



Energy Strategy

72-80 Leather Lane

Version 1.1

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Background

This Energy Strategy has been prepared by Verte on behalf of Hatton Garden Properties to provide a commentary on the sustainable energy issues for the proposed development at 72-80 Leather Lane. It sets out the energy efficiency and carbon reduction measures that will be incorporated into a number of the dwellings forming part of the development.

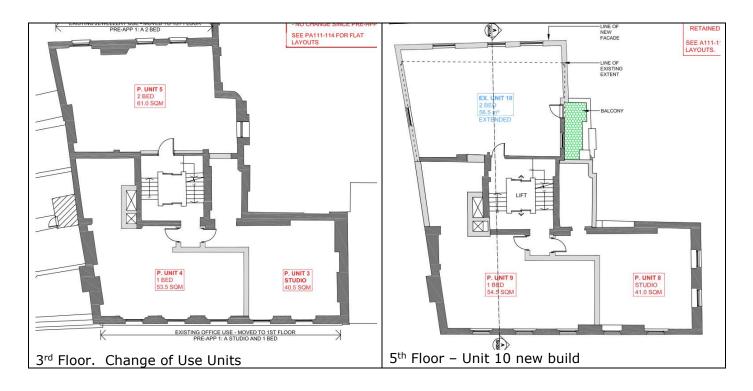
The building

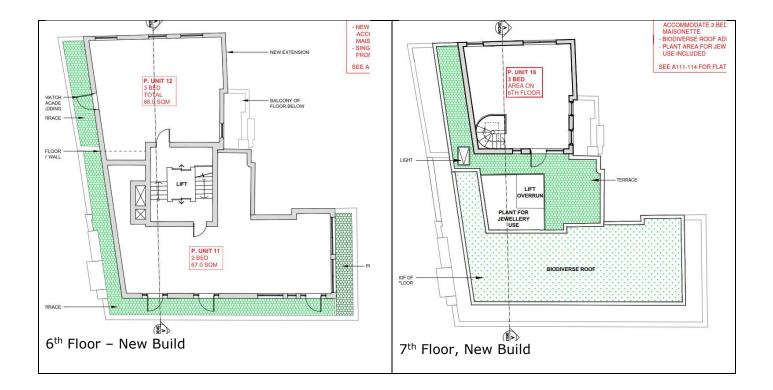
The application site is 72-80 Leather Lane. The building currently has a mix of uses including residential, office and retail. This energy strategy covers the dwellings on the third floor which are formed as a result of a change of use, and the new build dwellings at the rear of the fifth floor, and on the sixth and seventh floor. A total of three new dwellings are formed by change of use, and three by extending the building.

The existing dwellings that are undergoing refurbishment are not included in this Energy Statement.

The total net internal area of the newly dwellings is approximately 363m².

General Arrangement Drawings





Planning Policy

The Pre-application advice from the London Borough of Camden, dated 7th October 2015, stated that *The Council would require development to incorporate sustainable design and construction measures. You are advised to submit a statement demonstrating how relevant measures have been incorporated into the design and proposed implementation as per Policy DP22 - Promoting sustainable design and construction*

Camden's Development Policy 22 - Promoting sustainable design and construction

The parts of DP22 relevant to this document state that:

The Council will require development to incorporate sustainable design and construction measures. Schemes must:

a) demonstrate how sustainable development principles have been incorporated into the design and proposed implementation; and

b) incorporate green or brown roofs and green walls wherever suitable.

The Council will promote and measure sustainable design and construction by:

c) expecting new build housing to meet Code for Sustainable Homes Level 3 by 2010 and Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016.;

d) expecting developments (except new build) of 500 sq m of residential floorspace or above or 5 or more dwellings to achieve "very good" in EcoHomes assessments prior to 2013 and encouraging "excellent" from 2013;The Council will require development to be resilient to climate change by ensuring schemes include appropriate climate change adaptation measures, such as:

f) summer shading and planting;

The London Plan

Policies within Chapter 5 of the London Plan (March 2015) set out relevant design and climate change adaptation policies relating to developments, and establish expectations for applicant's commitments in terms of CO₂ savings and measures proposed.

As required by the GLA's Guidance, after establishing the baseline energy demand and profile for the site, the strategy for the project will follow the Mayor's Energy Hierarchy in appraising appropriate measures to reduce carbon emissions and other climate impacts from the development:

- Use Less Energy 'Be Lean'
- Supply Energy Efficiently 'Be Clean'
- Use Renewable Energy 'Be Green'

The Energy Hierarchy

The Mayor's energy hierarchy is central to the climate change policies. The stages of the hierarchy are:

Use Less Energy/Reduce Demand- 'Be Lean'

- Reduce use through behaviour change
- Improve insulation
- Incorporate passive heating and cooling
- Install energy efficient lighting and appliances

Supply Energy Efficiently - 'Be Clean'

- Use CHP and community heating and/or cooling
- Cut transmission losses though local generation

Use Renewable Energy - 'Be Green'

- Install renewables on site
- Import renewable energy

Structure of the Energy Assessment

This statement is structured to respond to the Energy Hierarchy following the GLA's guidance. The statement includes:

- An assessment of the baseline carbon emissions based on the target emission rate for the dwellings.
- A review of the energy efficient features incorporated into the design.
- An assessment of the feasibility of incorporating a combined heat and power system.
- A review of renewable energy technologies and their application for this development.
- Recommendations and commitments

Baseline energy consumption and carbon emissions

Before energy efficiency measures are investigated it is necessary to establish the baseline energy consumption of the scheme. This baseline sets the standard against which the proposed carbon reduction measures are compared and evaluation.

New Dwellings

The baseline case against which carbon savings are assessed for the new build dwellings is the target emission rate (TER) calculated in accordance with Approve Document L1A of Part L (2013) of the Building Regulations. This baseline case represents a typical new build arrangement; where electricity for the development is imported from the grid and space and heating water are provided by natural gas fired boilers.

The on site energy uses associated with non Building Regulations (e.g. cooking, appliances, lighting in areas not covered by Part L) is included in the baseline carbon emission rate.

The following 'regulated' energy uses are considered in the baseline energy analysis:

- Space Heating/Cooling
- Water Heating
- Ventilation
- Fans, Pumps and Controls
- Lighting (internal)

Change of Use Dwellings

The baseline case for the units formed by a change of use is the emission rate if the building is designed to the meet minimum requirements of the Building Regulations Approved Document L1B. Accordingly, the SAP calculations undertaken for this stage of the assessment adopt the minimum standards detailed in Approved Document L1B. This includes limiting standards for the thermal properties of building fabric, as well as building services.

For building services systems the Building Regulations refer to the Domestic Building Services Compliance Guide 2013, and the standards included therein have been followed where appropriate.

The parameters used to determine the CO_2 emissions using SAP calculations have been presented in the Table below.

Element / Service	Parameter	Limiting Values (AD L1B)		
External Wall	u-value	0.3 W/m²K		
Windows	u-value	1.6 W/m2K		
	Construction	Double glazed, argon filled.		
	g-value	0.76		
Floor		0.25 W/m2K		
Roof		0.18 W/m2K		
Air Permeability	m³/hm² @ 50Pa	None, SAP default used		
Ventilation		Natural Ventilation		
Space Heating	Туре	Communal boiler with independent controls in each flat		
	Fuel	Gas		

Element / Service	Parameter	Limiting Values (AD L1B)
	Efficiency Assumed	86% (Part L1B Minimum)
	Controls	Programmer and Room Thermostat
	Flue	Balanced, fan assisted
	Emitter	Underfloor (Timber)
Hot Water	Source	From Main System 110 litre tank in each flat.
Thermal Bridging	y-value	SAP default – 0.15 W/m²K
Lighting	Standard Fittings	25%
	Energy Efficient Fittings	75%

BE LEAN – reduce energy demand

This section outlines how energy consumption will be reduced through the design of the building.

The energy savings will be achieved by passive measures and the introduction of more energy efficient plant and services. Any improvement achieved at this stage will reduce the extent of measures or size of plant needed to address the subsequent 'be clean' and 'be green' stages.

Dwellings

The dwellings will be constructed to be energy efficient and achieve compliance with Part L1A 2013 without the need for low or zero carbon technologies. This performance will be achieved through the use of energy efficient design, including:

- Better U-values exceeding the requirements of Part L 2013
- Best practice system efficiencies for heating, and ventilation system
- Highly efficient light fittings
- Programmable timeclock, thermostat and thermostatic radiator valves.
- Balanced mechanical ventilation with heat recovery
- The mechanical ventilation units will incorporate the following design features:
 - Heat recovery of at least 90%.
 - Specific Fan Powers of no greater than 0.40 W/l/s.
 - Summer bypass to assist with summertime cooling
 - Variable speed controls with summertime cooling function

Fabric Standards - New Dwellings

The table below details the U-values for the domestic areas of the development in relation to the relevant Building Regulations minimum standards (Parts L1A).

New Build Dwellings (Units 10, 11, 12)	Limiting Values Building Regulations, Part L1A 2013	Proposed values
Air Tightness	5 m³/hr per m²	3.5 m ³ /hr per m ²
Wall U-Value	0.35 W/m²°C	0.15 W/m²°C
Roof U-Value	0.25 W/m²°C	0.15 W/m²°C
Floor U-Value	0.25 W/m²°C	N/A
Exposed Floor U-Value	0.25 W/m²°C	N/A
Glazing U-Value	2.2 W/m²°C	0.9 W/m²°C
Glazing G-Value		0.40
Thermal Bridging		Accredited Construction Details. Target y-value 0.06W/m²K

The improvements to the thermal efficiency of the building envelope, combined with a high efficiency gas fired boiler and centralised whole house ventilation will result in a considerable reduction in energy required for space heating relative to a dwelling constructed to the limiting standards permitted by the Approved Document.

Fabric Standards - Change of Use Dwellings

Having established the baseline case CO_2 emissions for the building, the next step is to determine the improvement in CO_2 emissions that is achieved through the use of energy efficiency measures and the incorporation of systems and equipment whose performance is better than the limiting requirements of the Building Regulations.

Change of Use (Units 3, 4, 5)	Limiting Values Building Regulations, Part L1B 2013	Proposed values
Air Tightness	None	10 m ³ /hr per m ²
Wall U-Value	0.30 W/m²°C	0.25 W/m²°C
Roof U-Value	N/A	N/A
Floor U-Value	N/A	N/A
Exposed Floor U-Value	N/A	N/A
Glazing U-Value	1.6 W/m²°C	1.9 W/m²°C (Secondary glazing behind existing windows)
Glazing G-Value		0.65
Thermal Bridging		Accredited Construction Details. Target y-value 0.06W/m²K

Heating and Hot Water

The generation of domestic hot water is responsible for approximately 45% of the regulated CO2 emissions from the dwellings. In order to reduce these emissions, the following measures will be implemented:

- Generation of the domestic hot water using high efficiency combi boilers with flue gas heat recovery
- Insulate domestic hot water distribution pipe-work in the dwellings.
- Provide low flow fittings, as required to meet the water use standards set by Part G of the Building Regulations and the Code for Sustainable Homes Wat 01 tool.

Lighting

Lighting accounts for 18% of the regulated CO2 emissions from the dwellings. All of the fixed light fittings will be dedicated low energy lamps. The dwellings benefit from good daylight and this will help to reduce the lighting energy consumption.

Conclusion

The 'Be Lean' measures provide a carbon reduction against the baseline Part L 2013 compliant buildings of 21.9% on regulated loads.

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GLA Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy									
Residences	Carbon dioxide emissions (Tonnes CO ₂ per annum)								
	Regulated	Unregulated							
Building Regulations 2013 Part L Baseline	7.9	6.9							
After energy demand reduction	6.2	6.9							

GLA Table 2: Carbon Dioxide Emissions from each stage of the Energy Hierarchy								
Residences	Carbon dioxide savings (Tonnes CO2 per annum)							
Savings from energy demand reduction	1.7	21.9%						

BE CLEAN – supply energy efficiently

The next step in the Energy Hierarchy is the 'Be Clean' strategy of supplying the required energy as efficiently as possible.

Potential approaches include connecting the scheme to existing low carbon or CHP-led district energy networks, or if no existing schemes exist, investigating whether such networks are planned in the area and designing systems with the flexibility to connect to these in the future.

With or without a district energy system, the feasibility of CHP (combined heat and power). For larger developments the use of a site wide communal heating system should be provided if considered viable.

District Energy Networks

The London Heat Map has been utilised to check if the development can connect into an existing distribution network. The City Gen network terminates approximately 400m on Charterhouse Street at the southern end of Farringdon Station, but extending the network to serve a small project is not viable.

