Newcombe House and Kensington Church Street
Energy Strategy Addendum

July 2018

Contents

1. Introduction

2. Passive and Active Energy Efficiency Measures "Be Lean"

3. Energy Networks and Combined Heat & Power "Be Clean"

4. Renewable Energy "Be Green"

5. Conclusion

Appendix 1 Sample TER Worksheets

Appendix 2 Sample 'Be Lean' DER Worksheets & BRUKL Documents

Appendix 3 TM52 Overheating Report

Appendix 4 Site Wide Schematics

Appendix 5 Sample 'Be Clean' DER Worksheets & BRUKL Documents

Appendix 6 Sample 'Be Green' DER Worksheets & BRUKL Document

Appendix 7 Roof Layout

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.

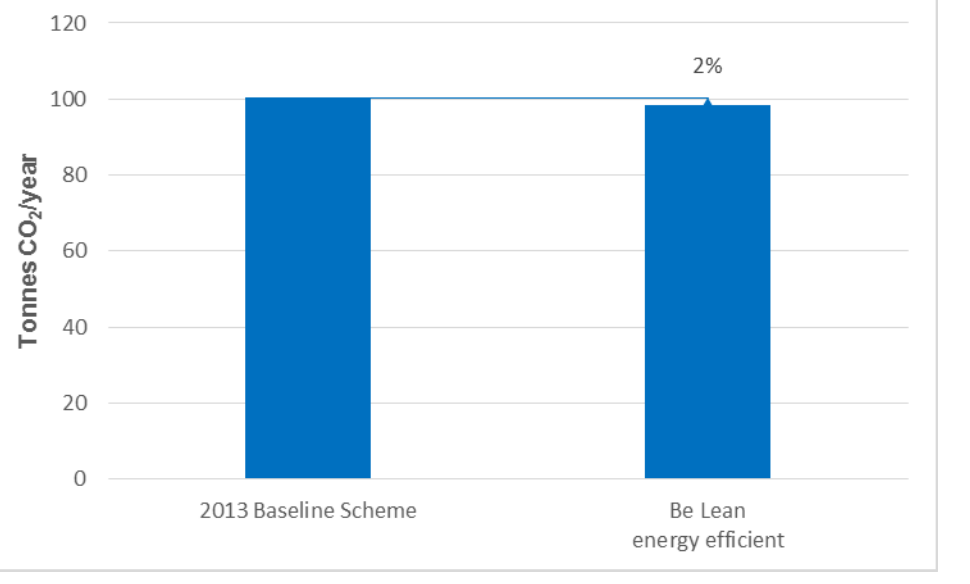

Figure 1: Domestic Regulated Carbon Dioxide Emissions – "Be Lean"

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.

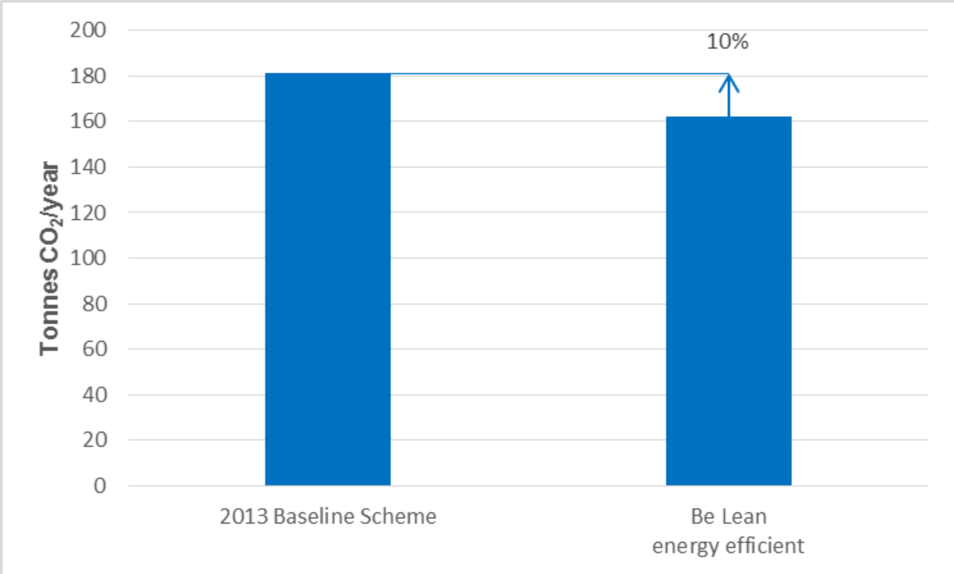

Figure 2: Non-Domestic Regulated Carbon Dioxide Emissions – "Be Lean"

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 July (kWh/m²)	Maximum domestic cooling demand for 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/m²) –	
	Office	Retail
Actual	2.60	6.19
Notional	5.06	7.22

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.

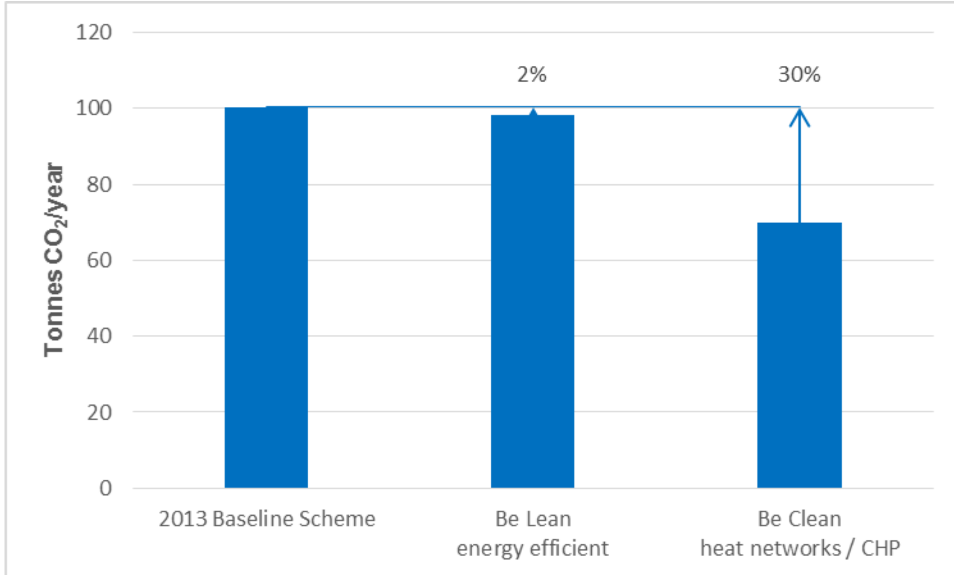

Figure 3: Domestic Regulated Carbon Dioxide Emissions – "Be Clean"

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.

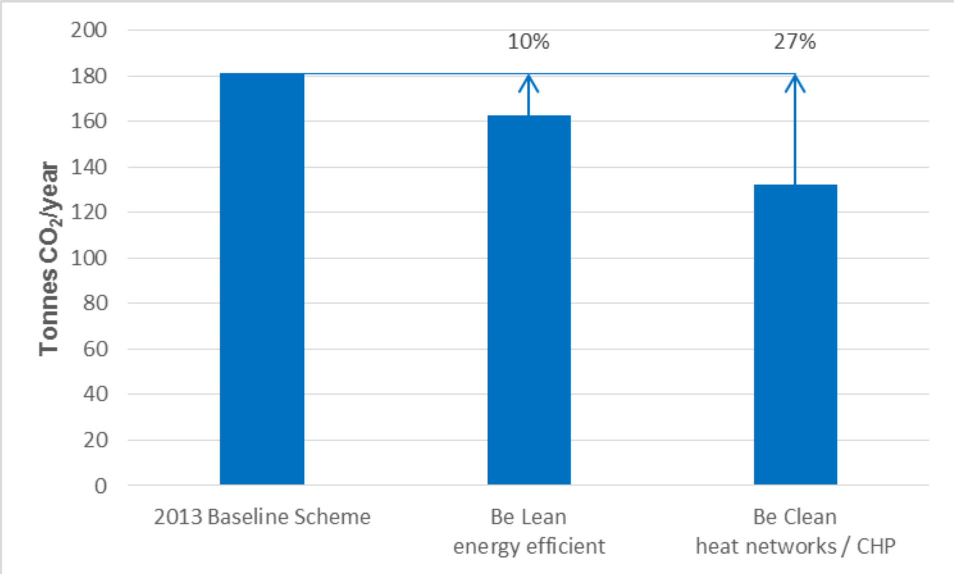

Figure 4: Non-Domestic Regulated Carbon Dioxide Emissions – "Be Clean"

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.

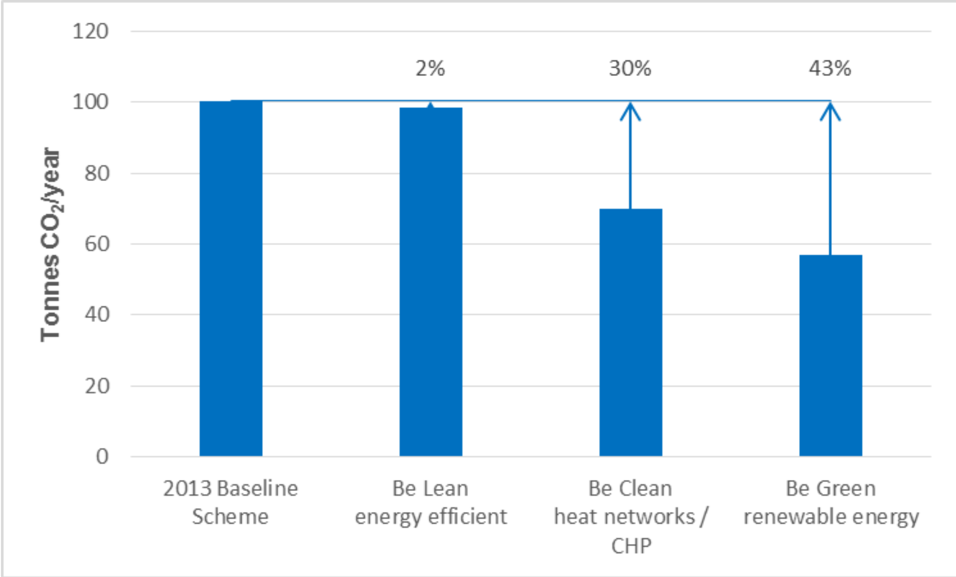

Figure 5: Domestic Regulated Carbon Dioxide Emissions – "Be Green"

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.

