

Newcombe House and Kensington Church Street Energy Strategy Addendum



July 2018

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L Documents

KL Documents

JKL Document

1.0 INTRODUCTION

This addendum to the Energy Strategy has been prepared in support of amendments made to planning application PP/17/05782 (GLA ref: 3109a) for the mixed use redevelopment of the Newcombe House Site in the Royal Borough of Kensington and Chelsea. This report should be read in conjunction with the Energy Strategy dated September 2017.

The proposed amendments do not alter the description of development, which remains as follows:

'Demolition of the existing buildings and redevelopment to provide office, residential, and retail uses, and a flexible surgery/office use, across six buildings (ranging from ground plus two storeys to ground plus 17 storeys), together with landscaping to provide a new public square, ancillary parking and associated works.'

The proposed amendments to the application can be summarised as:

- an increase in the number of homes (to a total of 55) and alterations to the housing mix;
- an increase in the proportion of affordable homes (to 35% by hab room and 41.8% by unit);
- an increase in office floorspace of 414 sqm GEA (to a total of 5,306 sqm);
- the addition of one storey to Kensington Church Street Building 1 in C3 residential use (from four storeys to five);
- the addition of two storeys to West Perimeter Building 3 in B1 office use (from five storeys to seven);
- alterations to the layouts of Kensington Church Street Buildings 1 and 2, and West Perimeter Buildings 1 and 3, with associated changes to the facades;
- minor alterations to the façade of the Corner Building on levels 4, 5 and 6 to respond to the revised massing of West Perimeter Building 3; and
- minor alterations to the services strategy for West Perimeter Building 2. •

Further details of the amendments are set out within the Design and Access Statement Addendum and Planning Statement Addendum.

The purpose of this addendum is to assess the proposed amendments and their impact on the proposed Energy Statement.

To inform this assessment, the energy modelling has been updated to take into account the proposed amendments, which incorporate the additional massing, further affordable units and inclusion of additional PV Array. The conclusion of the revised assessment is that the wider energy strategy should remain as per the original application.

The purpose of this addendum is to supplement the original document submitted with the planning application. It does not unnecessarily repeat information previously provided where it remains relevant, unless it assists the commentary within the report.

2.0 PASSIVE AND ACTIVE ENERGY EFFICIENCY MEASURES "BE LEAN"

The updated TER Worksheets are found in Appendix 1. Sample "Be Lean" SAP and BRUKL documents are found in Appendix 2.

2.1 Domestic "Be Lean" Case

The residential dwellings assessed to gain SAP results were based on the revised planning application drawings submitted alongside this addendum and dated July 2018. Figure 1 below shows that the domestic regulated carbon dioxide emissions of the Energy Efficient Scheme are approximately 2% below that of the Baseline Scheme.

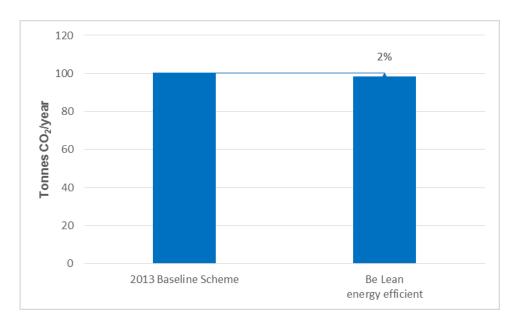


Figure 1: Domestic Regulated Carbon Dioxide Emissions – "Be Lean"

2.2 Non-Domestic "Be Lean" Case

The non-domestic elements assessed to gain BRUKL results were based on the revised planning application drawings submitted alongside this addendum and dated July 2018. Figure 2 below shows that the non-domestic regulated carbon dioxide emissions of the Energy Efficient Scheme are approximately 10% below that of the Baseline Scheme.

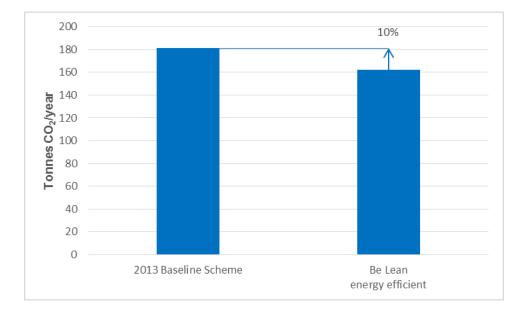


Figure 2: Non-Domestic Regulated Carbon Dioxide Emissions – "Be Lean"

2.3 Overheating and Cooling

The measures to reduce potential overheating and reliance on air conditioning systems are as per the original application. Please refer to the accompanying updated TM52 Overheating Study Report in Appendix 3 for further details.

2.4 Domestic Active Cooling

Active cooling is proposed within the private apartments, to living/dining spaces and bedrooms. The average monthly cooling requirement for the month of July and the maximum July cooling demand for the development is provided in Table 1 below. The average monthly cooling requirement has been extracted from Row 107 in Section 8c of the DER worksheets generated by the SAP 2012 software, and the maximum July cooling demand is the output for the worst case dwellings with regards to cooling. Please refer to Appendix 2 for figures.

Table 1: Domestic Average and Maximum Cooling Demand for July

Average domestic cooling demand for	Maximum domestic cooling demand for
July (kWh/m²)	July (kWh/m²)
2.19	6.67

2.5 Non-Domestic Active Cooling

Comfort cooling is proposed across all of the commercial elements on the development. Table 2 below confirms actual cooling demand to the non-domestic elements is lower than that of the notional building. These actual and notional cooling demands have been extracted from the BRUKL output documents, please refer to Appendix 2 for figures.

Table 2: Non-Domestic Actual and Notional Area Weighted Average Cooling Demand

	Area Weighted Average Building Cooling Demand (MJ/m ²) –		
	Office	Retail	
Actual	2.60	6.19	
Notional	5.06	7.22	

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3.0 ENERGY NETWORKS AND COMBINED HEAT AND POWER "BE CLEAN"

The strategy for the 'Be Clean' approach remains as per the previous report. The proposal is to install a site wide heat network that all uses will connect to. The Site Wide schematics have been provided showing the route of the heat network linking all buildings on the site, these can be found in Appendix 4.

Sample "Be Clean" SAP and BRUKL documents can be found in Appendix 5.

3.1 Domestic "Be Clean" case

Figure 3 below shows the revised estimated reduction in domestic regulated carbon dioxide emissions taking into account the contribution of CHP is approximately 28% below the energy efficient ("Be Lean") scheme and 30% below the baseline scheme.

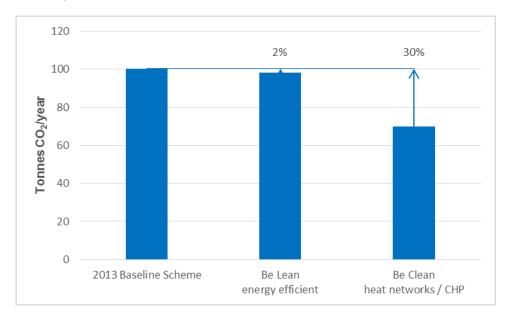


Figure 3: Domestic Regulated Carbon Dioxide Emissions - "Be Clean"

3.2 Non-Domestic "Be Clean" case

Figure 4 below shows the revised estimated reduction in non-domestic regulated carbon dioxide emissions taking into account the contribution of CHP is approximately 17% below the energy efficient ("Be Lean") scheme and 27% below the baseline scheme.

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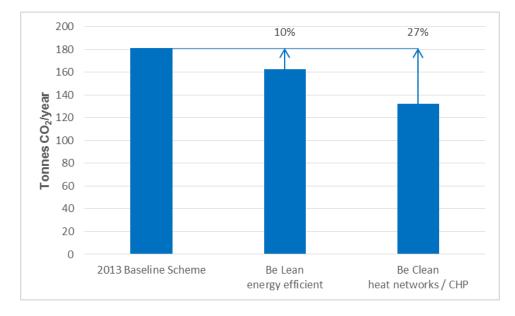


Figure 4: Non-Domestic Regulated Carbon Dioxide Emissions - "Be Clean"

4.0 RENEWABLE ENERGY "BE GREEN"

Sample "Be Green" SAP documents can be found in Appendix 6.

4.1 Solar Photovoltaic



The electrical energy produced by Solar PV panels could be used to provide additional carbon emission reductions and are compatible with the use of a CHP engine.

Optimal positioning and orientation of the panels is a key consideration in their integration into the strategy. The suitable available area has been restricted by a number of factors particular to this development such as:

- The articulation and design of the Corner Building Central Form;
- Heat rejection plant integrated on the roof of Kensington Church Street Building 2;
- Accessible roof terraces for provision of open space on West Perimeter Building 3, Notting Hill Gate Building and Corner Building East Form; and
- The visual impacts on the area the Council maintains that plant must be well handled and discreetly located not to disrupt the roofline.

The latest development proposals have provided the opportunity to further enhance the PV Array, with additional PV Panels now proposed on the roof of the KSC1 Building (as well as the WPB1 Building). This will maximise the overall achievable carbon reduction across the development.

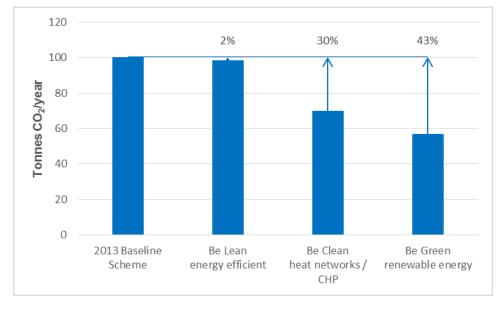
Solar Photovoltaic is therefore proposed to be integrated within this development. A total of 37.5kWp is provided to the development which will be applied to the dwellings and the office space.

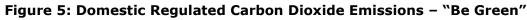
A revised roof layout can be found in Appendix 7.

4.2 Domestic "Be Green" Case

Figure 5 below shows the revised estimated reduction in domestic regulated carbon dioxide emissions taking into account the contribution of PV panels (approx. 33kWp attributed to the domestic usage) is approximately 13% below the "Be Clean" scheme and 43% below the baseline scheme.

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4.3 Non-Domestic "Be Green" Case

Figure 6 below shows the revised estimated reduction in non-domestic regulated carbon dioxide emissions taking into account the contribution of PV panels (approx. 4.5kWp attributed to the office usage) is approximately 1% below the "Be Clean", energy efficient scheme and 28% below the baseline scheme.

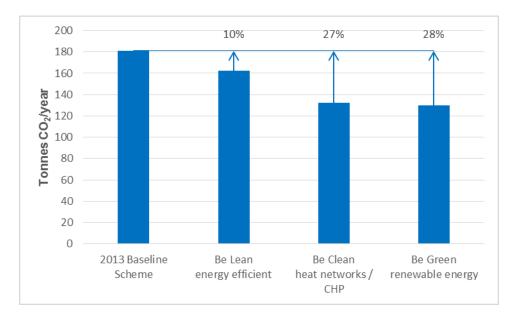


Figure 6: Non-Domestic Regulated Carbon Dioxide Emissions – "Be Green"

5.0 CONCLUSION

An Addendum to the energy strategy has been prepared in relation to the amendment to the scheme in line with GLA guidance to address RBKC's Local Plan and London Plan Policy.

The latest development proposals have provided the opportunity to further enhance the PV Array, therefore additional PV Panels are also proposed on the roof of the KSC1 Building (as well as the WPB1 Building). This will maximise the overall achievable carbon reduction across the development.

5.1 Domestic

The baseline energy benchmarks for the domestic energy strategy are based on the Dwelling CO_2 Emission Rates (DER) calculated through Part L1A 2013 of the Building Regulations methodology SAP 2012. These have been derived using the thermal modelling compliant software NHER Plan Assessor v6.3.4.

The domestic CO_2 emissions, after the incorporation of passive and active energy efficiency measures ("Be Lean"), are 2% lower than a Part L1A 2013 compliant development.

"Be Clean" measures include the link to site wide combined heat and power (CHP) unit. This will provide a reduction of around 28% in CO₂ emissions over the "Be Lean" case.

"Be Green" measures include PV array (approx. 33kWp) located at roof level. This renewable technology is delivering an additional 13% reduction, over the "Be Clean" stage.

The domestic predicted reduction in CO_2 emissions from the Baseline development model (which is Part L1A 2013 compliant) is approximately 43% which represents an annual saving of approximately 44 tonnes of CO_2 .

Figure 7 below sets out how the proposed domestic energy efficiency measures and LZC systems reduce CO_2 emissions in line with the London Plan Energy Hierarchy.

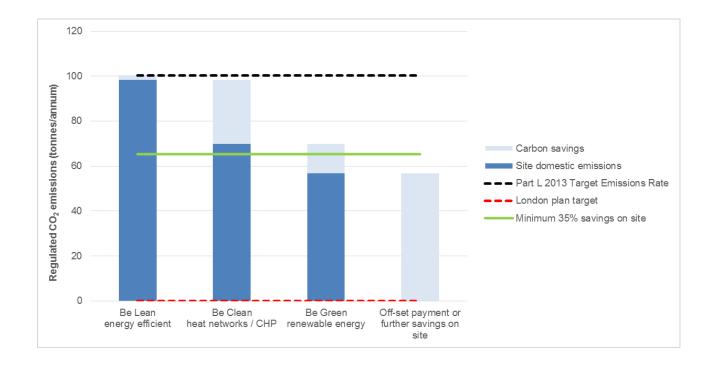


Figure 7: The Site Wide Domestic Energy Hierarchy and Targets

The domestic regulated carbon dioxide emissions are shown to be approximately 43% lower than a Part L1A 2013 compliant development. To enable the new dwellings to meet the zero carbon target, a one off carbon offset payment of approximately £102,193 will be required in line with RBKC's Local Plan and London Plan Policy. This figure is based on a shortfall of 57 tonnes CO₂ per year for a period of 30 years at a rate of $\pounds 60$ / tonne of CO₂.

Table 3 below shows the domestic CO_2 emissions breakdown. Table 4 shows the percentage breakdown at each stage of the hierarchy and the shortfall in regulated Carbon Dioxide emissions.

Table 3: Domestic CO₂ Emissions Breakdown

	Carbon Dioxide Emissions (tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Building Regulations 2013 Part L1A Compliant Development	100	50
After energy demand reduction	98	50
After heat network / CHP	70	50
After renewable energy	57	50

Table 4: Domestic Regulated CO₂ Emissions Savings

	Regulated Carbon Dioxide Savings	
	(Tonnes of CO ₂ per annum)	(%)
Savings from energy demand reduction	2	2%
Savings from heat network / CHP	29	28%
Savings from renewable energy	13	13%
Cumulative on site savings	44	43%
Annual savings from off-set payment	57	
	(Tonnes CO2)	
Cumulative savings for off-set payment	1,703	

5.2 Non-Domestic

The non-domestic CO_2 emissions, after the incorporation of passive and active energy efficiency measures ("Be Lean"), are 10% lower than a Part L2A compliant development.

"Be Clean" measures include the link to site wide combined heat and power (CHP) unit. This will provide a reduction of around 17% in CO₂ emissions over the "Be Lean" case.

"Be Green" measures include PV array (approx. 4.5kWp) located at roof level. This renewable technology is delivering an additional 1% reduction, over the "Be Clean" stage.

The non-domestic predicted reduction in CO₂ emissions from the Baseline development model (which is Part L2A 2013 compliant) is approximately 28% which represents an annual saving of approximately 51 tonnes of CO₂.

Figure 8 below sets out how the proposed non-domestic energy efficiency measures and LZC systems reduce CO_2 emissions in line with the London Plan Energy Hierarchy.

The non-domestic elements of the scheme are being assessed to a "shell only" standard with reasonable assumptions being made regarding energy efficiency systems that will be installed by a future tenant. On the basis of the "shell only" nature of this part of the development any further practical improvements are limited to those already incorporated.

By way of an example, to include further PV in the non-domestic modelling would improve the overall reduction in CO_2 , however the proposed PV array has been maximised based on the available roof space. A lot of work has been undertaken to optimise those areas that are available for rooftop plant, but space is limited as a result of the need to locate plant discreetly in such a sensitive townscape context. The Council maintains that plant must be well handled and discreetly located not to disrupt the roofline. Any benefit given to the non-domestic modelling would take away from the CO₂ reduction achieved for the domestic modelling.

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Table 6: Non-Domestic Regulated CO₂ Emissions Savings

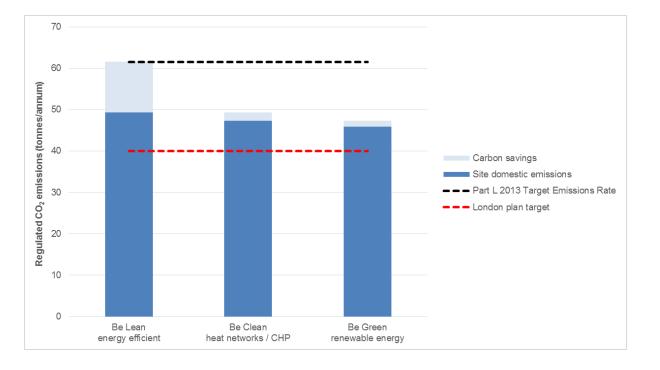


Figure 8: The Site Wide Non-Domestic Energy Hierarchy and Targets

The non-domestic regulated carbon dioxide emissions are shown to be approximately 28% lower than a Part L2A 2013 compliant development. To enable the non-domestic elements to meet the 35% carbon reduction target, a one off carbon offset payment of approximately £22,766 will be required in line with RBKC's Local Plan and London Plan Policy. This figure is based on a shortfall of 13 tonnes CO_2 per year for a period of 30 years at a rate of £60 / tonne of CO_2 .

Table 5 below shows the Non-Domestic CO₂ emissions breakdown. Table 6 shows the percentage breakdown at each stage of the hierarchy and Table 7 shows the shortfall in regulated Carbon Dioxide emissions.

Table 5: Non-Domestic CO₂ Emissions Breakdown

	Carbon Dioxide Emissions (tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Building Regulations 2013 Part L2A Compliant Development	181	80
After energy demand reduction	162	80
After heat network / CHP	133	80
After renewable energy	130	80

	Regulated Carbon Dioxide Savings	
	(Tonnes of CO ₂ per annum)	(%)
Savings from energy demand reduction	19	10%
Savings from heat network / CHP	30	17%
Savings from renewable energy	2	1%
Total cumulative savings	51	28%

Table 7: Non-Domestic Shortfall in Regulated CO₂ Emissions

	Annual Shortfall (Tonnes CO2)	Cumulative Shortfall (Tonnes CO ₂)
Total Target Savings	63	
Shortfall	13	379

5.3 Site Total

The overall site CO₂ emissions after the incorporation of energy efficiency measures are 7% lower than a Part L 2013 compliant development.

"Be Clean" measures include a link to the site wide combined heat and power (CHP) unit. This will provide a reduction of around 21% in CO₂ emissions over the "Be Lean" case.

"Be Green" measures include PV array (approx. total 37.5kWp) located at roof level. This renewable technology is delivering an additional 5% reduction, over the "Be Clean" stage.

The energy strategy has addressed the key elements of RBKC's Local Plan and London Plan Policy on energy and will make a positive contribution to reducing the Boroughs CO₂ emissions.

The overall site total predicted reduction in CO_2 emissions from the Baseline development model (which is Part L 2013 compliant) is approximately 34% which represents an annual saving of approximately 94 tonnes of CO_2 . To enable the domestic and non-domestic elements to meet their carbon reduction targets, a one off carbon offset payment of approximately £124,959 will be required in line with RBKC's Local Plan and London Plan Policy. This figure is based on a shortfall of 70 tonnes CO_2 per year for a period of 30 years at a rate of £60 / tonne of CO_2 .

Figure 9 below sets out how the proposed development energy efficiency measures and LZC systems reduce CO₂ emissions in line with the London Plan Energy Hierarchy.

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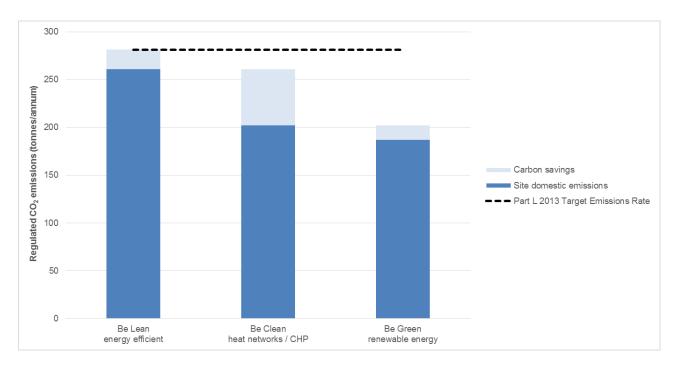


Figure 9: The Site Wide Energy Hierarchy and Targets

Table 8 below shows the site wide regulated carbon dioxide emissions and savings.

Table 8: Site Wide Regulated CO₂ Emissions and Savings

	Total Regulated Emissions (tonnes of CO2 per annum)	CO2 Savings (tonnes CO2 per annum)	Percentage Saving
Building Regulations 2013 Part L Compliant Development	284	-	-
After energy demand reduction (Be Lean)	261	21	7%
After heat network / CHP (Be Clean)	202	59	21%
After renewable energy (Be Green)	187	15	5%
	CO ₂ savings off-set		
	(Tonnes CO ₂)		
Off-set	2,083		

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APPENDICES

APPENDIX 1 – SAMPLE TER WORKSHEETS

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TER Worksheet

Design - Draft



3. Heat losses and heat loss parameter

Gross

area, m²

Openings

m²

Net area

A, m²

41.15

U-value

W/m²K

1.33

A x U W/K

54.55

к-value,

kJ/m².K

Ахк,

kJ/K

30.00 31.00 (40)

87.78 (38)

(27)

(28a)

(29a)

(32)

(31)

(33)

(34)

(35)

(36)

(37)

(39)

(40)

(42)

(43)

(44)

(45)

(47)

(48)

(49)

(50)

(55)

24.74 (46)

Element

Window

This design submission has	s been carried out using Approved SAP s	oftware. It has been prepared	from plans and specification	s and may not reflect the	Window 41.15 x 1.33 = 54.55	
property as constructed.					Ground floor [164.79] x 0.13 = 21.42	
					External wall 127.58 x 0.18 = 22.96	
Assessor name	Mr Liam Holden		Assessor number	10245	Party wall 9.58 x 0.00 = 0.00	
Client			Last modified	20/06/2018	Total area of external elements ∑A, m ² 333.52	
Address	A1, London				Fabric heat loss, W/K = $\Sigma(A \times U)$ (26)(30) + (32) = 98.94	4
					Heat capacity $Cm = \sum (A \times K)$ (28)(30) + (32) + (32a)(32e) = N/A	۱
1. Overall dwelling dime	nsions				Thermal mass parameter (TMP) in kJ/m ² K 250.0	00
		Area (m²)	Average storey	Volume (m³)	Thermal bridges: $\Sigma(L \times \Psi)$ calculated using Appendix K 16.60	8
			height (m)		Total fabric heat loss (33) + (36) = 115.6	52
Lowest occupied		164.79 (1a) x	2.85 (2a) =	469.65 (3a)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov D	Dec
Total floor area	(1a) + (1b) + (1c) + (1d)(1n) =	164.79 (4)			Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	
Dwelling volume			(3a) + (3b) + (3c) + (3d)	(3n) = 469.65 (5)	89.60 89.13 88.67 86.51 86.10 84.21 83.87 84.94 86.10 86.92 87	7.78
					Heat transfer coefficient, W/K (37)m + (38)m	
2. Ventilation rate					205.22 204.75 204.29 202.12 201.72 199.83 199.48 200.56 201.72 202.54 20)3.39
				m ³ per hour	Average = $\Sigma(39)112/12 = 202.1$	12
Number of chimneys			0 × 40	= <u>0</u> (6a)	Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	
Number of open flues			0 × 20	= 0 (6b)	1.25 1.24 1.24 1.23 1.22 1.21 1.21 1.22 1.22 1.23 1	1.23
Number of intermittent fa	ins		4 × 10	= 40 (7a)	Average = $\Sigma(40)112/12 = 1.23$	3
Number of passive vents			0 × 10	= 0 (7b)	Number of days in month (Table 1a)	
Number of flueless gas fire	es		0 × 40	= 0 (7c)	31.00 28.00 31.00 30.00 <th< td=""><td>1.00</td></th<>	1.00
				Air changes per hour	4. Water heating energy requirement	1
Infiltration due to chimne	us flues fame DSVs	(6a) + (6b) + (7a) + (7b) + (7c)) = 40 ÷ (5)			
Infiltration due to chimney	s been carried out or is intended, proceed			- 0.03 (8)		
	0, expressed in cubic metres per hour pe			5.00 (17)		Dec
	ty value, then $(18) = [(17) \div 20] + (8)$, oth		ied	0.34 (18)	Hot water usage in litres per day for each month Vd, $m = factor from Table 1c x (43)$	vec
Number of sides on which		100 = (10)			Interview Interview <t< td=""><td>4.92</td></t<>	4.92
Shelter factor	the dwelling is sheltered		1 - [0.075 x ($\sum_{i=1,2,3}^{i=1,1,0,0} 100.48 102.51 30.13 35.53 35.53 36.13 102.51 100.48 110.00 111 \sum_{i=1,2,3,3} (44)112 = 1252$	
Infiltration rate incorporat	ting choltor factor		(18) x		Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	75
Infiltration rate modified f			(10) X	(20) - 0.31 (21)		54.92
Jan		ay Jun Jul	Aug Sep Oct	Nov Dec	$\sum_{i=1,2,3,4} \frac{1}{140.34} + \frac{1}{133.05} + \frac{1}{133.05} + \frac{1}{120.37} + \frac{1}{110.53} + \frac{1}{102.01} + \frac{1}{117.37} + \frac{1}{113.30} + \frac{1}{133.13} + \frac{1}{101.07} + \frac{1}{100.07} + \frac{1}{$	
Monthly average wind spe		ay Jun Jun	Aug Jep Ott	Nov Dec	Distribution loss 0.15 x (45)m	52
5.10		30 3.80 3.80	3.70 4.00 4.30	4.50 4.70 (22)		4.74
Wind factor (22)m ÷ 4	5.00 4.50 4.40 4.	30 3.80 3.80	3.70 4.00 4.30	4.30 4.70 (22)	Storage volume (litres) including any solar or WWHRS storage within same vessel 10.04 13.42 17.70 17.51 20.87 22.78 24	
1.28	1.25 1.23 1.10 1.	08 0.95 0.95	0.93 1.00 1.08	1.13 1.18 (22a)	Water storage loss:	<u> </u>
	allowing for shelter and wind factor) (21		0.55 1.00 1.08	1.15 1.16 (228)	a) If manufacturer's declared loss factor is known (kWh/day) 0.21	1
0.40		33 0.29 0.29	0.29 0.31 0.33	0.35 0.36 (22b)	Temperature factor from Table 2b 0.54	
	nge rate for the applicable case:	0.25 0.25	0.25 0.51 0.55	0.55 0.56 (226)	Energy lost from water storage (kWh/day) (48) x (49)	
	on: air change rate through system			N/A (23a)	Enter (50) or (54) in (55)	
	ecovery: efficiency in % allowing for in-u	iso factor from Table 4b		N/A (23c)	Water storage loss calculated for each month (55) x (41)m	
	or whole house positive input ventilation			(230)		3.57
0.58		56 0.54 0.54	0.54 0.55 0.56	0.56 0.57 (24d)	If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	.57
	enter (24a) or (24b) or (24c) or (24d) in		0.54 0.55 0.50	0.50 0.57 (240)		3.57
0.58		56 0.54 0.54	0.54 0.55 0.56	0.56 0.57 (25)	Primary circuit loss for each month from Table 3	
0.58	0.50 0.57 0.50 0.	55 0.54 0.54	0.55 0.55	0.50 0.57 (25)		
				URN: CB-A1 version 14	URN: CB	
Coverage 30		Page 1	N	HER Plan Assessor version 6.3.4 SAP version 9.92	NHER Plan Assesso Page 2 SA	or vers AP vers

3.57	3.46	3.57	3.46	3.57	(56)
se (56)					
3.57	3.46	3.57	3.46	3.57	(57)
			URI	N: CB-A1 v	ersion 14
		NH	ER Plan As	sessor vers	sion 6.3.4
				SAP ver	sion 9.92

23.26 21.01 23.26 22.51 23.26 22.51 23.26 23.26 23.26 22.51 23.26 22.51 23.26 (59)	1.00 1.00 0.98 0.95 0.85 0.67 0.51 0.57 0.82 0.97 1.00 1.00 (86)
Combi loss for each month from Table 3a, 3b or 3c	Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 (61)	19.58 19.80 20.11 20.50 20.80 20.95 20.99 20.98 20.87 20.45 19.93 19.54 (87)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)
197.13 173.18 180.53 159.96 155.40 136.91 129.64 144.81 145.35 165.96 177.84 191.76 (62)	19.88 19.89 19.90 19.90 19.91 19.91 19.91 19.90 19.90 19.89 (88)
Solar DHW input calculated using Appendix G or Appendix H	Utilisation factor for gains for rest of dwelling n2,m
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 (63)	1.00 0.99 0.98 0.93 0.79 0.58 0.39 0.44 0.74 0.96 1.00 1.00 (89)
Output from water heater for each month (kWh/month) (62)m + (63)m	Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)
197.13 173.18 180.53 159.96 155.40 136.91 129.64 144.81 145.35 165.96 177.84 191.76	17.99 18.31 18.77 19.32 19.71 19.88 19.91 19.90 19.81 19.27 18.52 17.94 (90)
Σ(64)112 = <u>1958.47</u> (64)	Living area fraction Living area ÷ (4) = 0.52 (91)
Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2
78.09 68.91 72.57 65.33 64.22 57.66 55.65 60.69 60.47 67.73 71.27 76.30 (65)	18.81 19.08 19.46 19.92 20.27 20.43 20.46 20.35 19.88 19.25 18.77 (92)
5. Internal gains	Apply adjustment to the mean internal temperature from Table 4e where appropriate
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	18.81 19.08 19.46 19.92 20.27 20.43 20.46 20.46 20.35 19.88 19.25 18.77 (93)
Metabolic gains (Table 5)	8. Space heating requirement
147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	Utilisation factor for gains, nm
29.97 26.62 21.65 16.39 12.25 10.34 11.18 14.53 19.50 24.76 28.90 30.81 (67)	1.00 0.99 0.98 0.93 0.81 0.63 0.45 0.51 0.78 0.96 0.99 1.00 (94)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	Useful gains, ηmGm, W (94)m x (84)m
336.20 339.69 330.89 312.18 288.55 266.35 251.52 248.03 256.82 275.53 299.16 321.36 (68)	890.23 1145.28 1368.27 1517.51 1452.65 1106.25 762.53 793.12 1092.55 1106.27 915.64 821.77 (95)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	Monthly average external temperature from Table U1
37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78	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)
Pump and fan gains (Table 5a)	Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]
3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00	2977.65 2902.45 2647.90 2228.37 1728.29 1165.17 772.28 809.99 1254.42 1871.44 2460.44 2963.21 (97)
Losses e.g. evaporation (Table 5)	Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m
-118.22 -118.22	1553.04 1180.82 952.05 511.82 205.08 0.00 0.00 0.00 0.00 569.28 1112.26 1593.23
Water heating gains (Table 5)	Σ(98)15, 1012 = 7677.57 (98)
104.96 102.55 97.54 90.73 86.31 80.09 74.80 81.58 83.99 91.03 98.99 102.56 (72)	Space heating requirement kWh/m²/year (98) ÷ (4) (46.59 (99)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	9a. Energy requirements - individual heating systems including micro-CHP
541.46 539.19 520.42 489.63 457.45 427.12 407.82 414.46 430.64 461.66 497.38 525.06 (73)	Space heating
6. Solar gains	Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)
Access factor Area Solar flux g FF Gains	Fraction of space heat from main system(s) $1 - (201) = 1.00$ (202)
Table 6d m ² W/m ² specific data W	Fraction of space heat from main system 2 0.00 (202)
or Table 6b or Table 6c	Fraction of total space heat from main system 1 (202) x [1- (203)] = 1.00 (204)
North 0.77 x 8.64 x 10.63 x 0.9 x 0.63 x 0.70 = 28.08 (74)	Fraction of total space heat from main system 2 (202) x (203) = 0.00 (205)
East 0.77 x 14.40 x 19.64 x 0.9 x 0.63 x 0.70 = 86.43 (76)	Efficiency of main system 1 (%) 93.50 (206)
South 0.77 x 15.41 x 46.75 x 0.9 x 0.63 x 0.70 = 220.18 (78)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
West $0.77 \times 2.70 \times 19.64 \times 0.9 \times 0.63 \times 0.70 = 16.21$ (80)	Space heating fuel (main system 1), kWh/month
Solar gains in watts ∑(74)m(82)m 350.90 615.04 881.18 1147.86 1329.29 1336.84 1281.86 1145.21 974.03 691.06 423.60 298.07 (83)	1661.01 1262.91 1018.23 547.40 219.33 0.00 0.00 0.00 608.86 1189.58 1703.99
350.90 615.04 881.18 1147.86 1329.29 1336.84 1281.86 1145.21 974.03 691.06 423.60 298.07 (83) Total gains - internal and solar (73)m + (83)m	Σ(211)15, 1012 = 8211.30 (211)
892.36 1154.23 1401.59 1637.49 1786.74 1763.96 1689.69 1559.68 1404.67 1152.71 920.98 823.13 (84)	Water heating
	Efficiency of water heater
7. Mean internal temperature (heating season)	89.15 88.97 88.61 87.70 85.55 79.80 79.80 79.80 87.84 88.86 89.21 (217)
Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)	Water heating fuel, kWh/month
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	221.11 194.64 203.74 182.40 181.64 171.57 162.46 181.46 182.14 188.93 200.14 214.94
Utilisation factor for gains for living area n1,m (see Table 9a)	$\Sigma(219a)112 = 2285.18 $ (219)
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Annual totals			
Space heating fuel - main system 1		8211.30]
Water heating fuel		2285.18]
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		529.32	(232)
Total delivered energy for all uses	(211)(221) + (231) + (232)(237b) =	11100.80	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	8211.30] x	3.48	x 0.01 =	285.75	(240)
Water heating	2285.18] x	3.48	x 0.01 =	79.52	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	529.32	x	13.19	x 0.01 =	69.82	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)(242)	+ (245)(254) =	564.99	(255)

