	n in cale	culation	of (65)m	only if c	ylinder i	s in the o	dwelling	or hot w	vater is fr	om com	munity h	neating	
5. Int	ernal ga	ins (see	e Table 5	5 and 5a):									
Metabo	olic gain	s (Table	e 5), Wat	ts										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	129.79	129.79	129.79	129.79	129.79	129.79	129.79	129.79	129.79	129.79	129.79	129.79		(66)
Lighting	g gains	(calcula	ted in A	pendix	L, equat	ion L9 o	r L9a), a	lso see ⁻	Table 5				1	
(67)m=	21.92	19.47	15.84	11.99	8.96	7.57	8.18	10.63	14.26	18.11	21.14	22.53		(67)
Appliar	nces gai	ns (calc	ulated ir	n Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5			1	
(68)m=	235.16	237.6	231.45	218.36	201.84	186.3	175.93	173.49	179.64	192.73	209.25	224.78		(68)
Cookin	g gains	(calcula	ted in A	ppendix	L, equat	tion L15	or L15a), also se	e Table	5			1	
(69)m=	35.98	35.98	35.98	35.98	35.98	35.98	35.98	35.98	35.98	35.98	35.98	35.98		(69)
Pumps	and far	s dains	(Table (5a)	1	1	Į	1		I	l	1	1	
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losses	e.a. ev	aporatic	n (nega	ı tive valu	es) (Tab	le 5)							1	
	-103.83	•	-103.83	-103.83	<u>, , , , , , , , , , , , , , , , , , , </u>	-103.83	-103.83	-103.83	-103.83	-103.83	-103.83	-103.83		(71)
Water	heating	nains (1	I Table 5)										1	
(72)m=	87	84.79	79.81	72.9	68.19	61.81	56.96	63.84	66.71	73.83	81.52	84.8]	(72)
	nternal									(70)m + (7			I	
(73)m=	409.02	406.8	392.03	368.19	343.92	320.62	306	312.89	325.54	349.61	376.85	397.05]	(73)
	ar gains		002.00			020102		012100	020101			001100		
			using sola	r flux from	Table 6a	and assoc	iated equa	itions to co	nvert to th	ne applicat	ole orientat	ion.		
Orienta	ation: A	ccess F	actor	Area		Flu	IX		g_		FF		Gains	
	Т	able 6d		m²		Tal	ble 6a	Т	able 6b	Т	able 6c		(W)	
Solar g	ains in v	vatts, ca	alculated	for eac	h month			(83)m = S	um(74)m .	(82)m				