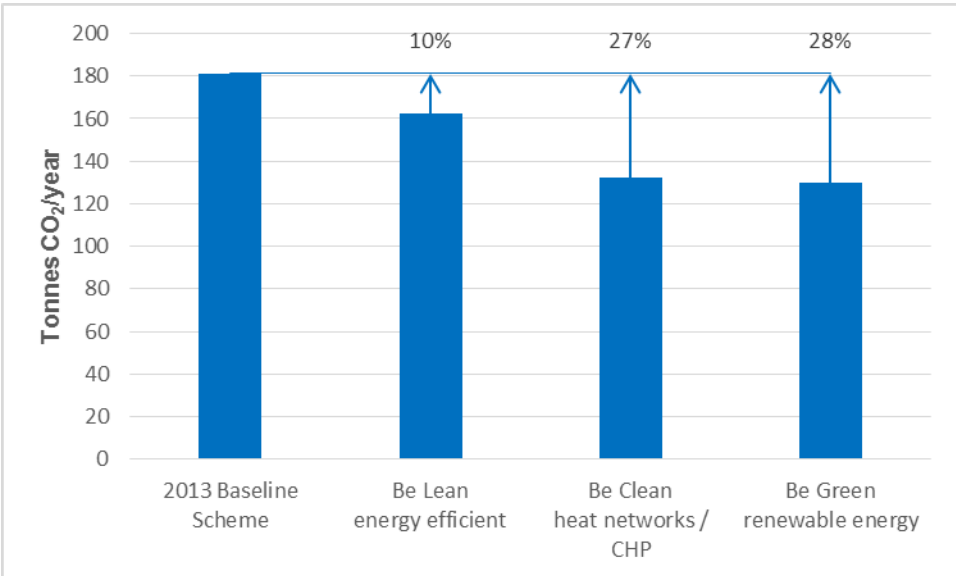

Figure 6: Non-Domestic Regulated Carbon Dioxide Emissions – "Be Green"

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 CO_2 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.

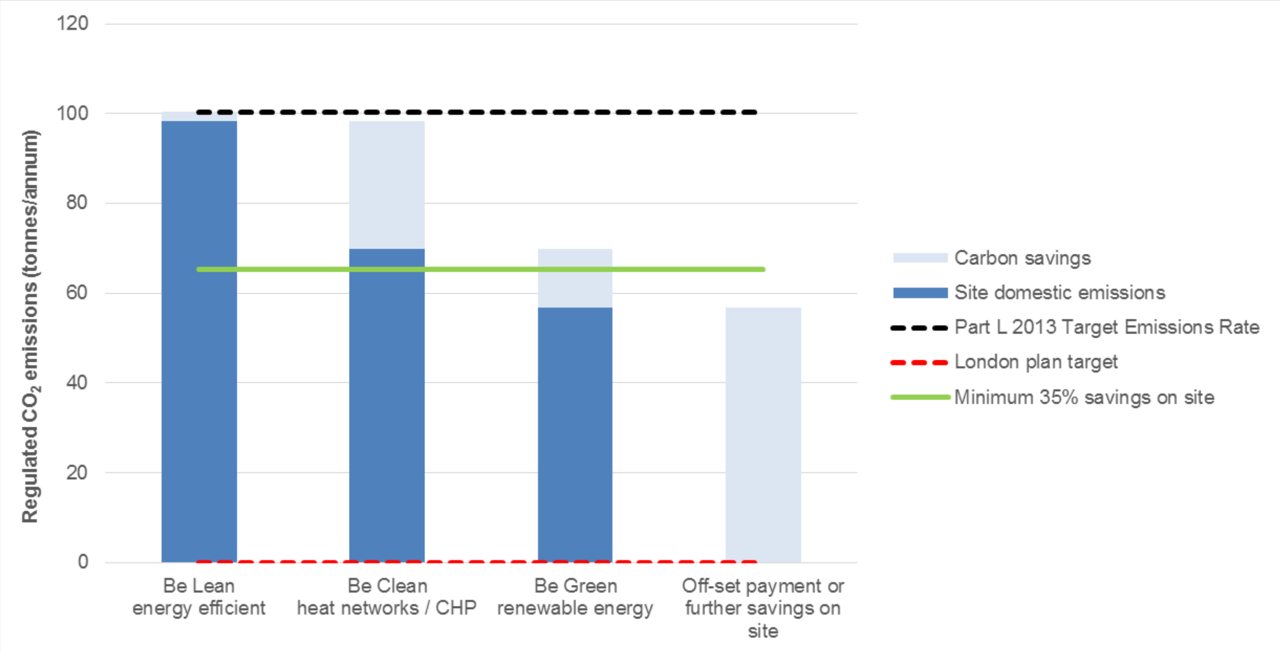

Figure 7: The Site Wide Domestic Energy Hierarchy and Targets

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 CO_2 per year for a period of 30 years at a rate of £60 / tonne of CO_2.

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 CO_2 Emissions Breakdown

	Carbon Dioxide Emissions (tonnes CO_2 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 CO_2 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 CO_2 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 CO_2 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 CO_2.

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 CO_2 reduction achieved for the domestic modelling.

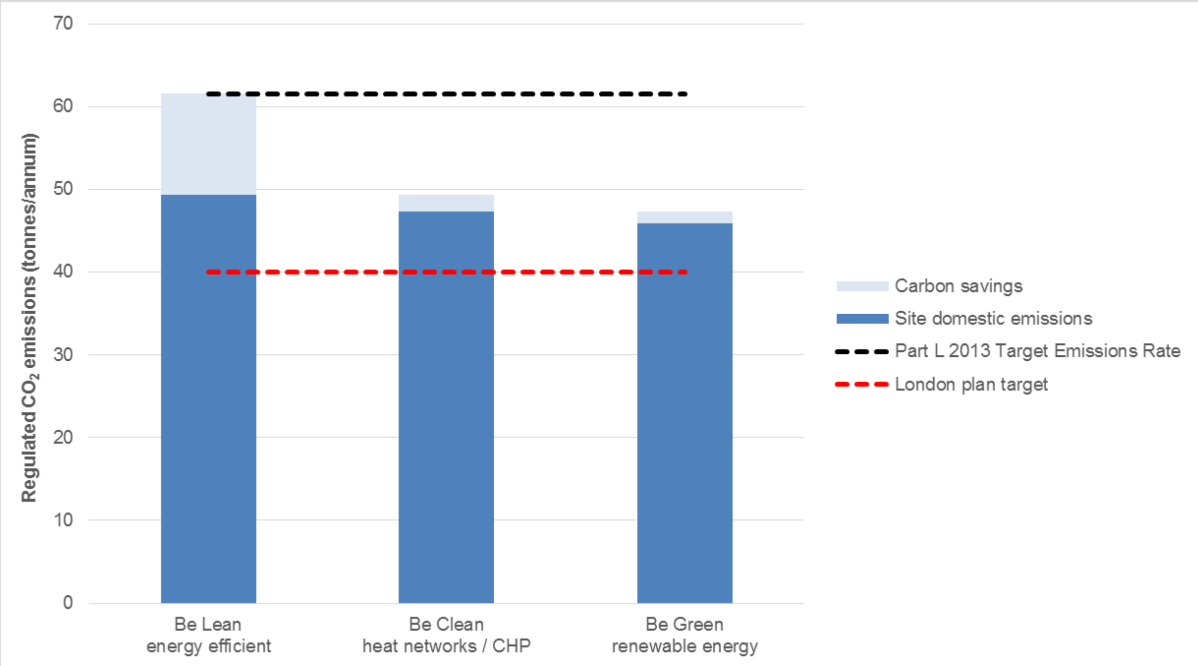

Figure 8: The Site Wide Non-Domestic Energy Hierarchy and Targets

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 CO_2 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 CO_2 Emissions Breakdown

	Carbon Dioxide Emissions (tonnes CO_2 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

Table 6: Non-Domestic Regulated CO_2 Emissions Savings

	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 CO_2 Emissions

	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	63	
Shortfall	13	379

5.3 Site Total

The overall site CO_2 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 CO_2 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 CO_2 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 CO_2 emissions in line with the London Plan Energy Hierarchy.