CHP and Communal Heating

On site communal heating systems serving small developments such as this are not commercially or technically viable and have not been considered.

Conclusion

The development will not be provided with a communal heating system due to the technical and management disadvantages.

The carbon emissions at the end of the 'be clean' stage are identical to those at the end of the 'be lean'.

BE GREEN – renewable energy

The third and final stage of the energy hierarchy - 'Be Green' is to review the potential of a range of renewable energy systems to serve the energy requirements of the site and thereby offset CO² emissions.

The following renewable energy technologies have been considered for the development:

- Solar Water Heating
- Wind Power
- Biomass Heating
- Heat Pumps
- Photovoltaics

SOLAR WATER HEATING

Solar thermal domestic hot water consumption is technically viable for this development. A solar thermal system with 2 m² of evacuated tube collector panel on the roof serving a solar domestic hot water tank would provide some carbon savings and the occupier would also benefit from renewable heat incentive payments.

WIND POWER

It is recognised that wind generators are often associated with unacceptable visual and noise implications. Wind technology as a renewable energy source is not considered appropriate for this site.

BIOMASS HEATING

Biomass heating is not considered to be a suitable technology for urban locations. With local boilers in each unit biomass boilers are not a viable solution due fuel distribution problems on the site. In addition, the boilers are often un-used due to maintenance issues, fuel supply issues, and operating costs.

HEAT PUMPS

The use of heat pump technologies has been checked one of the units and was found to give only a marginal improvement over the 'be lean' carbon emission rate, therefore, heat pumps are not considered to be a viable technology for reducing carbon emissions for this development.

PHOTOVOLTAICS

Photovoltaic collectors are compatible with the proposed building services solution. However, the 'be lean' measures achieve a 21.9% carbon emission reduction, which responds to Camden's requirement for sustainable design measures to be incorporated into the development.

Conclusion

The proposed approach of providing an efficient building envelope, providing carbon savings in excess of 21.9%, in preference to renewable technologies is felt to be the best long term solution, and provides the occupants with a robust solution that is not reliant on the operation of a technology.

CONCLUSIONS

Energy efficiency measures will be implemented to provide carbon savings of 21.9% in comparison to a baseline building that is fully compliant with the standard set by Part L 2013. The energy efficiency measures include: improved fabric insulation; improved air tightness; high efficiency fans; heat recovery on ventilation systems.

The development will not be provided with a communal heating system as it is too small for communal heating to be viable.

Renewable technologies will not be provided as the be lean measures result in a sustainable solution that provides the occupants with a robust solution.

GLA tables 6 shows the savings in carbon dioxide achieved by the three steps. The total regulated carbon saving through the combination of energy efficient design and renewable technologies is 21.9%.

Table 6: Site wide regulated carbon dioxide emissions and savings									
Site Total	Total regulated emissions (Tonnes CO ₂ /year)	CO_2 Savings(Tonnes CO_2 /year)	Percentage Saving						
	(Tonnes CO ₂ per annum)		(%)						
Building Regulations 2013 Part L Baseline	7.9								
After energy demand reduction	6.2	1.7	21.9%						
After CHP	6.2	0.0	0.0%						
After Low or Zero Carbon Technologies	6.2	0.0	0.0%						
Total cumulative savings		1.7	21.92%						

For the new build dwellings only the total floor area is 209m². The table below shows the carbon emissions and savings for the new build dwellings only. The carbon savings through energy efficient design for the new build dwellings is 23.2%

Table 6: Site wide regulated carbon dioxide emissions and savings										
New Build Only	Total regulated emissions (Tonnes CO ₂ /year)	CO ₂ Savings(Tonnes CO ₂ /year)	Percentage Saving							
	(Tonnes CO ₂ per annum)		(%)							
Building Regulations 2013 Part L Baseline	3.9									
After energy demand reduction	3.0	0.9	23.2%							
After CHP	3.0	0.0	0.0%							
After Low or Zero Carbon Technologies	3.0	0.0	0.0%							
Total cumulative savings		0.9	23.23%							

Appendix A – SAP Outputs

DER Worksheet Design - Draft



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

Assessor name	Mr Barry R	Redman					As	sessor num	iber	1		
Client	Hatton Garden Properties							Last modified				
17/10/2016 Address		80 Leath	ner lane 12	Lean, Lon	don							
1. Overall dwelling dimens	sions											
				A	rea (m²)			age storey ight (m)		١	/olume (m³)	
Lowest occupied					50.73](1a) x		2.85	(2a) =		144.58	(3a)
+1					37.99	(1b) x		3.00	(2b) =		113.97	(3b)
Total floor area	(1a) +	· (1b) + (1c	:) + (1d)(1	n) =	88.72	(4)						
Dwelling volume							(3a)	+ (3b) + (3	c) + (3d)(3	3n) =	258.55	(5)
2. Ventilation rate								<u></u>				
										r	m³ per hour	
Number of chimneys								0] x 40 =	-	0	(6a)
Number of open flues								0] x 20 =	=	0	(6b)
Number of intermittent fan	S							0] x 10 =	-	0	(7a)
Number of passive vents								0] x 10 =	-	0	(7b)
Number of flueless gas fires	;							0] x 40 =	-	0	(7c)
										Δi	r changes p	or
											hour	
Infiltration due to chimneys	s, flues, fans,	PSVs		(6a)	+ (6b) + (7a	a) + (7b) + (7c) =	0] ÷ (5) =			(8)
Infiltration due to chimneys If a pressurisation test has b			ntended, pro					-] ÷ (5) =		hour	
	been carried	out or is in		oceed to (1	17), otherw	vise continue	e from (9) t	-] ÷ (5) =		hour	
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If a pressurisation test has be Air permeability value, q50, If based on air permeability Number of sides on which t Shelter factor Infiltration rate incorporation Infiltration rate modified fo Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (all	expressed in value, then in he dwelling i hg shelter fac r monthly wi Feb ed from Table 5.00 1.25 llowing for sh 0.20	out or is in n cubic me (18) = [(17 is sheltered tor ind speed: Mar e U2 4.90 1.23 nelter and 0.20	etres per ho) ÷ 20] + (8) d Apr 4.40 1.10 wind factor 0.18	May 4.30 (21) x (2	17), otherw are metre se (18) = (10 Jun 3.80 0.95 2a)m	ise continue of envelope 6) Jul 3.80 0.95	Aug 3.70	2 (16) 1 - Sep 4.00 1.00	[0.075 x (1 (18) x (2 Oct 4.30	=	hour 0.00 3.50 0.18 1 0.93 0.16 Dec 4.70 1.18	(8) (17) (18) (19) (20) (21) (21) (22) (22a)
If a pressurisation test has be Air permeability value, q50, If based on air permeability Number of sides on which t Shelter factor Infiltration rate incorporation Infiltration rate modified fo Jan Monthly average wind spee 5.10 Wind factor (22) m ÷ 4 1.28 Adjusted infiltration rate (al 0.21	een carried of expressed in value, then of he dwelling i ng shelter fac r monthly wi Feb ed from Table 5.00 1.25 llowing for sh 0.20 ge rate for th	out or is in n cubic me (18) = [(17 is sheltered ctor ind speed: Mar e U2 4.90 1.23 nelter and 0.20 te applicab	etres per ho) ÷ 20] + (8) d Apr 4.40 1.10 wind factor 0.18 ble case:	May 4.30 (21) x (2	17), otherw are metre se (18) = (10 Jun 3.80 0.95 2a)m	ise continue of envelope 6) Jul 3.80 0.95	Aug 3.70	2 (16) 1 - Sep 4.00 1.00	[0.075 x (1 (18) x (2 Oct 4.30	=	hour 0.00 3.50 0.18 1 0.93 0.16 Dec 4.70 1.18	(8) (17) (18) (19) (20) (21) (21) (22) (22a) (22b)
If a pressurisation test has be Air permeability value, q50, If based on air permeability Number of sides on which t Shelter factor Infiltration rate incorporation Infiltration rate modified fo Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (all 0.21 Calculate effective air changed	expressed ir value, then he dwelling i ng shelter fac r monthly wi Feb d from Table 5.00 1.25 llowing for sh 0.20 ge rate for th a: air change	out or is in n cubic me (18) = [(17 is sheltered tor ind speed: Mar e U2 4.90 1.23 nelter and 0.20 ie application rate throu	etres per ho) ÷ 20] + (8) d Apr 4.40 1.10 wind factor 0.18 ble case: ugh system	May 4.30 (21) x (2 0.17	17), otherw hare metre se (18) = (10 Jun 3.80 0.95 2a)m 0.15	ise continue of envelope 6) Jul 3.80 0.95 0.15	Aug 3.70	2 (16) 1 - Sep 4.00 1.00	[0.075 x (1 (18) x (2 Oct 4.30	=	hour 0.00 3.50 0.18 1 0.93 0.16 Dec 4.70 1.18 0.19	(8) (17) (18) (19) (20) (21) (21) (22) (22a) (22b)
If a pressurisation test has be Air permeability value, q50, If based on air permeability Number of sides on which t Shelter factor Infiltration rate incorporation Infiltration rate modified fo Jan Monthly average wind speed 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (all 0.21 Calculate effective air change If mechanical ventilation	even carried of expressed in value, then of he dwelling i ng shelter fac r monthly wi Feb d from Table 5.00 1.25 llowing for sh 0.20 ge rate for th a: air change covery: efficient	out or is in n cubic me (18) = [(17 is sheltered tor ind speed: Mar e U2 4.90 1.23 nelter and 0.20 rate throu ency in % a	etres per ho) ÷ 20] + (8) d Apr 4.40 1.10 wind factor 0.18 ble case: ugh system allowing for	May 4.30 (21) x (2 0.17	17), otherw are metre se (18) = (10 Jun 3.80 0.95 2a)m 0.15	ise continue of envelope 6) Jul 3.80 0.95 0.15	Aug 3.70 0.15	2 (16) 1 - Sep 4.00 1.00	[0.075 x (1 (18) x (2 Oct 4.30	=	hour 0.00 3.50 0.18 1 0.93 0.16 Dec 4.70 4.70 1.18 0.19 0.50	(8) (17) (18) (19) (20) (21) (21) (22) (22a) (22a) (22a)
If a pressurisation test has be Air permeability value, q50, If based on air permeability Number of sides on which t Shelter factor Infiltration rate incorporation Infiltration rate modified fo Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al 0.21 Calculate effective air change If mechanical ventilation If balanced with heat red	even carried of expressed in value, then of he dwelling i ng shelter fac r monthly wi Feb d from Table 5.00 1.25 llowing for sh 0.20 ge rate for th a: air change covery: efficient	out or is in n cubic me (18) = [(17 is sheltered tor ind speed: Mar e U2 4.90 1.23 nelter and 0.20 rate throu ency in % a	etres per ho) ÷ 20] + (8) d Apr 4.40 1.10 wind factor 0.18 ble case: ugh system allowing for	May 4.30 (21) x (2 0.17	17), otherw are metre se (18) = (10 Jun 3.80 0.95 2a)m 0.15	ise continue of envelope 6) Jul 3.80 0.95 0.15	Aug 3.70 0.15	2 (16) 1 - Sep 4.00 1.00	[0.075 x (1 (18) x (2 Oct 4.30	=	hour 0.00 3.50 0.18 1 0.93 0.16 Dec 4.70 4.70 1.18 0.19 0.50	(8) (17) (18) (19) (20) (21) (21) (22) (22a) (22a) (22a)