11a. SAP rating - individual heating systems including micro-CHP		
Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.13	(257)
SAP value	84.22]
SAP rating (section 13)	84	(258)
SAP band	В	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO₂/kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	8211.30	x	0.216	= [1773.64	(261)
Water heating	2285.18	x	0.216	= [493.60	(264)
Space and water heating			(261) + (262) +	(263) + (264) = [2267.24	(265)
Pumps and fans	75.00	х	0.519	= [38.93	(267)
Electricity for lighting	529.32	х	0.519	= [274.72	(268)
Total CO ₂ , kg/year				(265)(271) = [2580.88	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	15.66	(273)
El value				[83.52]
El rating (section 14)				[84	(274)
El band				[В]

13a. Primary energy - individual heating systems including micro-CHP

, ,,						
	Energy kWh/year		Primary factor	Primary Energy kWh/year		
Space heating - main system 1	8211.30	x	1.22] =	10017.79	(261)
Water heating	2285.18	х	1.22] =	2787.92	(264)
Space and water heating			(261) + (262) +	- (263) + (264) =	12805.71	(265)
Pumps and fans	75.00	х	3.07] =	230.25	(267)
Electricity for lighting	529.32	х	3.07	=	1625.01	(268)
Primary energy kWh/year					14660.97	(272)

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88.97

(273)

TER Worksheet

Design - Draft



3. Heat losses and heat loss parameter

Gross

area, m²

Openings

m²

Net area

A, m²

U-value

W/m²K

Element

This design submission has been carried out using Approv	ed SAP software. It has been prena	red from plans and specification	as and may not reflect the	Window	43.96 x 1.33	= 58.28
property as constructed.	eu oral soleware. Ie nas been prepa		is and may not reneet the	Ground floor	175.65 x 0.13	= 22.83
				External wall	133.90 x 0.18	= 24.10
Assessor name Mr Liam Holden		Assessor number	10245	Total area of external elements ΣA , m ²	353.51	
Client		Last modified	20/06/2018	Fabric heat loss, $W/K = \Sigma(A \times U)$		(26)(30) + (32) = 105.22
Address A1, London				Heat capacity $Cm = \sum (A \times \kappa)$	(28).	(30) + (32) + (32a)(32e) = N/A
				Thermal mass parameter (TMP) in kJ/m ² K		250.00
1. Overall dwelling dimensions				Thermal bridges: $\Sigma(Lx\Psi)$ calculated using Appendix K		17.68
	Area (m²)	Average storey	Volume (m ³)	Total fabric heat loss		(33) + (36) = 122.89
		height (m)		Jan Feb Mar Apr May	Jun Jul Aug	Sep Oct Nov Dec
Lowest occupied	175.68 (1a) x	2.70 (2a) =	474.34 (3a)	Ventilation heat loss calculated monthly 0.33 x (25)m x (5)		
Total floor area (1a) + (1b) + (1c) + (1d).	(1n) = 175.68 (4)			90.43 89.96 89.50 87.32 86.92	85.02 85.02 84.67	85.75 86.92 87.74 88.60
Dwelling volume		(3a) + (3b) + (3c) + (3d)	(3n) = 474.34 (5)	Heat transfer coefficient, W/K (37)m + (38)m		
-				213.33 212.85 212.39 210.21 209.81	207.91 207.91 207.56	208.64 209.81 210.63 211.49
2. Ventilation rate						Average = ∑(39)112/12 = 210.21
			m ³ per hour	Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)		
Number of chimneys		0 x 40) = 0 (6a)	1.21 1.21 1.21 1.20 1.19	1.18 1.18 1.18	1.19 1.19 1.20 1.20
Number of open flues		0 x 20	0 = 0 (6b)			Average = $\sum (40)112/12 = 1.20$
Number of intermittent fans		4 x 10	0 = 40 (7a)	Number of days in month (Table 1a)		
Number of passive vents		0 x 10	0 = 0 (7b)	31.00 28.00 31.00 30.00 31.00	30.00 31.00 31.00	30.00 31.00 30.00 31.00
Number of flueless gas fires		0 x 40) = 0 (7c)			
			Air changes per	4. Water heating energy requirement		
			hour	Assumed occupancy, N		2.97
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + () = 0.08 (8)	Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	104.74
If a pressurisation test has been carried out or is intended,	proceed to (17), otherwise continue	e from (9) to (16)		Jan Feb Mar Apr May	Jun Jul Aug	Sep Oct Nov Dec
Air permeability value, q50, expressed in cubic metres per	hour per square metre of envelope	e area	5.00 (17)	Hot water usage in litres per day for each month Vd,m = factor from T	able 1c x (43)	
If based on air permeability value, then $(18) = [(17) \div 20] +$	(8), otherwise (18) = (16)		0.33 (18)	115.21 111.02 106.84 102.65 98.46	94.27 94.27 98.46	102.65 106.84 111.02 115.21
Number of sides on which the dwelling is sheltered			1 (19)			∑(44)112 = 1256.89
Shelter factor		1 - [0.075 x	(19)] = 0.93 (20)	Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh	/month (see Tables 1b, 1c 1d)	
Infiltration rate incorporating shelter factor		(18) x	(20) = 0.31 (21)	170.86 149.44 154.20 134.44 129.00	111.31 103.15 118.37	119.78 139.59 152.37 165.47
Infiltration rate modified for monthly wind speed:						∑(45)112 = <u>1647.98</u>
Jan Feb Mar Apr	May Jun Jul	Aug Sep Oct	Nov Dec	Distribution loss 0.15 x (45)m		
Monthly average wind speed from Table U2				25.63 22.42 23.13 20.17 19.35	16.70 15.47 17.75	17.97 20.94 22.86 24.82
5.10 5.00 4.90 4.40	4.30 3.80 3.80	3.70 4.00 4.30	4.50 4.70 (22)	Storage volume (litres) including any solar or WWHRS storage within s	same vessel	1.00
Wind factor (22)m ÷ 4				Water storage loss:		
1.28 1.25 1.23 1.10	1.08 0.95 0.95	0.93 1.00 1.08	1.13 1.18 (22a)	a) If manufacturer's declared loss factor is known (kWh/day)		0.21
Adjusted infiltration rate (allowing for shelter and wind fa	ctor) (21) x (22a)m			Temperature factor from Table 2b		0.54
0.39 0.39 0.38 0.34	0.33 0.29 0.29	0.29 0.31 0.33	0.35 0.36 (22b)	Energy lost from water storage (kWh/day) (48) x (49)		0.12
Calculate effective air change rate for the applicable case:				Enter (50) or (54) in (55)		0.12
If mechanical ventilation: air change rate through syste	em		N/A (23a)	Water storage loss calculated for each month (55) x (41)m		
If balanced with heat recovery: efficiency in % allowing	for in-use factor from Table 4h		N/A (23c)	3.57 3.23 3.57 3.46 3.57	3.46 3.57 3.57	3.46 3.57 3.46 3.57
d) natural ventilation or whole house positive input ve	ntilation from loft			If the vessel contains dedicated solar storage or dedicated WWHRS (5	6)m x [(47) - Vs] ÷ (47), else (56)	
0.58 0.57 0.57 0.56	0.56 0.54 0.54	0.54 0.55 0.56	0.56 0.57 (24d)	3.57 3.23 3.57 3.46 3.57	3.46 3.57 3.57	3.46 3.57 3.46 3.57
Effective air change rate - enter (24a) or (24b) or (24c) or	(24d) in (25)			Primary circuit loss for each month from Table 3		
0.58 0.57 0.57 0.56	0.56 0.54 0.54	0.54 0.55 0.56	0.56 0.57 (25)	23.26 21.01 23.26 22.51 23.26	22.51 23.26 23.26	22.51 23.26 22.51 23.26
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22.51 23.26 (59)

A x U W/K

к-value,

kJ/m².K

Ахк,

kJ/K

88.60 (38)

210.21 (39)

31.00 30.00 31.00 (40)

 $\Sigma(44)1...12 = 1256.89$ (44)

 $\Sigma(45)1...12 = 1647.98$ (45)

20.94 22.86 24.82 (46) 1.00

3.46 3.57 (56)

3.57 (57)

(27)

(28a)

(29a) (31)

(33)

(34)

(35) (36)

(37)

(40)

(42) (43)

(47)

(48)

(49) (50)

(55)

Combi loss for each month from Table 3a, 3b or 3c	19.59 19.81 20.14 20.54 20.83 20.96 20.99 20.89 20.46 19.94 19.56 (87)
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 (61)	Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)
Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$	19.91 19.91 19.92 19.92 19.93 19.93 19.93 19.92 19.92 19.92 (88)
197.69 173.67 181.04 160.41 155.83 137.28 129.98 145.20 145.75 166.42 178.34 192.30 (62)	Utilisation factor for gains for rest of dwelling n2,m
Solar DHW input calculated using Appendix G or Appendix H	1.00 0.99 0.98 0.92 0.77 0.55 0.36 0.42 0.73 0.96 1.00 1.00 (89)
0.00 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)	Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)
Output from water heater for each month (kWh/month) (62)m + (63)m	18.03 18.35 18.83 19.40 19.77 19.91 19.93 19.84 19.30 18.54 17.98 (90)
197.69 173.67 181.04 160.41 155.83 137.28 129.98 145.20 145.75 166.42 178.34 192.30	Living area fraction $Living area \div (4) = 0.52$ (91)
$\Sigma(64)112 = 1963.92 (64)$	Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2
Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$	18.85 19.11 19.52 20.00 20.33 20.46 20.49 20.48 20.39 19.91 19.27 18.80 (92)
	Apply adjustment to the mean internal temperature from Table 4e where appropriate
78.28 69.08 72.74 65.48 64.36 57.79 55.76 60.82 60.60 67.88 71.44 76.49 (65)	
5. Internal gains	18.85 19.11 19.52 20.00 20.33 20.46 20.49 20.48 20.39 19.91 19.27 18.80 (93)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	8. Space heating requirement
Metabolic gains (Table 5)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
148.51 148.51 148.51 148.51 148.51 148.51 148.51 148.51 148.51 148.51 148.51 148.51 148.51 148.51 148.51 148.51 (66)	Utilisation factor for gains, nm
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	1.00 0.99 0.98 0.92 0.79 0.59 0.42 0.48 0.77 0.96 1.00 1.00 (94)
	Useful gains, ηmGm, W (94)m x (84)m
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	
<u>347.30</u> <u>350.90</u> <u>341.82</u> <u>322.49</u> <u>298.08</u> <u>275.14</u> <u>259.82</u> <u>256.22</u> <u>265.30</u> <u>284.63</u> <u>309.04</u> <u>331.98</u> (68)	Monthly average external temperature from Table U1
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	4.30 4.90 6.50 8.90 11.70 14.60 16.60 14.10 10.60 7.10 4.20 (96)
<u>37.85</u>	Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]
Pump and fan gains (Table 5a)	3102.96 3025.33 2765.09 2333.10 1809.61 1218.58 807.98 847.45 1311.94 1952.69 2564.40 3088.78 (97)
<u>3.00</u> <u>(70)</u>	Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m
Losses e.g. evaporation (Table 5)	1640.48 1243.31 977.89 493.39 178.84 0.00 0.00 0.00 596.38 1179.18 1683.32
-118.80 -118.80 -118.80 -118.80 -118.80 -118.80 -118.80 -118.80 -118.80 -118.80 -118.80 -118.80 -118.80 -118.80 -118.80 (71)	Σ(98)15, 1012 = <u>7992.80</u> (98)
Water heating gains (Table 5)	Space heating requirement kWh/m ² /year (98) ÷ (4) 45.50 (99)
105.21 102.79 97.77 90.94 86.50 80.26 74.95 81.75 84.17 91.24 99.22 102.80 (72)	
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	9a. Energy requirements - individual heating systems including micro-CHP
554.03 551.75 532.51 500.91 467.79 436.64 416.87 423.53 440.16 472.00 508.66 537.15 (73)	Space heating
	Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)
6. Solar gains	Fraction of space heat from main system(s) 1 - (201) = 1.00 (202)
Access factor Area Solar flux g FF Gains Table 6d m ² W/m ² specific data specific data W	Fraction of space heat from main system 2 0.00 (202)
or Table 6b or Table 6c	Fraction of total space heat from main system 1 (202) x [1- (203)] = 1.00 (204)
East 0.77 x 17.81 x 19.64 x 0.9 x 0.63 x 0.70 = 106.90 (76)	Fraction of total space heat from main system 2 (202) × (203) = 0.00 (205)
South 0.77 x 9.87 x 46.75 x 0.9 x 0.63 x 0.70 = 141.02 (78)	Efficiency of main system 1 (%) 93.50 (206)
West 0.77 x 16.28 x 19.64 x 0.9 x 0.63 x 0.70 = 97.72 (80)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Solar gains in watts Σ(74)m(82)m	Space heating fuel (main system 1), kWh/month
345.64 631.24 953.40 1293.92 1524.74 1539.59 1474.10 1302.77 1074.01 724.08 422.30 290.13 (83)	1754.52 1329.74 1045.87 527.69 191.27 0.00 0.00 0.00 0.00 637.84 1261.16 1800.34
Total gains - internal and solar (73)m + (83)m	Σ(211)15, 1012 = 8548.45 (211)
899.67 1182.99 1485.91 1794.83 1992.53 1976.23 1890.97 1726.30 1514.17 1196.07 930.96 827.28 (84)	Water heating
633.67 1162.33 1463.31 1734.63 1392.33 1376.23 1630.37 1726.30 1514.17 1156.07 350.36 627.26 [64]	Efficiency of water heater
7. Mean internal temperature (heating season)	89.21 89.04 88.64 87.62 85.18 79.80 79.80 79.80 87.93 88.93 89.27 (217)
Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)	Water heating fuel, kWh/month
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	221.60 195.06 204.23 183.08 182.94 172.03 162.89 181.95 182.64 189.27 200.53 215.41
Utilisation factor for gains for living area n1,m (see Table 9a)	$\Sigma(219a)112 = 2291.63 $ (219)
1.00 1.00 0.98 0.94 0.82 0.64 0.48 0.54 0.81 0.98 1.00 1.00 (86)	Annual totals
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	Space heating fuel - main system 1 8548.45
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Water heating fuel Electricity for pumps, fans and electric keep-hot (Table 4f)	l	2291.63]
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		546.80	(232)
Total delivered energy for all uses	(211)(221) + (231) + (232)(237b) =	11461.88	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	8548.45	x	3.48	x 0.01 =	297.49	(240)
Water heating	2291.63	x	3.48	x 0.01 =	79.75	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	546.80	x	13.19	x 0.01 =	72.12	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)(242) +	(245)(254) =	579.25	(255)

11a. SAP rating - individual heating systems including micro-CHP		
Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.10	(257)
SAP value	84.62	
SAP rating (section 13)	85	(258)
SAP band	В	

12a. CO₂ emissions - individual heating systems including micro-CHP Energy **Emission factor** Emissions kWh/year kg CO₂/kWh kg CO₂/year Space heating - main system 1 8548.45 0.216 1846.46 (261) Water heating 2291.63 0.216 494.99 (264) = х Space and water heating (261) + (262) + (263) + (264) = 2341.46 (265) Pumps and fans 75.00 0.519 38.93 (267) Electricity for lighting 546.80 0.519 283.79 (268) = Total CO₂, kg/year (265)...(271) = 2664.17 (272) Dwelling CO₂ emission rate (272) ÷ (4) = 15.16 (273) EI value 83.82 El rating (section 14) 84 (274) EI band В

13a. Primary energy - individual heating systems including micro-CHP

15a. Primary energy - individual neating systems includ						
	Energy kWh/year		Primary factor		Primary Energy kWh/year	,
Space heating - main system 1	8548.45	x	1.22	=	10429.11	(261)
Water heating	2291.63	х	1.22	=	2795.79	(264)
Space and water heating			(261) + (262) +	(263) + (264) =	13224.90	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	546.80	х	3.07	=	1678.67	(268)
Primary energy kWh/year					15133.82	(272)
Dwelling primary energy rate kWh/m2/year					86.14	(273)

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TER Worksheet





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 Liam Holden	Assessor number	10245
Client		Last modified	20/06/2018
Address	A1, London		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)	Volume (m³)
Lowest occupied		110.05 (1	a) x	2.70 (2a) =	297.14 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)(1n) =	110.05 (4))		
Dwelling volume				(3a) + (3b) + (3c) + (3d)(3n) =	297.14 (5)

2. Ventilation rate

											n	n ³ per hour	
Number of chim	ineys								0	x 40 =	-	0	(6a)
Number of oper	n flues								0] x 20 =	-	0	(6b)
Number of inter	mittent far	IS							4) x 10 =	- [40	(7a)
Number of passi	ive vents								0] x 10 =	-	0	(7b)
Number of fluel	ess gas fire	s							0] x 40 =	- [0	(7c)
											Air	changes po hour	er
Infiltration due t	to chimney:	s, flues, fan	s, PSVs		(6a)	+ (6b) + (7	a) + (7b) + (7c) =	40] ÷ (5) =	-	0.13	(8)
lf a pressurisatio	on test has l	been carrie	d out or is ii	ntended, pi	roceed to (17), otherw	ise continu	e from (9) t	o (16)				
Air permeability	value, q50	, expressed	in cubic me	etres per h	our per squ	uare metre	of envelope	e area				5.00	(17)
If based on air p	ermeability	value, the	n (18) = [(17	7) ÷ 20] + (8	3), otherwis	se (18) = (1	6)					0.38	(18)
Number of sides	s on which t	the dwellin	g is sheltere	ed								1	(19)
Shelter factor									1 -	[0.075 x (1	.9)] =	0.93	(20)
Infiltration rate	incorporati	ng shelter f	actor							(18) x (2	20) =	0.36	(21)
Infiltration rate	modified fo	or monthly	wind speed	:									
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average	e wind spee	ed from Tab	ole U2										
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22))m ÷ 4												
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a
Adjusted infiltra	tion rate (a	llowing for	shelter and	l wind facto	or) (21) x (2	22a)m							
	0.45	0.44	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.40	0.42	(22b
Calculate effecti	ve air chan	ge rate for	the applical	ble case:									
If mechanica	l ventilation	n: air chang	e rate throu	ugh system								N/A	(23a
If balanced w	vith heat re	covery: effi	ciency in %	allowing fo	or in-use fa	ctor from T	able 4h					N/A	(23c
d) natural ve	ntilation or	whole hou	se positive	input venti	lation from	n loft							
	0.60	0.60	0.59	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d
Effective air cha	nge rate - e	enter (24a)	or (24b) or	(24c) or (24	4d) in (25)								
	0.60	0.60	0.59	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

Page 1



3. Heat losses and heat loss parameter	23.26 21.01 23.26 22.51 23.26 22.51 23.26 23.26 23.26 22.51 23.26 22.51 23.26 (59)
Element Gross Openings Net area U-value A x U W/K κ-value, A x κ,	Combi loss for each month from Table 3a, 3b or 3c
area, $m^2 = m^2 = A$, $m^2 = W/m^2 K = k//m^2 K k//K$	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 (61)
Window 27.50 x 1.33 = 36.46 (27)	Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$
Ground floor 110.05 x 0.13 = 14.31 (28a)	191.69 168.42 175.62 155.68 151.30 133.37 126.36 141.04 141.52 172.99 186.49 (62)
External wall 87.61 x 0.18 = 15.77 (29a)	Solar DHW input calculated using Appendix G or Appendix H
Party wall 21.57 x 0.00 = 0.00 (32)	
Total area of external elements ΣA , m ² 225.16 (31)	
Fabric heat loss, W/K = $\Sigma(A \times U)$ (26)(30) + (32) = 66.53 (33)	Output from water heater for each month (kWh/month) (62)m + (63)m
	<u>191.69</u> <u>168.42</u> <u>175.62</u> <u>155.68</u> <u>151.30</u> <u>133.37</u> <u>126.36</u> <u>141.04</u> <u>141.54</u> <u>161.52</u> <u>172.99</u> <u>186.49</u>
	$\Sigma(64)112 = 1906.00$ (64)
Thermal mass parameter (TMP) in kJ/m²K 250.00 (35) Thermal heideer, S(I, will) calculated using Appandix K (36)	Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]
Thermal bridges: $\sum (L \times \Psi)$ calculated using Appendix K [11.26] (36)	76.28 67.33 70.94 63.90 62.85 56.49 54.56 59.44 59.20 66.25 69.66 74.55 (65)
Total fabric heat loss $(33) + (36) = 77.79$ (37)	5. Internal gains
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	Metabolic gains (Table 5)
59.12 58.72 58.34 56.54 56.20 54.63 54.63 54.34 55.23 56.20 56.88 57.59 (38)	140.76 140.76 140.76 140.76 140.76 140.76 140.76 140.76 140.76 140.76 140.76 140.76 140.76 140.76 140.76 (66)
Heat transfer coefficient, W/K (37)m + (38)m	Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
136.91 136.52 136.13 134.33 133.99 132.42 132.42 132.13 133.03 133.99 134.67 135.39	24.22 21.51 17.49 13.24 9.90 8.36 9.03 11.74 15.75 20.00 23.35 24.89 (67)
Average = $\Sigma(39)112/12 = 134.33$ (39)	Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	271.63 274.45 267.34 252.22 233.13 215.19 203.21 200.39 207.49 222.62 241.70 259.64 (68)
1.24 1.24 1.22 1.22 1.20 1.20 1.21 1.22 1.23	
Average = $\sum (40) 112/12 = 1.22$ (40)	Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
Number of days in month (Table 1a)	37.08 37.08 37.08 37.08 37.08 37.08 37.08 37.08 37.08 37.08 37.08 37.08 37.08 37.08 (69)
31.00 28.00 31.00 30.00 31.00 30.00 31.00 30.00 31.00 30.00 31.00 400	Pump and fan gains (Table 5a)
4. Water heating energy requirement	3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00
	Losses e.g. evaporation (Table 5)
Assumed occupancy, N 2.82 (42)	-112.61 -112.61 -112.61 -112.61 -112.61 -112.61 -112.61 -112.61 -112.61 -112.61 -112.61 -112.61 -112.61 (71)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 [101.06] (43)	Water heating gains (Table 5)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	102.53 100.19 95.35 88.76 84.48 78.45 73.33 79.89 82.22 89.05 96.75 100.20 (72)
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (72)m
<u>111.17</u> <u>107.12</u> <u>103.08</u> <u>99.04</u> <u>95.00</u> <u>90.95</u> <u>90.95</u> <u>95.00</u> <u>99.04</u> <u>103.08</u> <u>107.12</u> <u>111.17</u>	466.60 464.38 448.41 422.45 395.74 370.23 353.80 360.25 373.70 399.89 430.02 452.96 (73)
Σ (44)112 = 1212.71 (44)	6. Solar gains
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	Access factor Area Solar flux g FF Gains
164.85 144.18 148.78 129.71 124.46 107.40 99.52 114.21 115.57 134.68 147.02 159.65	Table 6d m^2 W/m^2 specific data specific data W
$\Sigma(45)112 = 1590.06$ (45)	or Table 6b or Table 6c
Distribution loss 0.15 x (45)m	East 0.77 x 9.85 x 19.64 x 0.9 x 0.63 x 0.70 = 59.12 (76)
24.73 21.63 22.32 19.46 18.67 16.11 14.93 17.13 17.34 20.20 22.05 23.95 (46)	South 0.77 x 6.64 x 46.75 x 0.9 x 0.63 x 0.70 = 94.87 (78)
Storage volume (litres) including any solar or WWHRS storage within same vessel 1.00 (47)	West 0.77 x 11.01 x 19.64 x 0.9 x 0.63 x 0.70 = 66.09 (80)
Water storage loss:	Solar gains in watts ∑(74)m(82)m
a) If manufacturer's declared loss factor is known (kWh/day) 0.21 (48)	220.08 400.31 601.29 811.99 954.08 962.38 921.84 816.43 675.89 458.22 268.58 184.94 (83)
Temperature factor from Table 2b 0.54 (49)	Total gains - internal and solar (73)m + (83)m
Energy lost from water storage (kWh/day) (48) x (49) 0.12 (50)	686.68 864.69 1049.70 1234.44 1349.82 1332.61 1275.63 1176.67 1049.59 858.11 698.60 637.91 (84)
Enter (50) or (54) in (55) 0.12 (55)	
Water storage loss calculated for each month (55) x (41)m	7. Mean internal temperature (heating season)
3.57 3.23 3.57 3.46 3.57 3.46 3.57 3.46 3.57 3.46 3.57 (56)	Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
3.57 3.23 3.57 3.46 3.57 3.46 3.57 3.46 3.57 3.46 3.57 (57)	Utilisation factor for gains for living area n1,m (see Table 9a)
Primary circuit loss for each month from Table 3	1.00 0.99 0.98 0.92 0.79 0.61 0.45 0.51 0.77 0.96 0.99 1.00 (86)
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	19.66	19.88	20.20	20.59	20.85	20.97	20.99	20.99	20.91	20.52	20.01	19.62	(87)
Temperature du	iring heating	g periods in	the rest o	f dwelling fi	rom Table 9	9, Th2(°C)							
	19.88	19.89	19.89	19.90	19.91	19.92	19.92	19.92	19.91	19.91	19.90	19.90	(88)
Utilisation facto	r for gains fo	or rest of d	welling n2,	m									
	1.00	0.99	0.97	0.89	0.73	0.52	0.34	0.39	0.68	0.94	0.99	1.00	(89)
Mean internal te	emperature	in the rest	of dwelling	g T2 (follow	steps 3 to	7 in Table	Эс)						
	18.10	18.42	18.90	19.44	19.77	19.90	19.92	19.92	19.84	19.36	18.63	18.06	(90)
Living area fract	ion								Li	ving area ÷	(4) =	0.38	(91)
Mean internal te	emperature	for the wh	ole dwellin	ng fLA x T1 +	-(1 - fLA) x ⁻	Г2							
	18.69	18.98	19.39	19.88	20.18	20.31	20.33	20.32	20.25	19.80	19.15	18.66	(92)
Apply adjustme	nt to the me	an internal	l temperat	ure from Ta	ble 4e whe	re approp	riate						
	18.69	18.98	19.39	19.88	20.18	20.31	20.33	20.32	20.25	19.80	19.15	18.66	(93)
8. Space heatir				_						-	_		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto												1	٦
	1.00	0.99	0.96	0.89	0.75	0.55	0.38	0.44	0.71	0.94	0.99	1.00	(94)
Useful gains, ηm	, ,			I								1	۰
	683.59	853.71	1010.83	1100.98	1011.98	733.81	490.28	513.01	747.21	806.02	691.49	635.84	(95)
Monthly average												1	۰
	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 fo										1		1	-
	1970.68	1921.62			1136.49	755.49	493.32	518.48	817.80	1233.17	1623.34	1957.08	(97)
Space heating re					, , , ,							1	-
	957.60	717.64	553.83	268.81	92.64	0.00	0.00	0.00	0.00	317.81	670.93	983.00	
									∑(9)	8)15, 10		4562.25	(98)
Space heating re	equirement	kWh/m²/ye	ear										(99)
										(50)	÷ (4)	41.46] (33)
9a. Energy req	uirements -	individual	heating sy	stems inclu	ding micro	-СНР				(58)	÷ (4)	41.40] (33)
	uirements -	individual	heating sy	stems inclu	ding micro	-CHP				(38)	÷ (4)	41.40] (55)
Space heating					7.1					(56)	÷ (4)	0.00] (33)
Space heating Fraction of spac	e heat from	secondary,	/suppleme		7.1					1 - (2)			
Space heating Fraction of spac Fraction of spac	e heat from e heat from	secondary, main syste	/suppleme em(s)		7.1							0.00] (201
9a. Energy req Space heating Fraction of spac Fraction of spac Fraction of spac Fraction of spac	e heat from e heat from e heat from	secondary, main syste main syste	/suppleme em(s) em 2		7.1				(20		01) =	0.00] (201] (202
Space heating Fraction of spac Fraction of spac Fraction of spac	e heat from e heat from e heat from space heat	secondary, main syste main syste from main	r/suppleme em(s) em 2 system 1		7.1				(20	1 - (2	01) =	0.00 1.00 0.00] (201] (202] (202
Space heating Fraction of spac Fraction of spac Fraction of spac Fraction of total Fraction of total	e heat from e heat from e heat from space heat space heat	secondary, main syste main syste from main from main	r/suppleme em(s) em 2 system 1		7.1				(20	1 - (20)2) × [1- (20	01) =	0.00 1.00 0.00 1.00] (201] (202] (202] (202] (204
Space heating Fraction of spac Fraction of spac Fraction of spac Fraction of total Fraction of total	e heat from e heat from e heat from space heat space heat	secondary, main syste main syste from main from main	r/suppleme em(s) em 2 system 1		7.1		Jul	Aug	(20 Sep	1 - (20)2) × [1- (20	01) =	0.00 1.00 0.00 1.00 0.00] (201] (202] (202] (204] (205
Space heating Fraction of spac Fraction of spac Fraction of spac Fraction of total Fraction of total Efficiency of ma	e heat from e heat from e heat from space heat space heat in system 1 Jan	secondary, main syste main syste from main from main (%) Feb	r/suppleme em(s) em 2 system 1 system 2 Mar	ntary system	m (table 11)	Jul	Aug		1 - (20)2) x [1- (20 (202) x (20	D1) = []] []] = []] []] []] []] []] []]	0.00 1.00 0.00 1.00 0.00 93.50] (201] (202] (202] (204] (205
Space heating Fraction of spac Fraction of spac Fraction of spac Fraction of total Fraction of total Efficiency of ma	e heat from e heat from e heat from space heat space heat in system 1 Jan uel (main sys	secondary, main syste main syste from main from main (%) Feb	r/suppleme em(s) em 2 system 1 system 2 Mar	ntary system	m (table 11 May) Jun		-	Sep	1 - (20)2) x [1- (20 (202) x (20 Oct	01) = [] [3]] = [] 03) = [] Nov	0.00 1.00 0.00 1.00 0.00 93.50 Dec] (201] (202] (202] (204] (205] (206
Space heating Fraction of spac Fraction of spac Fraction of spac Fraction of total Fraction of total Efficiency of ma	e heat from e heat from e heat from space heat space heat in system 1 Jan	secondary, main syste main syste from main from main (%) Feb stem 1), kW	/suppleme em(s) em 2 system 1 system 2 Mar Vh/month	ntary system	m (table 11)	Jul 0.00	Aug	Sep	1 - (2))2) × [1- (20 (202) × (2) Oct 339.90	01) = 3)] = 03) = Nov 717.57	0.00 1.00 0.00 1.00 0.00 93.50 Dec 1051.34] (201] (202] (202] (204] (205] (206
Space heating Fraction of spac Fraction of spac Fraction of spac Fraction of total Fraction of total Efficiency of ma Space heating fu	e heat from e heat from e heat from space heat space heat in system 1 Jan uel (main sys	secondary, main syste main syste from main from main (%) Feb stem 1), kW	/suppleme em(s) em 2 system 1 system 2 Mar Vh/month	ntary system	m (table 11 May) Jun		-	Sep	1 - (20)2) x [1- (20 (202) x (20 Oct	01) = 3)] = 03) = Nov 717.57	0.00 1.00 0.00 1.00 0.00 93.50 Dec] (201] (202] (202] (204] (205] (206
Space heating Fraction of spac Fraction of spac Fraction of spac Fraction of total Fraction of total Efficiency of ma Space heating fu Water heating	e heat from e heat from space heat space heat in system 1 Jan Jel (main sys 1024.17	secondary, main syste main syste from main from main (%) Feb stem 1), kW	/suppleme em(s) em 2 system 1 system 2 Mar Vh/month	ntary system	m (table 11 May) Jun		-	Sep	1 - (2))2) × [1- (20 (202) × (2) Oct 339.90	01) = 3)] = 03) = Nov 717.57	0.00 1.00 0.00 1.00 0.00 93.50 Dec 1051.34] (201] (202] (202] (204] (205] (206
Space heating Fraction of spac Fraction of spac Fraction of spac Fraction of total Fraction of total Efficiency of ma	e heat from e heat from space heat space heat in system 1 Jan Jel (main sys 1024.17	secondary, main syste main syste from main from main (%) Feb stem 1), kW 767.53	/suppleme em(s) em 2 system 1 system 2 <u>Mar</u> Vh/month 592.34	Apr 287.50	m (table 11 May 99.08) Jun 0.00	0.00	0.00	Sep 0.00 Σ(21:	1 - (2))2) × [1- (20 (202) × (2) Oct 339.90 1)15, 10	01) =	0.00 1.00 0.00 1.00 93.50 Dec 1051.34 4879.41] (201] (202] (202] (204] (204] (205] (206]] (211
Space heating Fraction of spac Fraction of spac Fraction of spac Fraction of total Fraction of total Efficiency of ma Space heating fu Water heating Efficiency of wat	e heat from e heat from space heat space heat in system 1 Jan Jel (main sys 1024.17 ter heater 88.52	secondary, main syste main syste from main from main (%) Feb stem 1), kW 767.53	/suppleme em(s) em 2 system 1 system 2 Mar Vh/month	ntary system	m (table 11 May) Jun		-	Sep	1 - (2))2) × [1- (20 (202) × (2) Oct 339.90	01) = 3)] = 03) = Nov 717.57	0.00 1.00 0.00 1.00 0.00 93.50 Dec 1051.34] (201] (202] (202] (204] (205] (206
Space heating Fraction of spac Fraction of spac Fraction of spac Fraction of total Fraction of total Efficiency of ma Space heating fu Water heating	e heat from e heat from space heat space heat in system 1 Jan Jel (main sys 1024.17 ter heater 88.52 uel, kWh/m	secondary, main syste main syste from main from main (%) Feb stem 1), kW 767.53 88.25 onth	/suppleme em(s) em 2 system 1 system 2 Mar Vh/month 592.34	Apr 287.50 86.26	m (table 11 May 99.08 83.55) Jun 0.00 79.80	0.00	0.00	Sep 0.00 ∑(21: 79.80	1 - (20)2) × [1- (20 (202) × (20 Oct 339.90 1)15, 10 86.59	01) = (3)] = 03) = Nov 717.57 .12 = 88.08	0.00 1.00 0.00 93.50 Dec 1051.34 4879.41 88.61] (201] (202] (202] (204] (204] (205] (206]] (211
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Space heating fuel - main system 1		4879.41]
Water heating fuel		2242.26]
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		427.66	(232)
Total delivered energy for all uses	(211)(221) + (231) + (232)(237b) =	7624.33	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4879.41	х	3.48	x 0.01 =	169.80	(240)
Water heating	2242.26	х	3.48	x 0.01 =	78.03	(247)
Pumps and fans	75.00	х	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	427.66	x	13.19	x 0.01 =	56.41	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)(242) +	(245)(254) =	434.13	(255)