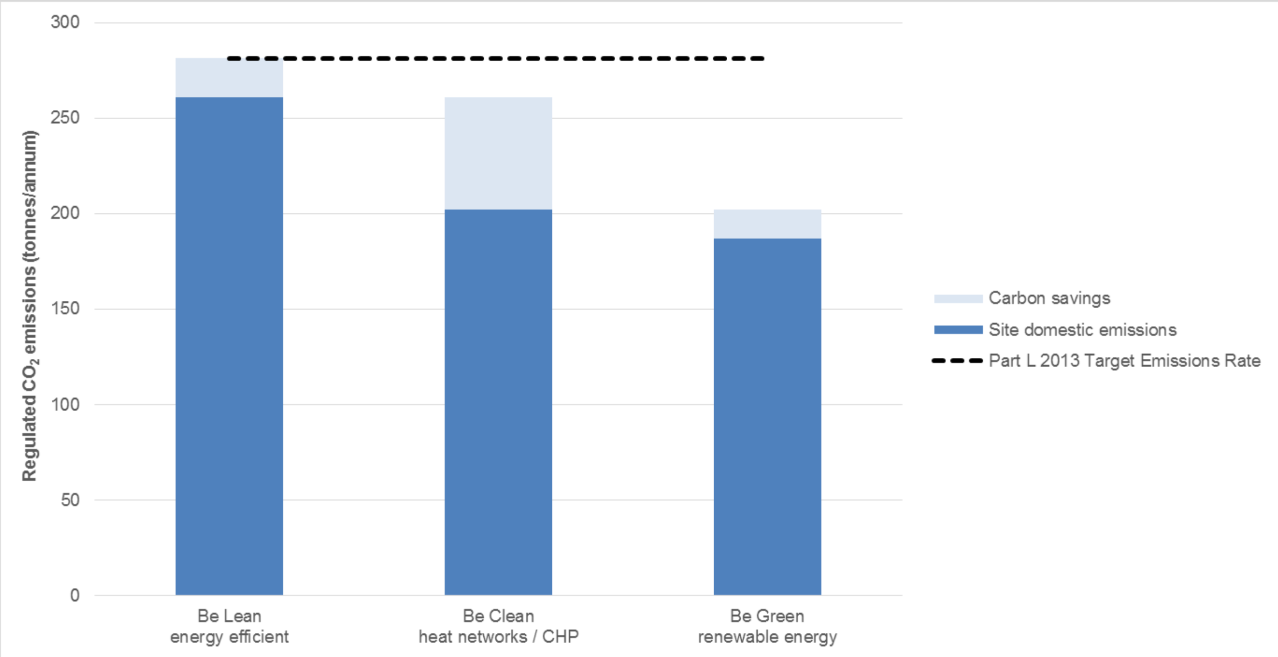

Figure 9: The Site Wide Energy Hierarchy and Targets

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

Table 8: Site Wide Regulated CO_2 Emissions and Savings

	Total Regulated Emissions (tonnes of CO_2 per annum)	CO_2 Savings (tonnes CO_2 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**		

APPENDICES

APPENDIX 1 – SAMPLE TER WORKSHEETS

TER Worksheet
Design - Draft

NHER

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		164.79	(1a)	x	2.85	(2a)	=	469.65	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	164.79	(4)						
Dwelling volume						(3a) + (3b) + (3c) + (3d)...(3n) =		469.65	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	4	x 10 =	40	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	40	÷ (5) =	0.09	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.34	(18)
Number of sides on which the dwelling is sheltered		1	(19)
Shelter factor	1 - [0.075 x (19)] =	0.93	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.31	(21)

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	3.80	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 infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.40	0.39	0.38	0.34	0.33	0.29	0.29	0.29	0.31	0.33	0.35	0.36	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
d) natural ventilation or whole house positive input ventilation from loft	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			41.15	x	1.33	=	54.55			(27)
Ground floor			164.79	x	0.13	=	21.42			(28a)
External wall			127.58	x	0.18	=	22.96			(29a)
Party wall			9.58	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			333.52							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	98.94	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		16.68	(36)
Total fabric heat loss	(33) + (36) =	115.62	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	89.60	89.13	88.67	86.51	86.10	84.21	84.21	83.87	84.94	86.10	86.92	87.78	(38)
Heat transfer coefficient, W/K (37)m + (38)m	205.22	204.75	204.29	202.12	201.72	199.83	199.83	199.48	200.56	201.72	202.54	203.39	
Average = ∑(39)1...12/12 =												202.12	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.25	1.24	1.24	1.23	1.22	1.21	1.21	1.21	1.22	1.22	1.23	1.23	
Average = ∑(40)1...12/12 =												1.23	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.96	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	104.39	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	114.83	110.66	106.48	102.31	98.13	93.95	93.95	98.13	102.31	106.48	110.66	114.83	
∑(44)1...12 =												1252.73	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	170.29	148.94	153.69	133.99	128.57	110.95	102.81	117.97	119.38	139.13	151.87	164.92	
∑(45)1...12 =												1642.52	(45)
Distribution loss 0.15 x (45)m	25.54	22.34	23.05	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 storage within same vessel	1.00	(47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)	0.21	(48)
Temperature factor from Table 2b	0.54	(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.12	(50)
Enter (50) or (54) in (55)	0.12	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) 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 contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	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)

Primary circuit loss for each month from Table 3

DRAFT

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 each month from Table 3a, 3b or 3c

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 required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

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)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

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

197.13	173.18	180.53	159.96	155.40	136.91	129.64	144.81	145.35	165.96	177.84	191.76

∑(64)1...12 = 1958.47 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

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)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	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)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	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)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	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)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	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)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-118.22	-118.22	-118.22	-118.22	-118.22	-118.22	-118.22	-118.22	-118.22	-118.22	-118.22	-118.22	(71)
Water heating gains (Table 5)	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)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	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)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	8.64	x	10.63	x 0.9 x	0.63	x	0.70	=	28.08	(74)
East	0.77	x	14.40	x	19.64	x 0.9 x	0.63	x	0.70	=	86.43	(76)
South	0.77	x	15.41	x	46.75	x 0.9 x	0.63	x	0.70	=	220.18	(78)
West	0.77	x	2.70	x	19.64	x 0.9 x	0.63	x	0.70	=	16.21	(80)

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)

Total gains - internal and solar (73)m + (83)m

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)

7. Mean internal temperature (heating season)

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	

Utilisation factor for gains for living area n1,m (see Table 9a)

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)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

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)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

19.88	19.89	19.89	19.90	19.90	19.91	19.91	19.91	19.91	19.90	19.90	19.89	(88)

Utilisation factor for gains for rest of dwelling n2,m

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)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

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)

Living area fraction — Living area ÷ (4) = 0.52 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.81	19.08	19.46	19.92	20.27	20.43	20.46	20.46	20.35	19.88	19.25	18.77	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

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)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	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)
Useful gains, ηmGm, W (94)m x (84)m	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)
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	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	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)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	1553.04	1180.82	952.05	511.82	205.08	0.00	0.00	0.00	0.00	569.28	1112.26	1593.23	

∑(98)1...5, 10...12 = 7677.57 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 46.59 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		93.50	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	1661.01	1262.91	1018.23	547.40	219.33	0.00	0.00	0.00	0.00	608.86	1189.58	1703.99

∑(211)1...5, 10...12 = 8211.30 (211)

Water heating

Efficiency of water heater

89.15	88.97	88.61	87.70	85.55	79.80	79.80	79.80	79.80	87.84	88.86	89.21	(217)

Water heating fuel, kWh/month

221.11	194.64	203.74	182.40	181.64	171.57	162.46	181.46	182.14	188.93	200.14	214.94

∑(219a)1...12 = 2285.18 (219)

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	B	

12a. CO_2 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	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	x	0.519	=	38.93	(267)
Electricity for lighting	529.32	x	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)
EI value					83.52	
EI rating (section 14)					84	(274)
EI band					B	

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	x	1.22	=	2787.92	(264)
Space and water heating				(261) + (262) + (263) + (264) =	12805.71	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	529.32	x	3.07	=	1625.01	(268)
Primary energy kWh/year					14660.97	(272)

Dwelling primary energy rate kWh/m2/year	88.97	(273)

DRAFT DRAFT

TER Worksheet
Design - Draft

NHER

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		

DRAFT

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		175.68	(1a)	x	2.70	(2a)	=	474.34	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	175.68	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			474.34	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	4	x 10 =	40	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs (6a) + (6b) + (7a) + (7b) + (7c) =	40	÷ (5) =	0.08	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.33	(18)
Number of sides on which the dwelling is sheltered	1	(19)
Shelter factor 1 - [0.075 x (19)] =	0.93	(20)
Infiltration rate incorporating shelter factor (18) x (20) =	0.31	(21)

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	3.80	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 infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	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)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
d) natural ventilation or whole house positive input ventilation from loft	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)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	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)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			43.96	x	1.33	=	58.28			(27)
Ground floor			175.65	x	0.13	=	22.83			(28a)
External wall			133.90	x	0.18	=	24.10			(29a)
Total area of external elements ∑A, m²			353.51							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	105.22	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		17.68	(36)
Total fabric heat loss	(33) + (36) =	122.89	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	90.43	89.96	89.50	87.32	86.92	85.02	85.02	84.67	85.75	86.92	87.74	88.60	(38)
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	
Average = ∑(39)1...12/12 =												210.21	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.21	1.21	1.21	1.20	1.19	1.18	1.18	1.18	1.19	1.19	1.20	1.20	
Average = ∑(40)1...12/12 =												1.20	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.97	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	104.74	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	115.21	111.02	106.84	102.65	98.46	94.27	94.27	98.46	102.65	106.84	111.02	115.21	
∑(44)1...12 =												1256.89	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	170.86	149.44	154.20	134.44	129.00	111.31	103.15	118.37	119.78	139.59	152.37	165.47	
∑(45)1...12 =												1647.98	(45)
Distribution loss 0.15 x (45)m	25.63	22.42	23.13	20.17	19.35	16.70	15.47	17.75	17.97	20.94	22.86	24.82	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00	(47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)	0.21	(48)
Temperature factor from Table 2b	0.54	(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.12	(50)
Enter (50) or (54) in (55)	0.12	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) 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 contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	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)
Primary circuit loss for each month from 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 each month from Table 3a, 3b or 3c