	0.31	0.30	0.30	0.28	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.29	(25)
3. Heat losses	and heat los	s paramet	er										
Element				Gross	Openings	s Net	area	U-value	A x U W	/К к-ч	value,	Ахк,	
			а	area, m²	m²	А,	m²	W/m²K		kJ	/m².K	kJ/K	
Window						15	.34 x	0.87	= 13.33				(27)
External wall						123	.28 x	0.15	= 18.49				(29a)
Party wall						60	.00 x	0.00	= 0.00				(32)
Roof						49	.85 x	0.12	= 5.98				(30)
Total area of ex	ternal eleme	ents ∑A, m²	:			188	.47						(31)
Fabric heat loss	s, W/K = ∑(A	× U)							(20	5)(30) + (32) =	37.80	(33)
Heat capacity C	Cm = ∑(А x к)							(28)((30) + (32) -	+ (32a)(3	2e) =	N/A	(34)
Thermal mass p	oarameter (T	MP) in kJ/n	n²K									250.00	(35)
Thermal bridge	s: Σ(L x Ψ) ca	lculated us	sing Appen	dix K								10.51	(36)
Total fabric hea	at loss									(33) + (36) =	48.31	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	-
Ventilation hea	t loss calcula	ted month	ly 0.33 x (25)m x (5)									
	26.18	25.84	25.49	23.77	23.42	21.70	21.70	21.35	22.39	23.42	24.11	24.80	(38)
Heat transfer c	oefficient, W	/K (37)m +	- ⊦ (38)m	•								1	
	74.49	74.15	73.80	72.07	71.73	70.00	70.00	69.66	70.69	71.73	72.42	73.11	1
									Average = 2		·	71.99	_] (39)
Heat loss parar	neter (HLP). '	W/m²K (39	∂)m ÷ (4)							_(,] (/
	0.84	0.84	0.83	0.81	0.81	0.79	0.79	0.79	0.80	0.81	0.82	0.82	1
	0.01	0.01	0.00	0.01	0.01	0.75	0.75		Average = 2		·	0.81	」](40)
Number of day	s in month (T	able 1a)						,	Weldge - 2	_(+0)112,	12 - <u> </u>	0.01] (40)
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
	51.00	20.00	51.00	30.00	51.00	50.00	51.00	51.00	50.00	51.00	50.00	51.00] (40)
4. Water heat	ing energy r	equiremen	t										
Assumed occup	bancy, N											2.61	(42)
Annual average	e hot water u	sage in litre	es per day	Vd,average	= (25 x N) +	- 36							
	1				. ,							96.14	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	96.14 Dec	(43)
Hot water usag					May	Jun		Aug	Sep	Oct	Nov] (43)
Hot water usag					May	Jun		Aug 90.37	Sep 94.21	Oct 98.06	Nov 101.90] (43)
Hot water usag	e in litres pe	r day for ea	ach month	Vd,m = fac	May tor from Tak	Jun ble 1c x (43)	-			101.90	Dec] (43)]] (44)
Hot water usag Energy content	e in litres pe 105.75	r day for ea 101.90	ach month 98.06	Vd,m = fac 94.21	May tor from Tak 90.37	Jun ble 1c x (43 86.52) 86.52	90.37		98.06	101.90	Dec 105.75]
-	e in litres pe 105.75	r day for ea 101.90	ach month 98.06	Vd,m = fac 94.21	May tor from Tak 90.37	Jun ble 1c x (43 86.52) 86.52	90.37		98.06	101.90	Dec 105.75]
-	e in litres pe 105.75 of hot wate	r day for ea 101.90 r used = 4.1	ach month 98.06 18 x Vd,m >	Vd,m = fac 94.21	May tor from Tak 90.37 3600 kWh/n	Jun ble 1c x (43 86.52 nonth (see) 86.52 Tables 1b,	90.37 1c 1d)	94.21	98.06 ∑(44)1	101.90 .12 = 139.86	Dec 105.75 1153.62]
-	e in litres pe 105.75 of hot water 156.82	r day for ea 101.90 r used = 4.1 137.16	ach month 98.06 18 x Vd,m >	Vd,m = fac 94.21	May tor from Tak 90.37 3600 kWh/n	Jun ble 1c x (43 86.52 nonth (see) 86.52 Tables 1b,	90.37 1c 1d)	94.21	98.06 Σ(44)1 128.12	101.90 .12 = 139.86	Dec 105.75 1153.62 151.87]] (44)]
Energy content	e in litres pe 105.75 of hot water 156.82 s 0.15 x (45)	r day for ea 101.90 r used = 4.1 137.16 m	ach month 98.06 18 x Vd,m > 141.53	Vd,m = fac 94.21 (nm x Tm/ 123.39	May tor from Tak 90.37 3600 kWh/n 118.40	Jun ble 1c x (43 86.52 nonth (see 102.17) 86.52 Tables 1b, 94.67	90.37 1c 1d) 108.64	94.21	98.06 Σ(44)1 128.12 Σ(45)1	101.90 .12 = 139.86 .12 =	Dec 105.75 1153.62 151.87 1512.58]] (44)] (45)
Energy content Distribution los	e in litres pe 105.75 of hot water 156.82 s 0.15 x (45) 23.52	r day for ea 101.90 r used = 4.1 137.16 m 20.57	ach month 98.06 18 x Vd,m > 141.53 21.23	Vd,m = fac 94.21 x nm x Tm/3 123.39 18.51	May tor from Tak 90.37 3600 kWh/n	Jun ble 1c x (43 86.52 nonth (see) 86.52 Tables 1b,	90.37 1c 1d)	94.21	98.06 Σ(44)1 128.12	101.90 .12 = 139.86	Dec 105.75 1153.62 151.87]] (44)]
Energy content	e in litres pe 105.75 of hot water 156.82 s 0.15 x (45) 23.52	r day for ea 101.90 r used = 4.1 137.16 m 20.57	ach month 98.06 18 x Vd,m > 141.53 21.23	Vd,m = fac 94.21 x nm x Tm/3 123.39 18.51	May tor from Tak 90.37 3600 kWh/n 118.40	Jun ble 1c x (43 86.52 nonth (see 102.17 15.33) 86.52 Tables 1b, 94.67	90.37 1c 1d) 108.64	94.21	98.06 Σ(44)1 128.12 Σ(45)1 19.22	101.90 .12 = 139.86 .12 =	Dec 105.75 1153.62 151.87 1512.58 22.78] (44)] (44)] (45)] (46)
Energy content Distribution los Water storage	e in litres pe 105.75 of hot water 156.82 is 0.15 x (45) 23.52 loss calculate 0.00	r day for ea 101.90 r used = 4.1 137.16 m 20.57 ed for each 0.00	ach month 98.06 18 x Vd,m > 141.53 21.23 month (5: 0.00	Vd,m = fac 94.21 x nm x Tm/3 123.39 18.51 5) x (41)m 0.00	May tor from Tak 90.37 3600 kWh/n 118.40 17.76	Jun ble 1c x (43 86.52 nonth (see 102.17 15.33) 86.52 Tables 1b, 94.67 14.20 0.00	90.37 1c 1d) 108.64 16.30	94.21 109.94 16.49	98.06 Σ(44)1 128.12 Σ(45)1	101.90 .12 = 139.86 .12 = 20.98	Dec 105.75 1153.62 151.87 1512.58]] (44)] (45)
Energy content Distribution los	e in litres pe 105.75 of hot water 156.82 s 0.15 x (45) 23.52 loss calculate 0.00 ntains dedica	r day for ea 101.90 r used = 4.1 137.16 m 20.57 ed for each 0.00 ated solar s	ach month 98.06 18 x Vd,m > 141.53 21.23 month (5) 0.00 torage or c	Vd,m = fac 94.21 nm x Tm/3 123.39 18.51 5) x (41)m 0.00 dedicated V	May tor from Tak 90.37 3600 kWh/m 118.40 17.76 0.00 WWHRS (56)	Jun ble 1c x (43 86.52 nonth (see 102.17 15.33 0.00 m x [(47) -) 86.52 Tables 1b, 94.67 14.20 0.00 Vs] ÷ (47),	90.37 1c 1d) 108.64 16.30 0.00 else (56)	94.21 109.94 16.49 0.00	98.06 Σ(44)1 128.12 Σ(45)1 19.22 0.00	101.90 .12 = 139.86 .12 = 20.98 0.00	Dec 105.75 1153.62 1512.58 22.78 0.00] (44)] (44)] (45)] (46)] (56)
Energy content Distribution los Water storage If the vessel co	e in litres pe 105.75 of hot water 156.82 s 0.15 x (45) 23.52 loss calculater 0.00 ntains dedica	r day for ea 101.90 r used = 4.1 137.16 m 20.57 ed for each 0.00 ated solar so	ach month 98.06 18 x Vd,m > 141.53 21.23 month (5: 0.00 torage or c 0.00	Vd,m = fac 94.21 x nm x Tm/3 123.39 18.51 5) x (41)m 0.00	May tor from Tak 90.37 3600 kWh/n 118.40 17.76	Jun ble 1c x (43 86.52 nonth (see 102.17 15.33) 86.52 Tables 1b, 94.67 14.20 0.00	90.37 1c 1d) 108.64 16.30	94.21 109.94 16.49	98.06 Σ(44)1 128.12 Σ(45)1 19.22	101.90 .12 = 139.86 .12 = 20.98	Dec 105.75 1153.62 151.87 1512.58 22.78] (44)] (44)] (45)] (46)
Energy content Distribution los Water storage	e in litres pe 105.75 of hot water 156.82 s 0.15 x (45) 23.52 loss calculate 0.00 ntains dedica 0.00 loss for each	r day for ea 101.90 r used = 4.1 137.16 m 20.57 ed for each 0.00 sted solar st 0.00 month fro	ach month 98.06 18 x Vd,m > 141.53 21.23 month (5: 0.00 torage or c 0.00 m Table 3	Vd,m = fac 94.21 123.39 18.51 5) x (41)m 0.00 dedicated V 0.00	May tor from Tak 90.37 3600 kWh/n 118.40 17.76 0.00 VWHRS (56) 0.00	Jun ole 1c x (43 86.52 nonth (see 102.17 15.33 0.00 m x [(47) - 0.00) 86.52 Tables 1b, 94.67 14.20 0.00 Vs] ÷ (47), 0.00	90.37 1c 1d) 108.64 16.30 0.00 else (56) 0.00	94.21 109.94 16.49 0.00	98.06 Σ (44)1 128.12 Σ (45)1 19.22 0.00 0.00	101.90 .12 =	Dec 105.75 1153.62 151.87 1512.58 22.78 0.00 0.00] (44)] (44)] (45)] (46)] (56)] (57)
Energy content Distribution los Water storage If the vessel co Primary circuit	e in litres pe 105.75 of hot water 156.82 s 0.15 x (45) 23.52 loss calculater 0.00 ntains dedica 0.00 loss for each 0.00	r day for ea 101.90 r used = 4.1 137.16 m 20.57 ed for each 0.00 nted solar si 0.00 month fro 0.00	ach month 98.06 18 x Vd,m > 141.53 21.23 month (5: 0.00 torage or c 0.00 m Table 3 0.00	Vd,m = fac 94.21 (nm x Tm/3 123.39 18.51 5) x (41)m 0.00 dedicated V 0.00	May tor from Tak 90.37 3600 kWh/m 118.40 17.76 0.00 WWHRS (56)	Jun ble 1c x (43 86.52 nonth (see 102.17 15.33 0.00 m x [(47) -) 86.52 Tables 1b, 94.67 14.20 0.00 Vs] ÷ (47),	90.37 1c 1d) 108.64 16.30 0.00 else (56)	94.21 109.94 16.49 0.00	98.06 Σ(44)1 128.12 Σ(45)1 19.22 0.00	101.90 .12 = 139.86 .12 = 20.98 0.00	Dec 105.75 1153.62 1512.58 22.78 0.00] (44)] (44)] (45)] (46)] (56)
Energy content Distribution los Water storage If the vessel co	e in litres pe 105.75 of hot water 156.82 s 0.15 x (45) 23.52 loss calculater 0.00 ntains dedicater 0.00 loss for each 0.00 each month f	r day for ea 101.90 r used = 4.1 137.16 m 20.57 ed for each 0.00 month fro 0.00 from Table	ach month 98.06 18 x Vd,m > 141.53 21.23 month (52 0.00 torage or c 0.00 m Table 3 0.00 3a, 3b or 3	Vd,m = fac 94.21 x nm x Tm/3 123.39 18.51 5) x (41)m 0.00 dedicated V 0.00 3c	May tor from Tak 90.37 3600 kWh/n 118.40 17.76 0.00 WHRS (56) 0.00	Jun ble 1c x (43 86.52 nonth (see 102.17 15.33 0.00 m x [(47) - 0.00 0.00) 86.52 Tables 1b, 94.67 14.20 0.00 Vs] ÷ (47), 0.00 0.00	90.37 1c 1d) 108.64 16.30 0.00 else (56) 0.00	94.21 109.94 16.49 0.00 0.00	98.06 Σ (44)1 128.12 Σ (45)1 19.22 0.00 0.00 0.00	101.90 .12 =	Dec 105.75 1153.62 151.87 1512.58 22.78 0.00 0.00 0.00] (44)] (44)] (45)] (46)] (56)] (57)] (59)
Energy content Distribution los Water storage If the vessel co Primary circuit Combi loss for	e in litres pe 105.75 of hot water 156.82 s 0.15 x (45) 23.52 loss calculate 0.00 ntains dedica 0.00 loss for each 0.00 each month f 50.96	r day for ea 101.90 r used = 4.1 137.16 m 20.57 ed for each 0.00 nted solar si 0.00 month fro 0.00 from Table 46.03	ach month 98.06 18 x Vd,m > 141.53 21.23 month (52 0.00 torage or c 0.00 m Table 3 0.00 3a, 3b or 3 49.97	Vd,m = fac 94.21 (nm x Tm/3 123.39 18.51 5) x (41)m 0.00 dedicated V 0.00 3c 46.46	May tor from Tak 90.37 3600 kWh/n 118.40 17.76 0.00 WHRS (56) 0.00 0.00	Jun ble 1c x (43 86.52 nonth (see 102.17 15.33 0.00 m x [(47) - 0.00 0.00 42.67) 86.52 Tables 1b, 94.67 14.20 0.00 Vs] ÷ (47), 0.00 0.00 44.09	90.37 1c 1d) 108.64 16.30 0.00 else (56) 0.00 46.05	94.21 109.94 16.49 0.00 0.00 0.00 46.46	98.06 Σ (44)1 128.12 Σ (45)1 19.22 0.00 0.00	101.90 .12 =	Dec 105.75 1153.62 151.87 1512.58 22.78 0.00 0.00] (44)] (44)] (45)] (46)] (56)] (57)
Energy content Distribution los Water storage If the vessel co Primary circuit	e in litres pe 105.75 of hot water 156.82 s 0.15 x (45) 23.52 loss calculate 0.00 ntains dedica 0.00 loss for each 0.00 each month f 50.96	r day for ea 101.90 r used = 4.1 137.16 m 20.57 ed for each 0.00 nted solar si 0.00 month fro 0.00 from Table 46.03	ach month 98.06 18 x Vd,m > 141.53 21.23 month (52 0.00 torage or c 0.00 m Table 3 0.00 3a, 3b or 3 49.97	Vd,m = fac 94.21 (nm x Tm/3 123.39 18.51 5) x (41)m 0.00 dedicated V 0.00 3c 46.46	May tor from Tak 90.37 3600 kWh/n 118.40 17.76 0.00 WHRS (56) 0.00 0.00	Jun ble 1c x (43 86.52 nonth (see 102.17 15.33 0.00 m x [(47) - 0.00 0.00 42.67) 86.52 Tables 1b, 94.67 14.20 0.00 Vs] ÷ (47), 0.00 0.00 44.09	90.37 1c 1d) 108.64 16.30 0.00 else (56) 0.00 46.05	94.21 109.94 16.49 0.00 0.00 0.00 46.46	98.06 Σ (44)1 128.12 Σ (45)1 19.22 0.00 0.00 0.00	101.90 .12 =	Dec 105.75 1153.62 151.87 1512.58 22.78 0.00 0.00 0.00] (44)] (44)] (45)] (46)] (56)] (57)] (59)