(84)m=	409.02	406.8	392.03	368.19	343.92	320.62	306	312.89	325.54	349.61	376.85	397.05		(84)
7. Me	an inter	nal temp	oerature	(heating	season)								
				periods ir			from Tab	ole 9, Th	1 (°C)			[21	(85)
Utilisa	ation fac	tor for a	ains for	living are	ea, h1,m	(see Ta	ble 9a)					L		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(86)m=	1	1	1	1	1	0.98	0.93	0.94	0.99	1	1	1		(86)
Mean	interna	l temper	ature in	living are	ea T1 (fo	ullow ste	ns 3 to 7	r in Tabl	e 9c)					
(87)m=	19.77	19.83	19.98	20.2	20.46	20.72	20.88	20.87	20.67	20.35	20.03	19.76		(87)
Tom		l during h	L Looting r	periods ir	rest of	dwelling	from Ta		ا ایک (۹ ۲)					
(88)m=	20.04	20.05	20.05	20.06	20.06	20.07	20.07	20.07	20.07	20.06	20.06	20.05		(88)
														. ,
(89)m=			ains for	rest of d	veiling, i 0.99	n∠,m (se 0.96	0.85	9a) 0.87	0.97	1	1	1		(89)
											· ·	I		(00)
	-	· · · ·	i	the rest		- · ·	i	i	1		40.70	40.00		(00)
(90)m=	18.38	18.47	18.69	19.03	19.4	19.78	19.99	19.98	19.72	19.25	18.78 g area ÷ (4	18.38		(90)
									1		iy alea ÷ (*	+) =	0.28	(91)
	r	<u> </u>	· ` `	or the wh			· · · · · · · · · · · · · · · · · · ·	<u>`</u>						
(92)m=	18.77	18.85	19.05	19.36	19.69	20.04	20.24	20.23	19.98	19.56	19.13	18.76		(92)
	<u> </u>	1	1	n internal		1	1	1	· · ·	· · · · · · · · · · · · · · · · · · ·				(02)
(93)m=	18.77	18.85	19.05	19.36	19.69	20.04	20.24	20.23	19.98	19.56	19.13	18.76		(93)
		iting requ			o obtoin	ad at at	on 11 of	Toble O	o oo tha	+ Ti m_('	76)m on	d re-calc	ulata	
				using Ta		ieu al Sit	ерттог	Table 91	0, 50 ina	t 11,111=(<i>i</i> 0)111 ani	u le-caic	ulate	
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisa	ation fac	tor for g	ains, hr	n:										
(94)m=	1	1	1	1	0.99	0.96	0.87	0.88	0.97	0.99	1	1		(94)
Usefu	<u> </u>	1	<u> </u>	4)m x (84	<i>,</i>		r	1			1			
(95)m=	408.55	406.25	391.29	366.93	340.86	309.07	266.82	276	316.57	347.64	376.12	396.67		(95)
	r –	r <u> </u>		nperature			40.0	40.4		10.0	74			(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)
(97)m=	1333.5	1	1150.49	al tempe 946.79	721.99	486.27	325.15	341.41	- (96)m 527.85] 809.12	1091.61	1328.18		(97)
				r each n								1020.10		()
(98)m=	688.16	588.78	564.84	417.5	283.56	0	0	0		343.34	515.15	693.04		
								Tota	l per year) = Sum(9	8)15,912 =	4094.37	(98)
Space	e heatin	a require	ement in	ı kWh/m²	wear						, ,	[46.58	 (99)
Opac	eneaun	grequit			/veai								40.00	(33)
0- F			امعا مغ	to define the	•		e e la cella e					L		
			nts – Ind	ividual h	•	ystems i	ncluding	micro-C	CHP)			L		
Spac	e heatir	ng:			eating sy		Ĭ		CHP)			ו 	0](201)
Spac Fracti	e heatin ion of sp	ng: bace hea	at from s	econdar	eating sy		system						0	(201) (202)
Spac Fracti Fracti	e heatin ion of sp ion of sp	ng: bace hea bace hea	it from s it from n		eating sy //supple em(s)		system	(202) = 1 -		(203)] =			0 1 1	(201) (202) (204)