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 required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

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)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

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

197.69	173.67	181.04	160.41	155.83	137.28	129.98	145.20	145.75	166.42	178.34	192.30	

∑(64)1...12 = 1963.92 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	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)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	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)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	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)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.85	37.85	37.85	37.85	37.85	37.85	37.85	37.85	37.85	37.85	37.85	37.85	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-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)
Water heating gains (Table 5)	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	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)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	17.81	x	19.64	x 0.9 x	0.63	x	0.70	=	106.90	(76)
South	0.77	x	9.87	x	46.75	x 0.9 x	0.63	x	0.70	=	141.02	(78)
West	0.77	x	16.28	x	19.64	x 0.9 x	0.63	x	0.70	=	97.72	(80)

Solar gains in watts ∑(74)m...(82)m	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)
Total gains - internal and solar (73)m + (83)m	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)

7. Mean internal temperature (heating season)

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	
Utilisation factor for gains for living area n1,m (see Table 9a)	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)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.59	19.81	20.14	20.54	20.83	20.96	20.99	20.99	20.89	20.46	19.94	19.56	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.91	19.91	19.91	19.92	19.92	19.93	19.93	19.93	19.93	19.92	19.92	19.92	(88)
Utilisation factor for gains for rest of dwelling n2,m	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)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.03	18.35	18.83	19.40	19.77	19.91	19.93	19.93	19.84	19.30	18.54	17.98	(90)

Living area fraction — Living area ÷ (4) = 0.52 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	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	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)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	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	898.02	1175.16	1450.72	1647.83	1569.24	1172.48	800.83	834.22	1159.81	1151.10	926.64	826.25	(95)
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	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	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)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	1640.48	1243.31	977.89	493.39	178.84	0.00	0.00	0.00	0.00	596.38	1179.18	1683.32	

∑(98)1...5, 10...12 = 7992.80 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 45.50 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		93.50	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	1754.52	1329.74	1045.87	527.69	191.27	0.00	0.00	0.00	0.00	637.84	1261.16	1800.34

∑(211)1...5, 10...12 = 8548.45 (211)

Water heating

Efficiency of water heater	89.21	89.04	88.64	87.62	85.18	79.80	79.80	79.80	79.80	87.93	88.93	89.27	(217)
Water heating fuel, kWh/month	221.60	195.06	204.23	183.08	182.94	172.03	162.89	181.95	182.64	189.27	200.53	215.41	

∑(219a)1...12 = 2291.63 (219)

Annual totals

Space heating fuel - main system 1 8548.45

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Water heating fuel					2291.63	
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)					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	B	

12a. CO_2 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	8548.45	x	0.216	=	1846.46	(261)
Water heating	2291.63	x	0.216	=	494.99	(264)
Space and water heating			(261) + (262) + (263) + (264) =		2341.46	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	546.80	x	0.519	=	283.79	(268)
Total CO_2, kg/year				(265)...(271) =	2664.17	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	15.16	(273)
EI value					83.82	
EI rating (section 14)					84	(274)
EI band					B	

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

	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	x	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	x	3.07	=	1678.67	(268)
Primary energy kWh/year					15133.82	(272)
Dwelling primary energy rate kWh/m2/year					86.14	(273)

TER Worksheet
Design - Draft

NHER

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	(1a)	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

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	4	x 10 =	40	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs (6a) + (6b) + (7a) + (7b) + (7c) =	40	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.38	(18)
Number of sides on which the dwelling is sheltered		1	(19)
Shelter factor	1 - [0.075 x (19)] =	0.93	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.36	(21)

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	3.80	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 infiltration rate (allowing for shelter and wind factor) (21) x (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 effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
d) natural ventilation or whole house positive input ventilation from 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 change rate - enter (24a) or (24b) or (24c) or (24d) 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)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			27.50	x	1.33	=	36.46			(27)
Ground floor			110.05	x	0.13	=	14.31			(28a)
External wall			87.61	x	0.18	=	15.77			(29a)
Party wall			21.57	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			225.16							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	66.53	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.26	(36)
Total fabric heat loss	(33) + (36) =	77.79	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	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)
Heat transfer coefficient, W/K (37)m + (38)m	136.91	136.52	136.13	134.33	133.99	132.42	132.42	132.13	133.03	133.99	134.67	135.39	
Average = ∑(39)1...12/12 =												134.33	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.24	1.24	1.24	1.22	1.22	1.20	1.20	1.20	1.21	1.22	1.22	1.23	
Average = ∑(40)1...12/12 =												1.22	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.82	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	101.06	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	111.17	107.12	103.08	99.04	95.00	90.95	90.95	95.00	99.04	103.08	107.12	111.17	
∑(44)1...12 =												1212.71	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	164.85	144.18	148.78	129.71	124.46	107.40	99.52	114.21	115.57	134.68	147.02	159.65	
∑(45)1...12 =												1590.06	(45)
Distribution loss 0.15 x (45)m	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)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00	(47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)	0.21	(48)
Temperature factor from Table 2b	0.54	(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.12	(50)
Enter (50) or (54) in (55)	0.12	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) 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 contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	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)

Primary circuit loss for each month from Table 3

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(Primary circuit loss)	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 each month from Table 3a, 3b or 3c	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 required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	191.69	168.42	175.62	155.68	151.30	133.37	126.36	141.04	141.54	161.52	172.99	186.49	(62)
Solar DHW input calculated using Appendix G or Appendix H	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from water heater for each month (kWh/month) (62)m + (63)m	191.69	168.42	175.62	155.68	151.30	133.37	126.36	141.04	141.54	161.52	172.99	186.49	
∑(64)1...12 =												1906.00	(64)
Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	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)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	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 (calculated in Appendix L, equation L9 or L9a), also see Table 5	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 (calculated in Appendix L, equation L13 or L13a), also see Table 5	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 (calculated in Appendix L, equation L15 or L15a), also see Table 5	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 gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 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 gains (Table 5)	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)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	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)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	9.85	x	19.64	x 0.9 x	0.63	x	0.70	=	59.12	(76)
South	0.77	x	6.64	x	46.75	x 0.9 x	0.63	x	0.70	=	94.87	(78)
West	0.77	x	11.01	x	19.64	x 0.9 x	0.63	x	0.70	=	66.09	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	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)
Total gains - internal and solar (73)m + (83)m	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)

7. Mean internal temperature (heating season)

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	
Utilisation factor for gains for living area n1,m (see Table 9a)	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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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 during heating periods in the rest of dwelling from Table 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 factor for gains for rest of dwelling 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 temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

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 fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

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 adjustment to the mean internal temperature from Table 4e where appropriate

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 heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	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, ηmGm, W (94)m x (84)m	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 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	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1970.68	1921.62	1755.23	1474.33	1136.49	755.49	493.32	518.48	817.80	1233.17	1623.34	1957.08	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	957.60	717.64	553.83	268.81	92.64	0.00	0.00	0.00	0.00	317.81	670.93	983.00	

∑(98)1...5, 10...12 = 4562.25 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 41.46 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		93.50	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	1024.17	767.53	592.34	287.50	99.08	0.00	0.00	0.00	0.00	339.90	717.57	1051.34

∑(211)1...5, 10...12 = 4879.41 (211)

Water heating

Efficiency of water heater	88.52	88.25	87.67	86.26	83.55	79.80	79.80	79.80	79.80	86.59	88.08	88.61	(217)
Water heating fuel, kWh/month	216.55	190.84	200.32	180.48	181.08	167.13	158.34	176.74	177.37	186.54	196.40	210.47	

∑(219a)1...12 = 2242.26 (219)

Annual totals

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	x	3.48	x 0.01 =	169.80	(240)
Water heating	2242.26	x	3.48	x 0.01 =	78.03	(247)
Pumps and fans	75.00	x	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 heating 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	B	

12a. CO_2 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	4879.41	x	0.216	=	1053.95	(261)
Water 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	x	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)
EI value					84.45	
EI rating (section 14)					84	(274)
EI band					B	

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	x	1.22	=	5952.88	(261)
Water heating	2242.26	x	1.22	=	2735.56	(264)
Space and water heating				(261) + (262) + (263) + (264) =	8688.44	(265)
Pumps and fans	75.00	x	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)

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TER Worksheet
Design - Draft

NHER

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	TH A1, London		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		69.47	(1a)	x	2.70	(2a)	=	187.57	(3a)
+1		41.56	(1b)	x	3.15	(2b)	=	130.91	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	111.03	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	318.48	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	4	x 10 =	40	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs (6a) + (6b) + (7a) + (7b) + (7c) =	40	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.38	(18)
Number of sides on which the dwelling is sheltered		1	(19)
Shelter factor	1 - [0.075 x (19)] =	0.93	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.35	(21)

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	3.80	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 infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.44	0.43	0.43	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

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

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, 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 external elements ∑A, m²			282.31							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	76.33	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		14.12	(36)
Total fabric heat loss	(33) + (36) =	90.44	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	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 coefficient, 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 = ∑(39)1...12/12 = 150.67 (39)

Heat loss parameter (HLP), W/m²K (39)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 = ∑(40)1...12/12 = 1.36 (40)

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.82	(42)
Annual average hot water usage in litres 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 usage in litres per day for each month Vd,m = factor from Table 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	

∑(44)1...12 = 1214.35 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (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) including any solar or WWHRS storage within same vessel	1.00	(47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)	0.21	(48)
Temperature factor from Table 2b	0.54	(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.12	(50)
Enter (50) or (54) in (55)	0.12	(55)

Water storage loss calculated for each month (55) 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 contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