Solar DHW inpu	t calculated	using Appe	endix G or A	Appendix H									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Flue gas heat re	covery syst	em 1 input	(Appendix	G1)	•	•	•	•			•	•	_
	-29.41	-25.65	-25.00	-19.19	-16.84	-14.37	-13.36	-15.21	-15.38	-20.50	-25.59	-28.97	(63)
Output from wa	ter heater f	for each mo	onth (kWh/	month) (62	2)m + (63)n	ו							_
	178.37	157.53	166.50	150.66	147.61	130.47	125.40	139.48	141.02	157.59	163.58	173.86	
										∑(64)1	.12 = 1	.832.08	(64)
Heat gains from	water heat	ing (kWh/m	nonth) 0.2	5 × [0.85 ×	(45)m + (61	.)m] + 0.8 ×	[(46)m + (57)m + (59)	m]				
	64.88	57.11	59.55	52.64	50.88	44.64	42.50	47.64	48.17	55.09	58.83	63.24	(65)
5. Internal gair	IS												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	(Table 5)												
	130.39	130.39	130.39	130.39	130.39	130.39	130.39	130.39	130.39	130.39	130.39	130.39	(66)
Lighting gains (c	alculated ir	n Appendix l	L, equation	L9 or L9a),	also see Ta	able 5							
	22.27	19.78	16.08	12.18	9.10	7.68	8.30	10.79	14.49	18.39	21.47	22.89	(67)
Appliance gains	(calculated	in Appendi	x L, equatio	on L13 or L	13a), also s	ee Table 5							
	236.70	239.16	232.97	219.79	203.16	187.53	177.08	174.63	180.82	193.99	210.63	226.26	(68)
Cooking gains (c	alculated ir	n Appendix	L, equation	L15 or L15	a), also see	Table 5							
	36.04	36.04	36.04	36.04	36.04	36.04	36.04	36.04	36.04	36.04	36.04	36.04	(69)
Pump and fan ga	ains (Table	5a)											
	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evap	oration (Ta	ble 5)											
	-104.31	-104.31	-104.31	-104.31	-104.31	-104.31	-104.31	-104.31	-104.31	-104.31	-104.31	-104.31	(71)
Water heating g	ains (Table	5)											
	87.21	84.99	80.04	73.12	68.39	62.00	57.13	64.03	66.90	74.05	81.71	85.00	(72)
Total internal ga	ins (66)m ·	+ (67)m + (6	68)m + (69)	m + (70)m	+ (71)m + (72)m							
	411.30	409.04	394.21	370.20	345.77	322.32	307.63	314.56	327.32	351.55	378.92	399.26	(73)
6. Solar gains													

			Access f Table		Area m²		ar flux //m²	•	g cific data Table 6b	FF specific o or Table		Gains W	
East			0.7	7 x	6.30	x 1	9.64 x	0.9 x	0.64	0.70	=	38.41	(76)
South			0.7	7 X	2.65	x 4	6.75 x	0.9 x	0.64	0.70	=	38.46	(78)
West			0.7	7 X	4.50	x 1	9.64 x	0.9 x	0.64	0.70	=	27.44	(80)
NorthWest			0.7	7 X	1.89	X 1	1.28 x	0.9 x	0.64	0.70	=	6.62	(81)
Solar gains in wa	tts ∑(74)m	(82)m											
	110.94	205.30	316.68	439.98	527.31	536.27	511.88	446.36	360.16	237.28	136.04	92.80	(83)
Total gains - inte	rnal and so	lar (73)m +	(83)m										
	522.23	614.34	710.89	810.19	873.07	858.60	819.51	760.93	687.48	588.83	514.96	492.06	(84)
7. Mean interna	al tempera	ture (heati	ng season)										
Temperature du	ring heating	g periods in	the living a	area from T	able 9, Th	L(°C)						21.00	(85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor	for gains f	or living are	ea n1,m (se	e Table 9a)	1								
	1.00	0.99	0.98	0.90	0.73	0.52	0.38	0.42	0.69	0.95	0.99	1.00	(86)
Mean internal te	mp of livin	g area T1 (s	steps 3 to 7	in Table 90	c)								
	20.19	20.35	20.58	20.84	20.97	21.00	21.00	21.00	20.98	20.79	20.44	20.17	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C) 20.22 20.22 20.23 20.24 20.25 20.26 20.26 20.27 20.26 20.25 20.24 20.23 (88)Utilisation factor for gains for rest of dwelling n2,m 1.00 0.99 0.97 0.87 0.68 0.46 0.31 0.35 0.62 0.93 0.99 1.00 (89)Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) 19.47 19.63 19.86 20.12 20.23 20.26 20.27 20.25 20.08 19.74 19.47 (90)20.26 Living area fraction Living area ÷ (4) = 0.34 (91) Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2 19.72 19.87 20.10 20.36 20.48 20.51 20.51 20.51 20.50 20.32 19.98 19.70 (92) Apply adjustment to the mean internal temperature from Table 4e where appropriate 19.57 19.72 19.95 20.36 20.36 20.35 20.17 19.83 19.55 20.21 20.33 20.36 (93) 8. Space heating requirement Jan Feb Mar Apr Mav Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, nm 1.00 0.99 0.97 0.87 0.69 0.47 0.32 0.36 0.93 0.99 1.00 (94)0.63 Useful gains, nmGm, W (94)m x (84)m 520.45 608.22 686.42 707.17 599.62 402.04 263.27 275.96 433.58 545.87 510.23 490.88 (95) Monthly average external temperature from Table U1 11.70 16.40 4.30 4.90 6.50 8.90 14.60 14.10 7.10 4.20 16.60 10.60 (96)Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m] 1137.11 1099.01 992.86 815.33 618.74 403.24 263.35 276.12 441.58 686.54 921.85 1122.55 (97) Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m 0.00 458.79 329.81 227.99 77.88 14.22 0.00 0.00 0.00 104.66 296.36 469.97 ∑(98)1...5, 10...12 = 1979.69 (98)Space heating requirement kWh/m²/year (98) ÷ (4) (99) 22.31 9a. Energy requirements - individual heating systems including micro-CHP Space heating 0.00 (201)Fraction of space heat from secondary/supplementary system (table 11) Fraction of space heat from main system(s) 1 - (201) = 1.00 (202)(202) Fraction of space heat from main system 2 0.00 (202) x [1- (203)] = 1.00 Fraction of total space heat from main system 1 (204)Fraction of total space heat from main system 2 0.00 (205)(202) x (203) = Efficiency of main system 1 (%) 90.90 (206)Feb Jan Mar Apr May Jun Jul Aug Sep Oct Nov Dec Space heating fuel (main system 1), kWh/month 362.83 326.03 504.72 250.82 85.67 15.65 0.00 0.00 0.00 0.00 115.13 517.02 ∑(211)1...5, 10...12 = 2177.87 (211)Water heating Efficiency of water heater 87.83 87.37 86.34 83.98 81.60 80.80 80.80 80.80 80.80 84.55 87.03 87.93 (217)Water heating fuel, kWh/month 172.62 174.53 197.72 203.09 180.31 192.83 179.40 180.90 161.47 155.20 186.39 187.96 ∑(219a)1...12 = 2172.43 (219)Annual totals Space heating fuel - main system 1 2177.87 Water heating fuel 2172.43

