Mendick Waring Limited

13 Netherhall Gardens, London, NW3

Sustainability Report for Phase 2 (Extension)

August 2021

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Issue Details

Project .... 13 Netherhall Gardens, London, NW3

MWL Reference J2629

Report Scope .... Sustainability Report for Phase 2

Revision .... 1.1 – Final Report for Submission

Date 11/08/2021

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Checked By .... Fergus Traynor

Rev	Date	Description	By	Approved
1.1 - Final	11/08/2021	Sustainability Report for Phase 2	IP	FT

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Contents

1.0 Executive Summary

This report describes the energy & sustainability measures for the new-build extension of the existing building in 13 Netherhall Gardens, in London.

The extension consists of the Phase 2 of the above scheme and contains 4 new flats, 2 on the lower ground floor and 2 on the basement floor.

This document seeks to address the measures of Sustainability and demonstrate the design intention in relation to policies at National, Regional and Local level as appropriate.

SAP calculations have been carried out for the scheme and viability of the available options have been explored. The proposed specification complies with the Part L1B of Building Regulations and the local & national policies.

Requirements, Energy Efficient Features and Approach

In accordance with Building Regulations Part L1B, the extension units are not required to achieve a Dwelling CO_2 Emission Rate (DER) below the notional Target CO_2 Emission Rate (TER), however it is mandatory any extensions to the existing building being made to comply with minimum energy efficiency requirements in relation to the selected fabric & systems specification.

The SAP 2012 methodology has been used to calculate the energy consumption and resultant CO_2 emissions for the proposed residential units.

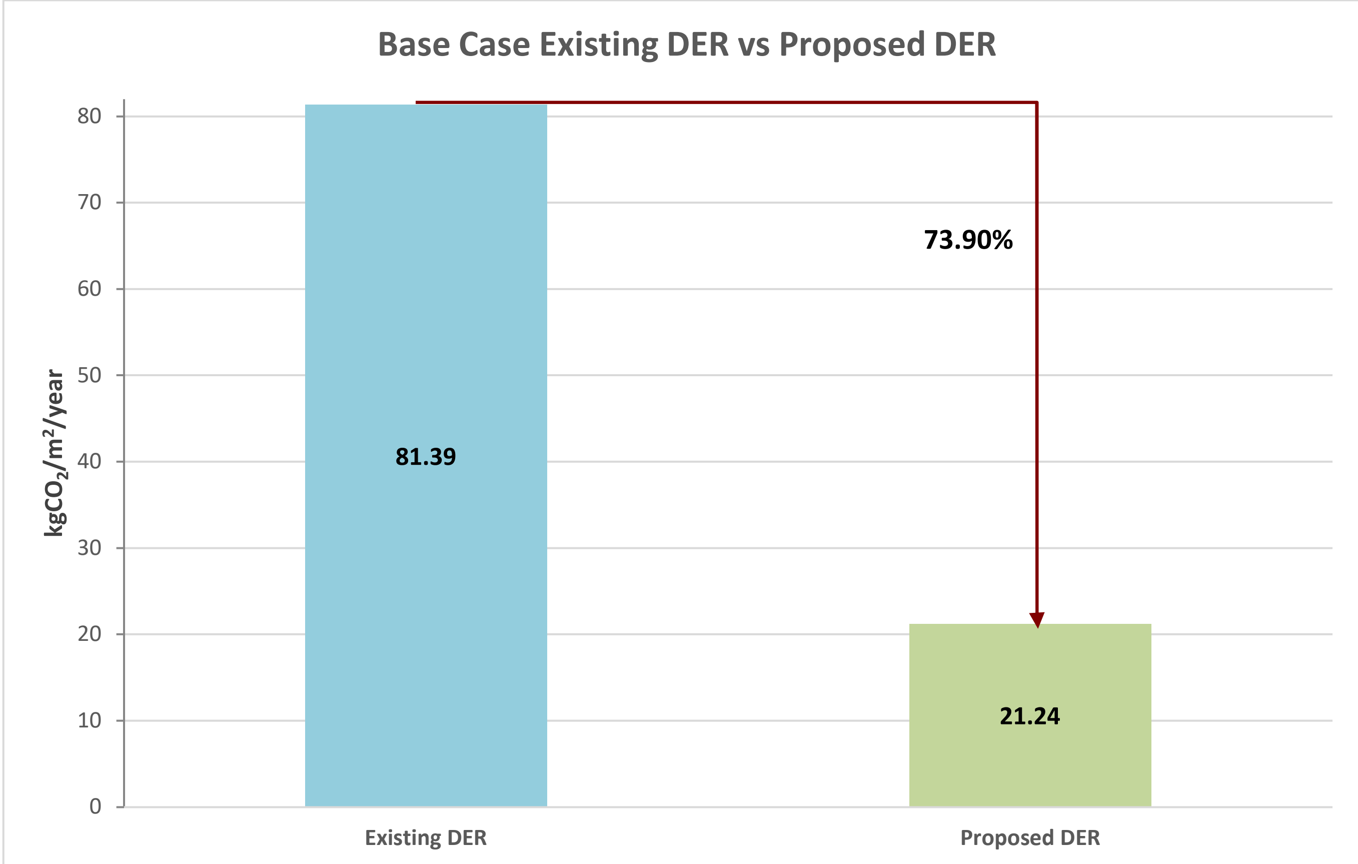
As an extension to the existing property, a 'fabric first' approach was initially considered by using upgraded thermal elements compared to the existing units, incorporating passive design measures such as low u-values, low air leakage and low thermal bridging.

Efficient energy use and distribution is assured by upgrading the existing outdated heating and hot water systems with highly efficient natural gas combi boilers for heating and hot water, using appropriate efficient heating controls. Further, 100% low energy lighting will replace the existing lights.

Summary of the Results

By incorporating a combination of feasible passive measures along with the use of highly efficient natural gas combi boilers and 100% low energy lights, the CO_2 emissions of the residential units, of the extension, have been reduced by 73.90% compared to the ones of the base case existing building. The results for are presented in the table & graph below:

Phase 2 Produced CO2 Emissions			
Development	**Regulated CO2 Emissions / Annum (tonnes)**	**% Improvements by Energy Hierarchy**	**% Cumulative Improvements**
Base Case Existing	30.51	-	-
Proposed	7.96	73.90%	73.90%
		Overall CO2 Emissions Reduction:	**73.90%**



In addition, a water calculation has been completed and has been included in Appendix B, which shows that the internal water consumption for the residential units is less than 105 litres/person/day, complying with the local policies.

2.0 Site Location and Development Proposal

The existing development is located at 13 Netherhall Gardens, in London. It is a fully residential building, consisting of ground floor, first floor, second floor and third floor.

The proposed Phase 2 design includes a new-build extension to the existing development, which consists of 2 extra floors, a lower ground floor containing 2 new flats and a basement floor containing another 2 new flats (plots 8-11).

The site is located in the London borough of Camden, in North London. The surrounding area is a mix of open spaces and low-rise residential developments. There are many nearby transport links close to the development, including a short walk to the closest bus stop and Finchley Road tube station.