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)

Primary circuit loss for each month from 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 each month from Table 3a, 3b or 3c

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 required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)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)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

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

∑(64)1...12 = 1908.15 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

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)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	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)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	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	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)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	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)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-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)
Water heating gains (Table 5)	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)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	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)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	23.05	x	19.64	x 0.9 x	0.63	x	0.70	=	138.35	(76)
West	0.77	x	4.72	x	19.64	x 0.9 x	0.63	x	0.70	=	28.33	(80)

Solar gains in watts ∑(74)m...(82)m

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)

Total gains - internal and solar (73)m + (83)m

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)

7. Mean internal temperature (heating season)

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	
Utilisation factor for gains for living area n1,m (see Table 9a)	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)
Mean internal temp of living area T1 (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)
Temperature during heating periods in the rest of dwelling from Table 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)
Utilisation factor for gains for rest of dwelling 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)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	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)

Living area fraction — Living area ÷ (4) = 0.45 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	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)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	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)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, 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)
Useful gains, ηmGm, W (94)m x (84)m	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)
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	(96)
Heat loss rate for mean internal temperature, 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)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)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)1...5, 10...12 = 5744.97 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 51.74 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		93.50	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/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)1...5, 10...12 = 6144.35 (211)

Water heating

Efficiency of water heater	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)
Water heating fuel, kWh/month	216.13	190.28	199.36	178.93	178.70	167.31	158.51	176.93	177.56	185.03	195.78	210.11	

∑(219a)1...12 = 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	B	

12a. CO_2 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	x	0.519	=	38.93	(267)
Electricity for lighting	429.86	x	0.519	=	223.10	(268)
Total CO_2, kg/year				(265)...(271) =	2071.89	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	18.66	(273)
EI value					82.21	
EI rating (section 14)					82	(274)
EI band					B	

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

Dwelling primary energy rate kWh/m2/year	106.03	(273)

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

HOARE LEA

SAP Results Sheet.

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

Parameters Used.

Category	Parameter	Value	Notes
External Fabric	External Wall U-Values (W/m²K)	0.25	As Calculated by BS EN ISO 6946
	Floor U-Values (W/m²K)	0.09	As Calculated by BS EN ISO 6946
	Roof U-Values (W/m²K)	0.18	As Calculated by BS EN ISO 6946
	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
Internal Walls	To Other Apartments	Fully Filled Cavity with Sealed Edges	
	To Corridors (W/m²K)	0.18	As Calculated by BS EN ISO 6946
	To Risers (W/m²K)	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/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 walls, 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 air pressure testing scheme Note to use the measured air perm rate each dwelling has to be pressure tested. If a dwelling is not pressure tested the value used in the calculation is an average of the tested dwellings of the same type plus 2.
Mechanical Ventilation	Strategy	Balanced with Heat Recovery	
	SFP (W/l/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
	Installer approved	Yes	The installer has be registered with a Government Approved Scheme e.g. BESCA, Blue Flame Certification, Certsure, NAPIT and Stroma
	Duct Type	Rigid	All ductwork is rigid except for occasional flexible ducting to join components together
	Ductwork Insulated	Yes	Ductwork can be assumed to be insulated if all of the ductwork is inside the insulated envelope even if the ductwork itself is uninsulated.
Space Heating	Category	Communal	
	Boilers - Fraction of Heat (-)	1	As design specification
	Boilers - Efficiency (%)	91.8	As calculated by SAP Appendix D
	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)	
Water Heating	Type	From Main System	
	Cylinder in Dwelling	No	
	Plate Heat Exchanger	Yes	
	Volume (litres)	5	
	Insulation Type	Spray Foam	
	Insulation Thickness (mm)	25	
	Waste Water Heat Recovery	No	
Renewables	Type	None	
Cooling	Areas Cooled	All Living Spaces and Bedrooms	
	EER	4.5	
	Controls	Variable Speed Compressor	
Summertime Overheating	Openable Windows	No	
	Mechanical Ventilation Required	Yes	
	Blinds	Light-coloured curtain or roller blind	

HOARE LEA

SAP Results Sheet.

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

Parameters Used.

Category	Parameter	Value	Notes
External Fabric	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
	Roof U-Values (W/m²K)	0.18	As Calculated by BS EN ISO 6946
	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
Internal Walls	To Other Apartments	Fully Filled Cavity with Sealed Edges	
	To Corridors (W/m²K)	0.18	As Calculated by BS EN ISO 6946
	To Risers (W/m²K)	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/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 walls, 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 air pressure testing scheme Note to use the measured air perm rate each dwelling has to be pressure tested. If a dwelling is not pressure tested the value used in the calculation is an average of the tested dwellings of the same type plus 2.
Mechanical Ventilation	Strategy	Balanced with Heat Recovery	
	SFP (W/l/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
	Installer approved	Yes	The installer has be registered with a Government Approved Scheme e.g. BESCA, Blue Flame Certification, Certsure, NAPIT and Stroma
	Duct Type	Rigid	All ductwork is rigid except for occasional flexible ducting to join components together
	Ductwork Insulated	Yes	Ductwork can be assumed to be insulated if all of the ductwork is inside the insulated envelope even if the ductwork itself is uninsulated.
Space Heating	Category	Communal	
	Boilers - Fraction of Heat (-)	1	As design specification
	Boilers - Efficiency (%)	91.8	As calculated by SAP Appendix D
	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)	
Water Heating	Type	From Main System	
	Cylinder in Dwelling	No	
	Plate Heat Exchanger	Yes	
	Volume (litres)	1	
	Insulation Type	Spray Foam	
	Insulation Thickness (mm)	30	
	Waste Water Heat Recovery	No	
Renewables	Type	None	
Cooling	Areas Cooled	All Living Spaces and Bedrooms	Private Units have Comfort Cooling Affordable Units have no Cooling
	EER	4.5	
	Controls	Variable Speed Compressor	
Summertime Overheating	Openable Windows	No	
	Mechanical Ventilation Required	Yes	
	Blinds	Light-coloured curtain or roller blind	

HOARE LEA

SAP Results Sheet.

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

Parameters Used.

Category	Parameter	Value	Notes
External Fabric	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
	Roof U-Values (W/m²K)	0.18	As Calculated by BS EN ISO 6946
	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
Internal Walls	To Other Apartments	Fully Filled Cavity with Sealed Edges	
	To Corridors (W/m²K)	0.18	As Calculated by BS EN ISO 6946
	To Risers (W/m²K)	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/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 walls, 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 air pressure testing scheme Note to use the measured air perm rate each dwelling has to be pressure tested. If a dwelling is not pressure tested the value used in the calculation is an average of the tested dwellings of the same type plus 2.
Mechanical Ventilation	Strategy	Balanced with Heat Recovery	
	SFP (W/l/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
	Installer approved	Yes	The installer has be registered with a Government Approved Scheme e.g. BESCA, Blue Flame Certification, Certsure, NAPIT and Stroma
	Duct Type	Rigid	All ductwork is rigid except for occasional flexible ducting to join components together
	Ductwork Insulated	Yes	Ductwork can be assumed to be insulated if all of the ductwork is inside the insulated envelope even if the ductwork itself is uninsulated.
Space Heating	Category	Communal	
	Boilers - Fraction of Heat (-)	1	As design specification
	Boilers - Efficiency (%)	91.8	As calculated by SAP Appendix D
	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)	
Water Heating	Type	From Main System	
	Cylinder in Dwelling	No	
	Plate Heat Exchanger	Yes	
	Volume (litres)	1	
	Insulation Type	Spray Foam	
	Insulation Thickness (mm)	30	
	Waste Water Heat Recovery	No	
Renewables	Type	None	
Summertime Overheating	Openable Windows	No	
	Mechanical Ventilation Required	Yes	
	Blinds	Light-coloured curtain or roller blind	

HOARE LEA

SAP Results Sheet.

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

Parameters Used.

Category	Parameter	Value	Notes
External Fabric	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
	Roof U-Values (W/m²K)	0.18	As Calculated by BS EN ISO 6946
	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
Internal Walls	To Other Apartments	Fully Filled Cavity with Sealed Edges	
	To Corridors (W/m²K)	0.18	As Calculated by BS EN ISO 6946
	To Risers (W/m²K)	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/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 walls, 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 air pressure testing scheme Note to use the measured air perm rate each dwelling has to be pressure tested. If a dwelling is not pressure tested the value used in the calculation is an average of the tested dwellings of the same type plus 2.
Mechanical Ventilation	Strategy	Balanced with Heat Recovery	
	SFP (W/l/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
	Installer approved	Yes	The installer has be registered with a Government Approved Scheme e.g. BESCA, Blue Flame Certification, Certsure, NAPIT and Stroma
	Duct Type	Rigid	All ductwork is rigid except for occasional flexible ducting to join components together
	Ductwork Insulated	Yes	Ductwork can be assumed to be insulated if all of the ductwork is inside the insulated envelope even if the ductwork itself is uninsulated.
Space Heating	Category	Communal	
	Boilers - Fraction of Heat (-)	1	As design specification
	Boilers - Efficiency (%)	91.8	As calculated by SAP Appendix D
	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)	
Water Heating	Type	From Main System	
	Cylinder in Dwelling	No	
	Plate Heat Exchanger	Yes	
	Volume (litres)	5	
	Insulation Type	Spray Foam	
	Insulation Thickness (mm)	25	
	Waste Water Heat Recovery	No	
Renewables	Type	None	
Summertime Overheating	Openable Windows	No	
	Mechanical Ventilation Required	Yes	
	Blinds	Light-coloured curtain or roller blind	