Electricity for pumps, fans and electric keep-hot (Table 4f)						
mechanical ventilation fans - balanced, extract or position	ve input from outside		169.54			(230a)
central heating pump or water pump within warm air he			30.00			(230c)
boiler flue fan	-		45.00			(230e)
Total electricity for the above, kWh/year					244.54	(231)
Electricity for lighting (Appendix L)					393.25	(232)
Total delivered energy for all uses		(211))(221) + (231) + (2	32)(237b) =	4988.10	(238)
				, , ,		
10a. Fuel costs - individual heating systems including mic						
	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2177.87	х	3.48	x 0.01 =	75.79	(240)
Water heating	2172.43	х	3.48	x 0.01 =	75.60	(247)
Pumps and fans	244.54	x	13.19	x 0.01 =	32.26	(249)
Electricity for lighting	393.25	x	13.19	x 0.01 =	51.87	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)(242) + (245)(254) =	355.52	(255)
11a. SAP rating - individual heating systems including mid	cro-CHP					
Energy cost deflator (Table 12)					0.42	(256)
Energy cost factor (ECF)					1.12	(257)
SAP value					84.42	
SAP rating (section 13)					84	(258)
SAP band					В	
12a. CO ₂ emissions - individual heating systems including	micro-CHP					
12a. CO ₂ emissions - individual heating systems including	; micro-CHP Energy kWh/year		Emission factor kg CO₂/kWh		Emissions kg CO₂/year	
12a. CO ₂ emissions - individual heating systems including Space heating - main system 1	Energy	x		=		(261)
	Energy kWh/year	x x	kg CO₂/kWh	=	kg CO ₂ /year	_ (261) _ (264)
Space heating - main system 1	Energy kWh/year 2177.87		kg CO₂/kWh	=	kg CO₂/year 470.42	
Space heating - main system 1 Water heating	Energy kWh/year 2177.87		kg CO ₂ /kWh 0.22 0.22	=	kg CO ₂ /year 470.42 469.25	(264)
Space heating - main system 1 Water heating Space and water heating	Energy kWh/year 2177.87 2172.43	x	kg CO ₂ /kWh 0.22 0.22 (261) + (262) + (2	= 263) + (264) =	kg CO ₂ /year 470.42 469.25 939.67	(264) (265)
Space heating - main system 1 Water heating Space and water heating Pumps and fans	Energy kWh/year 2177.87 2172.43 244.54	x x	kg CO ₂ /kWh 0.22 0.22 (261) + (262) + (2 0.52 0.52	= 263) + (264) = =	kg CO₂/year 470.42 469.25 939.67 126.92	(264) (265) (267)
Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting	Energy kWh/year 2177.87 2172.43 244.54	x x	kg CO ₂ /kWh 0.22 0.22 (261) + (262) + (2 0.52 0.52	= 263) + (264) = = =	kg CO₂/year 470.42 469.25 939.67 126.92 204.09 1270.68	(264) (265) (267) (268)
Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year	Energy kWh/year 2177.87 2172.43 244.54	x x	kg CO ₂ /kWh 0.22 0.22 (261) + (262) + (2 0.52 0.52	= 263) + (264) = = = 265)(271) =	kg CO₂/year 470.42 469.25 939.67 126.92 204.09 1270.68	(264) (265) (267) (268) (268) (272)
Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate	Energy kWh/year 2177.87 2172.43 244.54	x x	kg CO ₂ /kWh 0.22 0.22 (261) + (262) + (2 0.52 0.52	= 263) + (264) = = = 265)(271) =	kg CO ₂ /year 470.42 469.25 939.67 126.92 204.09 1270.68 14.32	(264) (265) (267) (268) (268) (272)
Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate El value	Energy kWh/year 2177.87 2172.43 244.54	x x	kg CO ₂ /kWh 0.22 0.22 (261) + (262) + (2 0.52 0.52	= 263) + (264) = = = 265)(271) =	kg CO ₂ /year 470.42 469.25 939.67 126.92 204.09 1270.68 14.32 87.27	(264) (265) (267) (268) (272) (272) (273)
Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate El value El rating (section 14)	Energy kWh/year 2177.87 2172.43 244.54 393.25	x x	kg CO ₂ /kWh 0.22 0.22 (261) + (262) + (2 0.52 0.52	= 263) + (264) = = = 265)(271) =	kg CO ₂ /year 470.42 469.25 939.67 126.92 204.09 1270.68 14.32 87.27 87	(264) (265) (267) (268) (272) (272) (273)
Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate El value El rating (section 14) El band	Energy kWh/year 2177.87 2172.43 244.54 393.25	x x	kg CO ₂ /kWh 0.22 0.22 (261) + (262) + (2 0.52 0.52	= 263) + (264) = = = 265)(271) =	kg CO ₂ /year 470.42 469.25 939.67 126.92 204.09 1270.68 14.32 87.27 87	(264) (265) (267) (268) (272) (273) (273) (274)
Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate El value El rating (section 14) El band	Energy kWh/year 2177.87 2172.43 244.54 393.25 393.25	x x	kg CO ₂ /kWh 0.22 (261) + (262) + (2 0.52 0.52 (= 263) + (264) = = = 265)(271) =	kg CO ₂ /year 470.42 469.25 939.67 126.92 204.09 1270.68 14.32 87.27 87 B Primary Energy	(264) (265) (267) (268) (272) (273) (273) (274)
Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate El value El rating (section 14) El band 13a. Primary energy - individual heating systems includin	Energy kWh/year 2177.87 2172.43 244.54 393.25 sg micro-CHP Energy kWh/year 2177.87	x x x	kg CO ₂ /kWh 0.22 (261) + (262) + (2 0.52 0.52 (1) 0.52 (1) 0.52	= 263) + (264) = = = 265)(271) = (272) ÷ (4) =	kg CO ₂ /year 470.42 469.25 939.67 126.92 204.09 1270.68 14.32 87.27 87 87 B Primary Energy kWh/year 2657.01	(264) (265) (267) (268) (272) (273) (273) (274) (274)
Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate El value El rating (section 14) El band 13a. Primary energy - individual heating systems includin Space heating - main system 1 Water heating	Energy kWh/year 2177.87 2172.43 244.54 393.25 sg micro-CHP Energy kWh/year	x x x	kg CO ₂ /kWh 0.22 (261) + (262) + (2 0.52 0.52 (1)	= 263) + (264) = = = 265)(271) = (272) ÷ (4) = = =	kg CO ₂ /year 470.42 469.25 939.67 126.92 204.09 1270.68 14.32 87.27 87 B Primary Energy kWh/year	(264) (265) (267) (268) (272) (273) (273) (274) (274) (274) (261) (264)
Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate El value El rating (section 14) El band 13a. Primary energy - individual heating systems includin Space heating - main system 1 Water heating Space and water heating	Energy kWh/year 2177.87 2172.43 244.54 393.25 sg micro-CHP Energy kWh/year 2177.87 2172.43	x x x x	kg CO ₂ /kWh 0.22 (261) + (262) + (2 0.52 0.52 (1) 0.52 0.52 (1) 0.52	= 263) + (264) = = = 265)(271) = (272) ÷ (4) = = =	kg CO ₂ /year 470.42 469.25 939.67 126.92 204.09 1270.68 14.32 87.27 87 B Primary Energy kWh/year 2657.01 2650.37 5307.37	(264) (265) (267) (268) (272) (272) (273) (274) (274) (274) (261) (264) (265)
Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate El value El rating (section 14) El band 13a. Primary energy - individual heating systems includin Space heating - main system 1 Water heating Space and water heating Pumps and fans	Energy kWh/year 2177.87 2172.43 244.54 393.25 sg micro-CHP Energy kWh/year 2177.87 2172.43	x x x x x	kg CO ₂ /kWh 0.22 (261) + (262) + (2 0.52 0.52 (1) 0.52 0.52 (1) 0.5	= 263) + (264) = = = 265)(271) = (272) ÷ (4) = = = 263) + (264) =	kg CO ₂ /year 470.42 469.25 939.67 126.92 204.09 1270.68 14.32 87.27 87 87 B Primary Energy kWh/year 2657.01 2650.37 5307.37 750.75	(264) (265) (267) (268) (272) (273) (273) (273) (274) (274) (261) (261) (264) (265) (265) (267)
Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate El value El rating (section 14) El band 13a. Primary energy - individual heating systems includin Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting	Energy kWh/year 2177.87 2172.43 244.54 393.25 sg micro-CHP Energy kWh/year 2177.87 2172.43	x x x x	kg CO ₂ /kWh 0.22 (261) + (262) + (2 0.52 0.52 (1) 0.52 (2) 0.52 (2) 0.52 (2) 0.52 (2) 0.52 (2) 0.52 (2) (2) (2) (2) (2) (2) (2) (2	= 263) + (264) = = = 265)(271) = (272) ÷ (4) = = = 263) + (264) = =	kg CO ₂ /year 470.42 469.25 939.67 126.92 204.09 1270.68 14.32 87.27 87 B Primary Energy kWh/year 2657.01 2650.37 5307.37 750.75 1207.27	(264) (265) (267) (268) (272) (273) (273) (274) (274) (274) (261) (264) (265) (265) (267) (268)
Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate El value El rating (section 14) El band 13a. Primary energy - individual heating systems includin Space heating - main system 1 Water heating Space and water heating Pumps and fans	Energy kWh/year 2177.87 2172.43 244.54 393.25 sg micro-CHP Energy kWh/year 2177.87 2172.43	x x x x x	kg CO ₂ /kWh 0.22 (261) + (262) + (2 0.52 0.52 (1) 0.52 0.52 (1) 0.5	= 263) + (264) = = = 265)(271) = (272) ÷ (4) = = = 263) + (264) = =	kg CO ₂ /year 470.42 469.25 939.67 126.92 204.09 1270.68 14.32 87.27 87 87 B Primary Energy kWh/year 2657.01 2650.37 5307.37 750.75	(264) (265) (267) (268) (272) (273) (273) (273) (274) (274) (261) (261) (264) (265) (265) (267)

DER Worksheet Design - Draft



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

	Mr Barry R	edman					As	sessor num	ber	1		
Client	Hatton Gar		erties						Last	modified		
17/10/2016 Address				Lean, Lond	on							
		00 2000		2001.) 20110								
1. Overall dwelling dimens	sions											
				Α	rea (m²)			age storey eight (m)		Vo	olume (m³)	
Lowest occupied					60.91] (1a) x		2.85	(2a) =		173.59	(3a)
Total floor area	(1a) +	(1b) + (1c	c) + (1d)(1n) =	60.91] (4)						
Dwelling volume							(3a)	+ (3b) + (3	c) + (3d)(3n) =	173.59	(5)
2. Ventilation rate												
										m	³ per hour	
Number of chimneys								0	x 40 =	-	0	(6a)
Number of open flues								0	x 20 =	-	0	(6b)
Number of intermittent fans	s							0	x 10 =	=	0	(7a)
Number of passive vents								0	x 10 =	=	0	(7b)
Number of flueless gas fires	;							0	x 40 =	-	0	(7c)
										Air	changes pe hour	r
Infiltration due to chimneys	, flues, fans, I	PSVs		(6a)	+ (6b) + (7a	a) + (7b) +	(7c) =	0	÷ (5) :	=	0.00	(8)
If a pressurisation test has b	peen carried o	out or is ir	ntended, pi	roceed to (1	17), otherw	ise continu	e from (9) t	o (16)		<u> </u>		
Air permeability value, q50,	expressed in	i cubic me	etres per h	our per squ	are metre	of envelop	e area				10.00	(17)
If based on air permeability	value then (18) = [(17	') ÷ 20] + (8	2) othorwig	ر (18) – (14							_
	value, then (s), other wis	e (10) – (1	5)					0.50	(18)
Number of sides on which th		s sheltere		5), otherwis	50 (10) - (10	5)					0.50	(18) (19)
		s sheltere		s), otherwis	se (18) – (10	5)		1 -	[0.075 x (1	.9)] =		
Number of sides on which the	he dwelling is			s), otherwis	e (18) - (10	5)		1 -	[0.075 x (1 (18) x (2	(19)
Number of sides on which the Shelter factor	he dwelling is	tor	d	<i>5),</i> 0therwis	e (10) - (10	5)		1 -			2 0.85] (19)] (20)
Number of sides on which the Shelter factor Infiltration rate incorporation	he dwelling is	tor	d	May	Jun	5) Jul	Aug	1 - Sep			2 0.85] (19)] (20)
Number of sides on which the Shelter factor Infiltration rate incorporation Infiltration rate modified for	he dwelling is ng shelter fac r monthly wir Feb	tor nd speed: Mar	d				Aug		(18) x (20) =	2 0.85 0.43] (19)] (20)
Number of sides on which the Shelter factor Infiltration rate incorporation Infiltration rate modified for Jan	he dwelling is ng shelter fac r monthly wir Feb	tor nd speed: Mar	d				Aug 3.70		(18) x (20) =	2 0.85 0.43] (19)] (20)
Number of sides on which the Shelter factor Infiltration rate incorporation Infiltration rate modified for Jan Monthly average wind spee	he dwelling is ng shelter fact r monthly wir Feb ed from Table	tor nd speed: Mar : U2	d Apr	Мау	Jun	Jul		Sep	(18) × (Oct	20) = Nov	2 0.85 0.43 Dec] (19)] (20)] (21)
Number of sides on which the Shelter factor Infiltration rate incorporation Infiltration rate modified for Jan Monthly average wind spee	he dwelling is ng shelter fact r monthly wir Feb ed from Table	tor nd speed: Mar : U2	d Apr	Мау	Jun	Jul		Sep	(18) × (Oct	20) = Nov	2 0.85 0.43 Dec] (19)] (20)] (21)
Number of sides on which the Shelter factor Infiltration rate incorporation Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4	he dwelling is ng shelter fact r monthly wir Feb ed from Table 5.00 1.25	tor nd speed: Mar 2 U2 4.90 1.23	d Apr 4.40 1.10	May 4.30	Jun 3.80 0.95	Jul 3.80	3.70	Sep	(18) x (Oct 4.30	20) = Nov 4.50	2 0.85 0.43 Dec 4.70] (19)] (20)] (21)] (22)
Number of sides on which the Shelter factor Infiltration rate incorporation Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28	he dwelling is ng shelter fact r monthly wir Feb ed from Table 5.00 1.25	tor nd speed: Mar 2 U2 4.90 1.23	d Apr 4.40 1.10	May 4.30	Jun 3.80 0.95	Jul 3.80	3.70	Sep	(18) x (Oct 4.30	20) = Nov 4.50	2 0.85 0.43 Dec 4.70] (19)] (20)] (21)] (22)
Number of sides on which the Shelter factor Infiltration rate incorporation Infiltration rate modified for Jan Monthly average wind speet 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (all	he dwelling is ng shelter fact r monthly wir Feb ed from Table 5.00 1.25 llowing for sh 0.53	tor md speed: Mar 4.90 1.23 melter and 0.52	d Apr 4.40 1.10 wind facto 0.47	May 4.30 1.08 or) (21) x (2	Jun 3.80 0.95 2a)m	Jul 3.80 0.95	3.70 0.93	Sep 4.00 1.00	(18) x (Oct 4.30	20) = Nov 4.50	2 0.85 0.43 Dec 4.70] (19)] (20)] (21)] (22)] (22a)
Number of sides on which the Shelter factor Infiltration rate incorporation Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al 0.54	he dwelling is ng shelter fact r monthly wir Feb d from Table 5.00 1.25 llowing for sh 0.53 ge rate for the	tor nd speed: Mar 4.90 1.23 nelter and 0.52 e applicat	d Apr 4.40 1.10 wind facto 0.47 ole case:	May 4.30 1.08 or) (21) x (2 0.46	Jun 3.80 0.95 2a)m	Jul 3.80 0.95	3.70 0.93	Sep 4.00 1.00	(18) x (Oct 4.30	20) = Nov 4.50	2 0.85 0.43 Dec 4.70] (19)] (20)] (21)] (22)] (22a)
Number of sides on which the Shelter factor Infiltration rate incorporation Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al 0.54 Calculate effective air change	he dwelling is ng shelter fact r monthly wir Feb ed from Table 5.00 1.25 Ilowing for sh 0.53 ge rate for the a: air change r	tor md speed: Mar U2 4.90 1.23 melter and 0.52 e application rate throu	Apr 4.40 1.10 wind facto 0.47 ole case: ugh system	May 4.30 1.08 or) (21) × (2 0.46	Jun 3.80 0.95 2a)m 0.40	Jul 3.80 0.95 0.40	3.70 0.93	Sep 4.00 1.00	(18) x (Oct 4.30	20) = Nov 4.50	2 0.85 0.43 Dec 4.70 1.18] (19)] (20)] (21)] (22)] (22a)] (22b)
Number of sides on which the Shelter factor Infiltration rate incorporation Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al 0.54 Calculate effective air change If mechanical ventilation	he dwelling is ng shelter fact r monthly wir Feb d from Table 5.00 1.25 llowing for sh 0.53 ge rate for the a: air change r covery: efficie	tor Mar Mar 4.90 1.23 melter and 0.52 e applications rate throughn %	Apr 4.40 1.10 wind facto 0.47 ole case: ugh system allowing fo	May 4.30 1.08 or) (21) x (2 0.46	Jun 3.80 0.95 2a)m 0.40	Jul 3.80 0.95 0.40 able 4h	3.70 0.93 0.39	Sep 4.00 1.00	(18) x (Oct 4.30	20) = Nov 4.50	2 0.85 0.43 Dec 4.70 1.18 0.50] (19)] (20)] (21)] (22)] (22a)] (22b)] (22b)] (23a)
Number of sides on which the Shelter factor Infiltration rate incorporation Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al 0.54 Calculate effective air change If mechanical ventilation If balanced with heat reco	he dwelling is ng shelter fact r monthly wir Feb d from Table 5.00 1.25 llowing for sh 0.53 ge rate for the a: air change r covery: efficie	tor Mar Mar 4.90 1.23 melter and 0.52 e applications rate throughn %	Apr 4.40 1.10 wind facto 0.47 ole case: ugh system allowing fo	May 4.30 1.08 or) (21) x (2 0.46	Jun 3.80 0.95 2a)m 0.40	Jul 3.80 0.95 0.40 able 4h	3.70 0.93 0.39	Sep 4.00 1.00	(18) x (Oct 4.30	20) = Nov 4.50	2 0.85 0.43 Dec 4.70 1.18 0.50] (19)] (20)] (21)] (22)] (22a)] (22b)] (22b)] (23a)
Number of sides on which the Shelter factor Infiltration rate incorporation Infiltration rate modified for Jan Monthly average wind speed 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al 0.54 Calculate effective air change If mechanical ventilation If balanced with heat rece a) If balanced mechanical	he dwelling is ng shelter fact r monthly wir Feb d from Table 5.00 1.25 llowing for sh 0.53 ge rate for the a: air change r covery: efficie al ventilation 0.63	tor nd speed: Mar 4.90 1.23 melter and 0.52 rate through ency in % with heat 0.62	d Apr 4.40 1.10 wind facto 0.47 ble case: ugh system allowing fo : recovery 0.57	May 4.30 1.08 or) (21) x (2 0.46 or in-use fac (MVHR) (22 0.56	Jun 3.80 0.95 2a)m 0.40 ctor from T 2b)m + (23b)	Jul 3.80 0.95 0.40 able 4h o) x [1 - (23	3.70 0.93 0.39 c) ÷ 100]	Sep 4.00 1.00 0.43	(18) x (Oct 4.30 1.08 0.46	20) = Nov 4.50 1.13 0.48	2 0.85 0.43 Dec 4.70 1.18 0.50 79.90] (19)] (20)] (21)] (22)] (22a)] (22a)] (22b)] (22b)] (23a)] (23c)