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

											- <i>u</i> '-'		
				- 0/			• •	ace heat	-	-			
tary heating system, %				, 		, 					E⊞CIEI Г		
or May Jun Jul Aug Sep Oct Nov Dec kWh/year ated above)	Oct No	Sep	Aug	Jul			Apr	Mar	Feb	Jan	Snoon		
	343.34 515.	0	0	0		r í	417.5	564.84	588.78	688.16	Space		
								(4)] } x 1			(211)m		
	367.6 551.	0	0	0	0	<u> </u>	447	604.76	630.39	736.79	(<u>2</u> 1),		
Total (kWh/year) =Sum(211) _{15,1012} = 4383.7 (211)	r) =Sum(211) _{15,}	l (kWh/yea	Tota				1				L		
Vh/month						month	y), kWh/	econdar	g fuel (s	heating	Space		
							<u> </u>	00 ÷ (20		T	E F		
		-		0	0	0	0	0	0	0	(215)m=		
Total (kWh/year) =Sum(215) _{15,1012} = 0 (215)	r) =Sum(215) _{15,}	i (kvvn/yea	lota										
d above)						hove)	ulated a	ter (calc		-			
	177.57 188.	155.94	154.23	138.36	144.41	<u> </u>	169.35	190.94	182.78	207.32	· · r		
80.3 (216								iter	ater hea	cy of wa	Efficien		
23 86.42 80.3 80.3 80.3 86.68 87.45 87.9 (217)	86.68 87.4	80.3	80.3	80.3	80.3	86.42	87.23	87.62	87.78	87.84	(217)m=		
								kWh/mo	-				
14 189.73 179.84 172.3 192.07 194.19 204.85 215.85 230.24	204.85 215.8	194.19	192.07	172.3	179.84	189.73	m 194.14) ÷ (217) 217.93	<u>m x 100</u> 208.22	<u>= (64)</u> r 236.01	· · ·		
Total = Sum(219a) ₁₁₂ = 2435.37 (219		I = Sum(21									Ľ		
kWh/year <u>kWh/year</u>	main system 1						Annual totals						
em 1 4383.7							ed, main	fuel use	neating	Space I			
2435.37								ed	fuel use	eating	Water h		
ric keep-hot					t	keep-ho	electric	ans and	oumps, fa	ty for p	Electric		
30 (230								:	g pump:	heating	centra		
45 (230								sted flue	an-assis	with a fa	boiler		
year sum of (230a)(230g) = 75 (231	sum of (230a)(230g) =						kWh/vea	above. k	/ for the	ectricity	Total el		
								Electricity for lighting					
		_	(227h)	L (222)	L (221)) (221)	coc (211	for all u					
			. ,	. ,		, , ,	•						
eating systems including micro-CHP			CIO-CHP	uaing mi	ems incl	ing syste	ual neat	– Individ	issions -	Oz emi	12a. C		
Energy Emission factor Emissions													
				•						_			
$(211) x \qquad \qquad 0.216 = 946.88 (261)$	0.216			1) x	(21))	ystem 1)	(main s	neating	Space I		
(215) x $0.519 = 0$ (263)	0.519			5) x	(21			dary)	(second	neating	Space I		
(219) x $0.216 = 526.04$ (264)	0.216			9) x	(219					eating	Water h		
(261) + (262) + (263) + (264) = 1472.92 (265)		264) =	+ (263) + (1) + (262) ·	(26			ng	ter heati	and wat	Space a		
ric keep-hot (231) x 0.519 = 38.93 (267)	0.519			1) x	t (23 ⁻	keep-ho	electric	ans and	umps, fa	ty for p	Electric		
				2) x	(232				ghting	ty for lie	Electric		
		sum of											
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	r) =Sum(215) ₁₅ 177.57 188. 86.68 87.4 204.85 215.4 9a) ₁₁₂ = kWh/y (230g) = Image: Comparison of the second seco	I (kWh/yea 155.94 80.3 194.19 I = Sum(21 of (230a) = 264) =	Tota 154.23 80.3 192.07 Tota sum (237b) Cro-CHP	138.36 80.3 172.3 + (232). uding mi ergy /h/year 1) x 5) x 9) x 1) + (262) - 1) x	144.41 80.3 179.84 t t t t t (231) ems inclu En kW (21) (21) (21) (21) (21) (21) (21) (21)	0 bove) 163.96 86.42 189.73 1 keep-ho ur)(221) ing syste	ulated a 169.35 87.23 onth m 194.14 system electric kWh/yea ses (211 ual heat	00 ÷ (20 0 ter (calc 190.94 ater 87.62 kWh/mc 217.93 ed, main ed ans and sted flue above, H for all us – Individ system 1) dary)	1)] } x 1 0 ater hea 182.78 ater hea 87.78 heating, m x 100 208.22 fuel use fuel use fuel use fuel use fuel use fuel use fuel use fuel use fuel use fuel se fuel use fuel use fuel use fuel use fuel use fuel se fuel se fuel use fuel se fuel se fu	m x (20) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	= {[(98)] (215)m=[Water H Output [Efficien (217)m=[Fuel for (219)m (219)m=[Annual Space H Water h Electric centra boiler Total el Electric Total de 12a. C Space H Space H Space H Space A		

TER =

19.49 (273)