DER Worksheet
Design - Draft

NHER

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		164.79	(1a)	x	2.85	(2a)	=	469.65	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	164.79	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	469.65	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs (6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability 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 (19)] =	0.93	(20)
Infiltration rate incorporating shelter factor (18) x (20) =	0.14	(21)

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	3.80	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 infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	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)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]	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)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	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. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			43.25	x	1.05	=	45.57			(27)
Ground floor			164.79	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 ∑A, m²			333.62							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	89.69	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		100.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		50.04	(36)
Total fabric heat loss	(33) + (36) =	139.73	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	42.99	42.46	41.92	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	181.65	178.96	178.42	175.74	175.74	175.20	176.81	178.42	179.50	180.57	
Average = ∑(39)1...12/12 =												178.83	(39)
Heat loss parameter (HLP), W/m²K (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 = ∑(40)1...12/12 =												1.09	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.96	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	104.39	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	114.83	110.66	106.48	102.31	98.13	93.95	93.95	98.13	102.31	106.48	110.66	114.83	
∑(44)1...12 =												1252.73	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	170.29	148.94	153.69	133.99	128.57	110.95	102.81	117.97	119.38	139.13	151.87	164.92	
∑(45)1...12 =												1642.52	(45)
Distribution loss 0.15 x (45)m	25.54	22.34	23.05	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 storage within same vessel	1.00	(47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	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/day) (47) x (51) x (52) x (53)	0.10	(54)
Enter (50) or (54) in (55)	0.10	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	3.24	2.92	3.24	3.13	3.24	3.13	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)	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 loss for each month from 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 each month from Table 3a, 3b or 3c	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 required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	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)
Solar DHW input calculated using Appendix G or Appendix H	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from water heater for each month (kWh/month) (62)m + (63)m	196.79	172.88	180.19	159.64	155.07	136.59	129.31	144.47	145.03	165.63	177.52	191.42	

∑(64)1...12 = 1954.54 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	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)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	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)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	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)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	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)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	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)
Pump and fan gains (Table 5a)	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. evaporation (Table 5)	-118.22	-118.22	-118.22	-118.22	-118.22	-118.22	-118.22	-118.22	-118.22	-118.22	-118.22	-118.22	(71)
Water heating gains (Table 5)	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)
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)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	9.09	x	10.63	x 0.9 x	0.55	x	0.80	=	29.47	(74)
East	0.77	x	15.15	x	19.64	x 0.9 x	0.55	x	0.80	=	90.73	(76)
South	0.77	x	16.18	x	46.75	x 0.9 x	0.55	x	0.80	=	230.66	(78)
West	0.77	x	2.83	x	19.64	x 0.9 x	0.55	x	0.80	=	16.95	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	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)
Total gains - internal and solar (73)m + (83)m	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)

7. Mean internal temperature (heating season)

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	
Utilisation factor for gains for living area n1,m (see Table 9a)	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)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	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)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	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)
Utilisation factor for gains for rest of dwelling n2,m	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)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	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)

Living area fraction — Living area ÷ (4) = 0.52 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	17.73	18.20	18.83	19.55	20.07	20.38	20.48	20.47	20.25	19.51	18.48	17.65	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	17.73	18.20	18.83	19.55	20.07	20.38	20.48	20.47	20.25	19.51	18.48	17.65	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	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)
Useful gains, ηmGm, W (94)m x (84)m	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)
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	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	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)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	1182.00	898.80	740.76	432.53	219.38	0.00	0.00	0.00	0.00	454.59	843.07	1210.24	

∑(98)1...5, 10...12 = 5981.35 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 36.30 (99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm	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)
Utilisation factor for loss ηm	0.00	0.00	0.00	0.00	0.00	0.83	0.88	0.86	0.00	0.00	0.00	0.00	(101)
Useful loss ηmLm (watts) (100)m x (101)m	0.00	0.00	0.00	0.00	0.00	1377.96	1149.02	1145.93	0.00	0.00	0.00	0.00	(102)
Gains	0.00	0.00	0.00	0.00	0.00	2256.40	2163.65	2006.03	0.00	0.00	0.00	0.00	(103)
Space cooling requirement, whole dwelling, continuous (kWh) 0.024 x [(103)m - (102)m] x (41)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	

∑(104)6...8 = 2027.28 (104)

Cooled fraction — cooled area ÷ (4) = 0.82 (105)

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 requirement (104)m x (105) 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 requirement kWh/m²/year	(107) ÷ (4) =	2.52	(108)

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	5981.35			(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) =	6280.42	(307b)

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 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	6280.42	x	4.24	x 0.01 =	266.29	(340b)
Water heating from boilers	2052.27	x	4.24	x 0.01 =	87.02	(342a)
Space cooling	68.47	x	13.19	x 0.01 =	9.03	(348)
Pumps and fans	379.60	x	13.19	x 0.01 =	50.07	(349)
Electricity for lighting	529.32	x	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

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.21	(357)
SAP value	83.18	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 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)
EI value						83.96	
EI rating (section 14)						84	(385)
EI band						B	

13b. Primary energy - community 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) =	9077.00	x	1.22	=	11073.94	(368)
Electrical energy for community heat distribution		83.33	x	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	x	3.07	=	210.19	(377)
Pumps and fans		379.60	x	3.07	=	1165.36	(378)
Electricity for lighting		529.32	x	3.07	=	1625.01	(379)
Primary energy kWh/year						14330.32	(383)
Dwelling primary energy rate kWh/m2/year						86.96	(384)

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DER Worksheet
Design - Draft

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

Assessor name	Mr 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		175.68	(1a)	x	2.70	(2a)	=	474.34	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	175.68	(4)						
Dwelling volume						(3a) + (3b) + (3c) + (3d)...(3n) =		474.34	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs (6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability 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 (19)] =	0.93	(20)
Infiltration rate incorporating shelter factor (18) x (20) =	0.14	(21)

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	3.80	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 infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	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)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]	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)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	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. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			50.94	x	1.05	=	53.67			(27)
Ground floor			175.65	x	0.09	=	15.81			(28a)
External wall			126.94	x	0.18	=	22.85			(29a)
Total area of external elements ∑A, m²			353.53							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	92.33	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		100.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		53.03	(36)
Total fabric heat loss	(33) + (36) =	145.36	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	43.42	42.88	42.34	39.62	39.08	36.36	36.36	35.82	37.45	39.08	40.16	41.25	(38)
Heat transfer coefficient, W/K (37)m + (38)m	188.78	188.24	187.70	184.98	184.44	181.72	181.72	181.18	182.81	184.44	185.52	186.61	
Average = ∑(39)1...12/12 =												184.85	(39)
Heat loss parameter (HLP), W/m²K (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	
Average = ∑(40)1...12/12 =												1.05	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.97	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	104.74	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	115.21	111.02	106.84	102.65	98.46	94.27	94.27	98.46	102.65	106.84	111.02	115.21	
∑(44)1...12 =												1256.89	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	170.86	149.44	154.20	134.44	129.00	111.31	103.15	118.37	119.78	139.59	152.37	165.47	
∑(45)1...12 =												1647.98	(45)
Distribution loss 0.15 x (45)m	25.63	22.42	23.13	20.17	19.35	16.70	15.47	17.75	17.97	20.94	22.86	24.82	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00	(47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	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/day) (47) x (51) x (52) x (53)	0.10	(54)
Enter (50) or (54) in (55)	0.10	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	3.24	2.92	3.24	3.13	3.24	3.13	3.24	3.24	3.13	3.24	3.13	3.24	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	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 loss for each month from 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 each month from Table 3a, 3b or 3c

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 required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

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)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

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

197.36	173.37	180.70	160.08	155.50	136.96	129.65	144.87	145.42	166.09	178.02	191.97

∑(64)1...12 = 1960.00 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

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)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	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)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	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)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	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)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.85	37.85	37.85	37.85	37.85	37.85	37.85	37.85	37.85	37.85	37.85	37.85	(69)
Pump and fan gains (Table 5a)	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. evaporation (Table 5)	-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)
Water heating gains (Table 5)	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	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)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	20.62	x	19.64	x 0.9 x	0.55	x	0.80	=	123.49	(76)
South	0.77	x	11.45	x	46.75	x 0.9 x	0.55	x	0.80	=	163.23	(78)
West	0.77	x	18.87	x	19.64	x 0.9 x	0.55	x	0.80	=	113.01	(80)

Solar gains in watts ∑(74)m...(82)m

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

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)

7. Mean internal temperature (heating season)

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	
Utilisation factor for gains for living area n1,m (see Table 9a)	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)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	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)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	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)
Utilisation factor for gains for rest of dwelling n2,m	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)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	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)

Living area fraction — Living area ÷ (4) = 0.52 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	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)
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)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	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)
Useful gains, ηmGm, W (94)m x (84)m	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)
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	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	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)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	1223.16	911.51	717.87	387.06	178.84	0.00	0.00	0.00	0.00	444.78	866.65	1256.40	

∑(98)1...5, 10...12 = 5986.28 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 34.07 (99)

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	5986.28			(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) =	6285.59	(307b)

Water heating

Annual water heating requirement	1960.00	(64)

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	x	2.97	x 0.01 =	0.00	(340a)
Space heating from boilers	6285.59	x	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 heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.14	(357)
SAP value	84.16	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 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) =	9088.87	x	0.216	=	1963.20	(368)
Electrical energy for community heat distribution	83.44	x	0.519	=	43.30	(372)
Total CO2 associated with community systems					2006.50	(373)
Total CO2 associated with space and water heating					2006.50	(376)
Pumps and fans	383.38	x	0.519	=	198.98	(378)
Electricity for lighting	546.80	x	0.519	=	283.79	(379)
Total CO_2, kg/year				(376)..(382) =	2489.26	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	14.17	(384)
EI value					84.88	
EI rating (section 14)					85	(385)
EI band					B	