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3. Heat losses and heat loss parameter									
Element	Gross area, m ²	Openings m ²	Net a A, ı		U-value W/m²K	A x U W	/Κ κ-valı kJ/m	• •	
Window			4.8	30 x	1.50	= 7.22			(27)
External wall			48.	76 x	0.35	= 17.07			(29a)
Party wall			50.	00 x	0.00	= 0.00			(32)
Total area of external elements ∑A, m ²			53.	56					(31)
Fabric heat loss, $W/K = \sum(A \times U)$						(26	5)(30) + (32)	= 24.28	(33)
Heat capacity Cm = ∑(А x к)					(28)	.(30) + (32) +	- (32a)(32e)	= N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K								250.00	(35)
Thermal bridges: $\Sigma(L \times \Psi)$ calculated using App	endix K							2.80	(36)
Total fabric heat loss							(33) + (36)	= 27.08	(37)
Jan Feb Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov Dec	
Ventilation heat loss calculated monthly 0.33	x (25)m x (5)								
36.80 36.19 35.58	3 32.54	31.93	28.89	28.89	28.28	30.10	31.93	33.15 34.36	(38)
Heat transfer coefficient, W/K (37)m + (38)m									
63.88 63.27 62.6	59.62	59.01	55.97	55.97	55.36	57.19	59.01	60.23 61.45	
						Average = ∑	(39)112/12	= 59.47	(39)
Heat loss parameter (HLP), W/m^2K (39)m ÷ (4									
1.05 1.04 1.03	0.98	0.97	0.92	0.92	0.91	0.94	0.97	0.99 1.01	
						Average = ∑	(40)112/12	= 0.98	(40)
Number of days in month (Table 1a)									
31.00 28.00 31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00 31.00	(40)
4. Water heating energy requirement								2.01] (12)
Assumed occupancy, N			26					2.01	」(42) ☐ (42)
Annual average hot water usage in litres per d				1.1	A	Com	Oct	81.87	(43)
Jan Feb Mar		May	Jun	Jul	Aug	Sep	Oct	Nov Dec	
Hot water usage in litres per day for each mor					76.06	00.00	02.54		٦
90.06 86.78 83.5	80.23	76.96	73.68	73.68	76.96	80.23		86.78 90.06	
Energy content of hot water used = 4.18 x Vd,	n v nm v Tm /2	600 kWh/m	onth (coo	Tables 1b	1c 1d)		∑(44)112	= 982.46	(44)
133.56 116.81 120.5		100.83	87.01	80.63	92.52	93.63	109.11	119.11 129.34	1
155.50 110.81 120.5	4 105.09	100.85	87.01	80.05	92.52	95.05	<u>Σ(45)112</u>	I	」 (45)
Distribution loss 0.15 x (45)m							2(45)112	- 1200.17	_ (45)
20.03 17.52 18.00									
	15 76	15 12	13.05	12.09	12.88	14.04	16.37	17 87 10 /0	(46)
		15.12	13.05	12.09	13.88	14.04	16.37	17.87 19.40	(46)
Water storage loss calculated for each month	(55) x (41)m				1				_ 、 、
Water storage loss calculated for each month 0.00 0.00	(55) x (41)m	0.00	0.00	0.00	0.00	0.00	16.37 0.00	17.87 19.40 0.00 0.00] (46)] (56)
Water storage loss calculated for each month 0.00 0.00 0.00 0.00	(55) x (41)m 0.00 or dedicated W	0.00 WHRS (56)m	0.00 n x [(47) - '	0.00 Vs] ÷ (47),	0.00 else (56)	0.00	0.00	0.00 0.00] (56)
Water storage loss calculated for each month 0.00 0.00 0.00 If the vessel contains dedicated solar storage of 0.00 0.00 0.00	(55) x (41)m 0.00 or dedicated W 0.00	0.00	0.00	0.00	0.00				_ 、 、
Water storage loss calculated for each month 0.00 0.00 0.00 If the vessel contains dedicated solar storage of 0.00 0.00 0.00 Primary circuit loss for each month from Table	(55) x (41)m 0.00 or dedicated W 0.00 3	0.00 WHRS (56)m 0.00	0.00 n x [(47) - \ 0.00	0.00 Vs] ÷ (47), 0.00	0.00 else (56)	0.00	0.00	0.00 0.00] (56)] (57)
Water storage loss calculated for each month 0.00 0.00 0.00 If the vessel contains dedicated solar storage of 0.00 0.00 0.00 Primary circuit loss for each month from Table 0.00 0.00 0.00	(55) x (41)m 0.00 or dedicated W 0.00 3 0.00	0.00 WHRS (56)m	0.00 n x [(47) - '	0.00 Vs] ÷ (47),	0.00 else (56)	0.00	0.00	0.00 0.00] (56)
Water storage loss calculated for each month 0.00 0.00 0.00 If the vessel contains dedicated solar storage of 0.00 0.00 0.00 Primary circuit loss for each month from Table 0.00 0.00 0.00 Combi loss for each month from Table 3a, 3b of	(55) x (41)m 0.00 or dedicated W 0.00 3 0.00 or 3c	0.00 WHRS (56)m 0.00	0.00 n x [(47) - \ 0.00	0.00 Vs] ÷ (47), 0.00	0.00 else (56) 0.00 0.00	0.00	0.00	0.00 0.00 0.00 0.00 0.00 0.00] (56)] (57)] (59)
Water storage loss calculated for each month 0.00 0.00 0.00 If the vessel contains dedicated solar storage of 0.00 0.00 0.00 Primary circuit loss for each month from Table 0.00 0.00 0.00 Combi loss for each month from Table 3a, 3b of 45.89 39.94 42.50	(55) x (41)m 0.00 or dedicated W 0.00 3 0.00 or 3c 39.57	0.00 WHRS (56)m 0.00 0.00 39.22	0.00 n x [(47) - ` 0.00 0.00 36.34	0.00 Vs] ÷ (47), 0.00 0.00 37.55	0.00 else (56) 0.00 0.00 39.22	0.00 0.00 0.00 39.57	0.00	0.00 0.00] (56)] (57)
Water storage loss calculated for each month 0.00 0.00 0.00 If the vessel contains dedicated solar storage of 0.00 0.00 0.00 Primary circuit loss for each month from Table 0.00 0.00 0.00 Combi loss for each month from Table 3a, 3b of 45.89 39.94 42.56 Total heat required for water heating calculated	(55) x (41)m 0.00 or dedicated W 0.00 3 0.00 or 3c 5 39.57 ed for each mo	0.00 WHRS (56)m 0.00 0.00 39.22 nth 0.85 x (4	0.00 n x [(47) - ¹ 0.00 0.00 36.34 45)m + (46	0.00 Vs] ÷ (47), 0.00 0.00 37.55 5)m + (57)1	0.00 else (56) 0.00 0.00 39.22 m + (59)m -	0.00 0.00 0.00 39.57 + (61)m	0.00 0.00 42.56	0.00 0.00 0.00 0.00 0.00 0.00 42.80 45.89] (56)] (57)] (59)] (61)
Water storage loss calculated for each month 0.00 0.00 0.00 If the vessel contains dedicated solar storage of 0.00 0.00 0.00 Primary circuit loss for each month from Table 0.00 0.00 0.00 Combi loss for each month from Table 3a, 3b of 45.89 39.94 42.50 Total heat required for water heating calculated 179.45 156.75 163.0	(55) x (41)m 0.00 or dedicated W 0.00 3 0.00 or 3c 5 39.57 cd for each mo 9 144.65	0.00 WHRS (56)m 0.00 0.00 39.22	0.00 n x [(47) - ` 0.00 0.00 36.34	0.00 Vs] ÷ (47), 0.00 0.00 37.55	0.00 else (56) 0.00 0.00 39.22	0.00 0.00 0.00 39.57	0.00 0.00 42.56	0.00 0.00 0.00 0.00 0.00 0.00] (56)] (57)] (59)
Water storage loss calculated for each month 0.00 0.00 0.00 If the vessel contains dedicated solar storage of 0.00 0.00 0.00 Primary circuit loss for each month from Table 0.00 0.00 0.00 Combi loss for each month from Table 3a, 3b of 45.89 39.94 42.56 Total heat required for water heating calculated	(55) x (41)m 0.00 or dedicated W 0.00 3 0.00 or 3c 5 39.57 cd for each mo 9 144.65 or Appendix H	0.00 WHRS (56)m 0.00 0.00 39.22 nth 0.85 x (4	0.00 n x [(47) - ¹ 0.00 0.00 36.34 45)m + (46	0.00 Vs] ÷ (47), 0.00 0.00 37.55 5)m + (57)1	0.00 else (56) 0.00 0.00 39.22 m + (59)m -	0.00 0.00 0.00 39.57 + (61)m	0.00 0.00 42.56	0.00 0.00 0.00 0.00 0.00 0.00 42.80 45.89] (56)] (57)] (59)] (61)