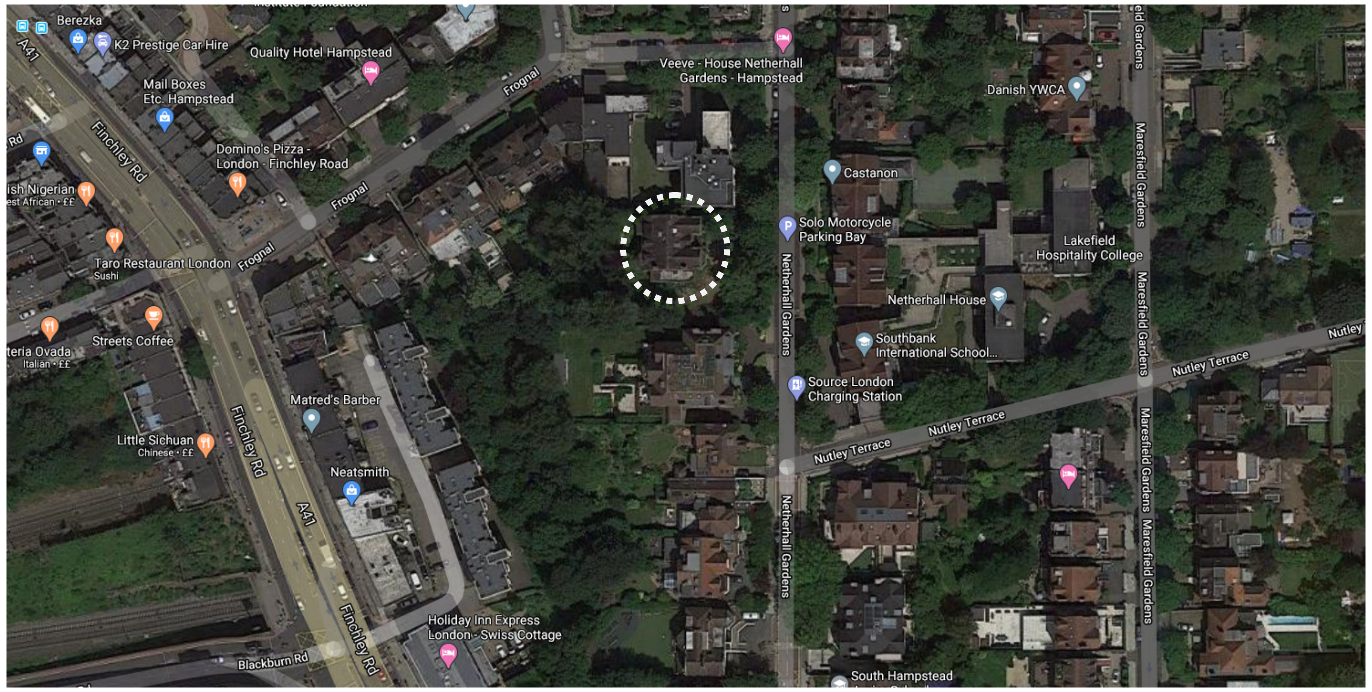


Figure 1: Site location, showing the 13 Netherhall Gardens development

3.0 Policy Context

In this section of the report, National, Regional and Local planning policies and requirements are presented. The energy and sustainability strategies to meet the policies have also briefly been introduced. The details of how the scheme incorporates these policies have been presented in the body of this report.

The following policies have been considered:

National Planning Policy Framework (February 2019)

Policy 14. Meeting the challenge of climate change, flooding and coastal change:

149. Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure.

152. New development should be planned for in ways that:

a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and

b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

153. In determining planning applications, local planning authorities should expect new development to:

> a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and
>
> b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

New London Plan (March 2021)

After a rigorous process of consultation and Examination in Public, the New London Plan has been finally published in March 2021.

Policy SI 2: Minimising greenhouse gas emission

Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

1. Be lean: use less energy.

2. Be clean: supply energy efficiently and cleanly, exploit local energy resource.

3. Be green: maximise use of renewable energy.

Policy SI 4: Managing heat risk

Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

Policy SI 5: Water infrastructure

Development proposals should, through the use of Planning Conditions, minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving **mains water consumption of 105 litres or less per head per day** (excluding allowance of up to five litres for external water consumption) and incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future-proofing.

Camden Borough Council Requirements (Camden Local Plan 2017 and Camden CPG Documents 2021)

With specific regards to the energy & sustainability requirements, the following policies of Camden Borough Council apply in this development:

- For Minor developments the performance against carbon reduction targets should be included in a Sustainability Statement and calculated through the Part L 2013 of the Building Regulations methodology Standard Assessment Procedure (SAP) 2012. The reduction carbon target for Minor Refurbishment developments is to achieve the greatest possible reduction - meeting Part L1B for retained thermal elements.

- The Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation (including support and encourage sensitive energy efficiency improvements to existing buildings).

- All buildings, whether being updated or refurbished, are expected to reduce their carbon emissions by making improvements to the existing building. Work involving a change of use or an extension to an existing property is included.

- All new residential development will be required to demonstrate that the development is capable of achieving a maximum internal water use of 105 litres per person/day.

- All development in Camden is expected to reduce carbon dioxide emissions by following the energy hierarchy of London Plan.

- Natural 'passive' measures should be prioritised over active measures to reduce energy.

- All developments (including refurbishments and minor developments) should incorporate green/blue roofs, brown roof and/or green walls where appropriate.

- Residential refurbishments, conversions or extensions should be assessed under Part L1B of Building Regulations.

- The Council will require all developments, including alterations and extensions to existing buildings, to be of the highest standard of design.

- All buildings, whether being updated or refurbished, are expected to reduce their carbon emissions by making improvements to the existing building. Work involving a change of use or an extension to an existing property is included.

Figure 2: Camden and London Plan Policies

Note: The proposed Phase 2 development consists of less than 5 units and less than 500 m^2 GIA, and therefore is considered as a minor development, which means that won't need to follow the local & national policies which are proposed for the larger developments (major developments).

Approved Document Part L1B 2013 of Building Regulations

Approved document Part L1B sets the standard for energy performance for existing residential buildings, including conversions and new-build extensions. The document gives guidance on compliance with the energy efficiency requirements as follow:

- Guidance for new thermal elements in the case of existing buildings including extensions. There are standard fabric parameters which should be considered.

- Guidance for the proposed building services in the case of existing buildings including extensions. There are standard requirements in terms of performance and controls, which should be considered.

- Consequential improvements also apply to major developments with an extension. Major existing developments considered the developments with a total useful floor area over 1000 m^2, therefore this doesn't apply for this development as the existing building of 13 Netherhall Gardens (without including the new-build extension) has a total useful floor area of less than 1000 m^2.

Figure 3: Approved Document Part L of Building Regulations

4.0 Energy Efficient Design

Carbon reduction and energy performance have been maximised through measures developed in line with the energy hierarchy. This includes:

Passive Design: As an extension to an existing listed property, a 'fabric first' approach was followed. Low U-values, air permeability and thermal will reduce the heat loss through the building envelope.

Energy Efficient Fabric: Opaque elements will target excellent U-values, whilst envelope air permeability will be reduced to a target rate of ≤ 5 m^3/hm^2 at 50 Pa through an airtight layer on the warm side of the insulation, and efficient windows are currently proposed for all the dwelling's facades.

Energy Efficient Systems: Efficient energy use and distribution is assured by upgrading the existing outdated heating and hot water systems with highly efficient natural gas combi boilers for heating and hot water, using appropriate efficient heating controls. Further, 100% low energy lighting will replace the existing lights.

Methodology: As mentioned, the strategy is based on the energy hierarchy of the London Plan. <u>However, for this development only a Be Lean strategy will be required in order to comply with the planning policies, as it is an extension and not a major new-build development.</u>

Government Approved Software **NHER Plan Assessor 6.3.9** has been used to calculate energy consumption and resultant CO2 emissions.

From this, the Target Emissions Rate (TER) and the potential improvement through energy efficiency, the Dwellings Emissions Rate (DER), are established for a Base Case - Existing building model for Phase 2 and for the Proposed Phase 2 development (which includes the 4 units of the extension).

The base case model is compared to the proposed Phase 2 model to demonstrate the effectiveness of all these proposed measures in relation to sustainability, energy efficiency and CO2 emissions.

The latest drawings have been used for the SAP calculations of the proposed Phase 2 development, as below:

- *AL.05.07.1.7 1. B1-Basement_reduced south wing*
- *AL.05.07.1.6 2. L1-Lower Ground Floor*
- *AL.05.07.1.5 3. GF-Ground Floor*
- *AL.08.01.1-4 Sections*

5.0 Water Usage

Based on the Camden Local Policies (as analysed in Chapter 3) the water consumption (internal) for the residential units must be equal or less than 105 litres/person/day.

The sanitary ware specification which yet to be clearly defined, however could achieve the desired savings with the following:

• 6 / 3 dual-flush WCs

• Taps on wash-hand basins with maximum flow rate of 2 litres per minute (aerated taps)

• Showers with maximum flow rate of 9 litres per minute (flow restrictors)

• Taps in the kitchen 10 litres per minute (aerated taps)

• Baths over flow prevention installed to activate at 150 litres

• 'A' rated washing machines, where provided (less than 8.17 litres per kg)

• 'A' rated dishwashers, where provided (less than 1.25 litres water usage per place setting)

By implementing measures such as those recommended above will reduce the internal potable water consumption to less than 105 litres per person per day, as required.

The preliminary water calculation for the residential units has been included in Appendix B.

6.0 Design Specifications

MWL has carried out the SAP calculations for the proposed dwellings, of Phase 2 scheme, with the below listed fabric and system specifications.

Passive Design

New-Build Extension (4 Residential Units)

Thermal Element	Standards for New Thermal Elements by Part L1B 2013	Proposed Fabric Parameters for Phase 2
Heat Loss Walls	0.28 W/m^2K	0.18 W/m^2K
Heat Loss Roofs	0.18 W/m^2K	0.15 W/m^2K
Heat Loss Floors	0.22 W/m^2K	0.18 W/m^2K
External Windows	1.60 W/m^2K	1.40 W/m^2K
External Glazed Doors	1.80 W/m^2K	1.40 W/m^2K
Entrance Internal Doors	1.80 W/m^2K	1.40 W/m^2K
Air permeability	Reasonable provision to reduce unwanted air leakage.	5.00 $m^3/m^2.h$ @ 50pa
Ψ values (Thermal Bridging)	The building fabric should be constructed so that there are no reasonably avoidable thermal bridges.	Accredited Construction Details (ACD) used in order to avoid thermal bridges.

Active Design

New-Build Extension (4 Residential Units)

Services	Proposals for Phase 2
Space Heating / Hot Water	Natural Gas Combi Boiler Boiler Model – Vaillant Boiler Efficiency – 88.8%
Mechanical Cooling	None
Renewables	None
Heating Controls	Programmer, Room Thermostat, TRVs
Ventilation	Natural Ventilation with Intermittent Extract Fans
Lighting	100% have luminous efficacy ≥ 45 lm/W

The above specifications (both for fabric and systems) are sufficient for complying with the requirements of Part L1B 2013 of Building Regulations, as required by the planning policies (presented in chapter 3).

As mentioned in the previous chapter, the proposed Phase 2 development will be compared with a base case existing model (based on Phase 2 design), by undertaking SAP calculations, in order to quantify the impact of the proposed improvements (which illustrated in the tables above).

The selected fabric parameters and systems for the base case existing model are based on the rdSAP (reduced data SAP for existing dwellings) methodology, which includes specific values based on the age of a building (the existing Netherhall Gardens building was built in late 19th century) and the actual materials & systems used in the existing property (based on a site survey).

The outcome of this comparison is presented in the next chapter.

7.0 SAP Results Analysis

As mentioned in the previous chapters, a fabric first approach was initially considered, by improving the U-Values and the other fabric parameters, based on Part L1B guidance. Then the heating systems and the lighting were upgraded compared to the existing building, in order to comply with the Part L standards but also to reduce further the produced CO2 emissions.

This chapter will present the result of the SAP calculations, which have been completed for the proposed residential units, in comparison with a base case existing model (as analysed in the previous chapter).

The result is illustrated in the following figure, which compares the area-weighted average Dwelling Emission Rate (DER) of the base case existing units with the area-weighted average Dwelling Emission Rate (DER) of the improved proposed units of Phase 2 Netherhall Gardens Development.

A reduction of 73.90% in CO_2 emissions has been achieved with the implementation of the proposed improvements in fabric and systems specification.

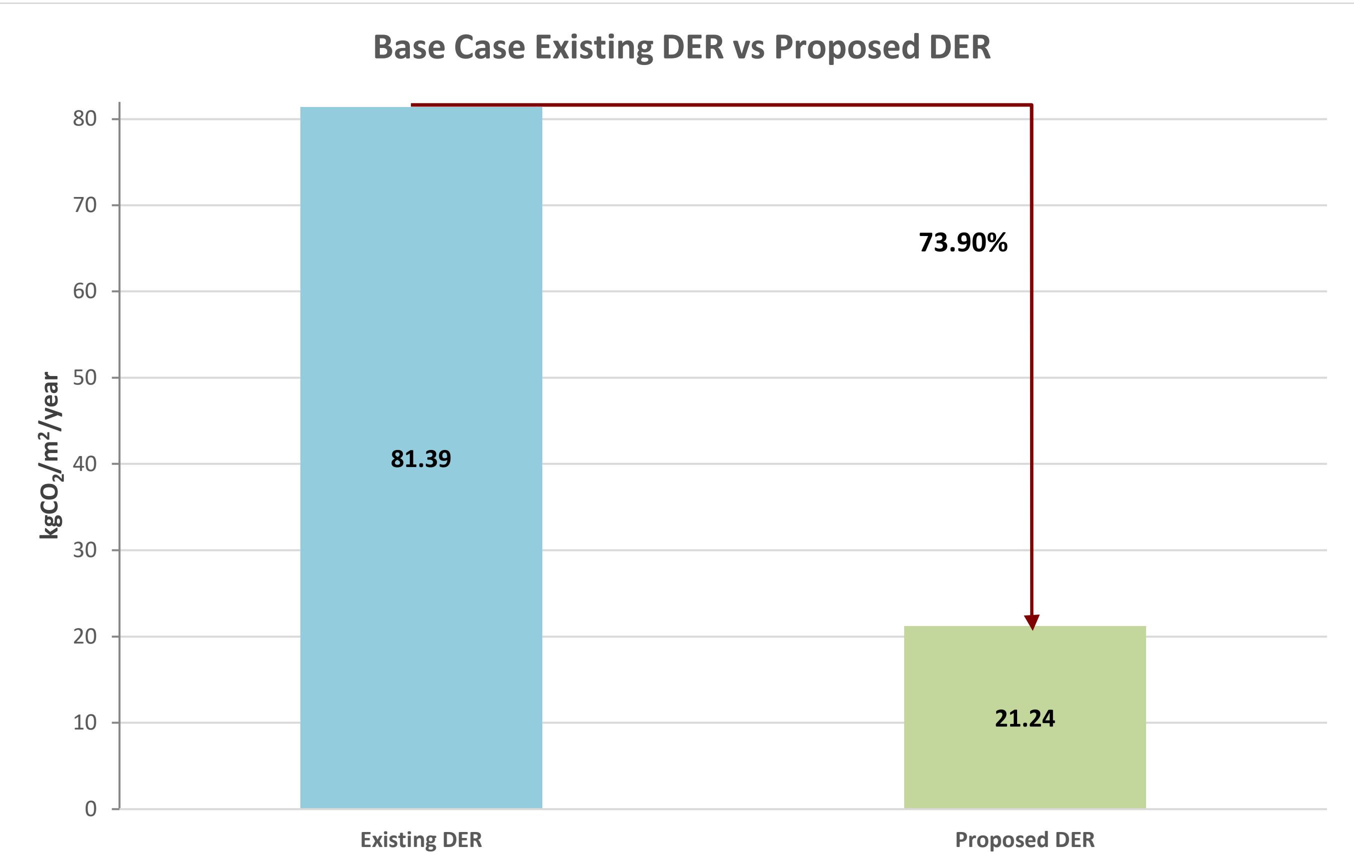


Figure 4: CO2 reduction of the proposed development over the base case existing model

The total regulated carbon dioxide (CO_2) emissions of the residential units by incorporating all the improvements have been calculated to 7.96 CO_2 tonnes per annum, compared to 30.51 CO_2 tonnes per annum of the base case existing carbon emissions, as illustrated in the table below.

Phase 2 Produced CO2 Emissions			
Development	Regulated CO2 Emissions / Annum (tonnes)	% Improvements by Energy Hierarchy	% Cumulative Improvements
Base Case Existing	30.51	-	-
Proposed	7.96	73.90%	73.90%
		Overall CO2 Emissions Reduction:	**73.90%**

Table 1: Produced CO2 emissions in tonnes/annum for proposed Phase 2 development

8.0 Conclusion

The Sustainability report seeks to address the measures of Sustainability (where applicable) and demonstrate the design intention in relation to policies at National, Regional and Local level as appropriate.

As analysed in the previous chapters of this report, Phase 2 residential units comply with the Part L1B of Building Regulations standards and with all the local & national planning policies.

The SAP methodology has been used to calculate the energy consumption and resultant CO_2 emissions for the proposed Phase 2 residential units, which consist of a new-build extension to the existing building located in 13 Netherhall Gardens, in London.

By incorporating a combination of all the feasible passive measures (fabric improvements) along with the use of low energy lights and highly efficient natural gas combi boilers for heating and hot water, the CO_2 emissions of the proposed Phase 2 development have been reduced by 73.90%, in comparison with the CO_2 emissions of a base case existing model (which is based on Phase 2 design and rdSAP parameters). The above result consists a huge improvement in produced carbon emissions.

In addition, a water calculation has been completed, which shows that the internal water consumption of the proposed residential units is less than 105 litres per person per day, as required by the planning policies.

The SAP reports for the proposed 4 residential units of Netherhall Gardens Phase 2 development, are presented in Appendix A.

Appendix A – SAP Reports

SAP 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 Ioannis Protonotarios	Assessor number	23
Client		Last modified	11/08/2021
Address	Flat 8, 13 Netherhall Gardens, London, NW3		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		53.23	(1a)	x	3.08	(2a)	=	163.95	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	53.23	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			163.95	(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	2	x 10 =	20	(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) =	20	÷ (5) =	0.12	(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)		0.37	(18)
Number of sides on which the dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.32	(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	0.40	0.39	0.35	0.34	0.30	0.30	0.29	0.32	0.34	0.36	0.37	(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	0.58	0.56	0.56	0.55	0.55	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	0.58	0.56	0.56	0.55	0.55	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	
Door			1.96	x	1.40	=	2.74			(26)
Window			13.06	x	1.33	=	17.31			(27)
Ground floor			4.20	x	0.18	=	0.76			(28a)
External wall			67.60	x	0.18	=	12.17			(29a)
Party wall			25.30	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			86.82							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.98	(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		9.38	(36)
Total fabric heat loss	(33) + (36) =	42.36	(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)	31.45	31.28	31.11	30.32	30.18	29.49	29.49	29.37	29.76	30.18	30.47	30.79	(38)
Heat transfer coefficient, W/K (37)m + (38)m	73.81	73.64	73.47	72.68	72.54	71.85	71.85	71.73	72.12	72.54	72.84	73.15	
Average = ∑(39)1...12/12 =												72.68	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.39	1.38	1.38	1.37	1.36	1.35	1.35	1.35	1.35	1.36	1.37	1.37	
Average = ∑(40)1...12/12 =												1.37	(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	1.79	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	76.60	(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)	84.26	81.20	78.13	75.07	72.01	68.94	68.94	72.01	75.07	78.13	81.20	84.26	
∑(44)1...12 =												919.22	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	124.96	109.29	112.78	98.32	94.34	81.41	75.44	86.57	87.60	102.09	111.44	121.02	
∑(45)1...12 =												1205.24	(45)
Distribution loss 0.15 x (45)m	18.74	16.39	16.92	14.75	14.15	12.21	11.32	12.98	13.14	15.31	16.72	18.15	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	42.94	37.37	39.82	37.02	36.69	34.00	35.13	36.69	37.02	39.82	40.04	42.94	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	167.90	146.66	152.59	135.34	131.03	115.41	110.57	123.26	124.62	141.91	151.48	163.95	(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

167.90	146.66	152.59	135.34	131.03	115.41	110.57	123.26	124.62	141.91	151.48	163.95	

∑(64)1...12 = 1664.73 (64)

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

52.28	45.68	47.45	41.95	40.54	35.57	33.87	37.96	38.38	43.90	47.06	50.97	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	107.12	107.12	107.12	107.12	107.12	107.12	107.12	107.12	107.12	107.12	107.12	107.12	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	34.68	30.80	25.05	18.97	14.18	11.97	12.93	16.81	22.56	28.65	33.44	35.65	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	232.26	234.67	228.60	215.67	199.34	184.00	173.76	171.35	177.42	190.35	206.67	222.01	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.50	47.50	47.50	47.50	47.50	47.50	47.50	47.50	47.50	47.50	47.50	47.50	(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)	-71.41	-71.41	-71.41	-71.41	-71.41	-71.41	-71.41	-71.41	-71.41	-71.41	-71.41	-71.41	(71)
Water heating gains (Table 5)	70.27	67.98	63.78	58.26	54.49	49.40	45.52	51.02	53.31	59.00	65.37	68.51	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	423.42	419.66	403.63	379.10	354.22	331.58	318.41	325.38	339.50	364.21	391.68	412.37	(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	
West	0.77	x	7.64	x	19.64	x 0.9 x	0.63	x	0.80	=	52.41	(80)
SouthWest	0.77	x	2.54	x	36.79	x 0.9 x	0.63	x	0.80	=	32.64	(79)
South	0.77	x	1.74	x	46.75	x 0.9 x	0.63	x	0.80	=	28.41	(78)
NorthWest	0.77	x	1.14	x	11.28	x 0.9 x	0.63	x	0.80	=	4.49	(81)

Solar gains in watts ∑(74)m...(82)m

117.96	213.80	320.67	434.56	513.54	519.70	497.08	437.91	360.74	244.47	143.78	99.25	(83)

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

541.37	633.46	724.30	813.65	867.76	851.28	815.49	763.29	700.23	608.68	535.46	511.63	(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)	0.98	0.97	0.93	0.84	0.70	0.52	0.38	0.43	0.66	0.89	0.97	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.82	20.03	20.34	20.67	20.89	20.98	21.00	20.99	20.94	20.64	20.16	19.77	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.77	19.78	19.78	19.79	19.79	19.80	19.80	19.80	19.80	19.79	19.79	19.78	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.96	0.91	0.80	0.63	0.43	0.28	0.32	0.56	0.85	0.96	0.98	(89)

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

18.74	18.95	19.24	19.56	19.73	19.79	19.80	19.80	19.77	19.54	19.09	18.70	(90)

Living area fraction — Living area ÷ (4) = 0.60 (91)

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

19.39	19.60	19.90	20.23	20.42	20.50	20.52	20.52	20.47	20.20	19.74	19.35	(92)

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

19.39	19.60	19.90	20.23	20.42	20.50	20.52	20.52	20.47	20.20	19.74	19.35	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.96	0.91	0.82	0.67	0.49	0.34	0.38	0.62	0.87	0.96	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	528.94	606.32	661.98	666.62	580.58	414.28	279.94	292.67	432.10	526.55	513.42	502.06	(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]	1113.53	1082.53	984.71	823.38	632.83	424.24	281.61	295.37	459.45	696.40	920.37	1107.94	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	434.94	320.01	240.12	112.87	38.88	0.00	0.00	0.00	0.00	126.36	293.00	450.78	

∑(98)1...5, 10...12 = 2016.95 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 37.89 (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 (%)		89.70	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	484.88	356.76	267.69	125.83	43.34	0.00	0.00	0.00	0.00	140.87	326.65	502.54

∑(211)1...5, 10...12 = 2248.55 (211)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Efficiency of water heater	86.64	86.26	85.49	83.90	81.71	79.60	79.60	79.60	79.60	84.06	85.98	86.76	(217)
Water heating fuel, kWh/month	193.79	170.02	178.50	161.32	160.38	144.99	138.91	154.85	156.56	168.82	176.18	188.97	

∑(219a)1...12 = 1993.28 (219)

Annual totals

Space heating fuel - main system 1		2248.55	
Water heating fuel		1993.28	
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)				245.00	(232)
Total delivered energy for all uses			(211)...(221) + (231) + (232)...(237b) =	4561.83	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2248.55	x	3.48	x 0.01 =	78.25	(240)
Water heating	1993.28	x	3.48	x 0.01 =	69.37	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	245.00	x	13.19	x 0.01 =	32.32	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		309.82	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.32	(257)
SAP value	81.52	
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	2248.55	x	0.216	=	485.69	(261)
Water heating	1993.28	x	0.216	=	430.55	(264)
Space and water heating			(261) + (262) + (263) + (264) =		916.24	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	245.00	x	0.519	=	127.16	(268)
Total CO_2, kg/year				(265)...(271) =	1082.32	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	20.33	(273)
EI value					85.24	
EI rating (section 14)					85	(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	2248.55	x	1.22	=	2743.24	(261)
Water heating	1993.28	x	1.22	=	2431.80	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5175.03	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	245.00	x	3.07	=	752.16	(268)
Primary energy kWh/year					6157.44	(272)
Dwelling primary energy rate kWh/m2/year					115.68	(273)

SAP 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 Ioannis Protonotarios	Assessor number	23
Client		Last modified	11/08/2021
Address	Flat 9, 13 Netherhall Gardens, London, NW3		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		116.18	(1a)	x	3.08	(2a)	=	357.83	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	116.18	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			357.83	(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	3	x 10 =	30	(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) =	30	÷ (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	
Door			1.96	x	1.40	=	2.74			(26)
Window			22.63	x	1.33	=	30.00			(27)
Ground floor			71.51	x	0.18	=	12.87			(28a)
External wall			136.01	x	0.18	=	24.48			(29a)
Party wall			24.98	x	0.00	=	0.00			(32)
Roof			19.57	x	0.15	=	2.94			(30)
Total area of external elements ∑A, m²			251.68							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	73.03	(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		18.18	(36)
Total fabric heat loss	(33) + (36) =	91.21	(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)	68.20	67.84	67.49	65.86	65.55	64.12	64.12	63.86	64.67	65.55	66.17	66.82	(38)
Heat transfer coefficient, W/K (37)m + (38)m	159.41	159.05	158.70	157.07	156.76	155.34	155.34	155.07	155.89	156.76	157.38	158.03	
Average = ∑(39)1...12/12 =												157.07	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.37	1.37	1.37	1.35	1.35	1.34	1.34	1.33	1.34	1.35	1.35	1.36	
Average = ∑(40)1...12/12 =												1.35	(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	2.85	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	101.82	(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)	112.00	107.93	103.86	99.79	95.71	91.64	91.64	95.71	99.79	103.86	107.93	112.00	
∑(44)1...12 =												1221.87	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	166.10	145.27	149.91	130.69	125.40	108.21	100.28	115.07	116.44	135.70	148.13	160.86	
∑(45)1...12 =												1602.06	(45)
Distribution loss 0.15 x (45)m	24.91	21.79	22.49	19.60	18.81	16.23	15.04	17.26	17.47	20.36	22.22	24.13	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	50.96	46.03	50.96	49.21	48.77	45.19	46.70	48.77	49.21	50.96	49.32	50.96	(61)

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

217.06	191.30	200.87	179.90	174.18	153.41	146.97	163.84	165.65	186.66	197.44	211.82	(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

217.06	191.30	200.87	179.90	174.18	153.41	146.97	163.84	165.65	186.66	197.44	211.82

∑(64)1...12 = 2189.10 (64)

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

67.97	59.81	62.58	55.76	53.89	47.28	45.02	50.45	51.02	57.86	61.58	66.23	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	170.84	170.84	170.84	170.84	170.84	170.84	170.84	170.84	170.84	170.84	170.84	170.84	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	62.44	55.46	45.10	34.15	25.52	21.55	23.28	30.27	40.62	51.58	60.20	64.18	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	418.14	422.48	411.54	388.27	358.88	331.27	312.82	308.48	319.41	342.69	372.07	399.69	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.93	54.93	54.93	54.93	54.93	54.93	54.93	54.93	54.93	54.93	54.93	54.93	(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)	-113.89	-113.89	-113.89	-113.89	-113.89	-113.89	-113.89	-113.89	-113.89	-113.89	-113.89	-113.89	(71)
Water heating gains (Table 5)	91.35	89.00	84.12	77.44	72.43	65.67	60.51	67.81	70.86	77.77	85.53	89.01	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	686.81	681.82	655.64	614.73	571.72	533.36	511.48	521.43	545.77	586.92	632.68	667.76	(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	1.82	x	19.64	x 0.9 x	0.63	x	0.80	=	12.48	(76)
West	0.77	x	8.25	x	19.64	x 0.9 x	0.63	x	0.80	=	56.59	(80)
North	0.77	x	10.56	x	10.63	x 0.9 x	0.63	x	0.80	=	39.22	(74)
NorthEast	0.77	x	2.00	x	11.28	x 0.9 x	0.63	x	0.80	=	7.88	(75)

Solar gains in watts ∑(74)m...(82)m	116.18	226.12	378.81	576.61	737.15	770.22	726.72	602.24	447.17	269.17	144.43	95.94	(83)
Total gains - internal and solar (73)m + (83)m	802.99	907.94	1034.45	1191.34	1308.87	1303.58	1238.21	1123.68	992.94	856.08	777.11	763.69	(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	0.95	0.86	0.69	0.53	0.60	0.85	0.97	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.55	19.71	20.00	20.40	20.74	20.93	20.98	20.97	20.82	20.38	19.90	19.53	(87)

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

19.78	19.79	19.79	19.80	19.80	19.81	19.81	19.81	19.81	19.80	19.80	19.79	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.98	0.93	0.80	0.59	0.40	0.46	0.77	0.96	0.99	1.00	(89)

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

18.49	18.65	18.94	19.33	19.63	19.78	19.81	19.81	19.71	19.32	18.84	18.47	(90)

Living area fraction — Living area ÷ (4) = 0.29 (91)

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

18.80	18.96	19.25	19.64	19.96	20.12	20.15	20.15	20.03	19.63	19.15	18.78	(92)

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

18.80	18.96	19.25	19.64	19.96	20.12	20.15	20.15	20.03	19.63	19.15	18.78	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.97	0.93	0.81	0.62	0.44	0.50	0.79	0.95	0.99	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	797.83	897.46	1007.09	1102.85	1061.80	806.74	543.31	565.91	780.93	817.06	768.13	759.73	(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]	2311.36	2235.86	2023.05	1687.20	1294.16	856.99	551.71	581.05	925.02	1415.07	1896.41	2303.64	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	1126.06	899.40	755.87	420.73	172.88	0.00	0.00	0.00	0.00	444.92	812.36	1148.66	

∑(98)1...5, 10...12 = 5780.88 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 49.76 (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 (%)		89.70	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	1255.36	1002.67	842.67	469.04	192.73	0.00	0.00	0.00	0.00	496.00	905.64	1280.56

∑(211)1...5, 10...12 = 6444.68 (211)

Water heating

Efficiency of water heater

87.90	87.75	87.37	86.42	84.33	79.60	79.60	79.60	79.60	86.46	87.53	87.96	(217)

Water heating fuel, kWh/month

246.94	218.01	229.90	208.18	206.54	192.72	184.64	205.83	208.10	215.90	225.58	240.81

∑(219a)1...12 = 2583.16 (219)

Annual totals

Space heating fuel - main system 1	6444.68
Water heating fuel	2583.16

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)					441.10	(232)
Total delivered energy for all uses				(211)...(221) + (231) + (232)...(237b) =	9543.94	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	6444.68	x	3.48	x 0.01 =	224.27	(240)
Water heating	2583.16	x	3.48	x 0.01 =	89.89	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	441.10	x	13.19	x 0.01 =	58.18	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	502.24	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.31	(257)
SAP value	81.74	
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	6444.68	x	0.216	=	1392.05	(261)
Water heating	2583.16	x	0.216	=	557.96	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1950.01	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	441.10	x	0.519	=	228.93	(268)
Total CO_2, kg/year				(265)...(271) =	2217.87	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	19.09	(273)
EI value					81.56	
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	6444.68	x	1.22	=	7862.51	(261)
Water heating	2583.16	x	1.22	=	3151.45	(264)
Space and water heating				(261) + (262) + (263) + (264) =	11013.97	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	441.10	x	3.07	=	1354.16	(268)
Primary energy kWh/year					12598.38	(272)
Dwelling primary energy rate kWh/m2/year					108.44	(273)

SAP 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 Ioannis Protonotarios	Assessor number	23
Client		Last modified	11/08/2021
Address	Flat 10, 13 Netherhall Gardens, London, NW3		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		113.54	(1a)	x	2.78	(2a)	=	315.64	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	113.54	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			315.64	(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		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.32	(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	0.41	0.40	0.39	0.35	0.34	0.30	0.30	0.30	0.32	0.34	0.36	0.38	(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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.58	0.58	0.58	0.56	0.56	0.55	0.55	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)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.58	0.58	0.58	0.56	0.56	0.55	0.55	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	
Door			1.96	x	1.40	=	2.74			(26)
Window			23.92	x	1.33	=	31.71			(27)
Basement floor			113.54	x	0.18	=	20.44			(28)
External wall			119.35	x	0.18	=	21.48			(29a)
Party wall			10.13	x	0.00	=	0.00			(32)
Roof			62.70	x	0.15	=	9.41			(30)
Total area of external elements ∑A, m²			321.47							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	85.78	(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		12.46	(36)
Total fabric heat loss	(33) + (36) =	98.24	(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)	60.76	60.43	60.09	58.54	58.25	56.90	56.90	56.65	57.42	58.25	58.84	59.45	(38)
Heat transfer coefficient, W/K (37)m + (38)m	159.00	158.66	158.33	156.78	156.49	155.14	155.14	154.89	155.66	156.49	157.08	157.69	
Average = ∑(39)1...12/12 =												156.78	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.40	1.40	1.39	1.38	1.38	1.37	1.37	1.36	1.37	1.38	1.38	1.39	
Average = ∑(40)1...12/12 =												1.38	(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	2.83	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	101.52	(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)	111.67	107.61	103.55	99.49	95.43	91.37	91.37	95.43	99.49	103.55	107.61	111.67	
∑(44)1...12 =												1218.23	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	165.60	144.84	149.46	130.30	125.03	107.89	99.98	114.72	116.10	135.30	147.69	160.38	
∑(45)1...12 =												1597.29	(45)
Distribution loss 0.15 x (45)m	24.84	21.73	22.42	19.55	18.75	16.18	15.00	17.21	17.41	20.29	22.15	24.06	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	50.96	46.03	50.96	49.06	48.63	45.06	46.56	48.63	49.06	50.96	49.32	50.96	(61)

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

216.56	190.87	200.42	179.37	173.66	152.95	146.54	163.35	165.16	186.26	197.00	211.34	(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

216.56	190.87	200.42	179.37	173.66	152.95	146.54	163.35	165.16	186.26	197.00	211.34	

∑(64)1...12 = 2183.47 (64)

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

67.80	59.67	62.44	55.59	53.73	47.14	44.88	50.30	50.87	57.73	61.43	66.07	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)													
	170.07	170.07	170.07	170.07	170.07	170.07	170.07	170.07	170.07	170.07	170.07	170.07	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.64	54.74	44.52	33.71	25.20	21.27	22.98	29.88	40.10	50.91	59.42	63.35	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	412.76	417.04	406.25	383.27	354.26	327.00	308.79	304.51	315.30	338.28	367.28	394.54	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.84	54.84	54.84	54.84	54.84	54.84	54.84	54.84	54.84	54.84	54.84	54.84	(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)													
	-113.38	-113.38	-113.38	-113.38	-113.38	-113.38	-113.38	-113.38	-113.38	-113.38	-113.38	-113.38	(71)
Water heating gains (Table 5)													
	91.13	88.79	83.92	77.21	72.22	65.47	60.33	67.61	70.65	77.59	85.33	88.80	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
	680.06	675.10	649.22	608.72	566.21	528.27	506.63	516.53	540.58	581.31	626.57	661.22	(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	11.15	x	10.63	x 0.9 x	0.63	x	0.80	=	41.41	(74)
West	0.77	x	6.67	x	19.64	x 0.9 x	0.63	x	0.80	=	45.75	(80)
SouthWest	0.77	x	3.05	x	36.79	x 0.9 x	0.63	x	0.80	=	39.20	(79)
NorthWest	0.77	x	3.05	x	11.28	x 0.9 x	0.63	x	0.80	=	12.02	(81)

Solar gains in watts ∑(74)m...(82)m

138.38	259.87	417.31	616.56	778.53	810.80	765.98	639.86	485.74	304.10	170.21	115.51	(83)

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

818.44	934.98	1066.53	1225.28	1344.73	1339.08	1272.61	1156.39	1026.32	885.41	796.77	776.73	(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	0.94	0.84	0.68	0.52	0.59	0.83	0.97	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	19.54	19.71	20.01	20.41	20.75	20.93	20.98	20.97	20.82	20.39	19.89	19.51	(87)

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

19.76	19.77	19.77	19.78	19.78	19.79	19.79	19.79	19.79	19.78	19.78	19.77	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.99	0.97	0.92	0.79	0.57	0.38	0.45	0.75	0.95	0.99	1.00	(89)

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

18.46	18.63	18.93	19.32	19.62	19.76	19.79	19.78	19.69	19.31	18.82	18.44	(90)

Living area fraction — Living area ÷ (4) = 0.46 (91)

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

18.96	19.13	19.42	19.82	20.13	20.30	20.33	20.33	20.21	19.80	19.31	18.93	(92)

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

18.96	19.13	19.42	19.82	20.13	20.30	20.33	20.33	20.21	19.80	19.31	18.93	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.97	0.92	0.81	0.62	0.45	0.51	0.78	0.95	0.99	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	812.55	922.63	1034.94	1127.76	1083.49	829.48	569.20	590.74	802.50	841.22	786.46	772.23	(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]	2330.59	2257.15	2046.07	1711.86	1319.87	883.80	579.34	608.45	951.40	1440.03	1918.44	2322.98	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	1129.42	896.80	752.28	420.55	175.87	0.00	0.00	0.00	0.00	445.52	815.03	1153.75	

∑(98)1...5, 10...12 = 5789.22 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 50.99 (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 (%)		89.70	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	1259.11	999.78	838.66	468.84	196.06	0.00	0.00	0.00	0.00	496.67	908.61	1286.24

∑(211)1...5, 10...12 = 6453.98 (211)

Water heating

Efficiency of water heater	87.91	87.75	87.37	86.42	84.38	79.60	79.60	79.60	79.60	86.47	87.54	87.97	(217)
Water heating fuel, kWh/month	246.36	217.52	229.40	207.55	205.80	192.15	184.09	205.22	207.48	215.41	225.05	240.23	

∑(219a)1...12 = 2576.27 (219)

Annual totals

Space heating fuel - main system 1	6453.98
Water heating fuel	2576.27
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)				435.40	(232)
Total delivered energy for all uses			(211)...(221) + (231) + (232)...(237b) =	9540.65	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	6453.98	x	3.48	x 0.01 =	224.60	(240)
Water heating	2576.27	x	3.48	x 0.01 =	89.65	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	435.40	x	13.19	x 0.01 =	57.43	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		501.57	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.33	(257)
SAP value	81.46	
SAP rating (section 13)	81	(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	6453.98	x	0.216	=	1394.06	(261)
Water heating	2576.27	x	0.216	=	556.47	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1950.53	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	435.40	x	0.519	=	225.97	(268)
Total CO_2, kg/year			(265)...(271) =		2215.43	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		19.51	(273)
EI value					81.27	
EI rating (section 14)					81	(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	6453.98	x	1.22	=	7873.86	(261)
Water heating	2576.27	x	1.22	=	3143.04	(264)
Space and water heating			(261) + (262) + (263) + (264) =		11016.90	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	435.40	x	3.07	=	1336.69	(268)
Primary energy kWh/year					12583.84	(272)
Dwelling primary energy rate kWh/m2/year					110.83	(273)

SAP 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 Ioannis Protonotarios	Assessor number	23
Client		Last modified	11/08/2021
Address	Flat 11, 13 Netherhall Gardens, London, NW3		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		91.86	(1a)	x	2.78	(2a)	=	255.37	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	91.86	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			255.37	(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) =	0.16	(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)		0.41	(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) =	0.38	(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	0.48	0.47	0.46	0.41	0.40	0.36	0.36	0.35	0.38	0.40	0.42	0.44	(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

0.61	0.61	0.61	0.59	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.60	(24d)

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

0.61	0.61	0.61	0.59	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.60	(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	
Door			1.96	x	1.40	=	2.74			(26)
Window			25.52	x	1.33	=	33.83			(27)
Basement floor			91.86	x	0.18	=	16.53			(28)
External wall			104.54	x	0.18	=	18.82			(29a)
Party wall			10.13	x	0.00	=	0.00			(32)
Roof			34.49	x	0.15	=	5.17			(30)
Total area of external elements ∑A, m²			258.37							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	77.10	(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		11.39	(36)
Total fabric heat loss	(33) + (36) =	88.49	(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)	51.83	51.45	51.08	49.35	49.03	47.52	47.52	47.24	48.10	49.03	49.68	50.37	(38)
Heat transfer coefficient, W/K (37)m + (38)m	140.32	139.94	139.57	137.84	137.52	136.01	136.01	135.73	136.59	137.52	138.17	138.86	
Average = ∑(39)1...12/12 =												137.84	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.53	1.52	1.52	1.50	1.50	1.48	1.48	1.48	1.49	1.50	1.50	1.51	
Average = ∑(40)1...12/12 =												1.50	(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	2.65	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	97.15	(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)	106.86	102.97	99.09	95.20	91.32	87.43	87.43	91.32	95.20	99.09	102.97	106.86	
∑(44)1...12 =												1165.74	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	158.47	138.60	143.02	124.69	119.64	103.24	95.67	109.78	111.09	129.47	141.33	153.47	
∑(45)1...12 =												1528.48	(45)
Distribution loss 0.15 x (45)m	23.77	20.79	21.45	18.70	17.95	15.49	14.35	16.47	16.66	19.42	21.20	23.02	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	50.96	46.03	50.49	46.95	46.53	43.12	44.55	46.53	46.95	50.49	49.32	50.96	(61)

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

209.43	184.63	193.52	171.64	166.18	146.36	140.22	156.32	158.04	179.96	190.64	204.43	(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

209.43	184.63	193.52	171.64	166.18	146.36	140.22	156.32	158.04	179.96	190.64	204.43

∑(64)1...12 = 2101.36 (64)

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

65.43	57.59	60.18	53.20	51.41	45.11	42.95	48.14	48.68	55.67	59.32	63.77	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	159.02	159.02	159.02	159.02	159.02	159.02	159.02	159.02	159.02	159.02	159.02	159.02	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	54.04	48.00	39.03	29.55	22.09	18.65	20.15	26.19	35.16	44.64	52.10	55.54	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	361.88	365.63	356.17	336.02	310.60	286.69	270.73	266.97	276.44	296.58	322.01	345.91	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.55	53.55	53.55	53.55	53.55	53.55	53.55	53.55	53.55	53.55	53.55	53.55	(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)	-106.01	-106.01	-106.01	-106.01	-106.01	-106.01	-106.01	-106.01	-106.01	-106.01	-106.01	-106.01	(71)
Water heating gains (Table 5)	87.94	85.70	80.88	73.88	69.11	62.65	57.73	64.70	67.61	74.83	82.39	85.71	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	613.42	608.89	585.65	549.02	511.35	477.55	458.16	467.42	488.76	525.61	566.06	596.72	(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	
South	0.77	x	14.21	x	46.75	x 0.9 x	0.63	x	0.80	=	232.04	(78)
West	0.77	x	11.31	x	19.64	x 0.9 x	0.63	x	0.80	=	77.58	(80)

Solar gains in watts ∑(74)m...(82)m	309.62	531.79	734.02	911.64	1016.87	1005.99	971.47	894.60	796.37	589.97	371.78	264.30	(83)
Total gains - internal and solar (73)m + (83)m	923.04	1140.68	1319.67	1460.66	1528.22	1483.54	1429.64	1362.03	1285.13	1115.58	937.84	861.02	(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)	0.99	0.97	0.93	0.85	0.73	0.56	0.41	0.45	0.66	0.89	0.97	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.63	19.90	20.24	20.59	20.84	20.96	20.99	20.99	20.91	20.58	20.03	19.58	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.67	19.67	19.67	19.69	19.69	19.70	19.70	19.70	19.70	19.69	19.68	19.68	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.96	0.91	0.81	0.65	0.46	0.29	0.33	0.56	0.85	0.96	0.99	(89)

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

18.47	18.74	19.06	19.40	19.60	19.69	19.70	19.70	19.66	19.40	18.88	18.43	(90)

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

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

19.07	19.34	19.67	20.02	20.24	20.35	20.37	20.37	20.31	20.01	19.48	19.03	(92)

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

19.07	19.34	19.67	20.02	20.24	20.35	20.37	20.37	20.31	20.01	19.48	19.03	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.95	0.91	0.82	0.69	0.51	0.36	0.39	0.61	0.86	0.96	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	903.06	1088.42	1199.84	1200.86	1049.05	754.29	507.91	531.51	789.01	957.50	899.47	846.34	(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]	2072.70	2020.75	1838.37	1532.44	1174.36	781.57	512.71	538.61	848.33	1293.95	1710.17	2058.79	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	870.21	626.53	475.07	238.74	93.23	0.00	0.00	0.00	0.00	250.32	583.70	902.06	

∑(98)1...5, 10...12 = 4039.86 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 43.98 (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 (%)		89.70	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	970.13	698.47	529.62	266.15	103.94	0.00	0.00	0.00	0.00	279.06	650.73	1005.65

∑(211)1...5, 10...12 = 4503.75 (211)

Water heating

Efficiency of water heater	87.55	87.18	86.52	85.18	82.96	79.60	79.60	79.60	79.60	85.18	86.98	87.65	(217)
Water heating fuel, kWh/month	239.22	211.77	223.66	201.50	200.32	183.87	176.16	196.38	198.55	211.27	219.17	233.25	

∑(219a)1...12 = 2495.12 (219)

Annual totals

Space heating fuel - main system 1	4503.75	
Water heating fuel	2495.12	
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)	381.73	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	7455.60	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4503.75	x	3.48	x 0.01 =	156.73	(240)
Water heating	2495.12	x	3.48	x 0.01 =	86.83	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	381.73	x	13.19	x 0.01 =	50.35	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	423.80	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.30	(257)
SAP value	81.86	
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	4503.75	x	0.216	=	972.81	(261)
Water heating	2495.12	x	0.216	=	538.95	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1511.75	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	381.73	x	0.519	=	198.12	(268)
Total CO_2, kg/year				(265)...(271) =	1748.80	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	19.04	(273)
EI value					82.88	
EI rating (section 14)					83	(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	4503.75	x	1.22	=	5494.57	(261)
Water heating	2495.12	x	1.22	=	3044.04	(264)
Space and water heating				(261) + (262) + (263) + (264) =	8538.61	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	381.73	x	3.07	=	1171.92	(268)
Primary energy kWh/year					9940.79	(272)
Dwelling primary energy rate kWh/m2/year					108.22	(273)

Appendix B – Water Calculation

breglobal

Job no:	J2629
Date:	11/08/2021
Assessor name:	Ioannis Protonotarios
Registration no:	
Development name:	13 Netherhall Gardens - Phase 2

PRINTING: before printing please make sure that in "Page Setup" you have selected the page to be as "Landscape" and that the Scale has been set up to 70% (maximum)

WATER EFFICIENCY CALCULATOR FOR NEW DWELLINGS - (BASIC CALCULATOR)

	House Type:	Type 1		Type 2		Type 3		Type 4		Type 5		Type 6		Type 7		Type 8		Type 9		Type 10	
	Description:	All Residential Units																			
Installation Type	Unit of measure	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day
Is a dual or single flush WC specified?		Dual		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Click to Select		Click to Select		Click to Select	
WC	Full flush volume	6	8.76		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
	Part flush volume	3	8.88		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Taps (excluding kitchen and external taps)	Flow rate (litres / minute)	2	4.74		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Are both a Bath & Shower Present?		Bath & Shower		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:	
Bath	Capacity to overflow	150	16.50		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Shower	Flow rate (litres / minute)	9	39.33		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Kitchen sink taps	Flow rate (litres / minute)	10	14.76		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a washing machine been specified?		Yes		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:	
Washing Machine	Litres / kg	8.17	17.16		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a dishwasher been specified?		Yes		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:	
Dishwasher	Litres / place setting	1.25	4.50		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a waste disposal unit been specified?		No	0.00	Select option:	0.00	Select option:	0.00	Select option:	0.00	Select option:	0.00	Select option:	0.00	Select option:	0.00	Select option:	0.00	Select option:	0.00	Select option:	0.00
Water Softener	Litres / person / day		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Calculated Use			114.6		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Normalisation factor			0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91
Code for Sustainable Homes	Total Consumption		104.3		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
	Mandatory level		Level 3/4		-		-		-		-		-		-		-		-		-
Building Regulations 17.K	External use		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0
	Total Consumption		109.3		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
	17.K Compliance?		Yes		-		-		-		-		-		-		-		-		-