13b. Primary energy - community 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) =	9088.87	x	1.22	=	11088.43	(368)
Electrical energy for community heat distribution	83.44	x	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	x	3.07	=	1176.98	(378)
Electricity for lighting	546.80	x	3.07	=	1678.67	(379)
Primary energy kWh/year					14200.23	(383)
Dwelling primary energy rate kWh/m2/year					80.83	(384)

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DER Worksheet
Design - Draft

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

Assessor name	Mr 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	(1a)	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

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs (6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability 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 (19)] =	0.93	(20)
Infiltration rate incorporating shelter factor (18) x (20) =	0.14	(21)

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	3.80	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 infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	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)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]	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)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	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. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, 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, m²			225.16							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	66.18	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		100.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		33.77	(36)
Total fabric heat loss	(33) + (36) =	99.96	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	27.20	26.86	26.52	24.82	24.48	22.78	22.78	22.44	23.46	24.48	25.16	25.84	(38)
Heat transfer coefficient, W/K (37)m + (38)m	127.16	126.82	126.48	124.78	124.44	122.73	122.73	122.39	123.41	124.44	125.12	125.80	
Average = ∑(39)1...12/12 =												124.69	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.16	1.15	1.15	1.13	1.13	1.12	1.12	1.11	1.12	1.13	1.14	1.14	
Average = ∑(40)1...12/12 =												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	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.82	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	101.06	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	111.17	107.12	103.08	99.04	95.00	90.95	90.95	95.00	99.04	103.08	107.12	111.17	
∑(44)1...12 =												1212.71	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	164.85	144.18	148.78	129.71	124.46	107.40	99.52	114.21	115.57	134.68	147.02	159.65	
∑(45)1...12 =												1590.06	(45)
Distribution loss 0.15 x (45)m	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)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00	(47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	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/day) (47) x (51) x (52) x (53)	0.10	(54)
Enter (50) or (54) in (55)	0.10	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	3.24	2.92	3.24	3.13	3.24	3.13	3.24	3.24	3.13	3.24	3.13	3.24	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

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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 loss for each month from 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 each month from Table 3a, 3b or 3c

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 required for water heating calculated for each month 0.85 x (45)m + (46)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 input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

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

∑(64)1...12 = 1902.08 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

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)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	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 (calculated in Appendix L, equation L9 or L9a), also see Table 5	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 (calculated in Appendix L, equation L13 or L13a), also see Table 5	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 (calculated in Appendix L, equation L15 or L15a), also see Table 5	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 gains (Table 5a)	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. evaporation (Table 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 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 gains (66)m + (67)m + (68)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 factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	14.57	x	19.64	x 0.9 x	0.55	x	0.80	=	87.26	(76)
South	0.77	x	9.83	x	46.75	x 0.9 x	0.55	x	0.80	=	140.13	(78)
West	0.77	x	16.30	x	19.64	x 0.9 x	0.55	x	0.80	=	97.62	(80)

Solar gains in watts ∑(74)m...(82)m	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 - internal and solar (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. Mean internal temperature (heating season)

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	
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	19.96	19.97	19.98	19.99	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

	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)
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	(95)
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	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1700.39	1693.44	1577.84	1344.68	1044.37	699.01	460.40	482.62	752.30	1114.68	1423.42	1681.75	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	724.01	525.32	399.41	205.24	89.91	0.00	0.00	0.00	0.00	239.49	500.76	748.72	

∑(98)1...5, 10...12 = 3432.87 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 31.19 (99)

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)

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 from 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	x	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	B	

12b. CO_2 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) =	6102.06	x	0.216	=	1318.05	(368)
Electrical energy for community heat distribution	56.02	x	0.519	=	29.07	(372)
Total CO2 associated with community systems					1347.12	(373)
Total CO2 associated with space and water heating					1347.12	(376)
Pumps and fans	240.16	x	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)
EI value					85.36	
EI rating (section 14)					85	(385)
EI band					B	

13b. Primary energy - community 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	x	1.22	=	7444.52	(368)
Electrical energy for community heat distribution	56.02	x	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	x	3.07	=	737.29	(378)
Electricity for lighting	427.66	x	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

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	TH A1, London		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		69.47	(1a)	x	2.70	(2a)	=	187.57	(3a)
+1		41.56	(1b)	x	3.15	(2b)	=	130.91	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	111.03	(4)						
Dwelling volume						(3a) + (3b) + (3c) + (3d)...(3n) =		318.48	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00	(17)
If based on air permeability 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 (19)] =	0.93	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.14	(21)

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	3.80	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 infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	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)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			33.63	x	1.05	=	35.43			(27)
Exposed floor			69.47	x	0.09	=	6.25			(28b
External wall			122.55	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 external elements ∑A, m²			282.31							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	73.94	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		100.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		42.35	(36)
Total fabric heat loss	(33) + (36) =	116.29	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	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 coefficient, 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 = ∑(39)1...12/12 = 142.80 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)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 = ∑(40)1...12/12 = 1.29 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.82	(42)
Annual average hot water usage in litres 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 usage in litres per day for each month Vd,m = factor from Table 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	

∑(44)1...12 = 1214.35 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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) including any solar or WWHRS storage within same vessel	1.00	(47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	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/day) (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 month (55) x (41)m

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	3.24	2.92	3.24	3.13	3.24	3.13	3.24	3.24	3.13	3.24	3.13	3.24	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	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 loss for each month from 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 each month from Table 3a, 3b or 3c	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 required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)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)
Solar DHW input calculated using Appendix G or Appendix H	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from water heater for each month (kWh/month) (62)m + (63)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	

∑(64)1...12 = 1904.22 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	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)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	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)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	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	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)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	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)
Pump and fan gains (Table 5a)	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. evaporation (Table 5)	-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)
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)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	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)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	27.91	x	19.64	x 0.9 x	0.55	x	0.80	=	167.14	(76)
West	0.77	x	5.72	x	19.64	x 0.9 x	0.55	x	0.80	=	34.26	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	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	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)

7. Mean internal temperature (heating season)

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	
Utilisation factor for gains for living area n1,m (see Table 9a)	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)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	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)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	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)
Utilisation factor for gains for rest of dwelling n2,m	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)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	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)

Living area fraction — Living area ÷ (4) = 0.45 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	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)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	17.15	17.63	18.39	19.26	19.87	20.21	20.32	20.30	20.02	19.13	17.97	17.07	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, η_m	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, $\eta_m G_m$, W (94)m x (84)m	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	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	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)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	921.68	717.18	591.06	340.45	170.50	0.00	0.00	0.00	0.00	377.85	670.93	941.31	

∑(98)1...5, 10...12 = 4730.96 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 42.61 (99)

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	4730.96		(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) =	4967.51	(307b)

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 from 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	B	

12b. CO_2 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) =	7589.26	x	0.216	=	1639.28	(368)
Electrical energy for community heat distribution	69.67	x	0.519	=	36.16	(372)
Total CO2 associated with community systems					1675.44	(373)
Total CO2 associated with space and water heating					1675.44	(376)
Pumps and fans	208.85	x	0.519	=	108.39	(378)
Electricity for lighting	429.86	x	0.519	=	223.10	(379)
Total CO_2, 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					B	

13b. Primary energy - community 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) =	7589.26	x	1.22	=	9258.89	(368)
Electrical energy for community heat distribution	69.67	x	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	x	3.07	=	641.15	(378)
Electricity for lighting	429.86	x	3.07	=	1319.68	(379)
Primary energy kWh/year					11433.61	(383)
Dwelling primary energy rate kWh/m2/year					102.98	(384)

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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

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 CO_2 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	$U_{a-Limit}$	U_{a-Calc}	U_{i-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

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = 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
$m^3/(h.m^2)$ 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.

^ 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
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	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
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
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/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
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]			
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
Area [m²]	2367.6	2367.6
External area [m²]	2554.6	2554.6
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	1320.6	1374.19
Average U-value [W/m²K]	0.52	0.54
Alpha value* [%]	10	10

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**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	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 & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	88.47	110.01
Primary energy* [kWh/m²]	87.98	126.14
Total emissions [kg/m²]	15.1	21.5

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

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 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	----	----

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.25	1F000000:Surf[1]
Floor	0.2	0.16	1F000000:Surf[0]
Roof	0.15	0.16	2F000001:Surf[0]
Windows, roof windows, and rooflights	1.5	1.1	1F000000:Surf[2]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* 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

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Notting Hill Gate Retail - Be Lean

As designed

Date: Mon May 21 13:00:30 2018

Administrative information

Building Details

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 CO_2 emission rate for the building should not exceed the target

CO_2 emission rate from the notional building, kgCO_2/m².annum	56.1
Target CO_2 emission rate (TER), kgCO_2/m².annum	56.1
Building CO_2 emission rate (BER), kgCO_2/m².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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	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

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)] $U_{i\text{-}Calc}$ = 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	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*	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.

^ 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
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	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
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
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	Luminous efficacy [lm/W]			
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?	NO
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
Area [m²]	151.7	151.7
External area [m²]	567.9	567.9
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	318.43	246.13
Average U-value [W/m²K]	0.56	0.43
Alpha value* [%]	10	10

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

Building Use

% Area	Building Type
100	**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 & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	327.96	236.81
Primary energy* [kWh/m²]	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.

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 systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	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	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

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

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	3

APPENDIX 3 – TM52 OVERHEATING REPORT

Contents

Executive Summary

1. Introduction

2. Cooling Hierarchy

3. Overheating Criteria

4. Model

5. Results

6. Conclusion

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.