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Flue gas heat re	covery syste	em 1 input	(Appendix (G1)									
	-26.54	-23.45	-23.32	-19.19	-16.00	-12.29	-11.37	-13.07	-13.22	-19.51	-23.10	-25.91	(63)
Output from wa	ater heater f	or each mo	onth (kWh/i	month) (62	!)m + (63)m	ı							
	152.91	133.30	139.77	125.47	124.05	111.06	106.81	118.67	119.98	132.16	138.81	149.33	
										∑(64)1	.12 = 1	.552.31	(64)
Heat gains from	water heat	ing (kWh/n	nonth) 0.25	5 × [0.85 × ((45)m + (61	.)m] + 0.8 ×	: [(46)m + (57)m + (59)	m]				
	55.88	48.82	50.72	44.83	43.33	38.02	36.20	40.57	41.02	46.92	50.30	54.48	(65)
5. Internal gai	ns												
5. Internal San	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains		105	Iviai	дμ	way	Jun	541	Aug	Jep	000	100	Det	
Wietabolie Sains	100.36	100.36	100.36	100.36	100.36	100.36	100.36	100.36	100.36	100.36	100.36	100.36	(66)
Lighting gains (c							100.00	100.50	100.00	100.00	100.00	100.00	
-8	18.91	16.80	13.66	10.34	7.73	6.53	7.05	9.17	12.30	15.62	18.23	19.44	(67)
Appliance gains	L						1.00		11.00	10.01	10.10		
	175.24	177.05	172.47	162.72	150.40	138.83	131.10	129.28	133.86	143.62	155.93	167.50	(68)
Cooking gains (o							1						_ (,
	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	(69)
Pump and fan g	ains (Table 5	5a)	1	1		1			1		1	ł	_ • •
	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evap	oration (Tal	ole 5)										•	_
	-80.29	-80.29	-80.29	-80.29	-80.29	-80.29	-80.29	-80.29	-80.29	-80.29	-80.29	-80.29	(71)
Water heating g	gains (Table	5)											
	75.11	72.66	68.17	62.27	58.24	52.80	48.65	54.53	56.98	63.06	69.86	73.22	(72)
		()		(= 0)	(74)								
Total internal ga	ains (66)m +	+ (67)m + (6	58)m + (69)	m + (70)m -	+ (71)m + (7	/2)m							
Total internal ga	ains (66)m + 325.36	- (67)m + (6 322.62	310.41	m + (70)m · 291.43	+ (71)m + (7 272.48	72)m 254.26	242.91	249.08	259.25	278.41	300.14	316.27	(73)
							242.91	249.08	259.25	278.41	300.14	316.27	(73)
Total internal ga			310.41	291.43	272.48	254.26		249.08			300.14	1] (73)
				291.43		254.26 Sol	242.91 ar flux V/m²		259.25 g fic data	278.41 FF specific o		316.27 Gains W	(73)
			310.41 Access f	291.43	272.48 Area	254.26 Sol	ar flux	spec	g	FF	lata	Gains] (73)
			310.41 Access f	291.43 factor 6d	272.48 Area	254.26 Sol V	ar flux V/m²	speci or T	g ific data	FF specific o or Table	lata	Gains	(73)
6. Solar gains	325.36	322.62	310.41 Access f Table	291.43 factor 6d	272.48 Area m²	254.26 Sol V	ar flux V/m²	speci or T	g ific data able 6b	FF specific o or Table	lata 9 Gc	Gains W	
6. Solar gains West	325.36	322.62	310.41 Access f Table	291.43 factor 6d	272.48 Area m²	254.26 Sol V	ar flux V/m²	speci or T	g ific data able 6b	FF specific o or Table	lata 9 Gc	Gains W	
6. Solar gains West	325.36 atts ∑(74)m 34.76	322.62 (82)m 67.99	310.41 Access f Table 0.7 111.97	291.43	272.48 Area m ² 4.80	254.26 Sol V	ar flux //m² 9.64 x	speci or T 0.9 x (g ific data able 6b).76 x	FF specific c or Table 0.70	lata : 6c	Gains W 34.76] (80)
6. Solar gains West Solar gains in w	325.36 atts ∑(74)m 34.76	322.62 (82)m 67.99	310.41 Access f Table 0.7 111.97	291.43	272.48 Area m ² 4.80	254.26 Sol V	ar flux //m² 9.64 x	speci or T 0.9 x (g ific data able 6b).76 x	FF specific c or Table 0.70	lata : 6c	Gains W 34.76] (80)
6. Solar gains West Solar gains in w Total gains - inte	325.36 atts ∑(74)m 34.76 ernal and so 360.12	322.62 (82)m 67.99 lar (73)m + 390.61	310.41 Access f Table 0.7 111.97 (83)m 422.38	291.43 Factor 6d 7 x 163.30	272.48 Area m ² 4.80 200.13	254.26 Sol V x 1 204.87	ar flux //m² 9.64 x 195.05	speci or T 0.9 x (167.54	g ific data able 6b 0.76 x 130.23	FF specific o or Table 0.70 80.68	lata 6c = 43.34	Gains W 34.76 28.58] (80)] (83)
 6. Solar gains West Solar gains in w Total gains - inter 7. Mean interr 	325.36 325.36 34.76 ernal and so 360.12 hal tempera	322.62 (82)m 67.99 lar (73)m + 390.61 ture (heati	310.41 Access f Table 0.7 111.97 (83)m 422.38 ng season)	291.43 factor 6d 7 x [163.30 454.74	272.48 Area m ² 4.80 200.13 472.62	254.26 Sol V 204.87 459.14	ar flux //m² 9.64 x 195.05	speci or T 0.9 x (167.54	g ific data able 6b 0.76 x 130.23	FF specific o or Table 0.70 80.68	lata 6c 343.34	Gains W 34.76 28.58 344.86] (80)] (83)] (84)
6. Solar gains West Solar gains in w Total gains - inte	atts $\Sigma(74)$ m 34.76 ernal and so 360.12 nal tempera	322.62 (82)m 67.99 lar (73)m + 390.61 ture (heati g periods ir	310.41 Access f Table 0.7 111.97 (83)m 422.38 ng season) the living a	291.43	272.48 Area m ² 4.80 200.13 472.62 able 9, Th1	254.26 Sol W 204.87 459.14 (°C)	ar flux V/m ² 9.64 x 195.05 437.96	speci or T 0.9 x (167.54 416.62	g ific data able 6b 0.76 x 130.23 389.48	FF specific c or Table 0.70 80.68 359.09	lata = 6c = 1 = [43.34 343.47	Gains W 34.76 28.58 344.86 21.00] (80)] (83)
 6. Solar gains West Solar gains in w Total gains - inter 7. Mean interr Temperature du 	atts $\Sigma(74)$ m 34.76 ernal and so 360.12 hal temperator uring heating Jan	322.62 (82)m 67.99 lar (73)m + 390.61 ture (heati g periods ir Feb	310.41 Access f Table 0.7 (83)m 422.38 ng season) the living a Mar	291.43 factor 6d 7 X (163.30 454.74 area from T Apr	272.48 Area m ² 4.80 200.13 472.62	254.26 Sol V 204.87 459.14	ar flux //m² 9.64 x 195.05	speci or T 0.9 x (167.54	g ific data able 6b 0.76 x 130.23	FF specific o or Table 0.70 80.68	lata 6c 343.34	Gains W 34.76 28.58 344.86] (80)] (83)] (84)
 6. Solar gains West Solar gains in w Total gains - inter 7. Mean interr 	atts $\Sigma(74)$ m 34.76 ernal and so 360.12 nal tempera uring heating Jan or for gains fo	322.62 (82)m 67.99 lar (73)m + 390.61 ture (heati g periods ir Feb or living are	310.41 Access f Table 0.7 111.97 (83)m 422.38 ng season) the living a Mar ea n1,m (se	291.43	272.48 Area m ² 4.80 200.13 472.62 able 9, Th1 May	254.26 Sol v 204.87 459.14 (°C) Jun	ar flux V/m ² 9.64 x 195.05 437.96	speci or T 0.9 x (167.54 416.62 Aug	g ific data able 6b 0.76 x 130.23 389.48 Sep	FF specific o or Table 0.70 80.68 359.09 Oct	lata 6c 343.34 343.47 Nov	Gains W 34.76 28.58 344.86 21.00 Dec] (80)] (83)] (83)] (84)] (85)
 6. Solar gains West Solar gains in w Total gains - inter 7. Mean interr Temperature du Utilisation factor 	atts $\Sigma(74)$ m 34.76 ernal and so 360.12 nal tempera uring heating Jan or for gains fo 1.00	322.62 (82)m 67.99 lar (73)m + 390.61 ture (heati g periods in Feb or living are 1.00	310.41 Access f Table 0.7 (83)m 422.38 (83)m 422.38 (83)m 422.38 (83)m (8))m (291.43 factor 6d 7 X (163.30 454.74 area from T Apr e Table 9a) 0.97	272.48 Area m ² 4.80 200.13 472.62 able 9, Th1 May 0.91	254.26 Sol W 204.87 459.14 (°C)	ar flux V/m ² 9.64 x 195.05 437.96	speci or T 0.9 x (167.54 416.62	g ific data able 6b 0.76 x 130.23 389.48	FF specific c or Table 0.70 80.68 359.09	lata = 6c = 1 = [43.34 343.47	Gains W 34.76 28.58 344.86 21.00] (80)] (83)] (84)
 6. Solar gains West Solar gains in w Total gains - inter 7. Mean interr Temperature du 	atts $\Sigma(74)$ m 34.76 ernal and so 360.12 nal tempera uring heating Jan or for gains fo 1.00	322.62 (82)m 67.99 lar (73)m + 390.61 ture (heati g periods ir Feb or living are 1.00 g area T1 (s	310.41 Access f Table 0.7 (83)m 422.38 (83)m 422.38 (83)m 422.38 (83)m (8))m (291.43	272.48 Area m ² 4.80 200.13 472.62 able 9, Th1 May 0.91)	254.26 Sol v 204.87 459.14 (°C) Jun 0.73	ar flux V/m ² 9.64 x 195.05 437.96	speci or T 0.9 x (167.54 416.62 Aug	<pre>g ific data able 6b 0.76 x 130.23 389.48 389.48 0.86</pre>	FF specific o or Table 0.70 80.68 359.09 Oct 0.98	lata 6c 343.34 343.47 Nov 1.00	Gains W 34.76 28.58 344.86 21.00 Dec 1.00] (80)] (83)] (83)] (84)] (85)] (86)
 6. Solar gains West Solar gains in w Total gains - inter 7. Mean interr Temperature du Utilisation factor Mean internal t 	atts $\Sigma(74)$ m 34.76 ernal and so 360.12 al tempera uring heating Jan or for gains for 1.00 emp of living 19.89	322.62 (82)m 67.99 lar (73)m + 390.61 ture (heati g periods in Feb or living are 1.00 g area T1 (s 20.01	310.41 Access f Table 0.7 111.97 (83)m 422.38 ng season) the living a Mar ea n1,m (se 0.99 steps 3 to 7 20.23	291.43 factor 6d 7 X (163.30 454.74 area from T Apr e Table 9a) 0.97 in Table 9c	272.48 Area m ² 4.80 200.13 472.62 able 9, Th1 May 0.91) 20.81	254.26 Sol V 204.87 459.14 (°C) Jun 0.73 20.97	ar flux V/m ² 9.64 x 195.05 437.96 Jul 0.55	speci or T 0.9 x () 167.54 416.62 Aug 0.60	g ific data able 6b 0.76 x 130.23 389.48 Sep	FF specific o or Table 0.70 80.68 359.09 Oct	lata 6c 343.34 343.47 Nov	Gains W 34.76 28.58 344.86 21.00 Dec] (80)] (83)] (83)] (84)] (85)
 6. Solar gains West Solar gains in w Total gains - inter 7. Mean interr Temperature du Utilisation factor 	325.36 atts ∑(74)m 34.76 ernal and so 360.12 nal temperation Jan or for gains fo 1.00 emp of living 19.89 uring heating	322.62 (82)m 67.99 lar (73)m + 390.61 ture (heati g periods ir Feb or living are 1.00 g area T1 (s 20.01 g periods ir	310.41 Access f Table 0.7 (83)m 422.38 ng season) the living a Mar ea n1,m (se 0.99 steps 3 to 7 20.23 the rest of	291.43 Factor 6d 7 x (163.30 454.74 area from T Apr e Table 9a) 0.97 in Table 9c 20.56 f dwelling fr	272.48 Area m ² 4.80 200.13 472.62 able 9, Th1 May 0.91) 20.81 rom Table 9	254.26 Sol V 204.87 459.14 (°C) Jun (°C) Jun 0.73 20.97 0, Th2(°C)	ar flux //m ² 9.64 x 195.05 437.96 Jul 0.55 20.99	speci or T 0.9 x () 167.54 416.62 Aug 0.60 20.99	<pre>g ific data able 6b 0.76 x 130.23 389.48 389.48 0.86 0.86 20.91</pre>	FF specific o or Table 0.70 80.68 359.09 Oct 0.98 20.58	lata 6c 343.34 343.47 Nov 1.00 20.21	Gains W 34.76 28.58 344.86 21.00 Dec 1.00 19.91] (80)] (83)] (83)] (84)] (85)] (86)] (86)] (87)
 6. Solar gains West Solar gains in w Total gains - inter 7. Mean interr Temperature du Utilisation factor Mean internal t 	325.36 atts ∑(74)m 34.76 ernal and so 360.12 nal tempera uring heating Jan or for gains fo 1.00 emp of living 19.89 uring heating 20.04	322.62 (82)m 67.99 lar (73)m + 390.61 ture (heati g periods in Feb or living are 1.00 g area T1 (s 20.01 g periods in 20.05	310.41 Access f Table 0.7 111.97 (83)m 422.38 ng season) the living a Mar ea n1,m (se 0.99 steps 3 to 7 20.23 the rest of 20.06	291.43 factor 6d 7 X (163.30 454.74 454.74 area from T Apr e Table 9a) 0.97 in Table 9c 20.56 f dwelling fi 20.10	272.48 Area m ² 4.80 200.13 472.62 able 9, Th1 May 0.91) 20.81	254.26 Sol V 204.87 459.14 (°C) Jun 0.73 20.97	ar flux V/m ² 9.64 x 195.05 437.96 Jul 0.55	speci or T 0.9 x () 167.54 416.62 Aug 0.60	<pre>g ific data able 6b 0.76 x 130.23 389.48 389.48 0.86</pre>	FF specific o or Table 0.70 80.68 359.09 Oct 0.98	lata 6c 343.34 343.47 Nov 1.00	Gains W 34.76 28.58 344.86 21.00 Dec 1.00] (80)] (83)] (83)] (84)] (85)] (86)
 6. Solar gains West Solar gains in w Total gains - inter 7. Mean intern Temperature du Utilisation factor Mean internal t Temperature du 	325.36 atts ∑(74)m 34.76 ernal and so 360.12 nal tempera uring heating Jan or for gains fo 1.00 emp of living 19.89 uring heating 20.04	322.62 (82)m 67.99 lar (73)m + 390.61 ture (heati g periods in Feb or living are 1.00 g area T1 (s 20.01 g periods in 20.05	310.41 Access f Table 0.7 111.97 (83)m 422.38 ng season) the living a Mar ea n1,m (se 0.99 steps 3 to 7 20.23 the rest of 20.06	291.43 factor 6d 7 X (163.30 454.74 454.74 area from T Apr e Table 9a) 0.97 in Table 9c 20.56 f dwelling fi 20.10	272.48 Area m ² 4.80 200.13 472.62 able 9, Th1 May 0.91) 20.81 rom Table 9	254.26 Sol V 204.87 459.14 (°C) Jun (°C) Jun 0.73 20.97 0, Th2(°C)	ar flux //m ² 9.64 x 195.05 437.96 Jul 0.55 20.99	speci or T 0.9 x () 167.54 416.62 Aug 0.60 20.99	<pre>g ific data able 6b 0.76 x 130.23 389.48 389.48 0.86 0.86 20.91</pre>	FF specific o or Table 0.70 80.68 359.09 Oct 0.98 20.58	lata 6c 343.34 343.47 Nov 1.00 20.21	Gains W 34.76 28.58 344.86 21.00 Dec 1.00 19.91] (80)] (83)] (83)] (84)] (85)] (86)] (86)] (87)

	19.03	19.15	19.38	19.73	19.98	20.14	20.15	20.16	20.08	19.77	19.39	19.08	(90)
Living area fract										ving area ÷		0.49	(91)
Mean internal t		for the wh	ole dwellin	g fLA x T1 +	+(1 - fLA) x T	Г2				0 * **			
	. 19.45	19.58	19.80	20.14	20.39	20.54	20.57	20.57	20.49	20.17	19.80	19.49	(92)
Apply adjustme] ()
	19.30	19.43	19.65	19.99	20.24	20.39	20.42	20.42	20.34	20.02	19.65	19.34	(93)
] ()
8. Space heati	ng requirem	ient											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	or for gains, I	ղՠ											
	1.00	0.99	0.99	0.96	0.88	0.68	0.48	0.53	0.82	0.97	0.99	1.00	(94)
Useful gains, ηn	nGm <i>,</i> W (94	l)m x (84)m											
	358.99	388.49	417.09	436.65	415.07	311.53	212.14	220.17	317.62	348.36	341.34	344.01	(95)
Monthly averag	e external to	emperature	e from Tabl	e U1									
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for	or mean inte	ernal tempe	erature, Lm	, W [(39)m	ı x [(93)m -	(96)m]							
	958.35	919.09	823.86	661.14	503.75	324.30	213.58	222.47	356.66	555.95	755.71	930.19	(97)
Space heating r	equirement,	, kWh/mon	th 0.024 x	[(97)m - (9	5)m] x (41)	m							
	445.92	356.57	302.63	161.63	65.98	0.00	0.00	0.00	0.00	154.45	298.35	436.12]
									∑(9)	8)15, 10	12 = 2	221.65	(98)
Space heating r	equirement	kWh/m²/y	ear							(98)	÷ (4)	36.47	(99)
9a. Energy req	uirements -	individual	heating sys	stems inclu	iding micro	-СНР							
Space heating		_											1
Fraction of space				ntary syste	m (table 11	.)						0.00	(201)
Fraction of space		-								1 - (20	01) =	1.00] (202) _
Fraction of space												0.00] (202) _
Fraction of tota	•								(20	02) x [1- (20		1.00] (204) _
Fraction of tota			system 2							(202) x (20)3) =	0.00	(205)
Efficiency of ma	iin system 1										L	90.90	(206)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating for										I		1	-
	490.56	392.26	332.93	177.82	72.58	0.00	0.00	0.00	0.00	169.91	328.21	479.78	
									∑(21)	1)15, 10	12 = 2	444.06	(211)
Water heating													
Efficiency of wa	ter heater												_
	88.09	87.91	87.45	86.19	84.04	80.80	80.80	80.80	80.80	85.95	87.43	88.09	(217)
Water heating f	uel, kWh/m	onth		_									_
	173.59	151.63	159.83	145.57	147.60	137.45	132.19	146.87	148.49	153.77	158.76	169.51	
										∑(219a)1	12 = 1	.825.27	(219)
Annual totals													
Space heating for	uel - main sy	vstem 1									2	444.06]
Water heating f	uel										1	.825.27]
Electricity for pu	umps, fans a	ind electric	keep-hot (Table 4f)									
mechanical	ventilation fa	ans - balan	ced, extract	or positive	e input fron	n outside		1	L05.89]			(230a)
central heat	ing pump or	water pum	np within w	arm air hea	ating unit				30.00]			(230c)
boiler flue fa	in								45.00]			(230e)
Total electricity	for the abov	ve, kWh/ye	ar									180.89	(231)

Total delivered energy for all uses

(232) (238)

333.96

4784.19

	Fuel		Fuel price		Fuel	
	kWh/year			1	cost £/year	-
Space heating - main system 1	2444.06	х	3.48	x 0.01 =	85.05	_ (24(
Water heating	1825.27	х	3.48	x 0.01 =	63.52	(24
Pumps and fans	180.89	x	13.19	x 0.01 =	23.86	(24
Electricity for lighting	333.96	x	13.19	x 0.01 =	44.05	(25
Additional standing charges					120.00	(25
Total energy cost			(240)(242) +	(245)(254) =	336.48	(25
11a. SAP rating - individual heating systems inc	luding micro-CHP					
Energy cost deflator (Table 12)					0.42	(25
Energy cost factor (ECF)					1.33	(25
					81.39	
SAP value						
					81	(25
SAP rating (section 13)					81 B	(25
SAP value SAP rating (section 13) SAP band] (25]
SAP rating (section 13)	s including micro-CHP] (25]
SAP rating (section 13) SAP band	s including micro-CHP Energy kWh/year		Emission factor kg CO2/kWh] (25]
SAP rating (section 13) SAP band 12a. CO2 emissions - individual heating systems	Energy	x		=	B Emissions] (25]] (26
SAP rating (section 13) SAP band 12a. CO ₂ emissions - individual heating systems Space heating - main system 1	Energy kWh/year	x x	kg CO₂/kWh	=	B Emissions kg CO ₂ /year]] (26
SAP rating (section 13) SAP band 12a. CO₂ emissions - individual heating systems Space heating - main system 1 Water heating	Energy kWh/year 2444.06		kg CO ₂ /kWh	=	B Emissions kg CO ₂ /year 527.92]] (26] (26
SAP rating (section 13) SAP band	Energy kWh/year 2444.06		kg CO₂/kWh 0.22 0.22	=	B Emissions kg CO ₂ /year 527.92 394.26] (26] (26] (26
SAP rating (section 13) SAP band 12a. CO₂ emissions - individual heating systems Space heating - main system 1 Water heating Space and water heating Pumps and fans	Energy kWh/year 2444.06 1825.27	x	kg CO₂/kWh 0.22 0.22 (261) + (262) + (= (263) + (264) =	B Emissions kg CO ₂ /year 527.92 394.26 922.18] (26] (26] (26] (26
SAP rating (section 13) SAP band 12a. CO₂ emissions - individual heating systems Space heating - main system 1 Water heating Space and water heating	Energy kWh/year 2444.06 1825.27 180.89	x x	kg CO₂/kWh 0.22 0.22 (261) + (262) + (0.52 0.52	= (263) + (264) = =	B Emissions kg CO ₂ /year 527.92 394.26 922.18 93.88] (26] (26] (26] (26] (26
SAP rating (section 13) SAP band 12a. CO₂ emissions - individual heating systems Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting	Energy kWh/year 2444.06 1825.27 180.89	x x	kg CO₂/kWh 0.22 0.22 (261) + (262) + (0.52 0.52	= (263) + (264) = = =	B Emissions kgCO ₂ /year 527.92 394.26 922.18 93.88 173.33) (26) (26) (26) (26) (26) (26) (26) (27)
SAP rating (section 13) SAP band 12a. CO₂ emissions - individual heating systems Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate	Energy kWh/year 2444.06 1825.27 180.89	x x	kg CO₂/kWh 0.22 0.22 (261) + (262) + (0.52 0.52	= (263) + (264) = (= ((265)(271) = (B Emissions kg CO ₂ /year 527.92 394.26 922.18 93.88 173.33 1189.39) (26) (26) (26) (26) (26) (26) (26) (27)
SAP rating (section 13) SAP band 12a. CO₂ emissions - individual heating systems Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year	Energy kWh/year 2444.06 1825.27 180.89	x x	kg CO₂/kWh 0.22 0.22 (261) + (262) + (0.52 0.52	= (263) + (264) = (= ((265)(271) = (B Emissions kg CO ₂ /year 527.92 394.26 922.18 93.88 173.33 1189.39 19.53	

15a. Finnary energy - mulvidual nearing systems including in						
	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2444.06	х	1.22] =	2981.76	(261)
Water heating	1825.27	x	1.22] =	2226.83	(264)
Space and water heating			(261) + (262) +	- (263) + (264) =	5208.59	(265)
Pumps and fans	180.89	x	3.07] =	555.34	(267)
Electricity for lighting	333.96	x	3.07] =	1025.27	(268)
Primary energy kWh/year					6789.20	(272)
Dwelling primary energy rate kWh/m2/year					111.46	(273)