11a. SAP rating - individual neating systems including micro-CHP	
Energy cost deflator (Table 12)	0.42 (256)
Energy cost factor (ECF)	1.18 (257)
SAP value	83.59
SAP rating (section 13)	84 (258)
SAP band	В

2a. CO ₂ emissions -	individual heat	ing systems inc	luding micro-CHP
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	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	4879.41	x	0.216	=	1053.95	(261)
Nater heating [2242.26	x	0.216	= [484.33	(264)
Space and water heating			(261) + (262) +	(263) + (264) =	1538.28	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	427.66	х	0.519	=	221.95	(268)
Total CO ₂ , kg/year				(265)(271) =	1799.16	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	16.35	(273)
El value				[84.45]
El rating (section 14)				[84	(274)
El band				[В]

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	4879.41	х	1.22	=	5952.88	(261)
Water heating	2242.26	х	1.22	=	2735.56	(264)
Space and water heating			(261) + (262) + (263) + (264) =	8688.44	(265)
Pumps and fans	75.00	х	3.07	=	230.25	(267)
Electricity for lighting	427.66	x	3.07	=	1312.91	(268)
Primary energy kWh/year					10231.60	(272)
Dwelling primary energy rate kWh/m2/year					92.97	(273)

TER Worksheet

Design - Draft



Address TH A1, London 1. Overall dwelling dimensions Area (m ²) Area (m ²) Average storey height (m) Volume (m ³) owest occupied 69.47 (1a) x 2.70 (2a) = 187.57 (3) 1 41.56 (b) x 3.15 (2b) = 130.91 (3) iotal floor area (1a) + (1b) + (1c) + (1d)(1n) = 11.03 (4) $(3a) + (3b) + (3c) + (3d)(3n) =$ 318.48 (5) 2. Ventilation rate m ³ per hour May be of open flues 0 x 40 = 0 (a) x 40 = 0 x 40 = 0 May be of flues size wents 0 x 40 = 0 Aurober of fluees size sites 0 x 40 = 0 Air changes per hour not resultion rate 0 x 40 = 0 Air changes per hour air colspan="2">Air changes per hour flintriation due to chimmeys, flues, fans, PSV		Mr Liam	Holden						Assessor n	umber	1024	5	
Area (m ³) Average storey height (m) Volume (m ³) Lowest occupied $69,47$ $(1a) \times$ 2.70 $(2a) =$ $187,57$ $(3) + (1a) \times$ 3.15 $(2b) =$ 130.91 $(3) + (1a) +$	Client								Last modifi	ied	20/06	5/2018	
Area (m ¹) Average storey height (m) Volume (m ¹) Lowest occupied 69.47 (1a) x 2.70 (2a) = 187.57 (3) 11 41.56 (1b) x 3.15 (2b) = 130.91 (3) Total floor area (1a) + (1b) + (1c) + (1d)(1n) = 111.03 (4) $(3a) + (3b) + (3c) + (3d)(3n) =$ 318.48 (5) Dwelling volume at (1a) + (1b) + (1c) + (1d)(1n) = 11.03 (4) Dwelling volume at (1a) + (1b) + (1c) + (1d)(1n) = 11.03 (4) Dwelling volume by (2b) + (3a) + (3b) + (3c) + (3d)(3n) = 318.48 (5) by (2b) by (2b) by (2b) <th>Address</th> <th>TH A1, Lo</th> <th>ondon</th> <th></th>	Address	TH A1, Lo	ondon										
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Shelter factor $1 - [0.075 \times (19)] =$ 0.93 (2 Infiltration rate incorporating shelter factor (18) × (20) = 0.35 (2 Infiltration rate modified for monthly wind speed: (18) × (20) = 0.35 (2 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Monthly average wind speed from Table U2 5.10 5.00 4.90 4.40 4.30 3.80 3.80 3.70 4.00 4.50 4.70 (2 Wind factor (22)m ÷ 4 1.28 1.25 1.23 1.10 1.08 0.95 0.93 1.00 1.08 1.13 1.18 (2	If a pressurisation test has b	een carried	d out or is ii		oceed to (2	17), otherw	vise contin	ue fron	n (9) to (16)	÷ (5)	_	0.13	_
Infiltration rate incorporating shelter factor (18) \times (20) = 0.35 (2) Infiltration rate incorporating shelter factor (18) \times (20) = 0.35 (2) Infiltration rate modified for monthly wind speed: Jan Feb May Jun Jul Aug Sep Oct Nov Dec Monthly average wind speed from Table U2 5.10 5.00 4.90 4.40 4.30 3.80 3.70 4.00 4.30 4.70 (2) Wind factor (22)m $\div 4$ 1.28 1.25 1.23 1.10 1.08 0.95 0.95 0.93 1.00 1.08 1.13 1.18 (2)	<i>If a pressurisation test has b</i> Air permeability value, q50,	een carried expressed	d out or is in in cubic m	etres per ho	oceed to (2 ur per squ	1 <i>7), otherw</i> uare metre	<i>vise contin</i> of envelop	ue fron	n (9) to (16)	÷ (5)	_	0.13 5.00	(8)
Infiltration rate modified for monthly wind speed: Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Monthly average wind speed from Table U2 5.10 5.00 4.90 4.40 4.30 3.80 3.70 4.00 4.30 4.50 4.70 (2 Wind factor (22)m ÷ 4 1.28 1.25 1.23 1.10 1.08 0.95 0.95 0.93 1.00 1.08 1.13 1.18 (2	lf a pressurisation test has b Air permeability value, q50, If based on air permeability	een carried expressed value, ther	d out or is in in cubic mo n (18) = [(17	etres per ho 7) ÷ 20] + (8)	oceed to (2 ur per squ	1 <i>7), otherw</i> uare metre	<i>vise contin</i> of envelop	ue fron	n (9) to (16)	÷ (5)	_	hour 0.13 5.00 0.38	(8) (17)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Monthly average wind speed from Table U2 5.10 5.00 4.90 4.40 4.30 3.80 3.70 4.00 4.30 4.50 4.70 (2 Wind factor (22)m ÷ 4 1.28 1.25 1.23 1.10 1.08 0.95 0.93 1.00 1.08 1.13 1.18 (2	If a pressurisation test has b Air permeability value, q50, If based on air permeability Number of sides on which tl	een carried expressed value, ther	d out or is in in cubic mo n (18) = [(17	etres per ho 7) ÷ 20] + (8)	oceed to (2 ur per squ	1 <i>7), otherw</i> uare metre	<i>vise contin</i> of envelop	ue fron	m (9) to (16)		=	hour 0.13 5.00 0.38 1	(8) (17) (18)
Monthly average wind speed from Table U2 5.10 5.00 4.90 4.40 4.30 3.80 3.70 4.00 4.30 4.50 4.70 (2 Wind factor (22)m ÷ 4 1.28 1.25 1.23 1.10 1.08 0.95 0.95 0.93 1.00 1.08 1.13 1.18 (2	If a pressurisation test has b Air permeability value, q50, If based on air permeability Number of sides on which th Shelter factor	een carried expressed value, ther he dwelling	d out or is in in cubic mo n (18) = [(17 g is sheltere	etres per ho 7) ÷ 20] + (8)	oceed to (2 ur per squ	1 <i>7), otherw</i> uare metre	<i>vise contin</i> of envelop	ue fron	m (9) to (16)	1 - [0.075 x (:	=	hour 0.13 5.00 0.38 1 0.93	(8) (17) (18) (19)
5.10 5.00 4.90 4.40 4.30 3.80 3.70 4.00 4.30 4.50 4.70 (2 Wind factor (22)m ÷ 4 1.28 1.25 1.23 1.10 1.08 0.95 0.93 1.00 1.08 1.13 1.18 (2	f a pressurisation test has b Air permeability value, q50, f based on air permeability Number of sides on which tl Shelter factor nfiltration rate incorporatin	een carried expressed value, ther he dwelling ng shelter fa	d out or is in in cubic mu n (18) = [(12 g is sheltere	etres per ho 7) ÷ 20] + (8) ed	oceed to (2 ur per squ	1 <i>7), otherw</i> uare metre	<i>vise contin</i> of envelop	ue fron	m (9) to (16)	1 - [0.075 x (:	=	hour 0.13 5.00 0.38 1 0.93	(8) (17) (18) (19) (20)
Wind factor (22)m ÷ 4 1.28 1.25 1.23 1.10 1.08 0.95 0.93 1.00 1.08 1.13 1.18 (2)	If a pressurisation test has b Air permeability value, q50, If based on air permeability Number of sides on which tl Shelter factor Infiltration rate incorporatin Infiltration rate modified for	een carried expressed value, ther he dwelling ng shelter fa	d out or is in in cubic me n (18) = [(12 g is sheltere actor wind speed	etres per ho 7) ÷ 20] + (8) ed	oceed to (2 ur per squ I, otherwis	17), otherw uare metre se (18) = (1	vise contin of envelo 6)	ue fron	n (9) to (16)	1 - [0.075 x (: (18) x (=	hour 0.13 5.00 0.38 1 0.93 0.35	(8) (17) (18) (19) (20)
1.28 1.25 1.23 1.10 1.08 0.95 0.93 1.00 1.08 1.13 1.18 (2)	If a pressurisation test has b Air permeability value, q50, If based on air permeability Number of sides on which th Shelter factor Infiltration rate incorporation Infiltration rate modified for Jan	een carried expressed value, ther he dwelling og shelter fa r monthly v Feb	d out or is in in cubic mo n (18) = [(17 g is sheltere actor wind speed Mar	etres per ho 7) ÷ 20] + (8) ed	oceed to (2 ur per squ I, otherwis	17), otherw uare metre se (18) = (1	vise contin of envelo 6)	ue fron	n (9) to (16)	1 - [0.075 x (: (18) x (=	hour 0.13 5.00 0.38 1 0.93 0.35	(8) (17) (18) (19) (20)
	If a pressurisation test has b Air permeability value, q50, If based on air permeability Number of sides on which ti Shelter factor Infiltration rate incorporatin Infiltration rate modified for Jan Monthly average wind spee	een carried expressed value, ther he dwelling og shelter fa r monthly v Feb d from Tab	d out or is in in cubic me n (18) = [(17 g is sheltere actor wind speed Mar ele U2	etres per ho 7) ÷ 20] + (8) ed : Apr	oceed to (2 ur per squ), otherwis May	17), otherw uare metre se (18) = (1 Jun	vise contin of enveloy 6) Jul	ue fron oe area A	n (9) to (16) a	1 - [0.075 x (: (18) x (Oct	=	hour 0.13 5.00 0.38 1 0.93 0.35 Dec	(8) (17) (18) (19) (20)
Adjusted inhitration rate (allowing for shelter and wind factor) (21) x (22a)m	If a pressurisation test has b Air permeability value, q50, If based on air permeability Number of sides on which tl Shelter factor Infiltration rate incorporatin Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4	een carried expressed value, ther he dwelling ng shelter fr r monthly v Feb d from Tab 5.00	d out or is in in cubic min n (18) = [(17) g is sheltered actor wind speed Mar le U2 4.90	etres per ho 7) ÷ 20] + (8) ed : Apr 4.40	oceed to (2 ur per squ), otherwis May 4.30	17), otherw Jare metre se (18) = (1 Jun <u>3.80</u>	rise contin of enveloy 6) Jul 3.80	A	n (9) to (16) a .ug Sep .70 4.00	1 - [0.075 x (: (18) x Oct 4.30	=	hour 0.13 5.00 0.38 1 0.93 0.35 Dec 4.70	(8) (17) (18) (19) (20) (21) (22)
	If a pressurisation test has b Air permeability value, q50, If based on air permeability Number of sides on which th Shelter factor Infiltration rate incorporatin Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28	een carried expressed value, ther he dwelling og shelter far r monthly v Feb d from Tab 5.00 1.25	d out or is in in cubic min n (18) = [(1); g is sheltered actor vind speed Mar le U2 4.90 1.23	etres per ho 7) ÷ 20] + (8) d : Apr 1.10	May 4.30	17), otherw Jare metre se (18) = (1 Jun 3.80	rise contin of enveloy 6) Jul 3.80	A	n (9) to (16) a .ug Sep .70 4.00	1 - [0.075 x (: (18) x Oct 4.30	=	hour 0.13 5.00 0.38 1 0.93 0.35 Dec 4.70	(8) (17) (18) (19) (20) (21)
	If a pressurisation test has b Air permeability value, q50, If based on air permeability Number of sides on which tl Shelter factor Infiltration rate incorporatin Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al	een carried expressed value, ther he dwelling og shelter far r monthly v Feb d from Tab 5.00 1.25 lowing for	d out or is in in cubic min n (18) = [(17) g is sheltered actor vind speed Mar le U2 4.90 1.23 shelter and	etres per ho 7) ÷ 20] + (8) ed .: Apr 1.10 wind factor	May 4.30 1.08 r) (21) x (2	17), otherw Jare metre se (18) = (1 Jun 3.80 0.95 22a)m	vise contin of envelop (6) Jul 3.80 0.95	A 3	n (9) to (16) a 	1 - [0.075 × (: (18) × (Oct 4.30	=	hour 0.13 5.00 0.38 1 0.93 0.35 Dec 4.70 1.18	(8) (17) (18) (19) (20) (21) (22) (22) (22a)
Calculate effective air change rate for the applicable case:	If a pressurisation test has b Air permeability value, q50, If based on air permeability Number of sides on which th Shelter factor Infiltration rate incorporatin Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al 0.44	een carried expressed value, ther he dwelling og shelter far r monthly v Feb d from Tab 5.00 1.25 lowing for 0.43	d out or is in in cubic min n (18) = [(17) g is sheltered actor vind speed Mar le U2 4.90 1.23 shelter and 0.43	etres per ho 7) ÷ 20] + (8) ed : Apr 1.10 wind factor 0.38	May 4.30	17), otherw Jare metre se (18) = (1 Jun 3.80	rise contin of enveloy 6) Jul 3.80	A 3	n (9) to (16) a 	1 - [0.075 × (: (18) × (Oct 4.30	=	hour 0.13 5.00 0.38 1 0.93 0.35 Dec 4.70	(8) (17) (18) (19) (20) (21) (22)
	If a pressurisation test has b Air permeability value, q50, If based on air permeability Number of sides on which th Shelter factor Infiltration rate incorporatin Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al 0.44 Calculate effective air chang	een carried expressed value, ther he dwelling og shelter fir r monthly v Feb d from Tab 5.00 1.25 lowing for 0.43 ge rate for f	d out or is in in cubic mon n (18) = [(17) g is sheltered actor vind speed Mar le U2 4.90 1.23 shelter and 0.43 the applical	etres per ho 7) ÷ 20] + (8) ed : Apr 4.40 1.10 1 wind factor 0.38 ble case:	May 4.30 1.08 r) (21) x (2	17), otherw Jare metre se (18) = (1 Jun 3.80 0.95 22a)m	vise contin of envelop (6) Jul 3.80 0.95	A 3	n (9) to (16) a 	1 - [0.075 × (: (18) × (Oct 4.30	=	hour 0.13 5.00 0.38 1 0.93 0.35 Dec 4.70 1.18 0.41	(8) (17) (18) (20) (21) (22) (22) (22a) (22b)
	If a pressurisation test has b Air permeability value, q50, If based on air permeability Number of sides on which th Shelter factor Infiltration rate incorporatin Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al 0.44 Calculate effective air chang If mechanical ventilation	een carried expressed value, ther he dwelling og shelter fr r monthly v Feb d from Tab 5.00 1.25 lowing for 0.43 ge rate for h : air change	d out or is in in cubic mon on (18) = [(17) g is sheltered actor vind speed Mar le U2 4.90 1.23 shelter and 0.43 the application e rate through	etres per ho 7) ÷ 20] + (8) ed .: Apr 4.40 1.10 I wind factor 0.38 ble case: ugh system	May 4.30 1.08 r) (21) x (2 0.37	17), otherw Jare metre se (18) = (1 Jun 3.80 0.95 22a)m 0.33	rise contin of envelop 6) Jul 3.80 0.95 0.33	A 3	n (9) to (16) a 	1 - [0.075 × (: (18) × (Oct 4.30	=	hour 0.13 5.00 0.38 1 0.93 0.35 Dec 4.70 1.18 0.41	(8) (17) (18) (20) (21) (22) (22) (22a) (22a) (22b)
	If a pressurisation test has b Air permeability value, q50, If based on air permeability Number of sides on which th Shelter factor Infiltration rate incorporatin Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al 0.44 Calculate effective air chang If mechanical ventilation If balanced with heat reco	een carried expressed value, ther he dwelling ag shelter fir r monthly v Feb d from Tab 5.00 1.25 lowing for 0.43 ge rate for fi : air chang covery: effici	d out or is in in cubic mo n (18) = [(17) g is sheltered actor vind speed Mar le U2 4.90 1.23 shelter and 0.43 the applical e rate throic ciency in %	etres per ho 7) ÷ 20] + (8) ed : Apr 4.40 1.10 1 wind factor 0.38 ble case: ugh system allowing for	May 4.30 1.08 r) (21) x (2 0.37	17), otherw Jare metre se (18) = (1 Jun 3.80 0.95 22a)m 0.33 ctor from T	rise contin of envelop 6) Jul 3.80 0.95 0.33	A 3	n (9) to (16) a 	1 - [0.075 × (: (18) × (Oct 4.30	=	hour 0.13 5.00 0.38 1 0.93 0.35 Dec 4.70 1.18 0.41	(8) (17) (18) (20) (21) (22) (22) (22a) (22b)
d) natural ventilation or whole house positive input ventilation from loft	If a pressurisation test has b Air permeability value, q50, If based on air permeability Number of sides on which th Shelter factor Infiltration rate incorporatin Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al 0.44 Calculate effective air chang If mechanical ventilation If balanced with heat rec d) natural ventilation or	een carried expressed value, ther he dwelling ag shelter fir r monthly v Feb d from Tab 5.00 1.25 lowing for 0.43 ge rate for fi : air chang covery: effii whole hou	d out or is in in cubic mo n (18) = [(1); g is sheltered actor vind speed Mar le U2 4.90 1.23 shelter and 0.43 the applical e rate throic ciency in % see positive	etres per ho 7) ÷ 20] + (8) ed • • • • • • • • • • • • • • • • • • •	May 4.30 1.08 r) (21) × (2 0.37	17), otherw Jare metre se (18) = (1 Jun 3.80 0.95 22a)m 0.33 ctor from T n loft	vise contin of envelop 6) Jul 3.80 0.95 0.33	■ 1 0 0	n (9) to (16) 	1 - [0.075 x (: (18) x (Oct 4.30	=	hour 0.13 5.00 0.38 1 0.93 0.35 Dec 4.70 1.18 0.41 N/A	(8) (17) (18) (20) (21) (22) (22a) (22a) (22b) (22b) (23a) (23c)
	If a pressurisation test has b Air permeability value, q50, If based on air permeability Number of sides on which th Shelter factor Infiltration rate incorporatin Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al 0.44 Calculate effective air chang If mechanical ventilation	een carried expressed value, ther he dwelling og shelter fr r monthly v Feb d from Tab 5.00 1.25 lowing for 0.43 ge rate for h : air change	d out or is in in cubic mon on (18) = [(17) g is sheltered actor vind speed Mar le U2 4.90 1.23 shelter and 0.43 the application e rate through	etres per ho 7) ÷ 20] + (8) ed .: Apr 4.40 1.10 I wind factor 0.38 ble case: ugh system	May 4.30 1.08 r) (21) x (2 0.37	17), otherw Jare metre se (18) = (1 Jun 3.80 0.95 22a)m 0.33	vise contin of envelop (6) Jul 3.80 0.95 0.33	A 3	n (9) to (16) a 	1 - [0.075 × (: (18) × (Oct 4.30	=	hour 0.13 5.00 0.38 1 0.93 0.35 Dec 4.70 1.18 0.41	(8) (17) (18) (20) (21) (22) (22a) (22b) (22a)
	If a pressurisation test has b Air permeability value, q50, If based on air permeability Number of sides on which th Shelter factor Infiltration rate incorporatin Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al 0.44 Calculate effective air chang If mechanical ventilation If balanced with heat rec	een carried expressed value, ther he dwelling ag shelter fir r monthly v Feb d from Tab 5.00 1.25 lowing for 0.43 ge rate for fi : air chang covery: effici	d out or is in in cubic mo n (18) = [(17) g is sheltered actor vind speed Mar le U2 4.90 1.23 shelter and 0.43 the applical e rate throic ciency in %	etres per ho 7) ÷ 20] + (8) ed : Apr 4.40 1.10 1 wind factor 0.38 ble case: ugh system allowing for	May 4.30 1.08 r) (21) x (2 0.37	17), otherw Jare metre se (18) = (1 Jun 3.80 0.95 22a)m 0.33 ctor from T	vise contin of envelop (6) Jul 3.80 0.95 0.33	A 3	n (9) to (16) a 	1 - [0.075 × (: (18) × (Oct 4.30	=	hour 0.13 5.00 0.38 1 0.93 0.35 Dec 4.70 1.18 0.41	(8) (17) (18) (20) (21) (22) (22) (22a) (22a) (22b)
d) natural ventilation or whole house positive input ventilation from loft	If a pressurisation test has b Air permeability value, q50, If based on air permeability Number of sides on which th Shelter factor Infiltration rate incorporatin Infiltration rate modified for Jan Monthly average wind spee 5.10 Wind factor (22)m ÷ 4 1.28 Adjusted infiltration rate (al 0.44 Calculate effective air chang If mechanical ventilation If balanced with heat rec d) natural ventilation or 0.60	een carried expressed value, ther he dwelling ag shelter fir r monthly v Feb d from Tab 5.00 1.25 lowing for 0.43 ge rate for fi : air chang sovery: effii whole hou: 0.59	d out or is in in cubic mo n (18) = [(17) g is sheltered actor wind speed Mar le U2 4.90 1.23 shelter and 0.43 the applicat e rate throw ciency in % se positive 0.59	etres per ho 7) ÷ 20] + (8) ed • • • • • • • • • • • • • • • • • • •	May 4.30 (1.08 (21) × (2 0.37 (1.08 (21) × (2 0.37 (21) × (2 0.37	17), otherw Jare metre se (18) = (1 Jun 3.80 0.95 22a)m 0.33 ctor from T n loft	vise contin of envelop 6) Jul 3.80 0.95 0.33	■ 1 0 0	n (9) to (16) 	1 - [0.075 x (: (18) x (Oct 4.30	=	hour 0.13 5.00 0.38 1 0.93 0.35 Dec 4.70 1.18 0.41 N/A	(8) (17) (18) (20) (21) (22) (22) (22a) (22a) (22b)

0.58 (25) 0.60 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58

3. Heat losses a	and heat lo	s paramet	er										
Element				Gross rea, m²	Openings m ²	Net a		U-value W/m²K	A x U W		alue, /m².K	Ахк, kJ/K	
Window						27.	77 x	1.33	= 36.82				(27)
Exposed floor						69.	47 x	0.13	= 9.03				(28b
External wall						128	.41 x	0.18	= 23.11				(29a)
Party wall						38.	39 x	0.00	= 0.00				(32)
Roof						56.	66 x	0.13	= 7.37				(30)
Total area of ext	ernal eleme	ents ∑A, m²	2			282	.31						(31)
Fabric heat loss,	W/K = ∑(A	× U)							(26	5)(30) + (3	32) =	76.33	(33)
Heat capacity Cr	n = ∑(А x к)							(28)	.(30) + (32) -	+ (32a)(32	2e) =	N/A	(34)
Thermal mass pa	arameter (T	MP) in kJ/r	m²K									250.00	(35)
Thermal bridges	: Σ(L x Ψ) ca	lculated u	sing Append	dix K								14.12	(36)
Total fabric heat	loss									(33) + (3	36) =	90.44	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat	loss calcula	ted month	ily 0.33 x (2	25)m x (5)									
	62.86	62.46	62.07	60.22	59.88	58.27	58.27	57.98	58.89	59.88	60.58	61.31	(38)
Heat transfer co	efficient, W	/K (37)m +	+ (38)m										
	153.30	152.90	152.51	150.67	150.32	148.72	148.72	148.42	149.34	150.32	151.02	151.75]
									Average = 2	<u>(</u> 39)112/	12 =	150.67	(39)
Heat loss param	eter (HLP),	W/m²K (39	9)m ÷ (4)										
	1.38	1.38	1.37	1.36	1.35	1.34	1.34	1.34	1.34	1.35	1.36	1.37	
									Average = 2	<u>(</u> 40)112/	12 =	1.36	(40)
Number of days	in month (1	able 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 heati	ng energy r	equiremen	ıt										
Assumed occupa												2.82	(42)
Annual average		sage in litr	es per day V	/d,average	= (25 x N) +	36						101.20	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	_
Hot water usage	in litres pe	r day for e;	ach month '	Vd,m = fact	or from Tab	le 1c x (43))						
	111.32	107.27	103.22	99.17	95.12	91.08	91.08	95.12	99.17	103.22	107.27	111.32	1
										∑(44)1	12 =	1214.35	(44)
Energy content of	of hot wate	r used = 4.:	18 x Vd,m x	nm x Tm/3	8600 kWh/m	onth (see	Tables 1b	, 1c 1d)					
	165.08	144.38	148.98	129.89	124.63	107.55	99.66	114.36	115.73	134.87	147.22	159.87]
										∑(45)1	12 =	1592.20	(45)
Distribution loss	0.15 x (45)	m											
	24.76	21.66	22.35	19.48	18.69	16.13	14.95	17.15	17.36	20.23	22.08	23.98	(46)
Storage volume	(litres) inclu	iding any s	olar or WW	HRS storag	e within san	ne vessel						1.00	(47)
Water storage lo	DSS:												
a) If manufactur	er's declare	d loss facto	or is known	(kWh/day)								0.21	(48)
Temperature	factor fron	ו Table 2b										0.54	(49)
Energy lost fr	om water s	torage (kW	/h/day) (48	8) x (49)								0.12	(50)
Enter (50) or (54) in (55)											0.12	(55)
Water storage lo	oss calculate	d for each	month (55	5) x (41)m									
	3.57	3.23	3.57	3.46	3.57	3.46	3.57	3.57	3.46	3.57	3.46	3.57	(56)
If the vessel con	tains dedica	ited solar s	torage or d	edicated W	/WHRS (56)1	m x [(47) - '	Vs] ÷ (47)	, else (56)					

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3.57 3.23 3.57 3.46 3.57 3.46 3.57 3.57 3.46 3.57 3.46 3.57 (57)	1.00 1.00 0.98 0.94 0.83
3.57 3.23 3.57 3.46 3.57 3.46 3.57 3.46 3.57 3.46 3.57 (57) Primary circuit loss for each month from Table 3	1.00 1.00 0.98 0.94 0.83 Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)
23.26 21.01 23.26 22.51 23.26 22.51 23.26 23.26 22.51 23.26 (59)	19.44 19.64 19.99 20.44 20.78
Combi loss for each month from Table 3a, 3b or 3c	Temperature during heating periods in the rest of dwelling from Tabl
0.00 0.00 <th< td=""><td>19.78 19.78 19.78 19.80 19.80</td></th<>	19.78 19.78 19.78 19.80 19.80
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	Utilisation factor for gains for rest of dwelling n2,m
191.91 168.61 175.82 155.86 151.47 133.52 126.49 141.19 141.69 161.70 173.19 186.70 (62)	1.00 0.99 0.98 0.92 0.77
Solar DHW input calculated using Appendix G or Appendix H	Mean internal temperature in the rest of dwelling T2 (follow steps 3
	17.71 18.01 18.52 19.16 19.59
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 63) Output from water heater for each month (kWh/month) (62)m + (63)m 63) 63) 63) 63)	
	Living area fraction
191.91 168.61 175.82 155.86 151.47 133.52 126.49 141.19 141.69 161.70 173.19 186.70	Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA)
$\sum (64) = 1008.15 (64)$	18.49 18.74 19.18 19.73 20.12
Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$	Apply adjustment to the mean internal temperature from Table 4e w
76.36 67.40 71.00 63.96 62.91 56.53 54.60 59.49 59.25 66.31 69.72 74.62 (65)	18.49 18.74 19.18 19.73 20.12
5. Internal gains	8. Space heating requirement
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	Jan Feb Mar Apr May
Metabolic gains (Table 5)	Utilisation factor for gains, ŋm
141.04 141.04 141.04 141.04 141.04 141.04 141.04 141.04 141.04 141.04 141.04 141.04 141.04 141.04 (66)	1.00 0.99 0.97 0.91 0.79
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	Useful gains, ηmGm, W (94)m x (84)m
24.34 21.62 17.58 13.31 9.95 8.40 9.08 11.80 15.84 20.11 23.47 25.02 (67)	632.88 785.30 960.78 1103.89 1066.8
Appliance gains (calculated in Appendix L, equation L13 a), also see Table 5	Monthly average external temperature from Table U1
273.03 275.86 268.72 253.52 234.34 216.30 204.26 201.42 208.56 223.76 242.95 260.98 (68)	4.30 4.90 6.50 8.90 11.70
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m
37.10 37.10 <th< td=""><td>2174.85 2116.73 1934.16 1632.12 1266.2</td></th<>	2174.85 2116.73 1934.16 1632.12 1266.2
Pump and fan gains (Table 5a)	Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (4
3.00 3.00 3.00 3.00 3.00 3.00 (70)	1147.23 894.72 724.19 380.33 148.35
Losses e.g. evaporation (Table 5)	1147.23 654.72 724.15 560.53 146.53
-112.83 -112.83 -112.83 -112.83 -112.83 (71)	Space besting requirement 1/1/h/m ² /vear
	Space heating requirement kWh/m ² /year
Water heating gains (Table 5)	9a. Energy requirements - individual heating systems including mic
102.63 100.29 95.44 88.84 84.55 78.52 73.39 79.96 82.30 89.13 96.84 100.30 (72)	Space heating
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (72)m	Fraction of space heat from secondary/supplementary system (table
468.31 466.08 450.05 423.98 397.15 371.54 355.04 361.50 375.01 401.31 431.57 454.61 (73)	Fraction of space heat from main system(s)
6. Solar gains	Fraction of space heat from main system 2
Access factor Area Solar flux g FF Gains	Fraction of total space heat from main system 1
Table 6d m ² W/m ² specific data W	Fraction of total space heat from main system 2
or Table 6b or Table 6c	Efficiency of main system 1 (%)
East 0.77 x 23.05 x 19.64 x 0.9 x 0.63 x 0.70 = 138.35 (76)	Jan Feb Mar Apr May
West 0.77 x 4.72 x 19.64 x 0.9 x 0.63 x 0.70 = 28.33 (80)	Space heating fuel (main system 1), kWh/month
Solar gains in watts ∑(74)m{82)m	1226.99 956.92 774.54 406.77 158.66
166.68 326.07 536.99 783.17 959.80 982.53 935.41 803.50 624.54 386.91 207.84 137.07 (83)	1220.55 550.52 774.54 400.77 158.00
Total gains - internal and solar (73)m + (83)m	Water heating
634.99 792.15 987.04 1207.15 1356.95 1354.07 1290.45 1165.00 999.55 788.22 639.40 591.68 (84)	Efficiency of water heater
7. Mean internal temperature (heating season)	88.79 88.62 88.19 87.11 84.76
Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)	Water heating fuel, kWh/month
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	216.13 190.28 199.36 178.93 178.70
Utilisation factor for gains for living area n1,m (see Table 9a)	
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	1.00	1.00	0.98	0.94	0.83	0.65	0.49	0.56	0.83	0.98	1.00	1.00	(86)
nternal te	emp of living	g area T1 (s	steps 3 to 7	in Table 9c	.)								
	19.44	19.64	19.99	20.44	20.78	20.94	20.99	20.98	20.83	20.35	19.81	19.41	(87)
rature du	ring heating	g periods in	the rest of	f dwelling fr	om Table 9	9, Th2(°C)							
	19.78	19.78	19.78	19.80	19.80	19.81	19.81	19.81	19.81	19.80	19.79	19.79	(88)
ion factor	for gains fo	or rest of d	welling n2,	m									
	1.00	0.99	0.98	0.92	0.77	0.55	0.37	0.43	0.75	0.96	0.99	1.00	(89)
nternal te	emperature	in the rest	of dwelling	g T2 (follow	steps 3 to	7 in Table 9	Əc)						
	17.71	18.01	18.52	19.16	19.59	19.78	19.81	19.80	19.68	19.05	18.27	17.67	(90)
irea fracti	on								Li	ving area ÷	(4) =	0.45	(91)
nternal te	emperature	for the wh	ole dwellin	g fLA x T1 +	(1 - fLA) x 1	Г2							
	18.49	18.74	19.18	19.73	20.12	20.30	20.34	20.33	20.20	19.64	18.96	18.45	(92)
djustmer	nt to the me	an interna	l temperati	ure from Ta	ble 4e whe	re appropr	iate						
	18.49	18.74	19.18	19.73	20.12	20.30	20.34	20.33	20.20	19.64	18.96	18.45	(93)
1													
ice heatin	g requirem												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
ion factor	for gains, r	ηm											-
	1.00	0.99	0.97	0.91	0.79	0.59	0.42	0.49	0.78	0.96	0.99	1.00	(94)
gains, ηm	Gm, W (94)m x (84)m	1					_					_
	632.88	785.30	960.78	1103.89	1066.86	805.16	548.27	569.92	776.01	756.73	634.98	590.23	(95)
ly average	e external te	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)
ss rate fo	r mean inte	rnal tempe	erature, Lm	, W [(39)m	x [(93)m -	(96)m]							
	2174.85	2116.73	1934.16	1632.12	1266.25	847.82	555.76	583.54	910.71	1358.52	1791.04	2162.87	(97)
neating re	quirement,	kWh/mon	th 0.024 x	[(97)m - (9	5)m] x (41)ı	m							
	1147.23	894.72	724.19	380.33	148.35	0.00	0.00	0.00	0.00	447.73	832.37	1170.05]
									∑(98	8)15, 10	.12 = 5	5744.97	(98)
neating re	quirement	kWh/m²/ye	ear							(98)	÷ (4)	51.74	(99)
													_
	irements -	individual	heating sy	stems inclu	ding micro	-CHP							
neating													1
n of space	e heat from	secondary	/suppleme	ntary system	m (table 11	.)						0.00	(201)
n of space	e heat from	main syste	em(s)							1 - (2	01) =	1.00	(202)
n of space	e heat from	main syste	em 2									0.00	(202)
n of total	space heat	from main	system 1						(20	02) x [1- (20	3)] =	1.00	(204)
n of total	space heat	from main	system 2							(202) x (2	03) =	0.00	(205)
icy of mai	n system 1	(%)										93.50	(206)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

	Jan	reb	Iviar	Арг	iviay	Jun	Jui	Aug	Sep	000	NOV	Dec
nting fu	el (main sy	stem 1), kV	Vh/month									
	1226.99	956.92	774.54	406.77	158.66	0.00	0.00	0.00	0.00	478.86	890.23	1251.39
				-	-							

	[
∑(211)15, 1012 =	6144.35	(211)

 88.79
 88.62
 88.19
 87.11
 84.76
 79.80
 79.80
 79.80
 79.80
 87.39
 88.46
 88.86
 (217)

216.13 190.28 199.36 178.93 178.70 167.31 158.51 176.93 177.56 185.03 195.78 210.11

		1
∑(219a)112 =	2234.64	(219)

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Annual totals			
Space heating fuel - main system 1		6144.35]
Water heating fuel		2234.64]
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		429.86	(232)
Total delivered energy for all uses	(211)(221) + (231) + (232)(237b) =	8883.86	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	6144.35] x	3.48	x 0.01 =	213.82	(240)
Water heating	2234.64	x	3.48) x 0.01 = [77.77	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	429.86	x	13.19	x 0.01 =	56.70	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)(242)	+ (245)(254) = [478.18	(255)

11a. SAP rating - individual heating systems including micro-CHP		
Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.29	(257)
SAP value	82.04]
SAP rating (section 13)	82	(258)
SAP band	В]

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	6144.35	x	0.216	= [1327.18	(261)
Water heating	2234.64	x	0.216	= [482.68	(264)
Space and water heating			(261) + (262) +	(263) + (264) = [1809.86	(265)
Pumps and fans	75.00	х	0.519	= [38.93	(267)
Electricity for lighting	429.86	х	0.519	= [223.10	(268)
Total CO ₂ , kg/year				(265)(271) = [2071.89	(272)
Dwelling CO₂ emission rate				(272) ÷ (4) =	18.66	(273)
El value				[82.21]
El rating (section 14)				[82	(274)
El band				[В]

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	6144.35	х	1.22	=	7496.11	(261)
Water heating	2234.64	х	1.22	=	2726.27	(264)
Space and water heating			(261) + (262) +	(263) + (264) =	10222.37	(265)
Pumps and fans	75.00	х	3.07	=	230.25	(267)
Electricity for lighting	429.86	х	3.07	=	1319.68	(268)
Primary energy kWh/year					11772.30	(272)

URN: WPB1-A1 version 14 NHER Plan Assessor version 6.3.4 SAP version 9.92 Dwelling primary energy rate kWh/m2/year

(273)

106.03

Newcombe House and Kensington Church Street Energy Strategy Addendum July 2018

APPENDIX 2 – SAMPLE 'BE LEAN' DER WORKSHEETS & BRUKL DOCUMENTS

hoare lea (H.)

Project	Newcombe House - CB (LEAN)
Revision	2
Version	7
Date	23/05/2018

Dwelling Reference	Dwelling Area (m²)	No. of Dwelling Type	TER	DER	Criterion 1 DER/TER Variance	TFEE	DFEE	Criterion 1 DFEE/TFEE Variance	Criterion 3 Overheating Strategy	Criterion 3 Overheating Risk
CB-A1	164.79	1	15.66	15.24	-2.70%	58.90	54.40	-7.65%	1.5	Medium
CB-A17 Duplex	333.64	1	14.86	14.20	-4.46%	64.95	61.11	-5.91%	1.9	Medium
CB-A2	162.36	1	16.50	16.75	1.52%	62.82	59.04	-6.02%	1.4	Medium
CB-A20 Duplex	365.9	1	13.92	13.20	-5.14%	60.95	56.66	-7.03%	1.9	Medium
CB-A21 Duplex	367.27	1	19.28	19.09	-0.96%	88.15	85.58	-2.92%	2.4	Medium
CB-A3	164.79	2	13.28	12.31	-7.31%	47.03	42.64	-9.35%	1.8	Medium
CB-A4	162.81	2	14.22	14.01	-1.49%	51.49	48.22	-6.35%	1.9	Medium
CB-A7	165.65	5	13.45	12.47	-7.29%	48.12	43.51	-9.59%	1.9	Medium
CB-A8	162.21	7	14.58	14.37	-1.46%	53.32	49.72	-6.75%	1.9	Medium
Area Weighted Results	4012.88	21	14.73	14.22	-3.42%	57.05	53.17	-6.80%		0

	Parameter	Value	Notes
	External Wall U-Values (W/m ² K)	0.25	As Calculated by BS EN ISO 6946
	Floor U-Values (W/m ² K)	0.09	As Calculated by BS EN ISO 6946
	Roof U-Values (W/m ² K)	0.18	As Calculated by BS EN ISO 6946
External Fabric	Glazing U-Value (W/m2K)	1.10	As Calculated by BS EN ISO 12567 or 10077 (U-Value includes glass and frame)
	G-Value (-)	0.55	(o value metudes glass and mame)
	Fraction Glazed (%)	0.80	Proportion of glass to overall opening size
	Fraction Glazed (76)	Fully Filled Cavity with	Proportion of glass to overall opening size
	To Other Apartments	Sealed Edges	
Internal Walls	To Corridors (W/m ² K)	0.18	As Calculated by BS EN ISO 6946
	To Risers (W/m ² K)	0.18	As Calculated by BS EN ISO 6946
	To Lift Shafts (W/m²K)	0.18	As Calculated by BS EN ISO 6946
	To Stair Wells (W/m ² K)	0.18	As Calculated by BS EN ISO 6946
Thermal Mass	Thermal Mass Parameter (Simple)	Low	Based on Construction of Walls, Floors, Roofs (including party and internal floors and ceilings)
Thermal Bridging	Thermal Bridge Specification	Default	No further information required on thermal bridges
Air Permeability	Air Permeability Rate (m3/hm2 at 50Pa)	3	As stated on a test certificate from a person registered by an authorised pressure testing scheme Note to use the measured air perm rate each dwelling has to be pressure t If a dwelling is not pressure tested the value used in the calculation is an as of the tested dwellings of the same type pus 2.
	Strategy	Balanced with Heat Recovery	
	SFP (W/I/s)	0.52 (K+1), 0.55 (K+2), 63 (K+3), 74 (K+4), 86 (K+5)	SAP Appendix Q Test Results
	Heat Exchange Efficiency (%)	92 (K+1), 92 (K+2), 90 (K+3), 89 (K+4), 89 (K+5)	SAP Appendix Q Test Results
Aechanical Ventilation	Installer approved	Yes	The installer has be registered with a Government Approved Scheme e.g. B Blue Flame Certification, Certsure, NAPIT and Stroma
	Duct Type	Rigid	All ductwork is rigid except for occasional flexible ducting to join compon together
	Ductwork Insulated	Yes	Ductwork can be assumed to be insulated if all of the ductwork is inside insulated envelope even if the ductwork itself is uninsulated.
	Category	Communal	
	Boilers - Fraction of Heat (-)	1	As design specification
	Boilers - Efficiency (%)	91.8	As calculated by SAP Appendix D
Space Heating	Heat Distribution System	Pre-insulated low temperature, variable flow (1991 or later)	District heating specification
	Controls	Charging system linked to use, programmer and TRVs	
	Controls Emitter		
		use, programmer and TRVs	
	Emitter Type	use, programmer and TRVs Underfloor (Screed)	
	Emitter Type Cylinder in Dwelling	use, programmer and TRVs Underfloor (Screed) From Main System	
	Emitter Type	use, programmer and TRVs Underfloor (Screed) From Main System	
Water Heating	Emitter Type Cylinder in Dwelling Plate Heat Exchanger	use, programmer and TRVs Underfloor (Screed) From Main System	
Water Heating	Emitter Type Cylinder in Dwelling Plate Heat Exchanger Volume (litres)	use, programmer and TRVs Underfloor (Screed) From Main System No Yes 5	
Water Heating	Emitter Type Cylinder in Dwelling Plate Heat Exchanger Volume (litres) Insulation Type Insulation Thickness (mm)	use, programmer and TRVs Underfloor (Screed) From Main System No Yes 5 Spray Foam	
0	Emitter Type Cylinder in Dwelling Plate Heat Exchanger Volume (litres) Insulation Type Insulation Thickness (mm) Waste Water Heat Recovery	use, programmer and TRVs Underfloor (Screed) From Main System No Yes 5 Spray Foam 25 No	
Water Heating Renewables	Emitter Type Cylinder in Dwelling Plate Heat Exchanger Volume (litres) Insulation Type Insulation Thickness (mm)	use, programmer and TRVs Underfloor (Screed) From Main System No Yes 5 Spray Foam 25 No 25 No None All Living Spaces and	
0	Emitter Type Cylinder in Dwelling Plate Heat Exchanger Volume (litres) Insulation Type Insulation Trickness (mm) Waste Water Heat Recovery Type Areas Cooled	use, programmer and TRVs Underfloor (Screed) From Main System No Yes 5 Spray Foam 25 No None All Living Spaces and Bedrooms	
Renewables	Emitter Type Cylinder in Dwelling Plate Heat Exchanger Volume (litres) Insulation Type Insulation Thickness (mm) Waste Water Heat Recovery Type Areas Cooled EER	use, programmer and TRVs Underfloor (Screed) From Main System No Yes 5 Spray Foam 25 No None All Living Spaces and Bedrooms 4.5	
Renewables	Emitter Type Cylinder in Dwelling Plate Heat Exchanger Volume (litres) Insulation Type Insulation Type Insulation Thickness (mm) Waste Water Heat Recovery Type Areas Cooled EER Controls	use, programmer and TRVs Underfloor (Screed) From Main System No Yes 5 Spray Foam 25 No Nore All Living Spaces and Bedrooms 4.5 Variable Speed Compressor	
Renewables	Emitter Type Cylinder in Dwelling Plate Heat Exchanger Volume (litres) Insulation Type Insulation Thickness (mm) Waste Water Heat Recovery Type Areas Cooled EER Controls Openable Windows	use, programmer and TRVs Underfloor (Screed) From Main System No Yes 5 Spray Foam 25 No None All Living Spaces and Bedrooms 4.5 Variable Speed Compressor No	
Renewables	Emitter Type Cylinder in Dwelling Plate Heat Exchanger Volume (litres) Insulation Type Insulation Type Insulation Thickness (mm) Waste Water Heat Recovery Type Areas Cooled EER Controls	use, programmer and TRVs Underfloor (Screed) From Main System No Yes 5 Spray Foam 25 No Nore All Living Spaces and Bedrooms 4.5 Variable Speed Compressor	

hoare lea (H.)

Project	Newcombe House - KCS1 (LEAN)
Revision	2
Version	7
Date	22/05/2018

Dwelling Reference	Dwelling Area (m²)	No. of Dwelling Type	TER	DER	Criterion 1 DER/TER Variance	TFEE	DFEE	Criterion 1 DFEE/TFEE Variance	Criterion 3 Overheating Strategy	Criterion 3 Overheating Risk
KCS1-A1	175.68	1	15.16	14.17	-6.57%	57.80	51.95	-10.12%	1.8	Medium
KCS1-A10	42.3	1	21.78	22.74	4.42%	58.86	66.26	12.57%	2.9	Medium
KCS1-A11	151	1	13.73	11.97	-12.80%	48.00	41.09	-14.40%	2.2	Medium
KCS1-A12	58.88	1	17.09	15.94	-6.76%	44.17	42.11	-4.66%	2.6	Medium
KCS1-A13	183.45	1	15.89	16.03	0.88%	62.25	59.91	-3.76%	2	Medium
KCS1-A14	151	1	16.04	15.87	-1.03%	59.61	57.18	-4.08%	2.2	Medium
KCS1-A15	58.88	1	19.40	19.77	1.91%	55.76	57.64	3.37%	2.2	Medium
KCS1-A2	42.3	1	21.78	21.28	-2.31%	58.86	62.44	6.09%	3	Medium
KCS1-A3	143.5	1	16.35	15.18	-7.15%	60.02	53.47	-10.91%	1.8	Medium
KCS1-A4	58.88	1	19.40	18.30	-5.68%	55.76	53.44	-4.16%	2.3	Medium
KCS1-A5	175.68	1	12.79	11.54	-9.76%	46.04	40.28	-12.51%	2.1	Medium
KCS1-A6	42.3	1	19.52	19.29	-1.20%	47.32	52.20	10.30%	3.3	Medium
KCS1-A7	143.5	1	14.00	12.53	-10.51%	48.26	41.87	-13.25%	2.1	Medium
KCS1-A8	58.88	1	17.09	15.93	-6.76%	44.17	42.11	-4.66%	2.6	Medium
KCS1-A9	183.45	1	13.48	12.13	-9.95%	50.16	43.90	-12.49%	2.1	Medium
Area Weighted Results	1669.68	15	15.64	14.77	-5.57%	53.54	49.66	-7.25%		0

Category	Parameter	Value	Notes
	External Wall U-Values (W/m ² K)	0.18	As Calculated by BS EN ISO 6946
	Floor U-Values (W/m ² K)	0.09	As Calculated by BS EN ISO 6946
	Roof U-Values (W/m ² K)	0.18	As Calculated by BS EN ISO 6946
External Fabric	Glazing U-Value (W/m2K)	1.10	As Calculated by BS EN ISO 12567 or 10077 (U-Value includes glass and frame)
	G-Value (-)	0.55	(2 1000 0000 0000 0000)
	Fraction Glazed (%)	0.80	Proportion of glass to overall opening size
		Fully Filled Cavity with	1 0 1 0
	To Other Apartments	Sealed Edges	
Internal Walls	To Corridors (W/m ² K)	0.18	As Calculated by BS EN ISO 6946
	To Risers (W/m ² K)	0.18	As Calculated by BS EN ISO 6946
	To Lift Shafts (W/m ² K)	0.18	As Calculated by BS EN ISO 6946
	To Stair Wells (W/m ² K)	0.18	As Calculated by BS EN ISO 6946
Thermal Mass	Thermal Mass Parameter (Simple)	Low	Based on Construction of Walls, Floors, Roofs (including party and internal floors and ceilings)
Thermal Bridging	Thermal Bridge Specification	Default	No further information required on thermal bridges
Air Permeability	Air Permeability Rate (m3/hm2 at 50Pa)	3	As stated on a test certificate from a person registered by an authorised pressure testing scheme Note to use the measured air perm rate each dwelling has to be pressure to If a dwelling is not pressure tested the value used in the calculation is an av
	Strategy	Balanced with Heat Recovery	of the tested dwellings of the same type plus 2.
	SFP (W/I/s)	0.52 (K+1), 0.55 (K+2), 63 (K+3), 74 (K+4), 86 (K+5)	SAP Appendix Q Test Results
	Heat Exchange Efficiency (%)	(K+3), 74 (K+4), 86 (K+5) 92 (K+1), 92 (K+2), 90 (K+3), 89 (K+4), 89 (K+5)	SAP Appendix Q Test Results
lechanical Ventilation	Installer approved	Yes	The installer has be registered with a Government Approved Scheme e.g. B Blue Flame Certification, Certsure, NAPIT and Stroma
	Duct Type	Rigid	All ductwork is rigid except for occasional flexible ducting to join compon together
	Ductwork Insulated	Yes	Ductwork can be assumed to be insulated if all of the ductwork is inside insulated envelope even if the ductwork itself is uninsulated.
	Category	Communal	
	Boilers - Fraction of Heat (-)	1	As design specification
	Boilers - Efficiency (%)	91.8	As calculated by SAP Appendix D
Space Heating	Heat Distribution System	Pre-insulated low temperature, variable flow (1991 or later)	District heating specification
	Controls	Charging system linked to use, programmer and TRVs	
	Emitter	Underfloor (Screed)	
	Туре	From Main System	
	Cylinder in Dwelling	No	
	Plate Heat Exchanger	Yes	
	Volume (litres)	1	
Water Heating	Insulation Type	Spray Foam	
	Insulation Thickness (mm)	30	
	Insulation Thickness (mm) Waste Water Heat Recovery	30 No	
Renewables		No	
Renewables	Waste Water Heat Recovery	No None All Living Spaces and	Private Units have Comfort Cooling
Renewables	Waste Water Heat Recovery Type Areas Cooled	No None All Living Spaces and Bedrooms	Private Units have Comfort Cooling Affordable Units have no Cooling
	Waste Water Heat Recovery Type Areas Cooled EER	No None All Living Spaces and Bedrooms 4.5	
	Waste Water Heat Recovery Type Areas Cooled EER Controls	No None All Living Spaces and Bedrooms 4.5 Variable Speed Compressor	
Cooling	Waste Water Heat Recovery Type Areas Cooled EER Controls Openable Windows	No None All Living Spaces and Bedrooms 4.5	
	Waste Water Heat Recovery Type Areas Cooled EER Controls	No None All Living Spaces and Bedrooms 4.5 Variable Speed Compressor No	

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Project	Newcombe House - KCS2 (LEAN)
Revision	2
Version	7
Date	22/05/2018

Dwelling Reference	Dwelling Area (m²)	No. of Dwelling Type	TER	DER	Criterion 1 DER/TER Variance	TFEE	DFEE	Criterion 1 DFEE/TFEE Variance	Criterion 3 Overheating Strategy	Criterion 3 Overheating Risk
KCS2-A1	110.05	1	16.35	15.39	-5.86%	54.74	51.32	-6.25%	2.4	Medium
KCS2-A2	50.2	1	19.84	18.43	-7.10%	53.83	51.63	-4.07%	2.3	Medium
KCS2-A3	140.6	1	16.03	14.66	-8.57%	58.21	50.77	-12.78%	1.7	Medium
KCS2-A4	110.05	1	14.11	12.71	-9.89%	43.46	40.48	-6.86%	2.7	Medium
KCS2-A5	50.2	1	17.51	15.57	-11.07%	42.13	40.25	-4.46%	2.6	Medium
KCS2-A6	140.6	1	13.73	11.73	-14.56%	46.61	39.06	-16.21%	2.0	Medium
KCS2-A7	110.05	1	17.19	17.05	-0.79%	59.07	59.43	0.61%	2.5	Medium
KCS2-A8	50.2	1	19.84	19.50	-1.69%	53.83	55.86	3.78%	2.2	Medium
KCS2-A9	140.6	1	16.60	16.02	-3.49%	61.20	57.43	-6.16%	1.8	Medium
Area Weighted Results	902.55	9	16.21	15.09	-6.93%	53.37	49.60	-7.07%		0

Category	Parameter	Value	Notes
	External Wall U-Values (W/m²K)	0.18	As Calculated by BS EN ISO 6946
	Floor U-Values (W/m²K)	0.09	As Calculated by BS EN ISO 6946
External Fabric	Roof U-Values (W/m²K)	0.18	As Calculated by BS EN ISO 6946
External Fabric	Glazing U-Value (W/m2K)	1.10	As Calculated by BS EN ISO 12567 or 10077 (U-Value includes glass and frame)
	G-Value (-)	0.55	
	Fraction Glazed (%)	0.80	Proportion of glass to overall opening size
	To Other Apartments	Fully Filled Cavity with Sealed Edges	
Internal Walls	To Corridors (W/m ² K)	0.18	As Calculated by BS EN ISO 6946
internal vvalis	To Risers (W/m ² K)	0.18	As Calculated by BS EN ISO 6946
	To Lift Shafts (W/m ² K)	0.18	As Calculated by BS EN ISO 6946
	To Stair Wells (W/m²K)	0.18	As Calculated by BS EN ISO 6946
Thermal Mass	Thermal Mass Parameter (Simple)	Low	Based on Construction of Walls, Floors, Roofs (including party and internal floors and ceilings)
Thermal Bridging	Thermal Bridge Specification	Default	No further information required on thermal bridges
Air Permeability	Air Permeability Rate (m3/hm2 at 50Pa)	3	As stated on a test certificate from a person registered by an authorised pressure testing scheme. Note to use the measured air perm rate each dwelling has to be pressure te If a dwelling is not pressure tested the value used in the calculation is an av of the tested dwelling of the same type plus 2.
	Strategy	Balanced with Heat Recover	y
	SFP (W/I/s)	0.52 (K+1), 0.55 (K+2), 63 (K+3), 74 (K+4), 86 (K+5)	SAP Appendix Q Test Results
	Heat Exchange Efficiency (%)	92 (K+1), 92 (K+2), 90 (K+3), 89 (K+4), 89 (K+5)	SAP Appendix Q Test Results
Mechanical Ventilation	Installer approved	Yes	The installer has be registered with a Government Approved Scheme e.g. B Blue Flame Certification, Certsure, NAPIT and Stroma
	Duct Type	Rigid	All ductwork is rigid except for occasional flexible ducting to join compone together
	Ductwork Insulated	Yes	Ductwork can be assumed to be insulated if all of the ductwork is inside insulated envelope even if the ductwork itself is uninsulated.
	Category	Communal	
	Boilers - Fraction of Heat (-)	1 91.8	As design specification
Space Heating	Boilers - Efficiency (%) Heat Distribution System	Pre-insulated low temperature, variable flow (1991 or later)	As calculated by SAP Appendix D District heating specification
	Controls	Charging system linked to use, programmer and TRVs	
	Emitter	Underfloor (Screed)	
	Туре	From Main System	
	Cylinder in Dwelling	No	
	Plate Heat Exchanger	Yes	
	Volume (litres)	1	
Water Heating	Insulation Type	Spray Foam	
	Insulation Thickness (mm)	30	
	Waste Water Heat Recovery	No	
Renewables	Туре	None	
	Openable Windows	No	
Summertime Overheating	Mechanical Ventilation Required	Yes Light-coloured curtain or	

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Project	Newcombe House - WPB1 (LEAN)
Revision	2
Version	7
Date	22/05/2018

Dwelling Reference	Dwelling Area (m²)	No. of Dwelling Type	TER	DER	Criterion 1 DER/TER Variance	TFEE	DFEE	Criterion 1 DFEE/TFEE Variance	Criterion 3 Overheating Strategy	Criterion 3 Overheating Risk
WPB1-A1	111.03	1	18.66	18.08	-3.14%	66.59	62.91	-5.52%	1.8	Medium
WPB1-A2	103.55	1	18.58	17.89	-3.75%	64.98	61.44	-5.45%	1.8	Medium
WPB1-A3	95.21	1	18.94	18.40	-2.86%	64.73	61.71	-4.67%	1.9	Medium
WPB1-A4	112.47	1	18.63	18.05	-3.11%	66.72	62.97	-5.62%	1.8	Medium
Area Weighted Results	422.26	4	18.70	18.10	-3.21%	65.81	62.29	-5.34%		0

Category	Parameter	Value	Notes
	External Wall U-Values (W/m ² K)	0.18	As Calculated by BS EN ISO 6946
	Floor U-Values (W/m ² K)	0.09	As Calculated by BS EN ISO 6946
External Fabric Internal Walls Thermal Mass Thermal Bridging Air Permeability Mechanical Ventilation	Roof U-Values (W/m ² K)	0.18	As Calculated by BS EN ISO 6946
External Fabric	Glazing U-Value (W/m2K)	1.10	As Calculated by BS EN ISO 12567 or 10077 (U-Value includes glass and frame)
	G-Value (-)	0.55	
	Fraction Glazed (%)	0.80	Proportion of glass to overall opening size
	To Other Apartments	Fully Filled Cavity with Sealed Edges	
lateral Malle	To Corridors (W/m ² K)	0.18	As Calculated by BS EN ISO 6946
internal vvalis	To Risers (W/m ² K)	0.18	As Calculated by BS EN ISO 6946
	To Lift Shafts (W/m ² K)	0.18	As Calculated by BS EN ISO 6946
	To Stair Wells (W/m²K)	0.18	As Calculated by BS EN ISO 6946
Thermal Mass	Thermal Mass Parameter (Simple)	Low	Based on Construction of Walls, Floors, Roofs (including party and internal v floors and ceilings)
Thermal Bridging	Thermal Bridge Specification	Default	No further information required on thermal bridges
Air Permeability	Air Permeability Rate (m3/hm2 at 50Pa)	3	As stated on a test certificate from a person registered by an authorised a pressure testing scheme. Note to use the measured air perm rate each dwelling has to be pressure test If a dwelling is not pressure tested the value used in the calculation is an ave of the tested dwelling of the same type plus 2.
	Strategy	Balanced with Heat Recovery	
	SFP (W/I/s)	0.52 (K+1), 0.55 (K+2), 63 (K+3), 74 (K+4), 86 (K+5)	SAP Appendix Q Test Results
	Heat Exchange Efficiency (%)	92 (K+1), 92 (K+2), 90 (K+3), 89 (K+4), 89 (K+5)	SAP Appendix Q Test Results
Mechanical Ventilation	Installer approved	Yes	The installer has be registered with a Government Approved Scheme e.g. BE Blue Flame Certification, Certsure, NAPIT and Stroma
	Duct Type	Rigid	All ductwork is rigid except for occasional flexible ducting to join compone together
	Ductwork Insulated	Yes	Ductwork can be assumed to be insulated if all of the ductwork is inside t insulated envelope even if the ductwork itself is uninsulated.
	Category	Communal	
	Boilers - Fraction of Heat (-)	1	As design specification
Space Heating	Boilers - Efficiency (%) Heat Distribution System	91.8 Pre-insulated low temperature, variable flow (1991 or later)	As calculated by SAP Appendix D District heating specification
	Controls	Charging system linked to use, programmer and TRVs	
	Emitter	Underfloor (Screed)	
	Туре	From Main System	
	Cylinder in Dwelling	No	
	Plate Heat Exchanger	Yes	
	Volume (litres)	5	
Water Heating	Insulation Type	Spray Foam	
	Insulation Thickness (mm)	25	
	Waste Water Heat Recovery	No	
Renewables	Туре	None	
	Openable Windows	No	
Summertime Overheating	Mechanical Ventilation Required	Yes Light-coloured curtain or	

DER Worksheet

Design - Draft



SAP version 9.92

Assessor name	Mr Liam Holden		Assessor number	10245
Client			Last modified	20/06/2018
Address	A1, London			
1. Overall dwelling dime	nsions			
		Area (m²)	Average storey height (m)	Volume (m³)
owest occupied		164.79 (1a) x	2.85 (2a) =	469.65 (3a)
fotal floor area	(1a) + (1b) + (1c) + (1d)			
welling volume	() () ()	,()	(3a) + (3b) + (3c) + (3d)(3n) = 469.65 (5)
-				
2. Ventilation rate				m ³ per hour
lumber of chimneys			0 × 40	
Number of chimneys			0 x 40 =	
Number of open flues Number of intermittent fa	ns		0 x 20 = 0 x 10 =	
Number of passive vents			0 x 10 =	
Number of flueless gas fire	25		0 x 40 =	
				Air changes per
				hour
nfiltration due to chimne		(6a) + (6b) + (7a) + (7b) + (= 0.00 (8)
f a pressurisation test has	been carried out or is intended	l, proceed to (17), otherwise continu	e from (9) to (16)	
		er hour per square metre of envelop	e area	3.00 (17)
	y value, then (18) = [(17) ÷ 20]	+ (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which	the dwelling is sheltered			1 (19)
Shelter factor			1 - [0.075 x (1	
nfiltration rate incorporat nfiltration rate modified f			(18) x (20) = 0.14 (21)
Jan	Feb Mar Apr	May Jun Jul	Aug Sep Oct	Nov Dec
Aonthly average wind spe		inay sain sain		
5.10	5.00 4.90 4.40	4.30 3.80 3.80	3.70 4.00 4.30	4.50 4.70 (22)
Wind factor (22)m ÷ 4				
1.28	1.25 1.23 1.10	0 1.08 0.95 0.95	0.93 1.00 1.08	1.13 1.18 (22a)
Adjusted infiltration rate (allowing for shelter and wind f	actor) (21) x (22a)m		
0.18	0.17 0.17 0.15	5 0.15 0.13 0.13	0.13 0.14 0.15	0.16 0.16 (22b)
Calculate effective air cha	nge rate for the applicable case	2:		
If mechanical ventilation	n: air change rate through syst	tem		0.50 (23a)
If balanced with heat r	ecovery: efficiency in % allowin	g for in-use factor from Table 4h		79.90 (23c)
a) If balanced mechani	cal ventilation with heat recove	ery (MVHR) (22b)m + (23b) x [1 - (23	c) ÷ 100]	
0.28	0.27 0.27 0.25		0.23 0.24 0.25	0.26 0.26 (24a)
ffective air change rate -	enter (24a) or (24b) or (24c) or			
0.28	0.27 0.27 0.25	5 0.25 0.23 0.23	0.23 0.24 0.25	0.26 0.26 (25)

3. Heat losses and heat loss parameter										
Element	Gross area, m ²	Openings m ²		area m²	U-value W/m²K	A x U W		alue, 'm².K	Ахк, kJ/K	
Window			43	.25 x	1.05	= 45.57				(27)
Ground floor			164	I.79 x	0.09	= 14.83				(28a)
External wall			95	.46 x	0.25	= 23.87				(29a)
External wall			30	.12 x	0.18	= 5.42				(29a)
Party wall			9.	58 x	0.00	= 0.00				(32)
Total area of external elements $\Sigma A,m^2$			333	8.62						(31)
Fabric heat loss, $W/K = \sum(A \times U)$						(26	5)(30) + (3	(2) =	89.69	(33)
Heat capacity Cm = Σ(A x κ)					(28)	.(30) + (32) -	+ (32a)(32	e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K									100.00	(35)
Thermal bridges: $\Sigma(L \times \Psi)$ calculated using	oppendix K								50.04	(36)
Total fabric heat loss							(33) + (3	6) =	139.73	(37)
Jan Feb P	lar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0	33 x (25)m x (5)									
42.99 42.46 4	92 39.23	38.69	36.00	36.00	35.47	37.08	38.69	39.77	40.84	(38)
Heat transfer coefficient, W/K (37)m + (38	m									
182.72 182.19 18	1.65 178.96	178.42	175.74	175.74	175.20	176.81	178.42	179.50	180.57	
						Average = 2	(39)112/	12 =	178.83	(39)
Heat loss parameter (HLP), W/m ² K (39)m -	(4)									
1.11 1.11 1	.10 1.09	1.08	1.07	1.07	1.06	1.07	1.08	1.09	1.10	
						Average = 2	(40)112/	12 =	1.09	(40)
Number of days in month (Table 1a)										
31.00 28.00 3	.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										
Assumed occupancy, N									2.96	(42)
Annual average hot water usage in litres pe	r dav Vd.average	e = (25 x N) +	36						104.39	(43)
	lar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each r	ionth Vd,m = fac	tor from Tak	ole 1c x (43)	-	-				
	6.48 102.31	98.13	93.95	93.95	98.13	102.31	106.48	110.66	114.83	7
						1	∑(44)1	12 = 1	252.73	(44)
Energy content of hot water used = 4.18 x	/d,m x nm x Tm/	3600 kWh/n	nonth (see	Tables 1b,	. 1c 1d)		2.			
170.29 148.94 15	3.69 133.99	128.57	110.95	102.81	117.97	119.38	139.13	151.87	164.92	
							<u>Σ</u> (45)1	12 = 1	642.52	(45)
Distribution loss 0.15 x (45)m								<u> </u>		_
25.54 22.34 2	.05 20.10	19.29	16.64	15.42	17.70	17.91	20.87	22.78	24.74	(46)
Storage volume (litres) including any solar	or WWHRS stora	ge within sar	ne vessel						1.00	(47)
Water storage loss:										
b) Manufacturer's declared loss factor is no	t known									
Hot water storage loss factor from Table	2 (kWh/litre/da	iy)							0.02	(51)
Volume factor from Table 2a									4.93	(52)
Temperature factor from Table 2b									1.00	(53)
Energy lost from water storage (kWh/d	y) (47) x (51) x (52) x (53)							0.10	(54)
Enter (50) or (54) in (55)									0.10	(55)
Water storage loss calculated for each mor	th (55) x (41)m									
· · · · · · · · · · · · · · · · · · ·	.24 3.13	3.24	3.13	3.24	3.24	3.13	3.24	3.13	3.24	(56)
		• •							•	

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If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] \div (47), else (56)	Temperature during heating periods in the living area from Table 9, Th1(°C) (85)
3.24 2.92 3.24 3.13 3.24 3.13 3.24 3.13 3.24 3.13 3.24 (57)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Primary circuit loss for each month from Table 3	Utilisation factor for gains for living area n1,m (see Table 9a)
23.26 21.01 23.26 22.51 23.26 22.51 23.26 23.26 22.51 23.26 23.26 (59)	0.97 0.95 0.90 0.81 0.69 0.54 0.41 0.46 0.67 0.87 0.95 0.98 (86)
Combi loss for each month from Table 3a, 3b or 3c	Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 (61)	18.61 19.00 19.52 20.12 20.57 20.85 20.95 20.93 20.72 20.08 19.23 18.55 (87)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)
196.79 172.88 180.19 159.64 155.07 136.59 129.31 144.47 145.03 165.63 177.52 191.42 (62)	19.99 20.00 20.00 20.01 20.01 20.03 20.03 20.03 20.02 20.01 20.01 20.00 (88)
Solar DHW input calculated using Appendix G or Appendix H	Utilisation factor for gains for rest of dwelling n2,m
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 (63)	0.97 0.94 0.88 0.79 0.65 0.48 0.33 0.38 0.61 0.84 0.95 0.97 (89)
Output from water heater for each month (kWh/month) (62)m + (63)m	Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)
196.79 172.88 180.19 159.64 155.07 136.59 129.31 144.47 145.03 165.63 177.52 191.42	16.79 17.35 18.10 18.94 19.54 19.89 19.99 19.98 19.74 18.90 17.69 16.70 (90)
$\Sigma(64)112 = 1954.54 $ (64)	Living area fraction Living area \div (4) = 0.52 (91)
Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$	Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2
77.82 68.67 72.30 65.07 63.95 57.41 55.38 60.43 60.21 67.46 71.01 76.04 (65)	17.73 18.20 18.83 19.55 20.07 20.38 20.47 20.25 19.51 18.48 17.65 (92)
77.62 08.07 72.50 05.07 05.55 57.41 55.56 00.45 00.21 07.40 71.01 70.04 (05)	Apply adjustment to the mean internal temperature from Table 4e where appropriate
5. Internal gains	17.73 18.20 18.83 19.55 20.07 20.38 20.47 20.25 19.51 18.48 17.65 (93)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	
Metabolic gains (Table 5)	8. Space heating requirement
147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 147.78 (66)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	Utilisation factor for gains, ŋm
29.97 26.62 21.65 16.39 12.25 10.34 11.18 14.53 19.50 24.76 28.90 30.81 (67)	0.95 0.92 0.86 0.77 0.65 0.50 0.37 0.41 0.62 0.83 0.93 0.96 (94)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	Useful gains, ŋmGm, W (94)m x (84)m
336.20 339.69 330.89 312.18 288.55 266.35 251.52 248.03 256.82 275.53 299.16 321.36 (68)	864.90 1085.31 1244.65 1305.22 1199.41 914.16 649.87 668.22 897.92 978.85 872.35 802.63 (95)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	Monthly average external temperature from Table U1
37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 37.78 (69)	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)
Pump and fan gains (Table 5a)	Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 (70)	2453.60 2422.80 2240.29 1905.95 1494.28 1016.32 682.55 712.76 1086.51 1589.86 2043.28 2429.30 (97)
Losses e.g. evaporation (Table 5)	Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m
-118.22 -118.22	1182.00 898.80 740.76 432.53 219.38 0.00 0.00 0.00 454.59 843.07 1210.24
Water heating gains (Table 5)	Σ(98)15, 1012 = 5981.35 (98)
104.60 102.19 97.18 90.37 85.95 79.73 74.44 81.22 83.63 90.67 98.63 102.20 (72)	Space heating requirement kWh/m ² /year (98) ÷ (4) 36.30 (99)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	
538.10 535.83 517.06 486.28 454.09 423.76 404.47 411.11 427.28 458.30 494.02 521.70 (73)	8c. Space cooling requirement
	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
6. Solar gains	Heat loss rate Lm
Access factor Area Solar flux g FF Gains Table 6d m ² W/m ² specific data specific data W	0.00 0.00 0.00 0.00 0.00 1651.91 1300.44 1331.50 0.00 0.00 0.00 0.00 (100)
or Table 6b or Table 6c	Utilisation factor for loss nm
North $0.77 \times 9.09 \times 10.63 \times 0.9 \times 0.55 \times 0.80 = 29.47$ (74)	0.00 0.00 0.00 0.00 0.00 0.83 0.88 0.86 0.00 0.00 0.00 (101)
East 0.77 x 15.15 x 19.64 x 0.9 x 0.55 x 0.80 = 90.73 (76)	Useful loss nmLm (watts) (100)m x (101)m
South 0.77 x 16.18 x 46.75 x 0.9 x 0.55 x 0.80 = 230.66 (78)	0.00 0.00 0.00 0.00 0.00 1377.96 1149.02 1145.93 0.00 0.00 0.00 (102)
West 0.77 x 2.83 x 19.64 x 0.9 x 0.55 x 0.80 = 16.95 (80)	Gains
Solar gains in watts Σ(74)m(82)m	0.00 0.00 0.00 0.00 0.00 2256.40 2163.65 2006.03 0.00 0.00 0.00 (103)
367.81 644.72 923.79 1203.51 1393.85 1401.80 1344.14 1200.78 1021.19 724.43 444.03 312.43 (83)	Space cooling requirement, whole dwelling, continuous (kWh) 0.024 x [(103)m - (102)m] x (41)m
Total gains - internal and solar (73)m + (83)m	0.00 0.00 0.00 0.00 0.00 632.48 754.88 639.92 0.00 0.00 0.00 0.00
905.91 1180.55 1440.85 1689.78 1847.94 1825.56 1748.60 1611.89 1448.46 1182.73 938.04 834.13 (84)	$\Sigma(104)68 = 2027.28 $ (104)
	Cooled fraction cooled area ÷ (4) = 0.82 (105)
7. Mean internal temperature (heating season)	Intermittency factor (Table 10)
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													_
[0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.25	0.00	0.00	0.00	0.00]
										∑(106)6	8 =	0.75	(106)
Space cooling red	quirement	(104)m x (1	.05) x (106)	m									
[0.00	0.00	0.00	0.00	0.00	129.77	154.88	131.29	0.00	0.00	0.00	0.00]
										∑(107)6	8 =	415.94	(107)
Space cooling red	quirement	kWh/m²/ye	ear							(107) ÷	(4) =	2.52	(108)
9b. Energy requ	irements -	communit	y heating s	cheme									
Fraction of space	heat from	secondary	/suppleme	ntary syste	m (table 11	.)				'0' if ı	none 🗌	0.00	(301)
Fraction of space	heat from	communit	y system							1 - (30	01) =	1.00	(302)
Fraction of comm	nunity heat	t from boile	rs									1.00	(303a
Fraction of comm	nunity heat	t from CHP										0.00	(303b

Fraction of total space heat from community boilers Factor for control and charging method (Table 4c(3)) for community space heating Factor for charging method (Table 4c(3)) for community water heating Distribution loss factor (Table 12c) for community heating system

Space heating

Annual space heating requirement Space heat from CHP Space heat from boilers

Fraction of total space heat from community CHP

Water heating

Annual water heating requirement	1954.54	(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) = 2052.27	(310a)
Electricity used for heat distribution	0.01 × [(307a)(307e) + (310a)(310e)] = 83.33	(313)

Cooling System Energy Efficiency Ratio			[6.08	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)			(107) ÷ (314)	68.47	(315)
Electricity for pumps, fans and electric keep-hot (Table 4f)					
mechanical ventilation fans - balanced, extract or positive input	from outside	379.60			(330a)
Total electricity for the above, kWh/year			[379.60	(331)
Electricity for lighting (Appendix L)			[529.32	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)(337b) =	9310.07	(338)

10b. Fuel costs - community heating scheme

	Fuel	Fuel Fuel price				
	kWh/year				Fuel cost £/year	
Space heating from CHP	0.00	х	2.97	x 0.01 =	0.00	(340a)
Space heating from boilers	6280.42	х	4.24	x 0.01 =	266.29	(340b)
Water heating from boilers	2052.27	х	4.24	x 0.01 =	87.02	(342a)
Space cooling	68.47	х	13.19	x 0.01 =	9.03	(348)
Pumps and fans	379.60	х	13.19	x 0.01 =	50.07	(349)
Electricity for lighting	529.32	х	13.19	x 0.01 =	69.82	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)(342e) +	+ (345)(354) =	602.22	(355)

11b. SAP rating - community heating scheme

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(302) x (303a) =

(302) x (303b) =

5981.35

(98) x (304a) x (305) x (306) =

(98) x (304b) x (305) x (306) =

0.00

1.00

1.00

1.00

1.05

0.00

6280.42

(304a)

(304b)

(305)

(305a)

(306)

(98)

(307b)

(307a)

Energy cost deflator (Table 12)	
Energy cost factor (ECF)	
SAP value	
SAP rating (section 13)	
SAP band	

12b. CO₂ emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)						
Power efficiency of CHP unit	31.50					(361)
Heat efficiency of CHP unit	48.50					(362)
Emissions from other sources (space heating)						
Efficiency of boilers	91.80					(367b)
CO2 emissions from boilers [(307b)+(310b)] x 100 ÷ (367b) =	9077.00	x	0.216	= [1960.63	(368)
Electrical energy for community heat distribution	83.33	x	0.519	= [43.25	(372)
Total CO2 associated with community systems				[2003.88	(373)
Total CO2 associated with space and water heating					2003.88	(376)
Space cooling	68.47	x	0.519	= [35.53	(377)
Pumps and fans	379.60	x	0.519	=	197.01	(378)
Electricity for lighting	529.32	x	0.519	=	274.72	(379)
Total CO ₂ , kg/year				(376)(382) =	2511.14	(383)
Dwelling CO ₂ emission rate				(383) ÷ (4) =	15.24	(384)
El value				[83.96]
El rating (section 14)				[84	(385)
El band				[В]

13b. Primary energy - community heating scheme Energy kWh/year Primary Energy from community CHP (space and water heating)

Primary Energy from community CHP	(space and water heating)						
Power efficiency of CHP unit		31.50					(361)
Heat efficiency of CHP unit		48.50					(362)
Primary energy from other sources (s	pace heating)						
Efficiency of boilers	[91.80					(367b)
Primary energy from boilers [(307	7b)+(310b)] x 100 ÷ (367b) = [9077.00	х	1.22	=	11073.94	(368)
Electrical energy for community heat	distribution	83.33	х	3.07	=	255.81	(372)
Total primary energy associated with	community systems					11329.76	(373)
Total primary energy associated with	space and water heating					11329.76	(376)
Space cooling		68.47	х	3.07	=	210.19	(377)
Pumps and fans		379.60	х	3.07	=	1165.36	(378)
Electricity for lighting		529.32	х	3.07	=	1625.01	(379)
Primary energy kWh/year						14330.32	(383)
Dwelling primary energy rate kWh/m	2/year					86.96	(384)

Primary factor

Primary energy

(kWh/year)

0.42

1.21

83.18

83

В

(356)

(357)

(358)

DER Worksheet

Design - Draft



3. Heat losses and heat loss parameter

Gross

area, m²

Openings

m²

Net area

A, m²

U-value

W/m²K

Element

This design submission ha	is been carried out using Approved SAP software. It has been prepar	ed from plans and specification	s and may not reflect the	Window 50.94 x 1.05 = 53.67
property as constructed.				Ground floor 175.65 x 0.09 = 15.81
				External wall 126.94 x 0.18 = 22.85
Assessor name	Mr Liam Holden	Assessor number	10245	Total area of external elements ∑A, m ²
Client		Last modified	20/06/2018	Fabric heat loss, W/K = $\Sigma(A \times U)$ (26)(30) + (32) = 92.33
Address	A1, London			Heat capacity $Cm = \Sigma(A \times \kappa)$ (28)(30) + (32) + (32a)(32e) = N/A
				Thermal mass parameter (TMP) in kJ/m ² K
1. Overall dwelling dime	ensions			Thermal bridges: $\Sigma(L \times \Psi)$ calculated using Appendix K 53.03
	Area (m²)	Average storey height (m)	Volume (m ³)	Total fabric heat loss (33) + (36) = 145.36
				Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
owest occupied	175.68 (1a) x	2.70 (2a) =	474.34 (3a)	Ventilation heat loss calculated monthly 0.33 x (25)m x (5) 43.42 42.88 42.34 39.62 39.08 36.36 36.36 35.82 37.45 39.08 40.16 41.25
otal floor area	(1a) + (1b) + (1c) + (1d)(1n) = 175.68 (4)		(a.). [] (a)	43.42 42.88 42.34 39.62 39.08 36.36 36.36 35.82 37.45 39.08 40.16 41.25 Heat transfer coefficient, W/K (37)m + (38)m 40.16 41.25 41.25 41.25 41.25 41.25
Owelling volume		(3a) + (3b) + (3c) + (3d)	(3n) = <u>474.34</u> (5)	Intel transfer coefficient, w/k (37)/11 + (36)/11 188.78 188.24 187.70 184.98 184.44 181.72 181.72 181.18 182.81 184.44 185.52 186.66
2. Ventilation rate		· · · · · · · · · · · · · · · · · · ·		
			m ³ per hour	Average = $\Sigma(39)112/12 = 184.85$
Number of chimneys		0 x 40		Heat loss parameter (HLP), W/m ² K (39)m ÷ (4) 1.07 1.07 1.07 1.05 1.05 1.03 1.03 1.03 1.04 1.05 1.06 1.06
Number of open flues		0 x 20		
Number of intermittent fa	ans	0 x 10		Average = $\Sigma(40)112/12$ = 1.05 Number of days in month (Table 1a)
lumber of passive vents		0 x 10		31.00 28.00 31.00 30.00 31.00 30.00 31.00 30.00 31.00
Number of flueless gas fire	es	0 x 40		<u>31.00</u> 20.00 <u>31.00</u> <u>30.00</u> <u>31.00</u> <u>31.00</u> <u>31.00</u> <u>31.00</u> <u>31.00</u> <u>31.00</u> <u>30.00</u> <u>31.00</u>
tamber of naciess gas int			Air changes per	4. Water heating energy requirement
			hour	Assumed occupancy, N 2.97
nfiltration due to chimne	ys, flues, fans, PSVs (6a) + (6b) + (7a) + (7b) + (7	7c) = 0 ÷ (5)	= 0.00 (8)	Annual average hot water usage in litres per day Vd,average = (25 x N) + 36
f a pressurisation test has	s been carried out or is intended, proceed to (17), otherwise continue	e from (9) to (16)		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Air permeability value, q5	0, expressed in cubic metres per hour per square metre of envelope	area	3.00 (17)	Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)
i based on air permeabilit	ty value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)	115.21 111.02 106.84 102.65 98.46 94.27 94.27 98.46 102.65 106.84 111.02 115.21
Number of sides on which	n the dwelling is sheltered		1 (19)	Σ(44)112 = 1256.89
helter factor		1 - [0.075 x (19)] = 0.93 (20)	Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)
Infiltration rate incorporat	ting shelter factor	(18) x	(20) = 0.14 (21)	170.86 149.44 154.20 134.44 129.00 111.31 103.15 118.37 119.78 139.59 152.37 165.4
nfiltration rate modified f	for monthly wind speed:			Σ(45)112 = 1647.98
Jan	Feb Mar Apr May Jun Jul	Aug Sep Oct	Nov Dec	Distribution loss 0.15 x (45)m
Monthly average wind spe	eed from Table U2			25.63 22.42 23.13 20.17 19.35 16.70 15.47 17.75 17.97 20.94 22.86 24.82
5.10	5.00 4.90 4.40 4.30 3.80 3.80	3.70 4.00 4.30	4.50 4.70 (22)	Storage volume (litres) including any solar or WWHRS storage within same vessel 1.00
Wind factor (22)m ÷ 4				Water storage loss:
1.28	1.25 1.23 1.10 1.08 0.95 0.95	0.93 1.00 1.08	1.13 1.18 (22a)	b) Manufacturer's declared loss factor is not known
Adjusted infiltration rate ((allowing for shelter and wind factor) (21) x (22a)m			Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02
0.18	0.17 0.17 0.15 0.15 0.13 0.13	0.13 0.14 0.15	0.16 0.16 (22b)	Volume factor from Table 2a 4.93
Calculate effective air cha	nge rate for the applicable case:			Temperature factor from Table 2b 1.00
If mechanical ventilation	on: air change rate through system		0.50 (23a)	Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53) 0.10
If balanced with heat r	recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)	Enter (50) or (54) in (55) 0.10
a) If balanced mechani	ical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c	:) ÷ 100]		Water storage loss calculated for each month (55) x (41)m
0.28	0.27 0.27 0.25 0.25 0.23 0.23	0.23 0.24 0.25	0.26 0.26 (24a)	3.24 2.92 3.24 3.13 3.24 3.13 3.24 3.13 3.24 3.13 3.24
ffective air change rate -	enter (24a) or (24b) or (24c) or (24d) in (25)			If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)
0.28	0.27 0.27 0.25 0.25 0.23 0.23	0.23 0.24 0.25	0.26 0.26 (25)	3.24 2.92 3.24 3.13 3.24
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A x U W/K

к-value,

kJ/m².K

Ахк,

kJ/K

31.00 30.00 31.00 (40)

 $\Sigma(44)1...12 = 1256.89$ (44)

 $\Sigma(45)1...12 = 1647.98$ (45)

20.94 22.86 24.82 (46) 1.00

41.25 (38)

(27)

(28a)

(29a) (31)

(33)

(34)

(35) (36)

(37)

(39)

(40)

(42) (43)

(47)

(51)

(52) (53)

(54)

(55)

3.24 (56)

3.24 (57)

Primary circuit loss for each month from Table 3	0.97 0.94 0.88 0.77 0.63 0.48 0.36 0.41 0.62 0.86 0.95 0.98 (86)
23.26 21.01 23.26 22.51 23.26 <th< td=""><td>Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)</td></th<>	Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)
Combi loss for each month from Table 3a, 3b or 3c	18.67 19.09 19.66 20.27 20.68 20.89 20.96 20.95 20.77 20.16 19.29 18.60 (87)
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 (61)	Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	20.02 20.02 20.03 20.04 20.04 20.05 20.05 20.06 20.05 20.04 20.04 20.03 (88)
197.36 173.37 180.70 160.08 155.50 136.96 129.65 144.87 145.42 166.09 178.02 191.97 (62)	Utilisation factor for gains for rest of dwelling n2,m
Solar DHW input calculated using Appendix G or Appendix H	0.97 0.93 0.87 0.75 0.59 0.42 0.29 0.33 0.56 0.83 0.95 0.98 (89)
0.00 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)	Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)
Output from water heater for each month (kWh/month) (62)m + (63)m	16.89 17.49 18.31 19.16 19.69 19.96 20.03 20.02 19.83 19.03 17.79 16.80 (90)
197.36 173.37 180.70 160.08 155.50 136.96 129.65 144.87 145.42 166.09 178.02 191.97	Living area fraction
$\Sigma(64)112 = 1960.00$ (64)	Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2
Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	17.82 18.33 19.01 19.74 20.21 20.45 20.52 20.51 20.32 19.62 18.57 17.74 (92)
78.01 68.84 72.47 65.22 64.09 57.53 55.50 60.56 60.34 67.61 71.18 76.22 (65)	Apply adjustment to the mean internal temperature from Table 4e where appropriate
	17.82 18.33 19.01 19.74 20.21 20.45 20.52 20.51 20.32 19.62 18.57 17.74 (93)
5. Internal gains	
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	8. Space heating requirement
Metabolic gains (Table 5)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
148.51 148.51<	Utilisation factor for gains, ηm
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	0.96 0.92 0.85 0.74 0.60 0.45 0.33 0.37 0.58 0.82 0.93 0.96 (94)
30.96 27.50 22.36 16.93 12.66 10.69 11.55 15.01 20.14 25.58 29.85 31.82 (67)	Useful gains, ηmGm, W (94)m x (84)m
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	908.88 1171.61 1384.03 1467.34 1328.59 986.71 689.26 711.31 976.18 1065.30 924.67 838.21 (95)
347.30 350.90 341.82 322.49 298.08 275.14 259.82 256.22 265.30 284.63 309.04 331.98 (68)	Monthly average external temperature from Table U1
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	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)
37.85 37.85	Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]
Pump and fan gains (Table 5a)	2552.91 2528.02 2348.91 2004.92 1568.97 1062.76 712.23 744.18 1137.63 1663.13 2128.35 2526.93 (97)
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 (70)	Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m
Losses e.g. evaporation (Table 5)	1223.16 911.51 717.87 387.06 178.84 0.00 0.00 0.00 444.78 866.65 1256.40
-118.80 -118.80 -118.80 -118.80 -118.80 -118.80 -118.80 -118.80 -118.80 -118.80 -118.80 -118.80 -118.80 -118.80 -118.80 (71)	Σ(98)15, 1012 = <u>5986.28</u> (98)
Water heating gains (Table 5)	Space heating requirement kWh/m ² /year (98) ÷ (4) 34.07 (99)
104.85 102.43 97.41 90.58 86.14 79.90 74.59 81.39 83.81 90.88 98.86 102.44 (72)	
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	9b. Energy requirements - community heating scheme
550.67 548.39 529.15 497.55 464.44 433.28 413.51 420.17 436.80 468.64 505.30 533.79 (73)	Fraction of space heat from secondary/supplementary system (table 11) '0' if none 0.00 (301)
	Fraction of space heat from community system 1 - (301) = 1.00 (302)
6. Solar gains	Fraction of community heat from boilers 1.00 (303a)
Access factor Area Solar flux g FF Gains Table 6d m ² W/m ² specific data specific data W	Fraction of community heat from CHP 0.00 (303b)
or Table 6b or Table 6c	Fraction of total space heat from community CHP (302) x (303a) = 0.00 (304a)
East 0.77 x 20.62 x 19.64 x 0.9 x 0.55 x 0.80 = 123.49 (76)	Fraction of total space heat from community boilers (302) x (303b) = 1.00 (304b)
South 0.77 x 11.45 x 46.75 x 0.9 x 0.55 x 0.80 = 163.23 (78)	Factor for control and charging method (Table 4c(3)) for community space heating 1.00 (305)
West 0.77 x 18.87 x 19.64 x 0.9 x 0.55 x 0.80 = 113.01 (80)	Factor for charging method (Table 4c(3)) for community water heating 1.00 (305a)
Solar gains in watts ∑(74)m(82)m	Distribution loss factor (Table 12c) for community heating system 1.05 (306)
399.72 729.96 1102.41 1496.04 1762.84 1779.99 1704.28 1506.24 1241.83 837.29 488.36 335.52 (83)	
Total gains - internal and solar (73)m + (83)m	Space heating
950.39 1278.35 1631.56 1993.59 2227.27 2213.27 2117.79 1926.41 1678.63 1305.93 993.66 869.32 (84)	Annual space heating requirement 5986.28 (98)
	Space heat from CHP (98) x (304a) x (305) x (306) = 0.00 (307a)
7. Mean internal temperature (heating season)	Space heat from boilers (98) x (304b) x (305) x (306) = 6285.59 (307b)
Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)	
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	Water heating
Utilisation factor for gains for living area n1,m (see Table 9a)	Annual water heating requirement 1960.00 (64)
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Water heat from boilers	(64) x (303a) x (305a) x (306) =	2058.00 (310a)
Electricity used for heat distribution	0.01 × [(307a)(307e) + (310a)(310e)] =	83.44 (313)
Electricity for pumps, fans and electric keep-hot (Table 4f)		
mechanical ventilation fans - balanced, extract or positive input from outside	383.38	(330a)

Total electricity for the above, kWh/year		383.38	(331)
Electricity for lighting (Appendix L)		546.80	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)(337b) =	9273.77	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	0.00	х	2.97	x 0.01 =	0.00	(340a)
Space heating from boilers	6285.59	х	4.24	x 0.01 =	266.51	(340b)
Water heating from boilers	2058.00	x	4.24	x 0.01 =	87.26	(342a)
Pumps and fans	383.38	x	13.19	x 0.01 =	50.57	(349)
Electricity for lighting	546.80	x	13.19	x 0.01 =	72.12	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)(342e) +	(345)(354) =	596.46	(355)

11b. SAP rating - community neating scheme			
Energy cost deflator (Table 12)	0.	42	(356)
Energy cost factor (ECF)	1.	14	(357)
SAP value	84	.16	
SAP rating (section 13)	8	34	(358)
SAP band		В	

12b. CO₂ emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CH	IP (space and water heating)						
Power efficiency of CHP unit		31.50					(361)
Heat efficiency of CHP unit		48.50					(362)
Emissions from other sources	(space heating)						
Efficiency of boilers		91.80					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	9088.87	x	0.216	=	1963.20	(368)
Electrical energy for communi	ty heat distribution	83.44	x	0.519	=	43.30	(372)
Total CO2 associated with com	nmunity systems					2006.50	(373)
Total CO2 associated with spa	ce and water heating					2006.50	(376)
Pumps and fans		383.38	х	0.519	=	198.98	(378)
Electricity for lighting		546.80	х	0.519	=	283.79	(379)
Total CO₂, kg/year					(376)(382) =	2489.26	(383)
Dwelling CO ₂ emission rate					(383) ÷ (4) =	14.17	(384)
EI value						84.88]
El rating (section 14)						85	(385)
El band						В]
13b. Primary energy - comm	unity heating scheme						
		Energy kWh/year		Primary factor		Primary energy (kWh/year)	1
		Page 5				URN: KCS1-A1 ve an Assessor vers	

Primary Energy from community CHP (space and water heating)						
Power efficiency of CHP unit	31.50					(361)
Heat efficiency of CHP unit	48.50					(362)
Primary energy from other sources (space heating)						
Efficiency of boilers	91.80					(367b)
Primary energy from boilers [(307b)+(310b)] x 100 ÷ (367b) =	9088.87	х	1.22	=	11088.43	(368)
Electrical energy for community heat distribution	83.44	х	3.07	=	256.15	(372)
Total primary energy associated with community systems					11344.57	(373)
Total primary energy associated with space and water heating					11344.57	(376)
Pumps and fans	383.38	х	3.07	=	1176.98	(378)
Electricity for lighting	546.80	х	3.07	=	1678.67	(379)
Primary energy kWh/year					14200.23	(383)
Dwelling primary energy rate kWh/m2/year					80.83	(384)

Page 5

DER Worksheet

Design - Draft



Assessor name	Mr Liam	Holden					As	sessor num	ber	10245	5	
Client							La	st modified		20/06	5/2018	
Address	A1, Lond	lon										
1. Overall dwelling dir	mensions											
				A	rea (m²)			age storey eight (m)		Vo	olume (m³)	
Lowest occupied					110.05	<mark>(1a)</mark> x		2.70	(2a) =		297.14	(3a)
Total floor area	(1a)) + (1b) + (1c)) + (1d)(1	1n) =	110.05	(4)						_
Dwelling volume							(3a)	+ (3b) + (3c	:) + (3d)(3	n) = 📃	297.14	(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 intermitten	t fans							0	x 10 =		0	(7a)
Number of passive vent	ts							0	x 10 =		0	(7b)
Number of flueless gas	fires							0	x 40 =		0	(7c)
										Air	changes pe hour	r
Infiltration due to chim	nous fluos fon			(6-)	. (Ch) . (7	-) + (7h) + ([*]	70) =	0	· (E) -			(0)
			tended nr			a) + (7b) + (1	·	0	÷ (5) =		0.00	(8)
If a pressurisation test l	has been carrie	d out or is int		roceed to (2	17), otherw	ise continue	e from (9) t		÷ (5) =		0.00	
<i>If a pressurisation test l</i> Air permeability value,	has been carrie q50, expressed	<i>d out or is int</i> I in cubic met	tres per ho	roceed to (2 our per squ	17), otherw Jare metre	<i>ise continue</i> of envelope	e from (9) t		÷ (5) =		0.00	(17)
If a pressurisation test l Air permeability value, If based on air permeat	has been carrie q50, expressed pility value, the	<i>d out or is int</i> l in cubic met n (18) = [(17)	tres per ho) ÷ 20] + (8	roceed to (2 our per squ	17), otherw Jare metre	<i>ise continue</i> of envelope	e from (9) t		÷ (5) =		0.00 3.00 0.15	(17) (18)
lf a pressurisation test l Air permeability value, If based on air permeat Number of sides on wh	has been carrie q50, expressed pility value, the	<i>d out or is int</i> l in cubic met n (18) = [(17)	tres per ho) ÷ 20] + (8	roceed to (2 our per squ	17), otherw Jare metre	<i>ise continue</i> of envelope	e from (9) t	o (16)	÷ (5) = [0.075 x (19)] =	0.00	(17)
If a pressurisation test I Air permeability value, If based on air permeat Number of sides on wh Shelter factor	has been carrie q50, expressed pility value, the ich the dwellin _i	d out or is int l in cubic met n (18) = [(17) g is shelterec	tres per ho) ÷ 20] + (8	roceed to (2 our per squ	17), otherw Jare metre	<i>ise continue</i> of envelope	e from (9) t	o (16)		· _	0.00 3.00 0.15 1) (17)) (18)] (19)
If a pressurisation test I Air permeability value, If based on air permeat Number of sides on wh Shelter factor Infiltration rate incorpo	has been carrie q50, expressed pility value, the ich the dwellin _i prating shelter f	d out or is int I in cubic met n (18) = [(17) g is shelterec factor	tres per ho) ÷ 20] + (8	roceed to (2 our per squ	17), otherw Jare metre	<i>ise continue</i> of envelope	e from (9) t	o (16)	[0.075 x (19	· _	0.00 3.00 0.15 1 0.93	(17) (18) (19) (20)
If a pressurisation test I Air permeability value, If based on air permeat Number of sides on wh Shelter factor Infiltration rate incorpo	has been carrie q50, expressed pility value, the ich the dwelling prating shelter f ed for monthly	d out or is int I in cubic met n (18) = [(17) g is shelterec factor	tres per ho) ÷ 20] + (8	roceed to (2 our per squ	17), otherw Jare metre	<i>ise continue</i> of envelope	e from (9) t	o (16)	[0.075 x (19	· _	0.00 3.00 0.15 1 0.93	(17) (18) (19) (20)
If a pressurisation test I Air permeability value, If based on air permeat Number of sides on wh Shelter factor Infiltration rate incorpo Infiltration rate modifie Jan	has been carrie q50, expressed pility value, the ich the dwellin prating shelter f ed for monthly n Feb	d out or is ini l in cubic met n (18) = [(17) g is sheltered factor wind speed: Mar	tres per ho) ÷ 20] + (8 j	roceed to (2 our per squ 3), otherwis	17), otherw uare metre se (18) = (16	of envelope	e from (9) to	o (16) 1 -	[0.075 x (19 (18) x (2	0) =	0.00 3.00 0.15 1 0.93 0.14	(17) (18) (19) (20)
If a pressurisation test I Air permeability value, If based on air permeat Number of sides on wh Shelter factor Infiltration rate incorpc Infiltration rate modifie Jar Monthly average wind	has been carrie q50, expressed pility value, the ich the dwellin prating shelter f ed for monthly n Feb speed from Tat	d out or is ini l in cubic met n (18) = [(17) g is sheltered factor wind speed: Mar	tres per ho) ÷ 20] + (8 j	roceed to (2 our per squ 3), otherwis	17), otherw uare metre se (18) = (16	of envelope	e from (9) to	o (16) 1 -	[0.075 x (19 (18) x (2	0) =	0.00 3.00 0.15 1 0.93 0.14	(17) (18) (19) (20)
If a pressurisation test I Air permeability value, If based on air permeat Number of sides on wh Shelter factor Infiltration rate incorpo Infiltration rate modifie Jar Monthly average wind 5.1 Wind factor (22) m ÷ 4	has been carrie q50, expressed pility value, the ich the dwelling orating shelter f ed for monthly n Feb speed from Tat 0 5.00	d out or is init I in cubic met n (18) = [(17) g is sheltered factor wind speed: Mar ble U2 4.90	tres per ho	roceed to (2 our per squ 3), otherwis May 4.30	17), otherw ware metre se (18) = (10 Jun 3.80	ise continue of envelope 6) Jul 3.80	Aug 3.70	o (16) 1 - Sep 4.00	[0.075 x (19 (18) x (2 Oct	0) = Nov 4.50	0.00 3.00 0.15 1 0.93 0.14 Dec 4.70	(17) (18) (19) (20) (21) (22)
If a pressurisation test I Air permeability value, If based on air permeat Number of sides on wh Shelter factor Infiltration rate incorpo Infiltration rate modifie Jar Monthly average wind 5.1 Wind factor (22)m ÷ 4	has been carrie q50, expressed pility value, the ich the dwelling brating shelter fi ed for monthly n Feb speed from Tat 0 5.00 8 1.25	d out or is int I in cubic met n (18) = [(17) g is sheltered factor wind speed: Mar ole U2 4.90 1.23	tres per ho	May 4.30 1.08	17), otherw Jare metre se (18) = (1(Jun 3.80	of envelope 6) Jul	e from (9) to e area Aug	o (16) 1 - Sep	[0.075 x (19 (18) x (2 Oct	0) = Nov	0.00 3.00 0.15 1 0.93 0.14 Dec) (17) (18) (19) (20) (21)
Monthly average wind 5.1 Wind factor (22)m ÷ 4 1.2 Adjusted infiltration rat	has been carrie q50, expressed pility value, the ich the dwelling prating shelter f ed for monthly n Feb speed from Tat 0 5.00 8 1.25 te (allowing for	d out or is int I in cubic met n (18) = [(17) g is sheltered factor wind speed: Mar ble U2 4.90 1.23 shelter and	tres per ho) ÷ 20] + (8 j Apr 4.40 1.10 wind facto	May 4.30 1.08 or) (21) x (2	17), otherw Jare metre se (18) = (1(Jun 3.80 0.95 22a)m	ise continue of envelope 6) Jul 3.80 0.95	Aug 3.70	o (16) 1 - Sep 1.00	[0.075 x (15 (18) x (2 Oct 4.30	0) = Nov 4.50	0.00 3.00 0.15 1 0.93 0.14 Dec 4.70 1.18	(17) (18) (19) (20) (21) (22) (22) (22a)
If a pressurisation test I Air permeability value, If based on air permeat Number of sides on wh Shelter factor Infiltration rate incorpo Infiltration rate modifie Jar Monthly average wind 5.1 Wind factor (22)m ÷ 4 1.2 Adjusted infiltration rat	has been carrie q50, expressed pility value, the ich the dwelling prating shelter f ed for monthly in Feb speed from Tat 0 5.00 8 1.25 te (allowing for 8 0.17	d out or is int I in cubic met n (18) = [(17) g is sheltered factor wind speed: Mar ble U2 4.90 1.23 shelter and 0.17	tres per ho) ÷ 20] + (8 j Apr 4.40 1.10 wind facto 0.15	May 4.30 1.08	17), otherw Jare metre se (18) = (1(Jun 3.80	ise continue of envelope 6) Jul 3.80	Aug 3.70	o (16) 1 - Sep 4.00	[0.075 x (19 (18) x (2 Oct	0) = Nov 4.50	0.00 3.00 0.15 1 0.93 0.14 Dec 4.70	(17) (18) (19) (20) (21) (22)
f a pressurisation test l Air permeability value, f based on air permeat Number of sides on wh Shelter factor Infiltration rate incorpo Infiltration rate modifie Jan Monthly average wind 5.1 Wind factor (22)m ÷ 4 1.2 Adjusted infiltration rat 0.1 Calculate effective air o	has been carrie q50, expressed pility value, the ich the dwelling prating shelter f ed for monthly on Feb speed from Tat 0 5.00 8 1.25 te (allowing for 8 0.17 thange rate for	d out or is int I in cubic met n (18) = [(17) g is sheltered factor wind speed: Mar ble U2 4.90 1.23 shelter and 0.17 the applicabl	tres per ho) ÷ 20] + (8) Apr 4.40 1.10 wind facto 0.15 le case:	May 4.30 1.08 0.15	17), otherw Jare metre se (18) = (1(Jun 3.80 0.95 22a)m	ise continue of envelope 6) Jul 3.80 0.95	Aug 3.70	o (16) 1 - Sep 1.00	[0.075 x (15 (18) x (2 Oct 4.30	0) = Nov 4.50	0.00 3.00 0.15 1 0.93 0.14 Dec 4.70 1.18 0.16	(17) (18) (19) (20) (21) (22) (22a) (22a) (22b)
If a pressurisation test I Air permeability value, If based on air permeat Number of sides on wh Shelter factor Infiltration rate incorpo Infiltration rate modifie Jar Monthly average wind 5.1 Wind factor (22)m ÷ 4 1.2 Adjusted infiltration rat 0.1 Calculate effective air c If mechanical ventila	has been carrie q50, expressed pility value, the ich the dwelling prating shelter f ed for monthly m Feb speed from Tat 0 5.00 8 1.25 te (allowing for 8 0.17 thange rate for ation: air change	d out or is int I in cubic met n (18) = [(17) g is sheltered iactor wind speed: Mar ole U2 4.90 1.23 shelter and v 0.17 the applicable	tres per ho + 20] + (8 - 4 - 4.40 - 1.10 wind factor 0.15 le case: gh system	May 4.30 1.08 0.15	Joint Jun 3.80 0.95 22a)m 0.13	ise continue of envelope 6) Jul 3.80 0.95 0.13	Aug 3.70	o (16) 1 - Sep 1.00	[0.075 x (15 (18) x (2 Oct 4.30	0) = Nov 4.50	0.00 3.00 0.15 1 0.93 0.14 Dec 4.70 1.18 0.16 0.50	(17) (18) (19) (20) (21) (22) (22a) (22a) (22b) (23a)
If a pressurisation test I Air permeability value, If based on air permeat Number of sides on wh Shelter factor Infiltration rate incorpo Infiltration rate modifie Jan Monthly average wind 5.1 Wind factor (22)m ÷ 4 1.2 Adjusted infiltration rat 0.1 Calculate effective air o	has been carrie q50, expressed pility value, the ich the dwelling prating shelter f ed for monthly n Feb speed from Tat 0 5.00 8 1.25 te (allowing for 8 0.17 thange rate for ation: air chang tt recovery: effi	d out or is int I in cubic met n (18) = [(17) g is sheltered iactor wind speed: Mar ble U2 4.90 1.23 shelter and v 0.17 the applicable gerate throug iciency in % a	tres per ho + 20] + (8 - 4 - 4.40 - 1.10 wind factor 0.15 le case: gh system system for	May 4.30 1.08 por) (21) × (2 0.15	17), otherw Jare metre se (18) = (1(Jun 3.80 0.95 22a)m 0.13 ctor from T	 <i>ise continue</i> of envelope <i>jul</i> <i>3.80</i> 0.95 0.13 able 4h 	Aug 3.70 0.93 0.13	o (16) 1 - Sep 1.00	[0.075 x (15 (18) x (2 Oct 4.30	0) = Nov 4.50	0.00 3.00 0.15 1 0.93 0.14 Dec 4.70 1.18 0.16	(17) (18) (19) (20) (21) (22) (22a) (22a) (22b)
If a pressurisation test I Air permeability value, If based on air permeat Number of sides on wh Shelter factor Infiltration rate incorpo Infiltration rate modifie Jar Monthly average wind 5.1 Wind factor (22)m ÷ 4 1.2 Adjusted infiltration rat 0.1 Calculate effective air c If mechanical ventila If balanced with hea	has been carrie q50, expressed oility value, the ich the dwelling orating shelter f ed for monthly on Feb speed from Tat 0 5.00 8 1.25 te (allowing for 8 0.17 thange rate for ation: air chang at recovery: effi anical ventilatio	d out or is int I in cubic met n (18) = [(17) g is sheltered iactor wind speed: Mar ble U2 4.90 1.23 shelter and v 0.17 the applicable gerate throug iciency in % a	tres per ho + 20] + (8 - 4 - 4.40 - 1.10 wind factor 0.15 le case: gh system system for	May 4.30 1.08 por) (21) × (2 0.15	17), otherw Jare metre se (18) = (1(Jun 3.80 0.95 22a)m 0.13 ctor from T	 <i>ise continue</i> of envelope <i>jul</i> <i>3.80</i> 0.95 0.13 able 4h 	Aug 3.70 0.93 0.13	o (16) 1 - Sep 1.00	[0.075 x (15 (18) x (2 Oct 4.30	0) = Nov 4.50	0.00 3.00 0.15 1 0.93 0.14 Dec 4.70 1.18 0.16 0.50	(17) (18) (19) (20) (21) (22) (22a) (22a) (22b) (23a)
If a pressurisation test I Air permeability value, If based on air permeat Number of sides on wh Shelter factor Infiltration rate incorpo Infiltration rate modifie Monthly average wind <u>5.1</u> Wind factor (22)m ÷ 4 <u>1.2</u> Adjusted infiltration rat <u>0.1</u> Calculate effective air co If mechanical ventila If balanced with hea a) If balanced mech-	has been carrie q50, expressed oility value, the ich the dwelling orating shelter f ed for monthly on Feb speed from Tat 0 5.00 8 1.25 te (allowing for 8 0.17 thange rate for ation: air chang at recovery: effi anical ventilatic 8 0.27	d out or is int I in cubic met n (18) = [(17) g is sheltered factor wind speed: Mar ole U2 4.90 1.23 shelter and u 0.17 the applicable iciency in % a on with heat 0.27	tres per ho) ÷ 20] + (8 d Apr 4.40 1.10 wind facto 0.15 le case: gh system allowing fo recovery (0.25	May 4.30 1.08 0.15 0.15 0.25	17), otherw Jare metre se (18) = (10 Jun 3.80 0.95 22a)m 0.13 ctor from T 2b)m + (23t)	ise continue of envelope 6) Jul 3.80 0.95 0.13 able 4h o) x [1 - (23cc)	Aug 3.70 0.93 0.13	o (16) 1 - Sep 4.00 0.14	[0.075 x (19 (18) x (2 Oct 1.08 0.15	Nov 4.50 1.13 0.16	0.00 3.00 0.15 1 0.93 0.14 Dec 4.70 1.18 0.16 0.50 79.90	(17) (18) (19) (20) (21) (21) (22) (22a) (22a) (22a) (22b) (23a) (23c)

3. Heat losses and heat loss parameter								
Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m²K	A x U W/	К к-value, kJ/m².K	Ахк, kJ/K	
Window			40.70	x 1.05	= 42.88			(27)
Ground floor			110.05	x 0.09	= 9.90]		(28a)
External wall			74.41	x 0.18	= 13.39			(29a)
Party wall			21.57	x 0.00	= 0.00			(32)
Total area of external elements ∑A, m ²			225.16]				(31)
Fabric heat loss, $W/K = \sum(A \times U)$					(26)	(30) + (32) =	66.18	(33)
Heat capacity Cm = Σ(A x κ)				(28)	(30) + (32) +	(32a)(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K							100.00	(35)
Thermal bridges: $\Sigma(L \times \Psi)$ calculated using App	endix K						33.77	(36)
Total fabric heat loss						(33) + (36) =	99.96	(37)
Jan Feb Mar	Apr	May	Jun J	ul Aug	Sep	Oct No	v Dec	
Ventilation heat loss calculated monthly 0.33	x (25)m x (5)							
27.20 26.86 26.5	2 24.82	24.48	22.78 22	2.78 22.44	23.46	24.48 25.1	.6 25.84	(38)
Heat transfer coefficient, W/K (37)m + (38)m								
127.16 126.82 126.4	8 124.78	124.44	122.73 12	2.73 122.39	123.41	124.44 125.	12 125.80]
					Average = ∑(39)112/12 =	124.69	(39)
Heat loss parameter (HLP), W/m ² K (39)m \div (4)							
1.16 1.15 1.15	1.13	1.13	1.12 1	.12 1.11	1.12	1.13 1.14	4 1.14]
					Average = ∑(4	40)112/12 =	1.13	(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 30.0	0 31.00	(40)
4. Water heating energy requirement								
Assumed occupancy, N							2.82	(42)
Annual average hot water usage in litres per d	ay Vd,average	= (25 x N) + 3	36				101.06	(43)
Jan Feb Mar	Apr	May	Jun J	ul Aug	Sep	Oct Nov	v Dec	
Hot water usage in litres per day for each mor	th Vd,m = fact	or from Tabl	e 1c x (43)					
111.17 107.12 103.0	8 99.04	95.00	90.95 90	.95 95.00	99.04	103.08 107.	12 111.17]
						∑(44)112 =	1212.71	(44)
Energy content of hot water used = 4.18 x Vd,	m x nm x Tm/3	8600 kWh/m	onth (see Table	es 1b, 1c 1d)				
164.85 144.18 148.7	8 129.71	124.46	107.40 99	0.52 114.21	115.57	134.68 147.0	02 159.65]
						∑(45)112 =	1590.06	(45)
Distribution loss 0.15 x (45)m								
24.73 21.63 22.3	19.46	18.67	16.11 14	.93 17.13	17.34	20.20 22.0	5 23.95	(46)
Storage volume (litres) including any solar or V	VWHRS storag	e within sam	ie vessel				1.00	(47)
Water storage loss:								
b) Manufacturer's declared loss factor is not k								
	nown							1
Hot water storage loss factor from Table 2		()					0.02	(51)
Hot water storage loss factor from Table 2 Volume factor from Table 2a		()					0.02 4.93	(51) (52)
-		y)						
Volume factor from Table 2a	(kWh/litre/day						4.93	(52)
Volume factor from Table 2a Temperature factor from Table 2b	(kWh/litre/day						4.93 1.00) (52)] (53)
Volume factor from Table 2a Temperature factor from Table 2b Energy lost from water storage (kWh/day)	(kWh/litre/day (47) x (51) x (5						4.93 1.00 0.10	(52) (53) (54)
Volume factor from Table 2a Temperature factor from Table 2b Energy lost from water storage (kWh/day) Enter (50) or (54) in (55)	(kWh/litre/day (47) x (51) x (5 (55) x (41)m		3.13 3	.24 3.24	3.13	3.24 3.1	4.93 1.00 0.10 0.10	(52) (53) (54)
Volume factor from Table 2a Temperature factor from Table 2b Energy lost from water storage (kWh/day) Enter (50) or (54) in (55) Water storage loss calculated for each month	(kWh/litre/day (47) x (51) x (5 (55) x (41)m 3.13	52) x (53) 3.24			3.13	3.24 3.12	4.93 1.00 0.10 0.10] (52)] (53)] (54)] (55)
Volume factor from Table 2a Temperature factor from Table 2b Energy lost from water storage (kWh/day) Enter (50) or (54) in (55) Water storage loss calculated for each month 3.24 2.92 3.24	(kWh/litre/day (47) x (51) x (5 (55) x (41)m 3.13	52) x (53) 3.24			3.13	3.24 3.12	4.93 1.00 0.10 0.10] (52)] (53)] (54)] (55)

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	3.24	2.92	3.24	3.13	3.24	3.13	3.24	3.24	3.13	3.24	3.13	3.24 (57)
Primary circuit I	oss for each	month fro	m Table 3									
	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26 (59)
Combi loss for e	ach month f	from Table	3a, 3b or 3	с								
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (61)
Total heat requi	ired for wate	er heating o	calculated f	or each mo	onth 0.85 ×	(45)m + (4	16)m + (57)	m + (59)m ·	+ (61)m			
	191.36	168.12	175.28	155.36	150.96	133.05	126.02	140.71	141.21	161.19	172.66	186.15 (62)
Solar DHW inpu	t calculated	using Appe	endix G or A	Appendix H	1							
	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)
Output from wa	ater heater f	or each mc	onth (kWh/r	month) (6	2)m + (63)n	n						
	191.36	168.12	175.28	155.36	150.96	133.05	126.02	140.71	141.21	161.19	172.66	186.15
										∑(64)1	.12 =	1902.08 (64)
Heat gains from	water heat	ing (kWh/n	nonth) 0.2	5 x [0 85 x	(45)m + (61	1)ml + 0.8 ;	× [(46)m + (57)m + (59)ml	2(01)20		(01)
incut gams in oni	76.01	67.09	70.67	63.65	62.58	56.23	54.29	59.17	58.94	65.98	69.40	74.28 (65)
	70.01	07.05	/0.0/	03.05	02.38	50.25	54.25	39.17	38.94	05.58	09.40	74.28 (03)
5. Internal gain	ns											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Metabolic gains	(Table 5)											
0	140.76	140.76	140.76	140.76	140.76	140.76	140.76	140.76	140.76	140.76	140.76	140.76 (66)
Lighting gains (c						1			1			(
EIBITEINE BUILD (C	24.22	21.51	17.49	13.24	9.90	8.36	9.03	11.74	15.75	20.00	23.35	24.89 (67)
Appliance gains							5.05	11.74	15.75	20.00	25.55	24.85
Appliance gains							202.24	200.20	207.40	222.62	244 70	
o 1	271.63	274.45	267.34	252.22	233.13	215.19	203.21	200.39	207.49	222.62	241.70	259.64 (68)
Cooking gains (o												
	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08 (69)
Pump and fan g												
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (70)
Losses e.g. evap	oration (Tab	ole 5)										
	-112.61	-112.61	-112.61	-112.61	-112.61	-112.61	-112.61	-112.61	-112.61	-112.61	-112.61	-112.61 (71)
Water heating g	gains (Table !	5)										
	102.17	99.84	94.99	88.40	84.12	78.09	72.97	79.53	81.87	88.69	96.39	99.85 (72)
Total internal ga	ains (66)m +	· (67)m + (6	58)m + (69)	m + (70)m	+ (71)m + (72)m						
	463.24	461.02	445.05	419.09	392.38	366.87	350.44	356.89	370.34	396.53	426.67	449.60 (73)
		_										
6. Solar gains												
			Access f Table		Area m ²		lar flux N/m²	sner	g ific data	FF specific o	lata	Gains W
			Table	ou			•/11		able 6b	or Table		
East			0.7	7 x	14.57	x	19.64 x	0.9 x	0.55 >	0.80	=	87.26 (76)
South			0.7		9.83						====	``
												. ,
West	- ()		0.7	7 X	16.30	x	19.64 x	0.9 x	0.55	0.80	=	97.62 (80)
Solar gains in w					1	1		1				
	325.00	591.15	887.93	1199.03	1408.84	1421.09	1361.22	1205.58	998.08	676.66	396.62	273.12 (83)
Total gains - inte	ernal and so	lar (73)m +	· (83)m									
	788.24	1052.17	1332.98	1618.12	1801.22	1787.96	1711.66	1562.47	1368.42	1073.20	823.28	722.72 (84)
			_									
7 Manuti	ial temperat											
7. Mean interr		a neriods in	1 the living a	area from	Table 9, Th	1(°C)						21.00 (85)
7. Mean interr Temperature du									-	<u> </u>		
	uring heating Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			Mar	Apr	May	Jun	Inf	Aug	Sep	Oct	Nov	Dec
			Mar	Apr	May	Jun	Iul	Aug	Sep	Oct		
			Mar	Apr	Мау	Jun	Jul	Aug	Sep		URN:	KCS2-A1 version
			Mar	Apr	Мау	Jun Page 3		Aug	Sep		URN:	

Utilisation factor for gains for living area n1,m (see Table 9a)					
0.95 0.91 0.83 0.70 0.55 0.41 0.31 0.34 0.54 0.79 0.92 0.96	(86)				
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)					
18.77 19.23 19.81 20.38 20.74 20.91 20.97 20.96 20.82 20.27 19.40 18.69	(87)				
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)					
19.96 19.96 19.97 19.98 19.99 19.99 19.98 19.98 19.97 19.97	(88)				
Utilisation factor for gains for rest of dwelling n2,m					
0.94 0.89 0.80 0.67 0.51 0.35 0.24 0.27 0.48 0.75 0.91 0.95	(89)				
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)					
17.00 17.65 18.46 19.24 19.70 19.92 19.97 19.96 19.81 19.12 17.91 16.88	(90)				
Living area fraction Living area ÷ (4) = 0.38	(91)				
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2					
17.67 18.25 18.98 19.68 20.09 20.30 20.35 20.34 20.20 19.56 18.48 17.57	(92)				
Apply adjustment to the mean internal temperature from Table 4e where appropriate					
17.67 18.25 18.98 19.68 20.09 20.30 20.35 20.34 20.20 19.56 18.48 17.57	(93)				
8. Space heating requirement					
8. Space heating requirement Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec					
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, ηm					
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	(94)				
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, ηm	(94)				
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, ηm 0.92 0.87 0.78 0.65 0.51 0.37 0.26 0.30 0.49 0.74 0.88 0.93	(94) (95)				
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, ηm 0.92 0.87 0.78 0.65 0.51 0.37 0.26 0.30 0.49 0.74 0.88 0.93 Useful gains, ηmGm, W (94)m x (84)m					
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, ηω 0.92 0.87 0.78 0.65 0.51 0.37 0.26 0.30 0.49 0.74 0.88 0.93 Useful gains, ηω (94)m x (84)m					
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, ηπ 0.92 0.87 0.78 0.65 0.51 0.37 0.26 0.30 0.49 0.74 0.88 0.93 Useful gains, ηmGm, W (94)m x (84)m	(95)				
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, ηπ 0.92 0.87 0.78 0.65 0.51 0.37 0.26 0.30 0.49 0.74 0.88 0.93 Useful gains, ηπGm, W (94)m x (84)m 727.25 911.71 1041.00 1059.62 923.52 662.85 450.08 467.85 674.17 792.78 727.91 675.41 Monthly average external temperature from Table 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	(95)				
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, ηπ 0.92 0.87 0.78 0.65 0.51 0.37 0.26 0.30 0.49 0.74 0.88 0.93 Useful gains, ηmGm, W (94)m x (84)m 727.25 911.71 1041.00 1059.62 923.52 662.85 450.08 467.85 674.17 792.78 727.91 675.41 Monthly average external temperature from Table 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 Heat loss rate for mean internal temperature, Lm, W ((39)m x ((93)m - (96)m) - <	(95) (96)				
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, ηπ 0.92 0.87 0.78 0.65 0.51 0.37 0.26 0.30 0.49 0.74 0.88 0.93 Useful gains, ηmGm, W (94)m x (84)m 727.25 911.71 104.00 1059.62 923.52 662.85 450.08 467.85 674.17 792.78 727.91 675.41 Monthly average external temperature from Table 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 Heat loss rate for mean internal temperature, Lm, W ((39)m x ((93)m - (96)m) 11700.39 1693.44 1577.84 1344.68 1044.37 69.01 460.40 482.62 752.30 1114.68 1423.42 1681.75	(95) (96)				
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, nm 0.92 0.87 0.78 0.65 0.51 0.37 0.26 0.30 0.49 0.74 0.88 0.93 Useful gains, nmGm, W (94)m x (84)m 727.25 911.71 1041.00 1059.62 923.52 662.85 450.08 467.85 674.17 792.78 727.91 675.41 Monthly average external temperature from Table 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 Heat loss rate for mean interrul temperature, Lm, W [(39)m x [(93)m - (96)m] [1700.39] 1693.44 1577.84 1344.68 1044.37 69.01 460.40 482.62 752.30 114.68 1423.42 1681.75 Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m 500 500 111.40 100.00 100.40 140.40 140.40 140.40 14	(95) (96)				

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of community heat from CHP		0.00	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.00	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	1.00	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	3432.87	(98)
Space heat from CHP	(98) x (304a) x (305) x (306) = 0.00	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) = 3604.51	(307b)

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Water heating

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Annual water heating requirement	1902.08	(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) = 1997.18	(310a)
Electricity used for heat distribution	0.01 × [(307a)(307e) + (310a)(310e)] = 56.02	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)		

mechanical ventilation fans - balanced, extract or positive input fi	rom outside	240.16			(330a)
Total electricity for the above, kWh/year				240.16	(331)
Electricity for lighting (Appendix L)				427.66	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312)	+ (315) + (331) + (332)	(337b) =	6269.51	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	0.00	х	2.97	x 0.01 =	0.00	(340a)
Space heating from boilers	3604.51	x	4.24	x 0.01 =	152.83	(340b)
Water heating from boilers	1997.18	x	4.24	x 0.01 =	84.68	(342a)
Pumps and fans	240.16	x	13.19	x 0.01 =	31.68	(349)
Electricity for lighting	427.66	x	13.19	x 0.01 =	56.41	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)(342e) +	(345)(354) =	445.60	(355)

11b. SAP rating - community heating scheme		
Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.21	(357)
SAP value	83.16]
SAP rating (section 13)	83	(358)
SAP band	В]

12b. CO₂ emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CH	P (space and water heating)						
Power efficiency of CHP unit		31.50					(361)
Heat efficiency of CHP unit		48.50					(362)
Emissions from other sources (space heating)						
Efficiency of boilers		91.80					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	6102.06	x	0.216	= [1318.05	(368)
Electrical energy for communit	y heat distribution	56.02	х	0.519	= [29.07	(372)
Total CO2 associated with com	munity systems				[1347.12	(373)
Total CO2 associated with space	e and water heating				[1347.12	(376)
Pumps and fans		240.16	х	0.519	= [124.64	(378)
Electricity for lighting		427.66	x	0.519	= [221.95	(379)
Total CO ₂ , kg/year					(376)(382) = [1693.72	(383)
Dwelling CO ₂ emission rate					(383) ÷ (4) = [15.39	(384)
El value					[85.36]
El rating (section 14)					[85	(385)
EI band					[В]
13b. Primary energy - comm	unity heating scheme						

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)						
Power efficiency of CHP unit	31.50					(361)
Heat efficiency of CHP unit	48.50					(362)
Primary energy from other sources (space heating)						
Efficiency of boilers	91.80					(367b)
Primary energy from boilers [(307b)+(310b)] x 100 ÷ (367b) =	6102.06	х	1.22	=	7444.52	(368)
Electrical energy for community heat distribution	56.02	х	3.07	=	171.97	(372)
Total primary energy associated with community systems					7616.49	(373)
Total primary energy associated with space and water heating					7616.49	(376)
Pumps and fans	240.16	х	3.07	=	737.29	(378)
Electricity for lighting	427.66	х	3.07	=	1312.91	(379)
Primary energy kWh/year					9666.69	(383)
Dwelling primary energy rate kWh/m2/year					87.84	(384)

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DER Worksheet

Design - Draft



	Mr Liam	Holden					A	ssessor num	ber	10245	5	
Client							Li	ast modified		20/06	6/2018	
Address	TH A1, Lo	ondon										
	,											
1. Overall dwelling dimens	sions											
				A	rea (m²)			rage storey eight (m)		Vo	olume (m³)	
owest occupied					69.47	(1a) x		2.70	(2a) =		187.57	(3a)
1					41.56	(1b) x		3.15	(2b) =		130.91	(3b)
otal floor area	(1a)	+ (1b) + (1d	c) + (1d)(1n) =	111.03	(4)						
welling volume							(3a) + (3b) + (3e	c) + (3d)(3	8n) =	318.48	(5)
2. Ventilation rate												
										m	³ per hour	
umber of chimneys								0	x 40 =		0	(6a)
umber of open flues								0	x 20 =		0	(6b
umber of intermittent fans	s							0	x 10 =		0	(7a
umber of passive vents								0	x 10 =		0	(7b
umber of flueless gas fires								0	x 40 =		0	(7c
										Air	changes pe hour	er
nfiltration due to chimneys,	fluor for											
		s. PSVs		(6a)	+ (6b) + (7a	a) + (7b) + (7c) =	0	÷ (5) =		0.00	(8)
			ntended, pr			a) + (7b) + (ise continue		0 to (16)	÷ (5) =		0.00	(8)
a pressurisation test has b	een carried	d out or is ii		roceed to (2	17), otherw	ise continu	e from (9)		÷ (5) =		0.00	
a pressurisation test has b ir permeability value, q50, based on air permeability	<i>een carried</i> expressed	d out or is in in cubic me	etres per h	roceed to (2 our per squ	1 <i>7), otherw</i> Jare metre	<i>ise continue</i> of envelope	e from (9)		÷ (5) =			(17)
a pressurisation test has b ir permeability value, q50,	een carried expressed value, ther	d out or is in in cubic me n (18) = [(17	etres per h 7) ÷ 20] + (8	roceed to (2 our per squ	1 <i>7), otherw</i> Jare metre	<i>ise continue</i> of envelope	e from (9)		÷ (5) =		3.00	(8) (17) (18) (19)
a pressurisation test has b ir permeability value, q50, based on air permeability	een carried expressed value, ther	d out or is in in cubic me n (18) = [(17	etres per h 7) ÷ 20] + (8	roceed to (2 our per squ	1 <i>7), otherw</i> Jare metre	<i>ise continue</i> of envelope	e from (9)	to (16)) ÷ (5) =		3.00 0.15	(17] (18] (19)
a pressurisation test has b ir permeability value, q50, based on air permeability lumber of sides on which th	een carried expressed value, ther he dwelling	d out or is in in cubic me n (18) = [(17 g is sheltere	etres per h 7) ÷ 20] + (8	roceed to (2 our per squ	1 <i>7), otherw</i> Jare metre	<i>ise continue</i> of envelope	e from (9)	to (16)		9)] =	3.00 0.15 1	(17) (18)
a pressurisation test has b ir permeability value, q50, i based on air permeability lumber of sides on which th helter factor hfiltration rate incorporatin	een carried expressed value, ther he dwelling ng shelter fa	d out or is in in cubic me n (18) = [(17 g is sheltere actor	etres per ho 7) ÷ 20] + (8 ed	roceed to (2 our per squ	1 <i>7), otherw</i> Jare metre	<i>ise continue</i> of envelope	e from (9)	to (16)	[0.075 x (19	9)] =	3.00 0.15 1 0.93	(17) (18) (19) (20)
a pressurisation test has b ir permeability value, q50, i based on air permeability lumber of sides on which th helter factor hfiltration rate incorporatin	een carried expressed value, ther he dwelling ng shelter fa	d out or is in in cubic me n (18) = [(17 g is sheltere actor	etres per ho 7) ÷ 20] + (8 ed	roceed to (2 our per squ	1 <i>7), otherw</i> Jare metre	<i>ise continue</i> of envelope	e from (9)	to (16)	[0.075 x (19	9)] =	3.00 0.15 1 0.93	(17) (18) (19) (20)
a pressurisation test has b ir permeability value, q50, i based on air permeability lumber of sides on which th helter factor filtration rate incorporatin filtration rate modified for Jan	een carried expressed value, ther he dwelling ng shelter fa r monthly v Feb	d out or is in in cubic me n (18) = [(17 g is sheltere actor wind speed Mar	etres per h 7) ÷ 20] + (8 d	roceed to (2 our per squ 3), otherwis	17), otherw uare metre se (18) = (16	ise continue of envelope 6)	e from (9) e area	to (16) 1 -	[0.075 x (1! (18) x (2	9)] =	3.00 0.15 1 0.93 0.14	(17) (18) (19) (20)
a pressurisation test has b ir permeability value, q50, based on air permeability umber of sides on which th helter factor afiltration rate incorporatin afiltration rate modified for Jan	een carried expressed value, ther he dwelling ng shelter fa r monthly v Feb	d out or is in in cubic me n (18) = [(17 g is sheltere actor wind speed Mar	etres per h 7) ÷ 20] + (8 d	roceed to (2 our per squ 3), otherwis	17), otherw uare metre se (18) = (16	ise continue of envelope 6)	e from (9) e area	to (16) 1 -	[0.075 x (1! (18) x (2	9)] =	3.00 0.15 1 0.93 0.14	(17) (18) (19) (20)
a pressurisation test has b ir permeability value, q50, based on air permeability lumber of sides on which th helter factor nfiltration rate incorporatin nfiltration rate modified for Jan Nonthly average wind species 5.10	eeen carried expressed value, ther he dwelling ng shelter fa r monthly v Feb d from Tab	d out or is in in cubic me n (18) = [(17 g is sheltere actor wind speed Mar ble U2	etres per h 7) ÷ 20] + (8 d : Apr	roceed to (2 our per squ 3), otherwis May	17), otherw uare metre se (18) = (10 Jun	ise continue of envelope 6) Jul	e from (9) e area Aug	to (16) 1 - Sep	[0.075 x (1! (18) x (2 Oct	9)] = 20) = Nov	3.00 0.15 1 0.93 0.14 Dec	(17) (18) (19) (20) (21)
a pressurisation test has b ir permeability value, q50, based on air permeability lumber of sides on which th helter factor nfiltration rate incorporatin nfiltration rate modified for Jan Nonthly average wind species 5.10	eeen carried expressed value, ther he dwelling ng shelter fa r monthly v Feb d from Tab	d out or is in in cubic me n (18) = [(17 g is sheltere actor wind speed Mar ble U2	etres per h 7) ÷ 20] + (8 d : Apr	roceed to (2 our per squ 3), otherwis May	17), otherw uare metre se (18) = (10 Jun	ise continue of envelope 6) Jul	e from (9) e area Aug	to (16) 1 - Sep	[0.075 x (1! (18) x (2 Oct	9)] = 20) = Nov	3.00 0.15 1 0.93 0.14 Dec	(17) (18) (19) (20) (21)
a pressurisation test has b ir permeability value, q50, based on air permeability lumber of sides on which th helter factor filtration rate incorporatin filtration rate modified for Jan Nonthly average wind speet 5.10 Vind factor (22)m ÷ 4 1.28	een carried expressed value, ther he dwelling ng shelter fa r monthly v Feb d from Tab 5.00	d out or is in in cubic me n (18) = [(17) g is sheltere actor wind speed Mar ble U2 4.90 1.23	etres per ho ?) ÷ 20] + (8 d : Apr 4.40 1.10	roceed to (2 our per squ 3), otherwis May 4.30	17), otherw Jare metre Se (18) = (10 Jun 3.80	ise continue of envelope 6) Jul 3.80	e from (9) e area Aug 3.70	to (16) 1 - Sep 4.00	[0.075 x (19 (18) x (2 Oct	9)] = 20) = Nov 4.50	3.00 0.15 1 0.93 0.14 Dec 4.70	_ (17 _ (18 _ (19 _ (20 _ (21
a pressurisation test has b ir permeability value, q50, based on air permeability lumber of sides on which th helter factor filtration rate incorporatin filtration rate modified for Jan Nonthly average wind speet 5.10 Vind factor (22)m ÷ 4 1.28	een carried expressed value, ther he dwelling ng shelter fa r monthly v Feb d from Tab 5.00	d out or is in in cubic me n (18) = [(17) g is sheltere actor wind speed Mar ble U2 4.90 1.23	etres per ho ?) ÷ 20] + (8 d : Apr 4.40 1.10	roceed to (2 our per squ 3), otherwis May 4.30	17), otherw Jare metre Se (18) = (10 Jun 3.80	ise continue of envelope 6) Jul 3.80	e from (9) e area Aug 3.70	to (16) 1 - Sep 4.00	[0.075 x (19 (18) x (2 Oct	9)] = 20) = Nov 4.50	3.00 0.15 1 0.93 0.14 Dec 4.70	(17) (18) (19) (20) (21) (21)
a pressurisation test has b ir permeability value, q50, based on air permeability umber of sides on which th helter factor filtration rate incorporatin filtration rate modified for Jan tonthly average wind speed 5.10 /ind factor (22)m ÷ 4 1.28 djusted infiltration rate (all 0.18	een carried expressed value, ther he dwelling ag shelter fa r monthly v Feb d from Tab 5.00 1.25 lowing for 0.17	d out or is in in cubic men n (18) = [(17) g is sheltered actor wind speed Mar ble U2 4.90 1.23 shelter and 0.17	etres per ho ?) ÷ 20] + (8 d Apr 4.40 1.10 wind facto 0.15	roceed to (2 our per squ 3), otherwis May 4.30 1.08 1.08	17), otherw iare metre se (18) = (10 Jun 3.80 0.95 22a)m	ise continuu of envelope 6) Jul 3.80 0.95	e from (9) e area Aug 3.70 0.93	to (16) 1 - Sep 4.00 1.00	[0.075 x (14 (18) x (2 Oct 4.30	9)] = 20) = Nov 4.50 1.13	3.00 0.15 1 0.93 0.14 Dec 4.70 1.18	(17) (18) (19) (20) (21) (21)
a pressurisation test has b ir permeability value, q50, based on air permeability umber of sides on which th helter factor filtration rate incorporatin filtration rate modified for Jan tonthly average wind speed 5.10 /ind factor (22)m ÷ 4 1.28 djusted infiltration rate (all 0.18	een carried expressed value, ther he dwelling ag shelter fa r monthly v Feb d from Tab 5.00 1.25 lowing for : 0.17 ge rate for t	d out or is in in cubic mon n (18) = [(17) g is sheltered actor wind speed Mar ble U2 4.90 1.23 shelter and 0.17 the applical	etres per ho ?) ÷ 20] + (8 d Apr 4.40 1.10 wind facto 0.15 ble case:	may 4.30 1.08 or) (21) x (2 0.15	17), otherw iare metre se (18) = (10 Jun 3.80 0.95 22a)m	ise continuu of envelope 6) Jul 3.80 0.95	e from (9) e area Aug 3.70 0.93	to (16) 1 - Sep 4.00 1.00	[0.075 x (14 (18) x (2 Oct 4.30	9)] = 20) = Nov 4.50 1.13	3.00 0.15 1 0.93 0.14 Dec 4.70 1.18	(17) (18) (19) (20) (21) (22) (22) (22)
a pressurisation test has b ir permeability value, q50, based on air permeability umber of sides on which th helter factor filtration rate incorporatin filtration rate modified for Jan tonthly average wind speet 5.10 /ind factor (22)m ÷ 4 1.28 djusted infiltration rate (all 0.18 alculate effective air chang	een carried expressed value, ther he dwelling ag shelter fa r monthly v Feb d from Tab 5.00 1.25 lowing for 0.17 ge rate for t c air change	d out or is in in cubic mon n (18) = [(17) g is sheltered actor wind speed Mar ble U2 4.90 1.23 shelter and 0.17 the applicate e rate through	etres per he ?) ÷ 20] + (8 d Apr 4.40 1.10 wind factor 0.15 oble case: ugh system	may 4.30 1.08 or) (21) x (2 0.15	17), otherw iare metre se (18) = (10 Jun 3.80 0.95 22a)m 0.13	ise continuu of envelope 6) Jul 3.80 0.95 0.13	e from (9) e area Aug 3.70 0.93	to (16) 1 - Sep 4.00 1.00	[0.075 x (14 (18) x (2 Oct 4.30	9)] = 20) = Nov 4.50 1.13	3.00 0.15 1 0.93 0.14 Dec 4.70 1.18 0.16	(17) (18) (19) (20) (21)
a pressurisation test has b ir permeability value, q50, based on air permeability lumber of sides on which th helter factor filtration rate incorporatin filtration rate modified for Jan Aonthly average wind speed 5.10 Vind factor (22) m ÷ 4 1.28 djusted infiltration rate (all 0.18 alculate effective air chang If mechanical ventilation	een carried expressed value, ther he dwelling ag shelter far monthly w Feb d from Tab 5.00 1.25 lowing for 0.17 ge rate for t : air change covery: effici	d out or is in in cubic me n (18) = [(17 g is sheltered actor wind speed Mar ble U2 4.90 1.23 shelter and 0.17 the applical e rate throo ciency in %	etres per ho ?) ÷ 20] + (£ d .: Apr 4.40 1.10 wind facto 0.15 oble case: ugh system allowing fo	may 4.30 1.08 0.15 0.15 0.15	17), otherw iare metre se (18) = (10 Jun 3.80 0.95 :2a)m 0.13 ctor from T	ise continuu of envelope 6) Jul 3.80 0.95 0.13 able 4h	e from (9) e area Aug 3.70 0.93 0.13	to (16) 1 - Sep 4.00 1.00	[0.075 x (14 (18) x (2 Oct 4.30	9)] = 20) = Nov 4.50 1.13	3.00 0.15 1 0.93 0.14 Dec 4.70 1.18 0.16 0.50	(17) (18) (19) (20) (21) (22) (22) (22)
a pressurisation test has b ir permeability value, q50, based on air permeability lumber of sides on which th helter factor filtration rate incorporatin filtration rate modified for Jan tonthly average wind speed 5.10 Vind factor (22) m ÷ 4 1.28 djusted infiltration rate (all 0.18 alculate effective air chang If mechanical ventilation If balanced with heat reco	een carried expressed value, ther he dwelling ag shelter far monthly w Feb d from Tab 5.00 1.25 lowing for 0.17 ge rate for t : air change covery: effici	d out or is in in cubic me n (18) = [(17 g is sheltered actor wind speed Mar ble U2 4.90 1.23 shelter and 0.17 the applical e rate throo ciency in %	etres per ho ?) ÷ 20] + (£ d .: Apr 4.40 1.10 wind facto 0.15 oble case: ugh system allowing fo	may 4.30 1.08 0.15 0.15 0.15	17), otherw iare metre se (18) = (10 Jun 3.80 0.95 :2a)m 0.13 ctor from T	ise continuu of envelope 6) Jul 3.80 0.95 0.13 able 4h	e from (9) e area Aug 3.70 0.93 0.13	to (16) 1 - Sep 4.00 1.00	[0.075 x (14 (18) x (2 Oct 4.30	9)] = 20) = Nov 4.50 1.13	3.00 0.15 1 0.93 0.14 Dec 4.70 1.18 0.16 0.50] (17] (18] (19] (20] (21] (22] (22] (22] (22] (23] (23
a pressurisation test has b ir permeability value, q50, i based on air permeability lumber of sides on which th helter factor filtration rate incorporatin filtration rate modified for Jan Nonthly average wind spece 5.10 Vind factor (22)m ÷ 4 1.28 djusted infiltration rate (all 0.18 alculate effective air chang If mechanical ventilation If balanced with heat rec a) If balanced mechanica	een carried expressed value, ther he dwelling ng shelter far monthly v Feb d from Tab 5.00 1.25 lowing for : 0.17 ge rate for t : air change covery: effic al ventilatio 0.27	d out or is in in cubic men n (18) = [(17) g is sheltered actor wind speed Mar be U2 4.90 1.23 shelter and 0.17 the applical e rate throu ciency in % on with hea 0.27	etres per ha ?) ÷ 20] + (£ d Apr 4.40 1.10 wind facto 0.15 ole case: ugh system allowing fot t recovery i 0.25	may 4.30 1.08 or) (21) x (2 or) in-use far (MVHR) (22 0.25	17), otherw iare metre se (18) = (10 Jun 3.80 0.95 :2a)m 0.13 ctor from T 2b)m + (238	ise continuu of envelope 6) Jul 3.80 0.95 0.13 able 4h 0) × [1 - (23)	e from (9) e area Aug 3.70 0.93 0.13	to (16) 1 - Sep 4.00 0.14	[0.075 × (1: (18) × (2 Oct 1.08 0.15	9)] = 20) = 4.50 1.13 0.16	3.00 0.15 1 0.93 0.14 Dec 4.70 1.18 0.16 0.50 79.90) (17) (18) (19) (20) (21) (22) (22) (22

0.26 (25) 0.28 0.27 0.27 0.25 0.25 0.23 0.23 0.23 0.24 0.25 0.26

3. Heat losses	and heat lo	ss paramet	er										
Element				Gross rea, m²	Openings m ²		area m²	U-value W/m²K	A x U W		/alue, /m².K	Ахк, kJ/K	
Window						33	.63 x	1.05	= 35.43				(27)
Exposed floor						69	.47 x	0.09	= 6.25				(28b
External wall						122	2.55 x	0.18	= 22.06				(29a)
Party wall						38	.39 x	0.00	= 0.00				(32)
Roof						56	.66 x	0.18	= 10.20				(30)
Total area of ex	ternal elem	ents ∑A, m²	!			282	2.31						(31)
Fabric heat loss	s, W/K = ∑(A	× U)							(26	5)(30) + (3	32) =	73.94	(33)
Heat capacity C	cm = ∑(А x к)	1						(28)	.(30) + (32) -	+ (32a)(32	2e) =	N/A	(34)
Thermal mass p	oarameter (1	TMP) in kJ/r	n²K									100.00	(35)
Thermal bridge	s: ∑(L x Ψ) c	alculated us	sing Appen	dix K								42.35	(36)
Total fabric hea	it loss									(33) + (3	36) =	116.29	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation hear	t loss calcula	ated month	ly 0.33 x (2	25)m x (5)									
	29.16	28.79	28.43	26.60	26.24	24.42	24.42	24.05	25.15	26.24	26.97	27.70	(38)
Heat transfer co	oefficient, W	//K (37)m +	- (38)m										
	145.45	145.08	144.72	142.89	142.53	140.71	140.71	140.34	141.44	142.53	143.26	143.99	
									Average = ∑	<u>(</u> 39)112/	12 =	142.80	(39)
Heat loss paran	neter (HLP),	W/m²K (39	9)m ÷ (4)										
	1.31	1.31	1.30	1.29	1.28	1.27	1.27	1.26	1.27	1.28	1.29	1.30	
									Average = ∑	<u>(</u> 40)112/	12 =	1.29	(40)
Number of days	-												_
	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 heat	ing energy r	equiremen	t										
Assumed occup	ancy, N											2.82	(42)
Annual average	hot water u	usage in litre	es per day	Vd,average	= (25 x N) +	36						101.20	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usag	e in litres pe	er day for ea	ach month	Vd,m = fact	tor from Tab	ole 1c x (43	3)				-		_
	111.32	107.27	103.22	99.17	95.12	91.08	91.08	95.12	99.17	103.22	107.27	111.32	
										∑(44)1	.12 =	1214.35	(44)
Energy content	of hot wate	r used = 4.1	L8 x Vd,m x	nm x Tm/3	3600 kWh/m	nonth (see	Tables 1b	, 1c 1d)					_
	165.08	144.38	148.98	129.89	124.63	107.55	99.66	114.36	115.73	134.87	147.22	159.87	
										∑(45)1	.12 =	1592.20	(45)
Distribution los	-								17.00				7 (
	24.76	21.66	22.35	19.48	18.69	16.13	14.95	17.15	17.36	20.23	22.08	23.98	(46)
Storage volume		uding any s	olar or WW	/HRS storag	e within sar	ne vessel						1.00	(47)
Water storage I													
b) Manufacture											_		7
Hot water st			Table 2 (kV	Vh/litre/day	¥)							0.02	(51)
Volume fact												4.93	(52)
Temperatur												1.00	(53)
Energy lost f		storage (kW	/h/day) (47	/) x (51) x (5	52) x (53)							0.10	(54)
Enter (50) or (5		od for'	month /r) v (44)								0.10	(55)
Water storage I	ioss calculat	eu for each	month (55	5) X (41)M									

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3.24 2.92 3.24 3.13 3.24 3.13 3.24 3.24 3.24 3.24 3.13 3.24 3.13 3.24 (56)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	Utilisation factor for gains for living area n1,m (see Table 9a)
3.24 2.92 3.24 3.13 3.24 3.13 3.24 3.24 3.24 3.24 3.13 3.24 (57)	0.97 0.94 0.89 0.79 0.65 0.50 0.39 0.44 0.66 0.87 0.95 0.97 (86)
Primary circuit loss for each month from Table 3	Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)
23.26 21.01 23.26 22.51 23.26 22.51 23.26 23.26 23.26 22.51 23.26 22.51 23.26 (59)	18.28 18.67 19.28 20.00 20.52 20.82 20.93 20.91 20.64 19.87 18.94 18.21 (87)
Combi loss for each month from Table 3a, 3b or 3c	Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 (61)	19.83 19.84 19.84 19.85 19.85 19.87 19.87 19.87 19.86 19.85 19.85 19.84 (88)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	Utilisation factor for gains for rest of dwelling n2,m
191.58 168.31 175.49 155.53 151.13 133.19 126.16 140.86 141.37 161.37 172.86 186.37 (62)	0.96 0.93 0.87 0.76 0.60 0.43 0.30 0.35 0.59 0.84 0.94 0.97 (89)
Solar DHW input calculated using Appendix G or Appendix H	Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)
0.00 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)	16.22 16.78 17.66 18.65 19.34 19.71 19.83 19.81 19.52 18.52 17.18 16.13 (90)
Output from water heater for each month (kWh/month) (62)m + (63)m	Living area fraction Living area ÷ (4) = 0.45 (91)
191.58 168.31 175.49 155.53 151.13 133.19 126.16 140.86 141.37 161.37 172.86 186.37	Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2
Σ(64)112 = <u>1904.22</u> (64)	17.15 17.63 18.39 19.26 19.87 20.21 20.32 20.30 20.02 19.13 17.97 17.07 (92)
Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	Apply adjustment to the mean internal temperature from Table 4e where appropriate
76.09 67.15 70.74 63.70 62.64 56.28 54.34 59.22 59.00 66.04 69.47 74.36 (65)	17.15 17.63 18.39 19.26 19.87 20.21 20.32 20.02 19.13 17.97 17.07 (93)
5. Internal gains	8. Space heating requirement
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Metabolic gains (Table 5)	Utilisation factor for gains, nm
141.04 141.04<	0.94 0.91 0.85 0.74 0.60 0.46 0.34 0.38 0.60 0.82 0.92 0.95 (94) Useful gains, ηmGm, W (94)m x (84)m (94)
24.34 21.62 17.58 13.31 9.95 8.40 9.08 11.80 15.84 20.11 23.47 25.02 (67) Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 5	629.67 779.35 925.83 1007.18 935.26 708.49 496.93 509.65 675.52 707.78 625.42 587.72 (95) Monthly average external temperature from Table U1
273.03 275.86 268.72 253.52 234.34 216.30 204.26 201.42 208.56 223.76 242.95 260.98 (68)	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)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	Heat loss rate for mean internal temperature, Lm, W [(33)m x [(93)m - (96)m]
37.10 37.10 37.10 37.10 37.10 37.10 37.10 37.10 37.10 37.10 37.10 37.10 37.10 37.10 37.10 (69)	1868.49 1846.58 1720.27 1480.04 1164.42 789.51 523.86 547.60 837.64 1215.64 1557.26 1852.91 (97)
Pump and fan gains (Table 5a)	Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	921.68 717.18 591.06 340.45 170.50 0.00 0.00 0.00 377.85 670.93 941.31
Losses e.g. evaporation (Table 5)	$\Sigma(98)15, 1012 = 4730.96 (98)$
-112.83 -112.83 -112.83 -112.83 -112.83 -112.83 -112.83 -112.83 -112.83 -112.83 -112.83 -112.83 -112.83 (71)	Space heating requirement kWh/m ² /year $(98) \div (4)$ 42.61 (99)
Water heating gains (Table 5)	
102.27 99.93 95.08 88.48 84.19 78.16 73.03 79.60 81.94 88.77 96.48 99.94 (72)	9b. Energy requirements - community heating scheme
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	Fraction of space heat from secondary/supplementary system (table 11) '0' if none 0.00 (301)
464.95 462.72 446.69 420.62 393.79 368.18 351.68 358.14 371.65 397.95 428.21 451.25 (73)	Fraction of space heat from community system $1 - (301) =$ (302)
	Fraction of community heat from boilers (303a)
6. Solar gains	Fraction of community heat from CHP (303b)
Access factor Area Solar flux g FF Gains Table 6d m ² W/m ² specific data specific data W	Fraction of total space heat from community CHP (302) x (303a) = 0.00 (304a)
or Table 6b or Table 6c	Fraction of total space heat from community boilers (302) x (303b) =(304b)
East 0.77 x 27.91 x 19.64 x 0.9 x 0.55 x 0.80 = 167.14 (76)	Factor for control and charging method (Table 4c(3)) for community space heating (305)
West 0.77 x 5.72 x 19.64 x 0.9 x 0.55 x 0.80 = 34.26 (80)	Factor for charging method (Table 4c(3)) for community water heating (305a)
Solar gains in watts Σ(74)m(82)m	Distribution loss factor (Table 12c) for community heating system 1.05 (306)
201.40 393.98 648.83 946.28 1159.70 1187.16 1130.23 970.85 754.62 467.49 251.12 165.62 (83)	
Total gains - internal and solar (73)m + (83)m	Space heating
666.35 856.71 1095.53 1366.91 1553.50 1555.34 1481.91 1328.99 1126.27 865.44 679.33 616.87 (84)	Annual space heating requirement 4730.96 (98)
	Space heat from CHP (98) x (304a) x (305) x (306) = 0.00 (307a)
7. Mean internal temperature (heating season)	Space heat from boilers (98) x (304b) x (305) x (306) = 4967.51 (307b)
Temperature during heating periods in the living area from Table 9, Th1(°C) (85)	
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Water heating			
Annual water heating requirement	1904.22		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1999.43	(310a)
Electricity used for heat distribution	0.01 × [(307a)(307e) + (310a)(310e)] =	69.67	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input fr	rom outside 208.85		(330a)
Total electricity for the above, kWh/year		208.85	(331)
Electricity for lighting (Appendix L)		429.86	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)(337b) =	7605.65	(338)

10b. Fuel costs - community heating scheme						
	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	0.00	x	2.97	x 0.01 =	0.00	(340a)
Space heating from boilers	4967.51	x	4.24	x 0.01 =	210.62	(340b)
Water heating from boilers	1999.43	x	4.24	x 0.01 =	84.78	(342a)
Pumps and fans	208.85	x	13.19	x 0.01 =	27.55	(349)
Electricity for lighting	429.86	x	13.19	x 0.01 =	56.70	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)(342e) +	(345)(354) =	499.64	(355)

11b. SAP rating - community heating scheme		
Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.34	(357)
SAP value	81.24	
SAP rating (section 13)	81	(358)
SAP band	В	

12b. CO₂ emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CH	P (space and water heating)						
Power efficiency of CHP unit		31.50					(361)
Heat efficiency of CHP unit		48.50					(362)
Emissions from other sources	(space heating)						
Efficiency of boilers		91.80					(367b
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	7589.26	х	0.216	= [1639.28	(368)
Electrical energy for communi	ty heat distribution	69.67	x	0.519	= [36.16	(372)
Total CO2 associated with con	nmunity systems				[1675.44	(373)
Total CO2 associated with spa	ce and water heating				[1675.44	(376)
Pumps and fans		208.85	х	0.519	= [108.39	(378)
Electricity for lighting		429.86	x	0.519	= [223.10	(379)
Total CO₂, kg/year					(376)(382) =	2006.93	(383)
Dwelling CO ₂ emission rate					(383) ÷ (4) = [18.08	(384)
EI value					[82.76	
EI rating (section 14)					[83	(385)
EI band					[В]

13b. Primary energy - community heating scheme

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	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)					
Power efficiency of CHP unit	31.50					(361)
Heat efficiency of CHP unit	48.50					(362)
Primary energy from other sources (space heating)						
Efficiency of boilers	91.80					(367b
Primary energy from boilers [(307b)+(310b)] x 100 ÷ (367b)	= 7589.26	х	1.22	=	9258.89	(368)
Electrical energy for community heat distribution	69.67	х	3.07	=	213.89	(372)
Total primary energy associated with community systems					9472.78	(373)
Total primary energy associated with space and water heating					9472.78	(376)
Pumps and fans	208.85	х	3.07	=	641.15	(378)
Electricity for lighting	429.86	х	3.07	=	1319.68	(379)
Primary energy kWh/year					11433.61	(383)
Dwelling primary energy rate kWh/m2/year					102.98	(384)

BRUKL Output Document

HM Government Compliance with England Building Regulations Part L 2013

Project name

Notting Hill Gate Office - Be Lean

As designed

Date: Mon May 21 12:13:53 2018

Administrative information

Building Details Address: Address 1, City, Postcode	Owner Details Name: Name
	Telephone number: Phone
Certification tool	Address: Street Address, City, Postcode
Calculation engine: Apache	
Calculation engine version: 7.0.6	Certifier details
Interface to calculation engine: IES Virtual Environment	Name: Name
Interface to calculation engine version: 7.0.6	Telephone number: Phone
BRUKL compliance check version: v5.2.g.3	Address: Street Address, City, Postcode

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	21.5
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	21.5
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	15.1
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red. Building fabric

Element	Ua-Limit	Ua-Calc		Surface where the maximum value occurs*	
Wall**	0.35	0.25	0.25	1F000000:Surf[1]	
Floor	0.25	0.16	0.16	1F000000:Surf[0]	
Roof	0.25	0.16	0.16	2F000001:Surf[0]	
Windows***, roof windows, and rooflights	2.2	1.1	1.1	1F000000:Surf[2]	
Personnel doors	2.2	-	-	No Personnel doors in building	
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building	
High usage entrance doors	3.5	-	-	No High usage entrance doors in building	
Us-Limit = Limiting area-weighted average U-values [W/(m²K)] Us-cate = Calculated area-weighted average U-values [W/(m²K)] Us-cate = Calculated maximum individual element U-values [W/(m²K)]					
* There might be more than one surface where the n	avimum I	Lvalue oc	CUTC		

There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m³/(h.m²) at 50 Pa	10	3

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES	
Whole building electric power factor achieved by power factor correction	0.9 to 0.95	

1- FCU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency	
This system	0.96	4.5	0	1.6	0.75	
Standard value	0.91*	3.2	N/A	1.6^	0.5	
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system YES						
* Standard shown is for gas single boiler systems <= 2 MW output. For single boiler systems > 2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.						

A Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide

"No HWS in project, or hot water is provided by HVAC system"

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
Α	Local supply or extract ventilation units serving a single area
В	Zonal supply system where the fan is remote from the zone
С	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
н	Fan coil units
1	Zonal extract system where the fan is remote from the zone with grease filter

Zone name		SFP [W/(I/s)]										
ID of system type	Α	в	С	D	E	F	G	н	I	HR efficiency		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard	
1F - Office W	-	-	-	-	-	-	-	0.2	-	-	N/A	
2F - Office W	-	-	-	-	-	-	-	0.2	-	-	N/A	
3F - Office W	-	-	-	-	-	-	-	0.2	-	-	N/A	
GF - Office Circulation	-	-	-	-	-	-	-	0.2	-	-	N/A	
GF - Office Reception W	-	-	-	-	-	-	-	0.2	-	-	N/A	
1F - Office Circulation W	-	-	-	-	-	-	-	0.2	-	-	N/A	
1F - Office W	-	-	-	-	-	-	-	0.2	-	-	N/A	
1F - Office Circulation	-	-	-	-	-	-	-	0.2	-	-	N/A	
1F - Office W	-	-	-	-	-	-	-	0.2	-	-	N/A	
1F - Office Circulation W	-	-	-	-	-	-	-	0.2	-	-	N/A	
1F - Office Circulation	-	-	-	-	-	-	-	0.2	-	-	N/A	
1F - Office	-	-	-	-	-	-	-	0.2	-	-	N/A	
2F - Office Circulation W	-	-	-	-	-	-	-	0.2	-	-	N/A	
2F - Office Circulation W	-	-	-	-	-	-	-	0.2	-	-	N/A	
2F - Office Circulation	-	-	-	-	-	-	-	0.2	-	-	N/A	
2F - Office	-	-	-	-	-	-	-	0.2	-	-	N/A	

Zone name	SFP [W/(I/s)]							HP officiency			
ID of system type	Α	в	С	D	E	F	G	н	1	HR efficiency	
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
2F - Office W	-	-	-	-	-	-	-	0.2	-	-	N/A
2F - Office W	-	-	-	-	-	-	-	0.2	-	-	N/A
2F - Office Circulation	-	-	-	-	-	-	-	0.2	-	-	N/A
3F - Office Circulation W	-	-	-	-	-	-	-	0.2	-	-	N/A
3F - Office Circulation W	-	-	-	-	-	-	-	0.2	-	-	N/A
3F - Office Circulation	-	-	-	-	-	-	-	0.2	-	-	N/A
3F - Office	-	-	-	-	-	-	-	0.2	-	-	N/A
3F - Office W	-	-	-	-	-	-	-	0.2	-	-	N/A
3F - Office W	-	-	-	-	-	-	-	0.2	-	-	N/A
3F - Office Circulation	-	-	-	-	-	-	-	0.2	-	-	N/A

General lighting and display lighting

Luminous efficacy [lm/W]

General lighting and display lighting	Lumino	ous effic			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]	
Standard value	60	60	22		
1F - Office W	100	-	-	1562	
2F - Office W	100	-	-	1562	
3F - Office W	100	-	-	1562	
GF - Office Circulation	-	100	-	91	
GF - Office Reception W	-	100	70	741	
1F - Office Circulation W	-	100	-	52	
1F - Office W	100	-	-	1025	
1F - Office Circulation	-	100	-	50	
1F - Office W	100	-	-	418	
1F - Office Circulation W	-	100	-	30	
1F - Office Circulation	-	100	-	125	
1F - Office	100	-	-	284	
2F - Office Circulation W	-	100	-	52	
2F - Office Circulation W	-	100	-	30	
2F - Office Circulation	-	100	-	125	
2F - Office	100	-	-	284	
2F - Office W	100	-	-	1025	
2F - Office W	100	-	-	418	
2F - Office Circulation	-	100	-	50	
3F - Office Circulation W	-	100	-	52	
3F - Office Circulation W	-	100	-	30	
3F - Office Circulation	-	100	-	125	
3F - Office	100	-	-	284	
3F - Office W	100	-	-	1025	
3F - Office W	100	-	-	418	
3F - Office Circulation	-	100	-	50	

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
1F - Office W	NO (-63.9%)	YES
2F - Office W	NO (-56.7%)	YES
3F - Office W	NO (-60.7%)	YES
GF - Office Circulation	NO (-93.1%)	NO
GF - Office Reception W	NO (-22.3%)	YES
1F - Office Circulation W	NO (-58.2%)	YES
1F - Office W	NO (-56.8%)	YES
1F - Office Circulation	NO (-97.3%)	NO
1F - Office W	NO (-57.7%)	YES
1F - Office Circulation W	NO (-37.3%)	YES
1F - Office Circulation	NO (-98.2%)	NO
1F - Office	NO (-98.8%)	NO
2F - Office Circulation W	NO (-58.2%)	YES
2F - Office Circulation W	NO (-37.4%)	YES
2F - Office Circulation	NO (-98.1%)	NO
2F - Office	NO (-98.8%)	NO
2F - Office W	NO (-53.6%)	YES
2F - Office W	NO (-57.5%)	YES
2F - Office Circulation	NO (-97.2%)	NO
3F - Office Circulation W	NO (-58.1%)	YES
3F - Office Circulation W	NO (-36.4%)	YES
3F - Office Circulation	NO (-98%)	NO
3F - Office	NO (-98.7%)	NO
3F - Office W	NO (-51.5%)	YES
3F - Office W	NO (-56.7%)	YES
3F - Office Circulation	NO (-97.2%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters				
Actual	Notional	% Are		
2367.6	2367.6			
2554.6	2554.6			
LON	LON	100		
3	3	-		
1320.6	1374.19	-		
0.52	0.54	-		
10	10	_		
	Actual 2367.6 2554.6 LON 3 1320.6 0.52	Actual Notional 2367.6 2367.6 2554.6 2554.6 LON LON 3 3 1320.6 1374.19 0.52 0.54		

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

ng Use
Building Type
A1/A2 Retail/Financial and Professional services
A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
B1 Offices and Workshop businesses
B2 to B7 General Industrial and Special Industrial Groups
B8 Storage or Distribution
C1 Hotels
C2 Residential Inst.: Hospitals and Care Homes
C2 Residential Inst.: Residential schools
C2 Residential Inst.: Universities and colleges
C2A Secure Residential Inst.
Residential spaces
D1 Non-residential Inst.: Community/Day Centre
D1 Non-residential Inst.: Libraries, Museums, and Galleries
D1 Non-residential Inst.: Education
D1 Non-residential Inst.: Primary Health Care Building
D1 Non-residential Inst.: Crown and County Courts
D2 General Assembly and Leisure, Night Clubs and Theatres
Others: Passenger terminals
Others: Emergency services
Others: Miscellaneous 24hr activities
Others: Car Parks 24 hrs
Others - Stand alone utility block

ŀ	HVAC Systems Performance									
System (vpe)						Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[S1	[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
	Actual	47.8	40.6	15.3	2.6	11.3	0.87	4.34	0.96	5.5
	Notional	40.9	69.1	13.2	5.1	15.6	0.86	3.79		

Rey to terms	
Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key to terms

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	15.34	13.19
Cooling	2.6	5.06
Auxiliary	11.92	15.62
Lighting	5.85	15.18
Hot water	6.03	2.2
Equipment*	31.57	31.57
TOTAL**	41.74	51.26

* Energy used by equipment does not count towards the total for calculating emissions. ** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	88.47	110.01
Primary energy* [kWh/m ²]	87.98	126.14
Total emissions [kg/m ²]	15.1	21.5

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U _{i-Typ}	Ui-Min	Surface where the minimum value occurs*	
Wall	0.23	0.25	1F000000:Surf[1]	
Floor	0.2	0.16	1F000000:Surf[0]	
Roof		0.16	2F000001:Surf[0]	
Windows, roof windows, and rooflights		1.1	1F000000:Surf[2]	
Personnel doors		-	No Personnel doors in building	
Vehicle access & similar large doors	15	-	No Vehicle access doors in building	
High usage entrance doors		-	No High usage entrance doors in building	
Ui-Typ = Typical individual element U-values [W/(m ² K)]			Ui-Min = Minimum individual element U-values [W/(m ² K)]	
* There might be more than one surface where the minimum U-value occurs.				

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	3

BRUKL Output Document

Compliance with England Building Regulations Part L 2013

Project name

Notting Hill Gate Retail - Be Lean

As designed

HM Government

Date: Mon May 21 13:00:30 2018

Administrative information

Building Details

Dunung	Botano
Address:	Notthing Hill Gate, London, Postcode

Certification tool

Calculation engine: Apache Calculation engine version: 7.0.6 Interface to calculation engine: IES Virtual Environment Interface to calculation engine version: 7.0.6 BRUKL compliance check version: v5.2.g.3 Owner Details Name: Name Telephone number: Phone Address: Street Address, City, Postcode

Certifier details Name: Name Telephone number: Phone Address: Street Address, City, Postcode

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	56.1
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	56.1
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	46.5
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red. Building fabric

Element	Ua-Limit	Ua-Calc	Ui-Calc	Surface where the maximum value occurs*
Wall**	0.35	0.25	0.25	GF000002:Surf[3]
Floor	0.25	0.16	0.16	GF000002:Surf[0]
Roof	0.25	-	-	UNKNOWN
Windows***, roof windows, and rooflights	2.2	1.1	1.1	GF000002:Surf[1]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building
$\begin{array}{l} U_{a\text{-Limit}} = Limiting \ area-weighted \ average \ U-values \ [W/(m^2K)] \\ U_{a\text{-Calc}} = Calculated \ area-weighted \ average \ U-values \ [W/(m^2K)] \end{array}$			Ui-Calc = C	Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building		
m³/(h.m²) at 50 Pa	10	3		

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values				
Whole building electric power factor achieved by power factor correction	0.9 to 0.95			

1- FCU

Tiouti	ig eniciency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system 0.96		4.5	0	1.6	0.75
Standard value 0.91*		0.7	N/A	1.6^	0.5

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system YES
* Standard shown is for gas single boiler systems <- 2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting
efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^A Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

"No HWS in project, or hot water is provided by HVAC system"

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic	System type in Non-domestic Building Services Compliance Guide									
Α	Local supply or extract ventilation units serving a single area										
В	Zonal supply system where the fa	Zonal supply system where the fan is remote from the zone									
С	Zonal extract system where the f	Zonal extract system where the fan is remote from the zone									
D	Zonal supply and extract ventilati	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery									
Е	Local supply and extract ventilation	Local supply and extract ventilation system serving a single area with heating and heat recovery									
F	Other local ventilation units										
G	Fan-assisted terminal VAV unit										
н	Fan coil units										
I	Zonal extract system where the f	an is	remot	e from	the zo	one wit	h grea	ase filt	er		
Zon	e name	SFP [W/(I/s)]							HR efficiency		
	ID of system type	Α	в	С	D	Е	F	G	н	1	HR efficiency

	ID of system type	Α	в	С	D	E	F	G	н	I	HR efficiency	
	Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
GF - Retail		-	-	-	-	-	-	-	0.2	-	-	N/A
GF - Retail		-	-	-	-	-	-	-	0.2	-	-	N/A
GF - Retail		-	-	-	-	-	-	-	0.2	-	-	N/A

General lighting and display lighting	Lumino	us effic		
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
GF - Retail	-	100	70	723
GF - Retail	-	100	70	818
GF - Retail	-	100	70	766

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?		
GF - Retail	YES (+12%)	NO		
GF - Retail	NO (-46.6%)	NO		
GF - Retail	NO (-43.2%)	NO		

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?					
Is evidence of such assessment available as a separate submission?	NO				
Are any such measures included in the proposed design?	NO				

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters						
	Actual	Notional	% Are			
Area [m²]	151.7	151.7	100			
External area [m ²]	567.9	567.9				
Weather	LON	LON				
Infiltration [m ³ /hm ² @ 50Pa]	3	3				
Average conductance [W/K]	318.43	246.13				
Average U-value [W/m ² K]	0.56	0.43				
Alpha value* [%]	10	10				

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

ldi	ing Use
ea	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs

Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	74.96	44.55
Cooling	6.19	7.22
Auxiliary	26.91	21.46
Lighting	18.96	62.36
Hot water	21.53	1.86
Equipment*	20.26	20.26
TOTAL**	148.55	137.46

* Energy used by equipment does not count towards the total for calculating emissions. ** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	327.96	236.81
Primary energy* [kWh/m ²]	269.01	329.15
Total emissions [kg/m²]	46.5	56.1

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

ŀ	HVAC Systems Performance										
System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Fan coil s	ystems, [HS	6] LTHW bo	iler, [HFT] I	Natural Gas	, [CFT] Ele	ctricity				
	Actual	233.8	94.2	75	6.2	16.5	0.87	4.34	0.96	5.5	
	Notional	138.3	98.5	44.6	7.2	21.5	0.86	3.79			

Key to terms	
Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Marsha Armera

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

	1	T	1	
Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*	
Wall	0.23	0.25	GF000002:Surf[3]	
Floor	0.2	0.16	GF000002:Surf[0]	
Roof	0.15	-	UNKNOWN	
Windows, roof windows, and rooflights	1.5	1.1	GF000002:Surf[1]	
Personnel doors	1.5	-	No Personnel doors in building	
Vehicle access & similar large doors	15	-	No Vehicle access doors in building	
High usage entrance doors 1.5		-	No High usage entrance doors in building	
Ui-Typ = Typical individual element U-values [W/(m ² K)]			Ui-Min = Minimum individual element U-values [W/(m ² K)]	
* There might be more than one surface where the minimum U-value occurs.				

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	3

APPENDIX 3 – TM52 OVERHEATING REPORT

Energy Strategy Addendum

Contents

Executive Summary

- 1. Introduction
- Cooling Hierarchy 2.
- 3. Overheating Criteria
- Model 4.
- 5. Results
- Conclusion 6.

Appendix A Modelling Profiles

Executive Summary

This is an update to the TM52 Report dated September 2017 submitted in respect of the proposed development of Newcombe House and Kensington Church Street. This report outlines how the proposed development, as amended by the Proposed Amendments, complies with London Plan Policy 5.9 "Overheating and Cooling" and addresses Stage 1 comments made by the GLA in relation to the September 2017 application.

Policy 5.9 seeks to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation and to reduce overheating due to the impacts of climate change and the urban heat island effect on an area wide basis.

In order to reduce overheating and reliance on air conditioning, the design of the proposed development has followed the Cooling Hierarchy detailed in Policy 5.9.

The strategy has focused on minimising heat generation within the dwellings. This has mainly been achieved by the specification of energy efficient services and placing them in non-occupied areas, where overheating is not considered an issue.

The next step of the strategy was to reduce the amount of heat entering the building. The design of the façade, including appropriate proportions of glazing and balcony to living/kitchen rooms were central to this step. The glazing g-value was also considered not only to reduce the amount of solar gain in the summer, but also to maximise beneficial heat gain in the winter.

Managing the heat within the building through exposed thermal mass and high ceilings was considered. Both these options were deemed to be inappropriate. Due to residential nature of the development there is a need to conceal services which reduces the possibility of incorporating exposed thermal mass. Ceiling heights have been maximised within the constraints of the overall building height and massing.

The baseline approach to mitigate against the likelihood of overheating within the apartments adopts a strategy that incorporates openable windows throughout the apartments to provide the purge ventilation requirements and help mitigate against summertime overheating. Alongside this strategy an enhanced level of MVHR will be provided.

In order to quantify the strategy outlined above, a dynamic thermal model was created in IES VE 2017.4.0. A simulation was carried out using a number of assumptions and using the CIBSE TM49 Weather Files. The results were then compared to the CIBSE TM52 Overheating Criteria.

Having undertaken an initial modelling (as shown in Tables 5,6 & 7) in consideration of the above conditions, but excluding openable windows it can be demonstrated that during peak summertime conditions a limited number of habitable rooms within the dwellings were found to be susceptible to a risk of overheating by a small margin. By opening the windows all the bedrooms are showing compliance with all criteria across all 3 of the weather files, whilst the living/ kitchen areas are exceeding the criteria by a small margin in the 1989 and 1976 weather files.

This report concludes the dwellings are complying with London Plan Policy 5.9 'Overheating and Cooling' by following the 'Cooling Hierarchy' as defined.

As a further benefit to this strategy, a limited amount of comfort cooling is proposed to the habitable spaces of the private apartments to assist with marketing although this has not been included in the modelling iterations as cooling does not form part of the overheating mitigation strategy.

Newcombe House and Kensington Church Street TM52 Overheating Study **July 2018**

1 INTRODUCTION

This update to the TM52 has been prepared in support of amendments made to planning application PP/17/05782 (GLA ref: 3109a) for the mixed use redevelopment of the Newcombe House Site in the Royal Borough of Kensington and Chelsea. This report should be read in conjunction with the TM52 Report dated September 2017.

The proposed amendments do not alter the description of development, which remains as follows:

'Demolition of the existing buildings and redevelopment to provide office, residential, and retail uses, and a flexible surgery/office use, across six buildings (ranging from ground plus two storeys to ground plus 17 storeys), together with landscaping to provide a new public square, ancillary parking and associated works.'

The proposed amendments to the application can be summarised as:

- an increase in the number of homes (to a total of 55) and alterations to the housing mix;
- an increase in the proportion of affordable homes (to 35% by hab room and 41.8% by unit);
- an increase in office floorspace of 414 sqm GEA (to a total of 5,306 sqm);
- the addition of one storey to Kensington Church Street Building 1 in C3 residential use (from four storeys to five);
- the addition of two storeys to West Perimeter Building 3 in B1 office use (from five storeys to seven);
- alterations to the layouts of Kensington Church Street Buildings 1 and 2, and West Perimeter Buildings 1 and 3, with associated changes to the facades;
- minor alterations to the façade of the Corner Building on levels 4, 5 and 6 to respond to the revised massing of West Perimeter Building 3; and
- minor alterations to the services strategy for West Perimeter Building 2.

Further details of the amendments are set out within the Design and Access Statement Addendum and Planning Statement Addendum.

Policy 5.9 of the London Plan 'Overheating and Cooling' seeks to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation and to reduce overheating due to the impacts of climate change and the urban heat island effect on an area wide basis.

In order to reduce overheating and reliance on air conditioning, the design of the Newcombe House and Kensington Church Street scheme has followed the Cooling Hierarchy detailed in Policy 5.9:

- 1. Minimise internal heat generation through energy efficient design;
- 2. Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls;
- 3. Manage the heat within the building through exposed internal thermal mass and high ceilings;
- 4. Passive ventilation;
- 5. Mechanical ventilation; and
- 6. Active cooling systems (ensuring they are the lowest carbon options).

2 COOLING HIERARCHY

This section sets out how the design of the development has followed the six-step approach to minimising overheating and excessive heat generation.

2.1 Minimise Internal Heat Generation

A number of energy efficient design measures have been incorporated into the design to minimise internal heat generation. These include:

- Energy efficient light fittings;
- Locating the heat interface unit in a non-occupied space so that heat is not emitted into an occupied space. The units will be specified with fully insulated components and casing;
- Space heating and domestic hot water pipework will be insulated beyond the levels required by the Domestic Building Services Compliance Guide;
- EU Energy Efficiency Labelling Scheme Information will be provided to encourage the procurement of energy efficient white goods (if white goods are not provided as part of the fit out);
- Energy efficient MVHR (Mechanical Ventilation with Heat Recovery) units will be installed. These units will be installed in non-occupied spaces so that heat gains from the unit are not emitted into occupied spaces.

2.2 Reduce the Heat Entering the Building

The amount of heat entering the building will be reduced by:

- Energy efficient facades with appropriate proportions of glazing;
- Carefully selecting a glazing shading coefficient to reduce the amount of solar radiation passing through the glazing in summer but also to maximise beneficial solar gains during the heating season;
- Balcony to Kitchen/ Living rooms provide overhang shading which minimizes solar gain through the glazed elements into the occupied spaces;
- Installing blinds. These not only reduce the amount of solar energy entering the space but they can also provide an adaptive approach to comfort for localised areas.

2.3 Manage the Heat with the Building

Due to the residential nature of the development there is a need to conceal services, which reduces the possibility of incorporating exposed internal thermal mass. Ceiling heights have been maximised within the constraints of the overall building's height and massing.

2.4 Passive Ventilation

Passive ventilation (openable windows) has been incorporated within the development.

There are some constraints identified within the Environmental Noise and Vibration Strategy and Air Quality Assessment regarding the permanent use of openable windows, however, the GLA requested a version of the calculations utilising openable windows, in order to understand the limitations posed to the design by the local authority. The Air Quality Assessment has advised that from an air quality point of view, 'opening of the windows periodically for a short period of time for cooling is not prohibitive, as long as the units are not permanently relying on openable windows for the background ventilation.'

This will allow the occupant the option of passive ventilation during the brief periods during the year that the apartments may experience overheating.

In addition, there will be a small amount of natural ventilation through infiltration.

2.5 Mechanical Ventilation

Background ventilation will be provided by MVHR units in accordance with Approved Document F 2010 minimum requirements. These units will incorporate a summer by-pass, which will allow the unit to supply fresh air without heat being transferred from the extract air into this supply air.

A boost mode will be available to occupants in the affordable apartments to double the minimum ventilation rates, thereby allowing the purging of excess heat as well as remove unwanted odours. It should be made clear to occupants through a resident's handbook or otherwise that instructs on the use of this facility for mitigating periods of overheating.

2.6 Active Cooling Systems

As a further benefit to this strategy, a limited amount of comfort cooling is proposed to the habitable spaces of the private apartments to assist with marketing although this has not been included in the modelling iterations as cooling does not form part of the overheating mitigation strategy.

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3 OVERHEATING CRITERIA

CIBSE publication TM52:2013 takes the opinion that discomfort is not a function of only the temperature, but the deviation from a comfort temperature.

Studies have shown that temperatures at which a person feels comfortable are related to the outdoor temperature. This comfortable temperature is related to the thermal history the person experiences, with more recent experiences being more influential. For example during a hot period, people are more likely to wear lighter clothes and hence a higher indoor temperature is more likely to be comfortable.

Therefore a running mean is used to describe the external conditions. This running mean puts greater weight on the temperature for the days closer to the present.

To help define whether a building overheats, CIBSE recommends that a maximum acceptable temperature, which is related to the external running mean temperature, is set.

Three criteria have been set, which are all defined in terms of the difference between the actual operative temperature in the room at any time and the maximum acceptable temperature.

The three criteria are described below:

1. Hours of Exceedance

The number of hours during which the difference between the actual operative temperature and the maximum acceptable temperature, during the period May to September inclusive shall not be more than 3% of occupied hours.

2. Daily Weighted Exceedance

This criterion assesses the severity of overheating including large short term exceedance and also short-term exceedance. The weighted exceedance shall be less than or equal to 6 degreehours in any one day.

3. Upper Limit Temperature

This sets an absolute maximum value for the indoor operative temperature. This maximum temperature shall not exceed a temperature difference between the actual operative temperature and the maximum acceptable temperature by 4°C.

To show compliance with TM52 at least two out of three of the criteria must be met in all habitable rooms, that is bedrooms, living rooms and dining rooms.

The GLA has recommended that the CIBSE TM49 weather files are used in the assessments.

4 MODEL

4.1 Geometry

The three dwellings which were selected for the study were selected as a representative scenario. The dwellings selected have a south, southeast and southwest aspect orientation.

A model was created in IES 2017.4.0 to simulate the internal conditions in each of the spaces. A screenshot of the model is shown in Figure 1

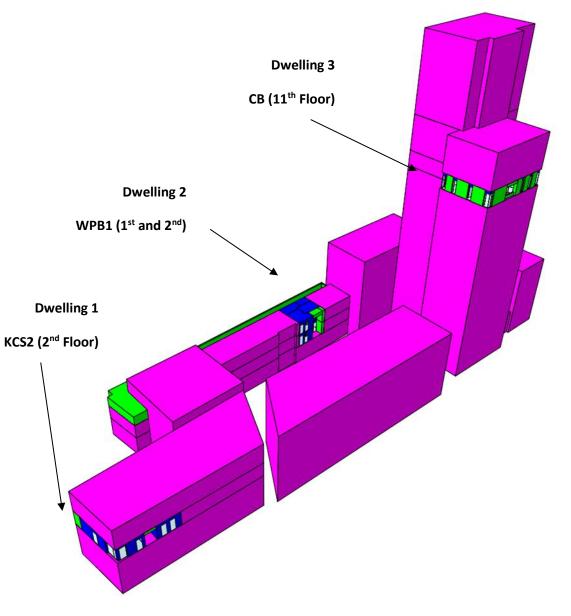


Figure 1: Model Screenshot

The geometry was modelled using floor plans, sections and elevations from the revised planning application drawings submitted alongside this addendum and dated July 2018.

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4.2 Fabric

The building fabric parameters have been based on the values that were used in the SAP assessment. A summary of the values used in the assessment are shown in Table 1 and Table 2.

Table 1: Element U-Values					
Element	U-Value (W/m²K)				
External Wall	0.18/ 0.25				
Window (glazing & frame)	1.10				
Heat Loss Floors	0.18				
Heat Loss Roofs	0.18				

Table 1, Element II-Values

A thorough investigation of the passive design measures has been undertaken by the design team looking at Part L compliance (DFEE/TFEE) and Overheating, resulting in a g-value of 0.55.

Table 2: Further Glazing Unit Parameters

Parameter	Value
G-Value	0.55
Frame Proportion	20%

The fabric parameters utilised in the model have been optimised where technically feasible in order to create the best performing building against the relevant criteria.

4.3 Internal Gains

This section sets out the heat gains that have been assumed in the model.

4.3.1 Occupancy

These are the gains associated with humans in the space. The values used are typical of a human seated at rest and have been taken from CIBSE Guide A 2006. The values used are summarised in Table 3

Table 3: Occupancy Heat Gains

Gain	Value per Person (W)		
Sensible	65		
Latent	30		

Table 4 shows the occupancy levels in each room. The profiles used to describe when the occupants will be present is shown in Appendix A. The profiles are the same as the NCM (National Calculation Methodology) profiles which are used in the calculation to show compliance with Part L1 and L2 of the Building Regulations.

4.3.2 Lighting

A lighting gain of $1.5W/m^2$ has been used. This is a value that could be realised from a lighting design using LEDs.

Appendix A contains the profiles used to describe when the lights will be on and off.

4.3.3 Casual Gains

These are the gains associated with the equipment in the space. The values have been taken from CIBSE TM37:2006.

- that the gains will be intermittent and therefore negligible.
- adapter box and an A-rated fridge-freezer.

Appendix A contains the profiles used to describe when these gains will occur.

4.4 Infiltration

An infiltration rate of 0.15 air changes per hour has been used in the model. This infiltration rate has been derived from CIBSE Guide A 2015 for a building with an air permeability of 3m³/hm² at 50Pa.

4.5 Passive Ventilation

Passive ventilation (openable windows) has been incorporated within the development.

There are some constraints identified within the Environmental Noise and Vibration Strategy and Air Quality Assessment regarding the permanent use of openable windows, however, the GLA requested a version of the calculations utilising openable windows, in order to understand the limitations posed to the design by the local authority. The Air Quality Assessment has advised that from an air quality point of view, 'opening of the windows periodically for a short period of time for cooling is not prohibitive, as long as the units are not permanently relying on openable windows for the background ventilation.'

This will allow the occupant the option of passive ventilation during the brief periods during the year that the apartments may experience overheating.

In addition, there will be a small amount of natural ventilation through infiltration.

cupancy Level (Number of People)				
Flat occupants + 1				
2				

Bedrooms: No casual gains have been included. This has been based on an assumption Living and Kitchen Areas: 95W; this has been based on a 60cm LCD screen, digital TV Openable windows (OW), glazed doors to balcony and fixed glazed panels have included as designed and identified in the floor plan and elevation drawings from the revised planning application drawings submitted alongside this addendum and dated July 2018.

Openable windows have been assumed to be top hang openable at 45°. All openable glazing doors/windows have been assumed to be opened between 10am and 10:00pm when room air temperature (internal) is greater than outside air temperature (external).

4.6 Mechanical Ventilation

As specified in the MEP Report, a ventilation rate of 13 l/s to the living/kitchen room and a ventilation rate of 8 l/s to the bedrooms have been included in the model

A boost mode has been provided for the affordable apartments to double the ventilation rates as detailed above.

4.7 Active Cooling

As a further benefit to this strategy, a limited amount of comfort cooling is proposed to the habitable spaces of the private apartments to assist with marketing although this has not been included in the modelling iterations as cooling does not form part of the overheating mitigation strategy.

4.8 Weather Data

Following the GLA guidance the CIBSE TM49 weather files have been used to describe the external temperature profile. For this project, the London Weather Centre weather file was used.

5 RESULTS

To show compliance with TM52 at least two out of three of the criteria must be met in all habitable rooms, that is bedrooms, living rooms and dining rooms.

5.1 1st Iteration

Tables 5-7 show the results of the simulations incorporating the inputs described in Section 4 of the report - excluding openable windows. Table 5 shows the results for the simulation using the 2003 weather file, Table 6 the 1989 weather file and Table 7 the 1976 weather file. The results highlighted orange indicate a non-compliant result.

Table 5: TM52 Overheating Results (2003 Weather File)

	TM52				
	Criterion 1	Criterion 2	Criterion 3		
Room	(% Hours of Exceedance)	(Daily Weighted Exceedance)	(Max ΔT)	Overall Compliance	
Target	3	6	4		
Dwelling 1 – Bedroom	0.0	0	0	~	
Dwelling 1 – Living / Kitchen	12.6	27	5	×	
Dwelling 2 – Single Bedroom	0.0	0	0	✓	
Dwelling 2 – Double Bedroom	0.2	2	1	×	
Dwelling 2 – Master Bedroom	0.0	0	0	✓	
Dwelling 2 – Living / Kitchen	3.8	19	3	×	
Dwelling 3 – Bedroom North	0	0	0	✓	
Dwelling 3 – Bedroom East	0.1	2	1	×	
Dwelling 3 – Bedroom South	0.1	1	1	✓	
Dwelling 3 – Living / Kitchen	2.1	8	2	✓	

Table 6: TM52 Overheating Results (1989 Weather File)

	TM52				
	Criterion 1	Criterion 2	Criterion 3		
Room	(% Hours of Exceedance)	(Daily Weighted Exceedance)	(Max ΔT)	Overall Compliance	
Target	3	6	4		
Dwelling 1 – Bedroom	1.6	16	3	✓	
Dwelling 1 – Living / Kitchen	13.6	46	8	×	
Dwelling 2 – Single Bedroom	0.5	3	1	✓	
Dwelling 2 – Double Bedroom	1.1	10	3	✓	
Dwelling 2 – Master Bedroom	0.6	4	1	✓	
Dwelling 2 – Living / Kitchen	8.2	35	6	×	
Dwelling 3 – Bedroom North	0.8	5	1	✓	
Dwelling 3 – Bedroom East	1.5	15	3	✓	
Dwelling 3 – Bedroom South	1.4	10	2	✓	
Dwelling 3 – Living / Kitchen	5.5	24	4	×	

Table 7: TM52 Overneating Results (1976 Weather File)						
	TM52					
	Criterion 1	Criterion 2	Criterion 3			
Room	(% Hours of Exceedance)	(Daily Weighted Exceedance)	(Max ∆T)	Overall Compliance		
Target	3	6	4			
Dwelling 1 – Bedroom	3.3	21	4	×		
Dwelling 1 – Living / Kitchen	16.2	44	7	×		
Dwelling 2 – Single Bedroom	0.5	4	2	✓		
Dwelling 2 – Double Bedroom	1.0	12	3	✓		
Dwelling 2 – Master Bedroom	0.9	7	1	✓		
Dwelling 2 – Living / Kitchen	10.6	35	6	×		
Dwelling 3 – Bedroom North	0.8	6	1	✓		
Dwelling 3 – Bedroom East	3.7	20	3	×		
Dwelling 3 – Bedroom South	1.0	7	2	✓		
Dwelling 3 – Living / Kitchen	8.7	20	3	×		

Table 7: TM52 Overheating Results (1976 Weather File)

It can be concluded during peak summertime conditions a limited number of habitable rooms within the dwellings were found to be susceptible to a risk of overheating by a small margin, as the results show on Tables above.

It is proposed that openable windows could assist in the mitigation strategy and a further revised model has been undertaken to demonstrate the improvement in thermal comfort envisaged through their use.

5.2 2nd Iteration

Tables 8-10 show the results of the simulations incorporating the inputs described in Section 4, although the following changes have been made as requested by the GLA in the Stage 1 comments received for the 2017 Planning Submission:

> Openable windows applied though out

Table 8 shows the results for the simulation using the 2003 weather file, Table 9 the 1989 weather file and Table 10 the 1976 weather file. The results highlighted orange indicate a non-compliant result.

	TM52				
	Criterion 1	Criterion 2	Criterion 3		
Room	(% Hours of Exceedance)	(Daily Weighted Exceedance)	(Max ∆T)	Overall Compliance	
Target	3	6	4		
Dwelling 1 – Bedroom	0.0	0	0	✓	
Dwelling 1 – Living / Kitchen	1.5	11	3	✓	
Dwelling 2 – Single Bedroom	0.0	0	0	✓	
Dwelling 2 – Double Bedroom	0.0	0	0	✓	
Dwelling 2 – Master Bedroom	0.0	0	0	✓	
Dwelling 2 – Living / Kitchen	1.3	8	2	✓	
Dwelling 3 – Bedroom North	0.0	0	0	✓	
Dwelling 3 – Bedroom East	0.0	0	0	✓	
Dwelling 3 – Bedroom South	0.0	0	0	✓	
Dwelling 3 – Living / Kitchen	0.9	8	2	✓	

Table 9: TM52 Overheating Results (1989 Weather File)

	TM52				
	Criterion 1	Criterion 2	Criterion 3		
Room	(% Hours of Exceedance)	(Daily Weighted Exceedance)	(Max ΔT)	Overall Compliance	
Target	3	6	4		
Dwelling 1 – Bedroom	0.1	1	1	✓	
Dwelling 1 – Living / Kitchen	3.5	29	7	×	
Dwelling 2 – Single Bedroom	0.1	1	1	✓	
Dwelling 2 – Double Bedroom	0.2	3	2	✓	
Dwelling 2 – Master Bedroom	0.1	1	1	✓	
Dwelling 2 – Living / Kitchen	2.9	22	5	×	
Dwelling 3 – Bedroom North	0.0	0	0	✓	
Dwelling 3 – Bedroom East	0.1	1	1	✓	
Dwelling 3 – Bedroom South	0.1	1	1	✓	
Dwelling 3 – Living / Kitchen	2.8	23	6	×	

ts (2003 Weather File)

Table 10: TM52 Overheating Results (1976 Weather File)						
	TM52					
Room	Criterion 1	Criterion 2	Criterion 3	Overall Compliance		
	(% Hours of Exceedance)	(Daily Weighted Exceedance)	(Max ∆T)			
Target	3	6	4			
Dwelling 1 – Bedroom	0.1	2	1	✓		
Dwelling 1 – Living / Kitchen	4.1	25	5	×		
Dwelling 2 – Single Bedroom	0.1	2	1	✓		
Dwelling 2 – Double Bedroom	0.2	4	2	✓		
Dwelling 2 – Master Bedroom	0.1	2	1	✓		
Dwelling 2 – Living / Kitchen	3.4	24	5	×		
Dwelling 3 – Bedroom North	0.1	2	1	✓		
Dwelling 3 – Bedroom East	0.2	3	2	✓		
Dwelling 3 – Bedroom South	0.1	2	1	×		
Dwelling 3 – Living / Kitchen	3.5	22	4	×		

Table 10: TM52 Overheating Results (1976 Weather File)

It can be concluded during peak summertime conditions the living and kitchens were found to be susceptible to a risk of overheating by a small margin as results shown on Tables above.

6 CONCLUSION

The study has shown how the proposed development has been designed to minimise the risk of overheating. The strategy has followed the Cooling Hierarchy in Policy 5.9 of the London Plan.

The strategy has focused on minimising heat generation within the dwellings. This has mainly been achieved by the specification of energy efficient services and placing them in non-occupied areas, where overheating is not considered an issue.

The next step of the strategy was to reduce the amount of heat entering the building. The design of the façade, including appropriate proportions of glazing and balcony to living/kitchen rooms were central to this step. The glazing g-value was also considered not only to reduce the amount of solar gain in the summer, but also to maximise beneficial heat gain in the winter.

Managing the heat within the building through exposed thermal mass and high ceilings was considered. Both of these options were deemed to be inappropriate. Due to residential nature of the development there is a need to conceal services, which reduces the possibility of incorporating exposed thermal mass. Ceiling heights have been maximised within the constraints of the overall building height and massing.

The internal apartment layout design has been developed integrating the minimum Part F of the Building Regulation mechanical ventilation rates with openable windows. In addition, there will be a small amount of natural ventilation through infiltration. A boost mode on the mechanical ventilation has been provided for the affordable apartments.

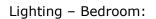
In order to quantify the strategy outlined above, a dynamic thermal model was created in IES 2017.4.0. A simulation was carried out using a number of assumptions and using the CIBSE TM49 Weather Files. The results were then compared to the CIBSE TM52 Overheating Criteria.

Having undertaken an initial modelling in consideration of the above conditions, but excluding openable windows it can be demonstrated that during peak summertime conditions a limited number of habitable rooms within all dwellings were found to be susceptible to a risk of overheating by a small margin. By opening the windows all the bedrooms are showing compliance with all criteria across all 3 of the weather files, whilst the living/kitchen areas are exceeding the criteria by a small margin in the 1989 and 1976 weather files.

This report concludes the dwellings are complying with London Plan Policy 5.9 'Overheating and Cooling' by following the 'Cooling Hierarchy' as defined.

As a further benefit to this strategy, a limited amount of comfort cooling is proposed to the habitable spaces of the private apartments to assist with marketing although this has not been included in the modelling iterations as cooling does not form part of the overheating mitigation strategy.

APPENDIX A – MODELLING PROFILES



Lighting – Living Room:

1.0

0.90

0.80

0.70

0.50

0.40

0.30

0.20

0.10

0.30

0.20

0.10

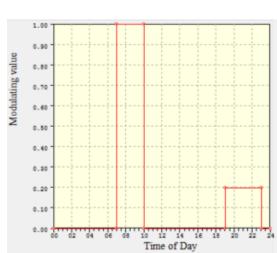
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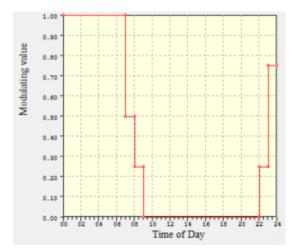
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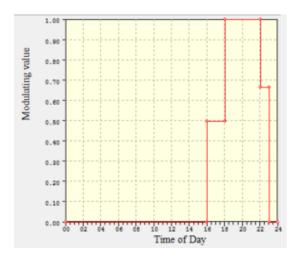
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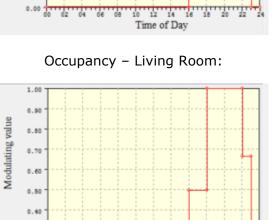


Occupancy – Bedroom:



Equipment – Living Room:





10 12 14

Time of Day

18

22 2

16