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.

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 degree-hours 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

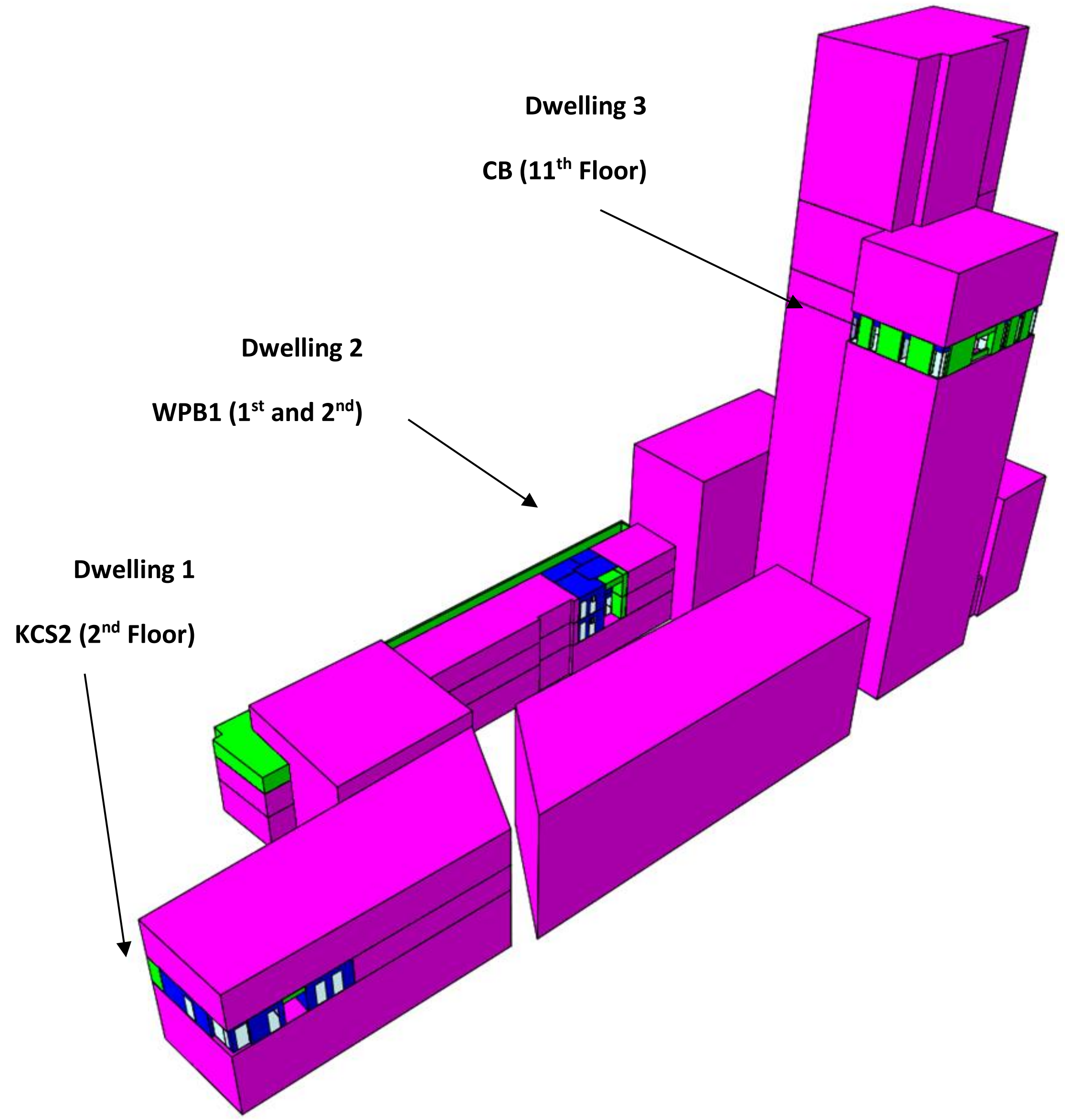


Figure 1: Model Screenshot

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

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

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.

Table 4: Occupancy Levels

Room	Occupancy Level (Number of People)
Living Kitchen Room	Flat occupants + 1
Double Bedroom / Master Bedroom	2

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.

- Bedrooms: No casual gains have been included. This has been based on an assumption that the gains will be intermittent and therefore negligible.
- Living and Kitchen Areas: 95W; this has been based on a 60cm LCD screen, digital TV 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 3m^3/hm^2 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.

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)

Room	TM52			
	Criterion 1 (% Hours of Exceedance)	Criterion 2 (Daily Weighted Exceedance)	Criterion 3 (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)

Room	TM52			
	Criterion 1 (% Hours of Exceedance)	Criterion 2 (Daily Weighted Exceedance)	Criterion 3 (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 Overheating Results (1976 Weather File)

Room	TM52			
	Criterion 1 (% Hours of Exceedance)	Criterion 2 (Daily Weighted Exceedance)	Criterion 3 (Max ΔT)	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	×

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.

Table 8: TM52 Overheating Results (2003 Weather File)

Room	TM52			
	Criterion 1 (% Hours of Exceedance)	Criterion 2 (Daily Weighted Exceedance)	Criterion 3 (Max ΔT)	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)

Room	TM52			
	Criterion 1 (% Hours of Exceedance)	Criterion 2 (Daily Weighted Exceedance)	Criterion 3 (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	×

Table 10: TM52 Overheating Results (1976 Weather File)

Room	TM52			
	Criterion 1 (% Hours of Exceedance)	Criterion 2 (Daily Weighted Exceedance)	Criterion 3 (Max ΔT)	Overall Compliance
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	×

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.

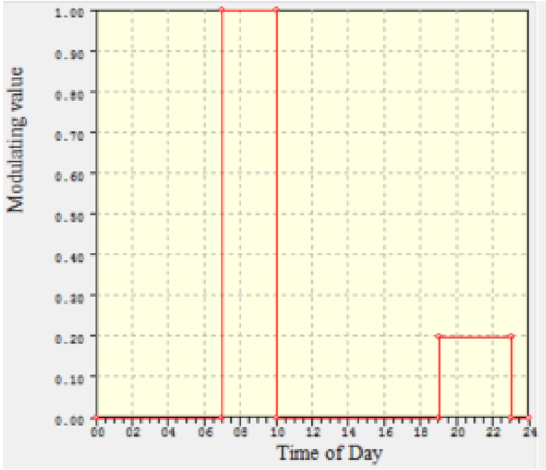
Having undertaken an initial modelling in consideration of the above conditions, but excluding openable windows it can be demonstrated that during peak summertime conditions a limited number of habitable rooms within all dwellings were found to be susceptible to a risk of overheating by a small margin. 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.

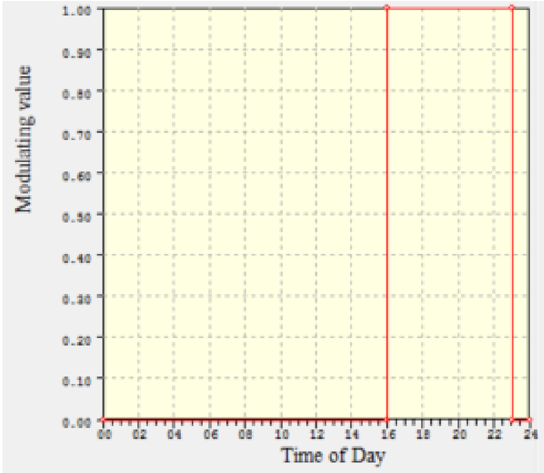
As a further benefit to this strategy, a limited amount of comfort cooling is proposed to the habitable spaces of the private apartments to assist with marketing although this has not been included in the modelling iterations as cooling does not form part of the overheating mitigation strategy.

APPENDIX A – MODELLING PROFILES

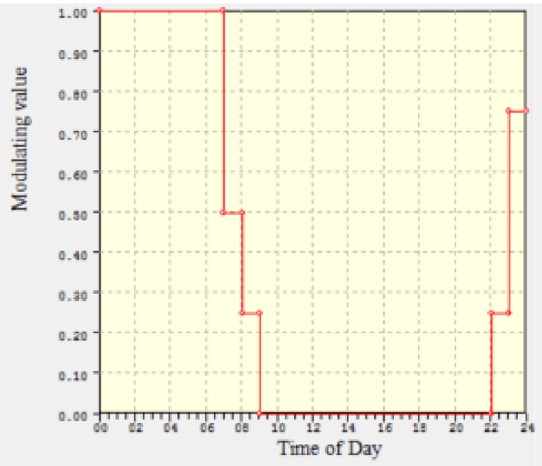
Lighting – Bedroom:



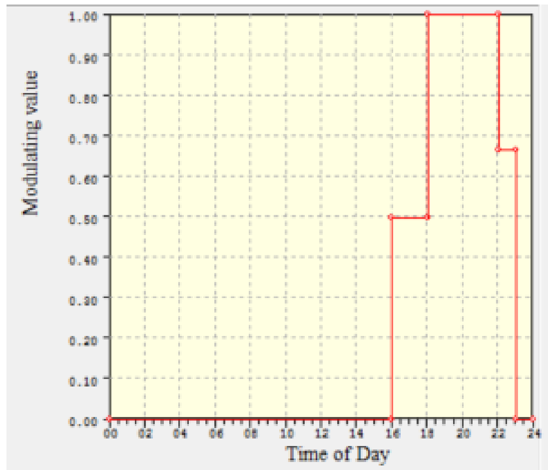
Lighting – Living Room:



Occupancy – Bedroom:



Occupancy – Living Room:



Equipment – Living Room: