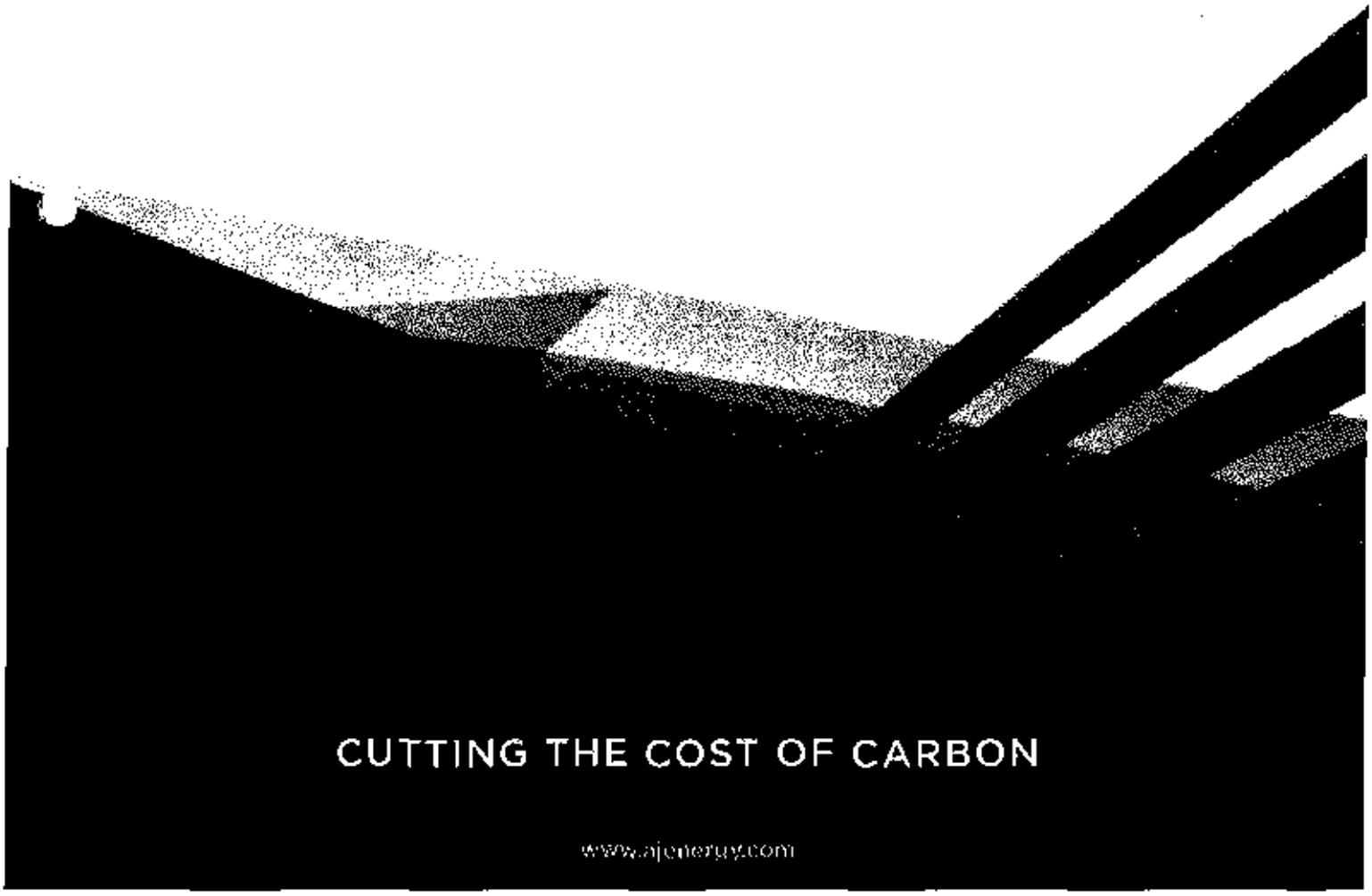
AJ ENERGY CONSULTANTS LIMITED

4 & 4a Oaklands Road, Bromley

Energy Statement

October 2015



CUTTING THE COST OF CARBON

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1 Issue Register

Revision	Reason for Issue	Date of Issue	Issued By
1.0	For comment	29/09/2015	J Simpson CEng MCIBSE
2.0	Updated for submission	01/10/2015	J Simpson CEng MCIBSE

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3 Executive Summary

This document responds to planning policy in respect of energy consumption and carbon dioxide emissions. The methodology used herein is consistent with the London Renewables Toolkit (LRT) and Part L of the Building Regulations.

The Proposed Development features improved insulation and air tightness standards, when compared against the compliance requirements of Part L 2013 of the Building Regulations. In addition, energy efficient lighting is to be provided throughout the dwellings in excess of the Part L1 2013 requirements.

There are no details of installed district heating schemes in the immediate vicinity of the site, and the Proposed Development is considered to be too small to successfully incorporate a community heating system. It is also considered that the small increase in heating plant efficiency due to the incorporation of a system would be cancelled out by the increase in energy consumption required to pump the heating water circuit.

Combined heat and power (CHP) has been assessed in terms of feasibility. There is no economic or sustainable justification for over-sizing the CHP plant, and therefore the CHP unit size needs to be carefully matched to the demands of the development. The smallest commercially available CHP unit is too large for the scheme due to the limited number of residential dwellings, and therefore CHP is not considered to be viable for the Proposed Development.

A feasibility study of the currently available low and zero carbon technologies has been undertaken, with photovoltaic panels proposed for the development at roof level to generate electricity for the site. It has been estimated that the proposed photovoltaic systems would reduce the annual carbon dioxide emissions of the site by 4,326 $kgCO_2$, which equates to a reduction of 32.7% against the TER 2013.

The incorporation of the energy efficiency measures, and photovoltaic panels equates to a reduction of 37.4% against the TER 2013 for the scheme, which exceeds the local policy requirements.

A summary of the reduction in emissions is shown in Tables 1 and 2 below, and graphically in Figure 1 below, for the SAP 2012 calculations for comparison against London Plan energy policy:

Stage	Regulated carbon dioxide emissions (heating, cooling, hot water, lighting, fans & pumps) ($kgCO_2/yr$)	Unregulated carbon dioxide emissions (cooking, appliances, communal lighting & power) ($kgCO_2/yr$)
Building Regulations Compliance (TER 2013)	13,235	6,169
Energy Efficiency Measures ('Be Lean')	12,616	6,169
Proposed Development with PVs ('Be Green')	8,290	6,169

Table 1 – Carbon dioxide emissions after each stage of the Energy Hierarchy for SAP 2012

Stage	Regulated carbon dioxide savings (Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	619	4.7
Savings from PVs	4,326	32.7
Total Cumulative Savings	**4,945**	**37.4**

Table 2 – Regulated carbon dioxide savings from each stage of the Energy Hierarchy for SAP 2012

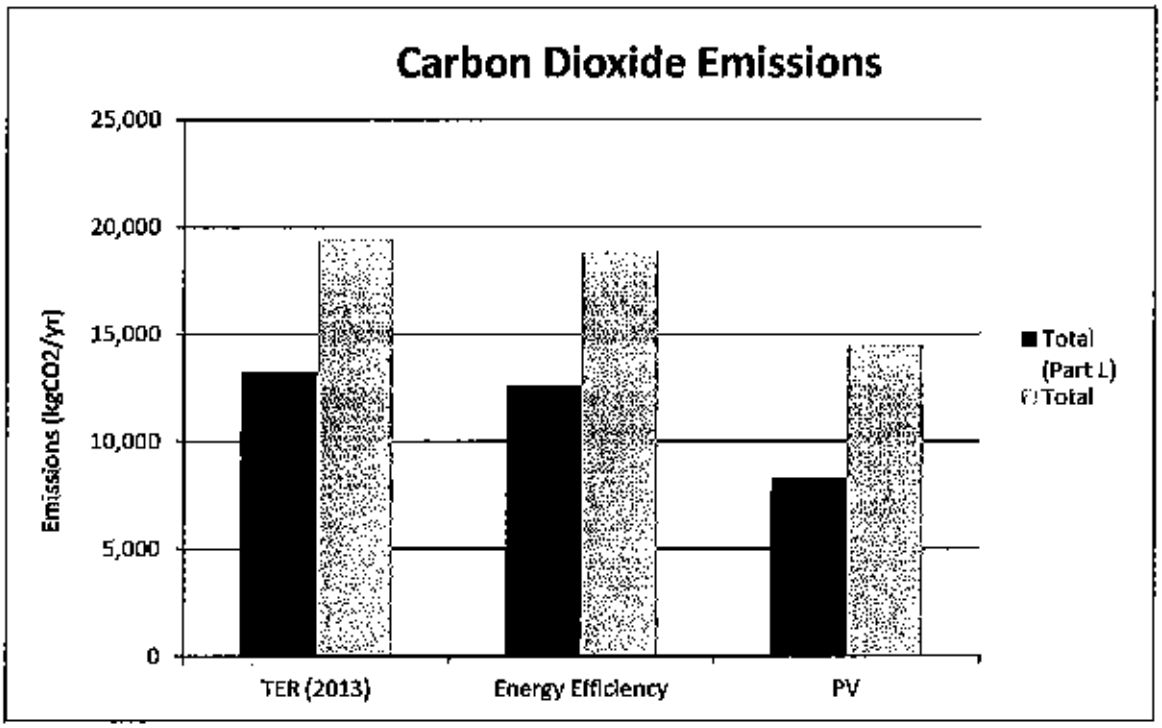

Figure 1 – Summary of carbon dioxide emissions

4 Introduction

4.1 Proposed Development

The Proposed Development comprises the construction of 11 new build apartments within a single block.

4.2 Planning Policy Context

4.2.1 National

The following description is taken from the LRT

"Increased development of renewable energy resources is vital to facilitating the delivery of the Government's commitments on both climate change and renewable energy. The Government's Energy Policy, including its policy on renewable energy, is set out in the Energy White Paper. This aims to put the UK on a path to cut its carbon dioxide emissions by some 60% by 2050, with real progress by 2020, and to maintain reliable and competitive energy supplies. As part of the strategy for achieving these reductions the White Paper sets out:

- The Government's target to generate 10% of UK electricity from renewable energy sources by 2010
- The Government's aspiration to double that figure to 20% by 2020 and suggests that still more renewable energy will be needed beyond that date.

"The Energy White Paper indicated that the Government would be looking to work with regional and local bodies to deliver its objectives, including establishing regional targets for renewable energy generation. Regional Planning Guidance should include the target for renewable energy generation for its respective region, derived from assessments of the region's renewable energy resource potential."

The *National Planning Policy Framework* sets out the Government's national policy for renewable energy. It states that "to help increase the use and supply of renewable and low carbon energy, local planning authorities should recognise the responsibility on all communities to contribute to energy generation from renewable or low carbon sources."

4.2.2 Regional

The London Plan is the overall strategic plan for London, and it sets out a fully integrated economic, environmental, transport and social framework for the development of the capital to 2031. It forms part of the development plan for Greater London. The Further Alterations to the London Plan was adopted on 10 March 2015.

Policy 5.2 (Minimising Carbon Dioxide Emissions) states that:

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

1 – Be lean: use less energy

2 – Be clean: supply energy efficiently
3 – Be green: use renewable energy

The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Year	Improvement on 2010 Building Regulations	
	Residential buildings	Non-domestic buildings
2010 – 2013	25 per cent	25 per cent
2013 – 2016	40 per cent	40 per cent
2016 – 2019	Zero carbon	As per building regulations requirements
2019 – 2031		Zero carbon

Table 3 – Proposed carbon dioxide reduction targets under the 2015 London Plan

Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy.

As a minimum, energy assessments should include the following:

a) Calculation of the energy demand and carbon dioxide emissions covered by the Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations at each stage of the energy hierarchy
b) Proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services
c) Proposals to further reduce carbon dioxide emissions through the use of decentralized energy where feasible, such as district heating and cooling and combined heat and power (CHP)
d) Proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies."

Policy 5.7 (Renewable Energy) states that:

"The Mayor seeks to increase the proportion of energy generated from renewable sources, and expects that the projections for installed renewable energy capacity outlined in the Climate Change Mitigation and Energy Strategy and in supplementary planning guidance will be achieved in London.

Within the framework of the energy hierarchy, major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible."

Following the update to Part L of the Building Regulations in April 2014, the carbon dioxide reduction targets have been revised to reflect the changes in software and Building Regulations compliance targets. The GLA have confirmed in their policy update that the current requirement is for a 35% reduction in carbon dioxide emissions against the Part L 2013 TER requirements.

4.2.3 Local

The 2004 Planning and Compulsory Purchase Act requires the Council to replace the Unitary Development Plan (UDP) with new development plan documents which form part of the Council's emerging Local Development Framework. A number of UDP policies have now expired, with the London Plan 2011 policies used to assess the sustainability and energy efficiency measures within new developments.

5 Methodology

This report draws on the information and approach set out in the LRT. The currency used for emissions is carbon dioxide, rather than the carbon equivalent, for consistency with Part L of the Building Regulations.

A Part L analysis is conducted to calculate carbon dioxide emissions for the following end uses: heating; hot water; cooling; fans, pumps and controls; and lighting. Various energy-saving measures are considered in terms of technical and economic feasibility and their effect on carbon dioxide emissions. A package of energy-saving measures is proposed that meets the Part L standard, without reliance on the contribution of CHP or renewables. Unregulated energy end uses, such as appliances, are added using the SBEM or SAP software.

CHP is then considered in terms of technical and economic feasibility and its effect on carbon dioxide emissions. The strategic issues relating to each technology are also considered in the context of the Proposed Development, and two or three preferred options are short-listed. These are then considered in more detail in terms of technical and economic feasibility and its effect on carbon dioxide emissions.

Calculations are presented in summary form in subsequent sections, with detailed calculations in Appendix A.

Figure 2 below provides a summary of the methodology in the form of a flow diagram.

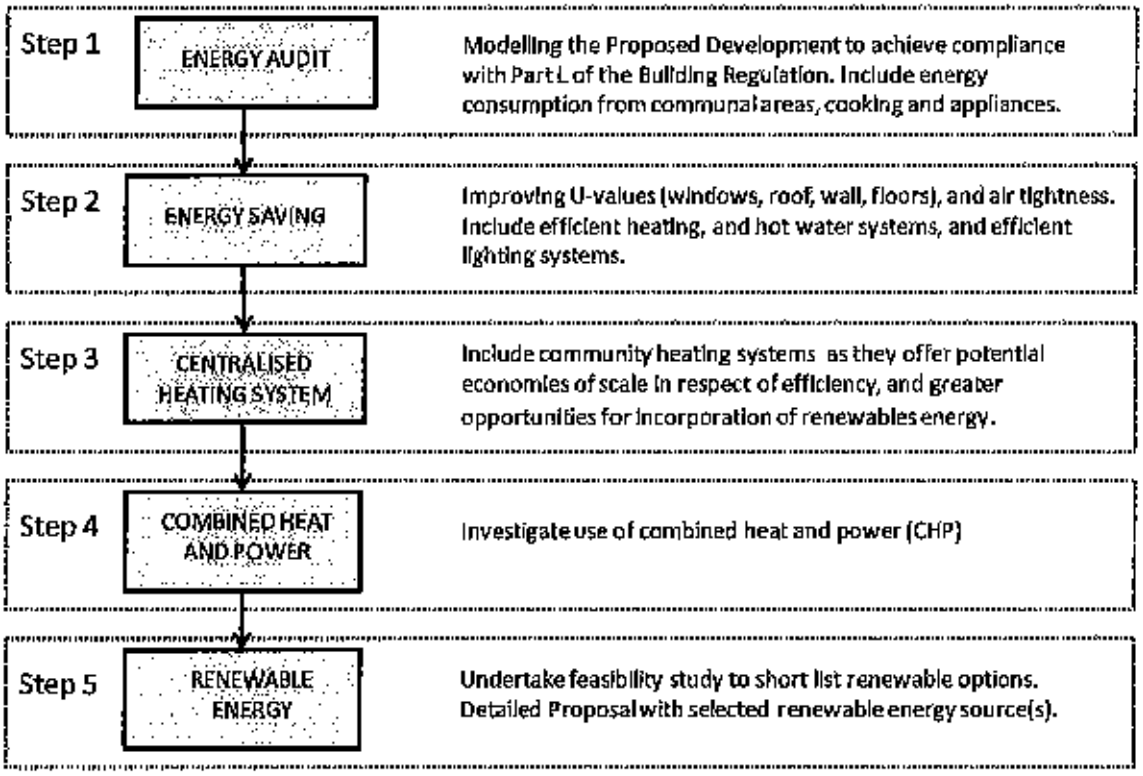

Figure 2 – Flow diagram of methodology

6 Energy Demand

The Development would feature energy saving measures such that compliance with Part L of the Building Regulations (2013) would be achieved without reliance on the contribution of CHP or renewable technologies.

As required under Part L, the residential units have been assessed under Part L1A, with SAP calculations undertaken using the Part L1A 2013 methodology.

The minimum requirements for compliance with Part L1A 2013 were established, and feasible improvements were included to further reduce the carbon dioxide emissions. The measures outlined below have been used in the Part L1A calculations, and exceed the requirements of Part L1A. The proposed fabric performance is compared against the Part L1A 2013 requirements in Table 4 below:

Element	Proposed Development	Part L1A 2013 Requirements
External wall U-value	0.20 W/m².K	0.30 W/m².K
Exposed roof U-value	0.15 W/m².K	0.20 W/m².K
Exposed floor U-value	0.15 W/m².K	0.25 W/m².K
Window & glazed door U-value	1.40 W/m².K	2.00 W/m².K
Solid doors	1.00 W/m².K	2.00 W/m².K
Air permeability	3 m³/hr/m² @ 50 Pa (with tests undertaken in each dwelling)	10 m³/hr/m² @ 50 Pa
Thermal bridging	Accredited Construction Details to be used throughout	0.15
Low energy lighting	100%	75%

Table 4 – Comparison of proposed residential performance

High efficiency condensing gas-fired boilers are proposed for each dwelling. It has been assumed that heating is provided by radiators to each dwelling, with design flow temperature greater than 45°C. Time and temperature zone control would be provided for each dwelling, with delayed start thermostats and weather compensation.

7 Community Heating & CHP

The Mayor's Energy Strategy favours community heating systems because they offer:

- Potential economies of scale in respect of efficiency and therefore reduced carbon emissions; and
- Greater potential for future replacement with Low or Zero Carbon (LZC) technologies.

There are no existing district heating systems in the immediate vicinity of the site, and therefore not considered to be feasible to connect to a district heating system. The Proposed Development is considered to be too small to successfully incorporate a community heating system, with typically 60 dwellings being the minimum to provide an economically feasible centralized system which also provides a reduction in carbon dioxide emissions. It is also considered that the small increase in heating plant efficiency due to the incorporation of a system of the limited size that this particular scheme would require would be cancelled out by the increase in energy consumption required to pump the heating water circuit.

Combined heat and power (CHP) has been assessed in terms of feasibility. There is no economic or sustainable justification for over-sizing the CHP plant, and therefore the CHP unit size needs to be carefully matched to the demands of the development. The Proposed Development is not large enough to contain a district wide CHP system to serve surrounding buildings and future schemes, and the smallest commercially available CHP unit is too large for the scheme due to the limited number of residential dwellings. CHP systems are usually specified for large schemes with more than 100-150 dwellings due to the need to have a large enough heat demand to supply from the CHP system – the smallest commercially available CHP unit (the Baxi DACHS micro-CHP unit) would supply 60 dwellings, and therefore would not be economically or technically feasible for this scheme. Therefore CHP is not considered to be viable for the Proposed Development.

8 Renewables – Feasibility Study

The LRT provides benchmark sizing and cost data for "renewable energy technologies suitable for London". It therefore provides information to assess the various technologies at an early design stage, with initial measurements of the impact of using each technology on the building's carbon dioxide emissions. Table 5 (below) outlines these technologies and the variations proposed in the LRT used in this assessment.

Technology	End Use Demand Met
Wind	Electricity
PV Cells - rooftop	Electricity
PV Cells - cladding	Electricity
Solar Water Heating	Annual DHW (50 %)
Biomass heating (a)	Annual Space Heating +Domestic Hot Water (33%)
Biomass heating (b)	Annual Space Heating +Domestic Hot Water (50%)
Biomass heating (c)	Annual Space Heating +Domestic Hot Water (100%)
Biomass CHP (a)	Annual Space Heating +Domestic Hot Water (33%)
Biomass CHP (b)	Annual Space Heating +Domestic Hot Water (50%)
Ground sourced heat pumps (a)	Annual Space Heating +Domestic Hot Water (50%)
Ground sourced heat pumps (b)	Annual Space Heating +Domestic Hot Water (100%)
Ground sourced heat pumps (c)	Peak Space Heating (50 %) Annual Space Heating + Domestic Hot Water (85 %)
Ground cooling (a)	Annual Cooling (50%)
Ground cooling (b)	Annual Cooling (100%)

Table 5 – Renewable energy technologies suitable for London

The following other "acceptable renewable energy technologies" are considered to be not typically appropriate in London:

- Fuel cells using hydrogen from renewable sources;
- Gas from anaerobic digestion;
- Geothermal;
- Ground cooling air systems;
- Micro hydro; and
- Solar air collectors.

On the basis of this preliminary analysis, and a review of the general advantages and disadvantages of the different technologies relative to the Proposed Development, the following technologies were not considered to be appropriate to the Proposed Development:

- **Wind turbines:** on the basis of visual appearance, noise issues and concerns over outputs in urban areas. Wind turbines are not considered appropriate for the urban context. There are still concerns over noise with the horizontal axis turbines, and therefore they are not considered appropriate for the development. The average wind speed for the Proposed Development is noted on the Encraft website as 4.7m/s at 10m – this is significantly below the required average wind speed to make wind turbines a practical solution, particularly when the power output of the turbines is reduced by 7/8ths when the wind speed is halved;

- **Biomass:** on the basis of concerns over air quality issues from flue discharge; concerns over transport issues relating to regular deliveries of biomass; security and cost of fuel supply; concerns over disposal of ash; and relatively high maintenance. Biomass is not considered to be a suitable fuel for use within an urban development, and therefore this technology is not considered appropriate for the development. Deliveries of biomass pellets is undertaken by large vehicles the equivalent size of domestic oil delivery tankers and it is not considered appropriate to have vehicles of this size navigating the local streets and making regular deliveries to the site;

- **Biomass CHP:** on the basis of embodied impacts; high maintenance; concerns over air quality issues from flue discharge; concerns over transport issues relating to regular deliveries of biomass; lack of micro-scale units on the market to suit this scale of development; and it being an immature technology. Biomass is not considered to be a suitable fuel for use within an urban development, therefore this technology is not considered appropriate for the development. A large biomass fuelled CHP with heat output of 200 kW is available, but this is approximately 50 times larger than required for this scheme, particularly as the current biomass fuelled CHP units need to operate 24/7 – biomass CHP is therefore not considered to be feasible for this scheme;

- **Solar thermal:** due to changes in the Building Regulations calculations, the incorporation of photovoltaic panels provide a greater percentage reduction in carbon dioxide than a solar thermal system, and therefore the proposed strategy of photovoltaic panels is considered to be the most appropriate solution; and

- **Ground source:** due to the limited site area at ground level, there is insufficient area available for horizontal loops. The use of open loop boreholes has been discounted as there is a risk of drilling and not finding a suitable aquifer. The use of closed loop boreholes has been discounted because there is insufficient site area to contain the required number. The resultant carbon footprint of the scheme with gas boilers and photovoltaic panels is significantly lower than that using ground source or air source heat pumps, and therefore the proposed strategy is considered to be the most appropriate solution.

9 Renewables - Detailed Proposal

On the basis of this preliminary analysis, and a review of the general advantages and disadvantages of the different technologies relative to the Proposed Development, the following technologies were considered to be appropriate to the Proposed Development:

- Photovoltaic panels.

9.1 Photovoltaic Panels

Photovoltaic panels extract the energy of the sun to generate electricity. It is proposed that photovoltaic panels be installed on the roofs, to generate electricity for the development. These electrical generation systems would be connected to the National Grid so that any surplus electricity can be exported to the Grid, and would be eligible for the feed-in tariffs.

A photovoltaic system of 10.75 kWp is proposed for the apartments, installed horizontally and at a 45° inclination, to provide an annual output of 8,335 kWh.

The incorporation of the photovoltaic systems within the scheme would reduce the annual carbon dioxide emissions of the Proposed Development by 4,326 kgCO_2, which equates to a reduction of 32.7% against the regulated emissions (2013). A proposed layout is attached in Appendix A, which would be reviewed during the detailed design stage to reflect changes in available products and prices.

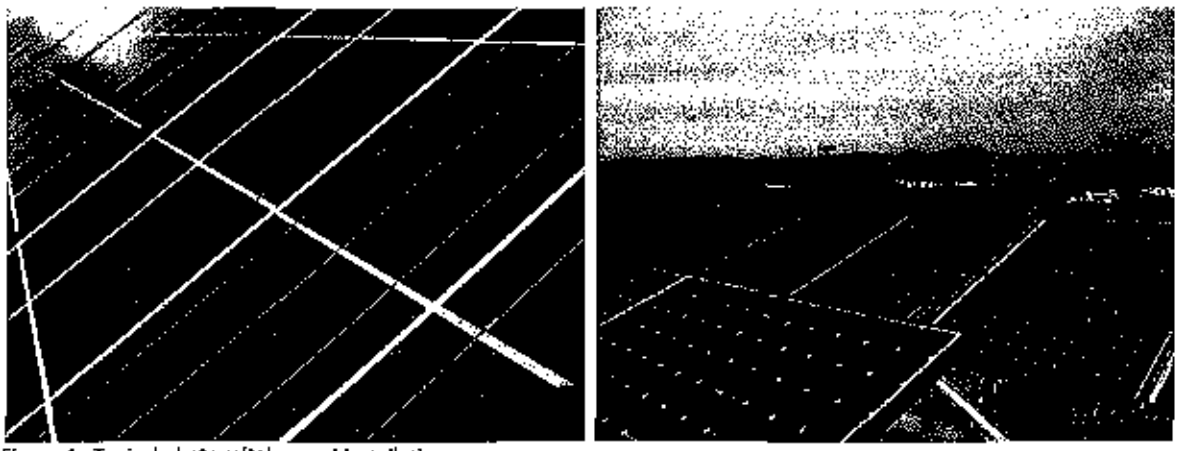

Figure 4 - Typical photovoltaic panel installations

10 Conclusion

This document responds to planning policy in respect of energy consumption and carbon dioxide emissions. The methodology used herein is consistent with the London Renewables Toolkit (LRT) and Part L of the Building Regulations.

The Proposed Development features improved insulation and air tightness standards, when compared against the compliance requirements of Part L 2013 of the Building Regulations. In addition, energy efficient lighting is to be provided throughout the dwellings in excess of the Part L1 2013 requirements.

There are no details of installed district heating schemes in the immediate vicinity of the site, and the Proposed Development is considered to be too small to successfully incorporate a community heating system. It is also considered that the small increase in heating plant efficiency due to the incorporation of a system would be cancelled out by the increase in energy consumption required to pump the heating water circuit.

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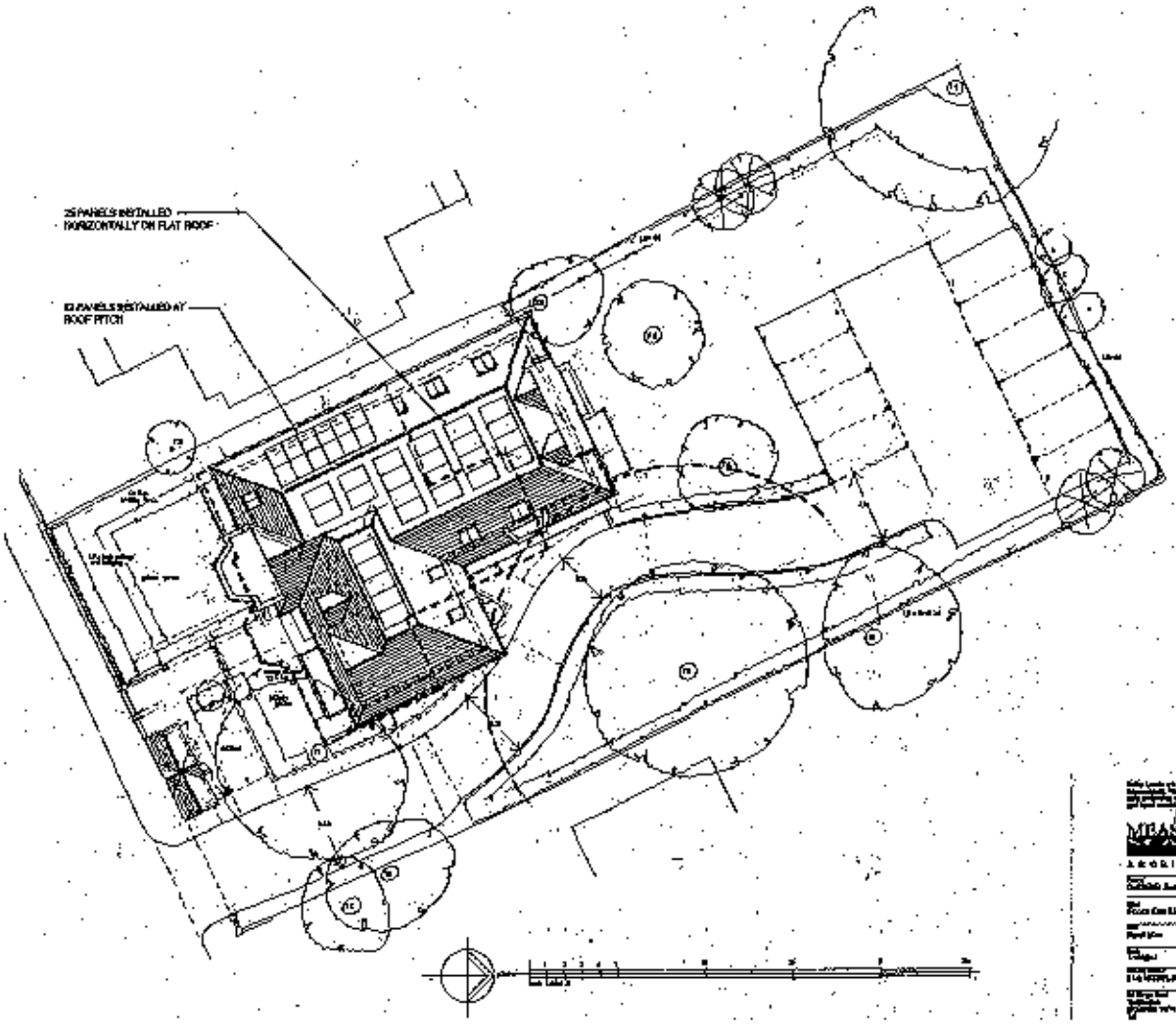
A feasibility study of the currently available low and zero carbon technologies has been undertaken, with photovoltaic panels proposed for the development at roof level to generate electricity for the site. It has been estimated that the proposed photovoltaic systems would reduce the annual carbon dioxide emissions of the site by 4,326 $kgCO_2$, which equates to a reduction of 32.7% against the TER 2013.

The incorporation of the energy efficiency measures, and photovoltaic panels equates to a reduction of 37.4% against the TER 2013 for the scheme, which exceeds the local policy requirements.

11 Appendix A – Proposed PV Layout

The attached roof plan shows the currently proposed photovoltaic panel layout for scheme – these are preliminary layouts and are subject to revisions in the event of changes in standard panel sizes and outputs.


25 PANELS INSTALLED HORIZONTALLY ON FLAT ROOF
10 PANELS INSTALLED AT ROOF PITCH

12 Appendix B – Energy Efficiency DER Worksheets (Part L 2013)

The following DER Worksheets are taken from the SAP 2012 software for each dwelling in accordance with current London Plan policy – these are following inclusion of the energy efficiency measures, but before inclusion of the photovoltaic systems proposed.

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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 1 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		78.17	(1a) x	2.50	(2a) =	195.43	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	78.17	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	195.43	(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) =	0.15	(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)		0.30 (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) =	0.26 (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	0.33	0.32	0.32	0.28	0.28	0.25	0.25	0.24	0.26	0.28	0.29	0.30	(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

0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.55	(24d)

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

0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.55	(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			1.80	x	1.00	=	1.80			(26)
Window			9.96	x	1.33	=	13.20			(27)
Ground floor			78.17	x	0.15	=	11.73			(28a)
External wall			80.64	x	0.20	=	16.13			(29a)
Roof			11.30	x	0.15	=	1.70			(30)
Total area of external elements ∑A, m²			181.87							(31)

Fabric heat loss, W/K = ∑(A x U)	(26)...(30) + (32) =	44.55 (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		13.66 (36)
Total fabric heat loss	(33) + (36) =	58.22 (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)	35.73	35.60	35.47	34.84	34.73	34.18	34.18	34.08	34.39	34.73	34.96	35.21	(38)
Heat transfer coefficient, W/K (37)m + (38)m	93.95	93.82	93.68	93.06	92.94	92.40	92.40	92.30	92.61	92.94	93.18	93.43	
Average = ∑(39)1...12/12 = 93.06 (39)													
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.20	1.20	1.20	1.19	1.19	1.18	1.18	1.18	1.18	1.19	1.19	1.20	
Average = ∑(40)1...12/12 = 1.19 (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	2.43 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	91.85 (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)	101.03	97.36	93.68	90.01	86.34	82.66	82.66	86.34	90.01	93.68	97.36	101.03	
∑(44)1...12 = 1102.16 (44)													
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	149.83	131.04	135.22	117.89	113.12	97.61	90.45	103.79	105.08	122.41	133.62	145.10	
∑(45)1...12 = 1445.10 (45)													
Distribution loss 0.15 x (45)m	22.47	19.66	20.28	17.68	16.97	14.64	13.57	15.57	15.76	18.36	20.04	21.76	(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	26.88	24.28	26.88	26.01	26.88	26.01	26.88	26.88	26.01	26.88	26.01	26.88	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	176.71	155.32	162.10	143.90	140.00	123.62	117.33	130.67	131.05	149.29	159.63	171.98	(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)

Flue gas heat recovery system 1 input (Appendix G1)

-7.62	-7.01	-6.83	-6.08	-4.53	0.00	0.00	0.00	0.00	-6.07	-6.83	-7.63	(63)

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

169.08	148.31	155.27	137.82	135.47	123.62	117.33	130.67	131.05	143.22	152.80	164.35	

∑(64)1...12 = 1708.99 (64)

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

56.54	49.64	51.68	45.70	44.33	38.96	36.80	41.23	41.43	47.42	50.93	54.97	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	121.36	121.36	121.36	121.36	121.36	121.36	121.36	121.36	121.36	121.36	121.36	121.36	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.53	19.13	15.55	11.78	8.80	7.43	8.03	10.44	14.01	17.79	20.76	22.13	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	215.57	217.81	212.17	200.17	185.02	170.79	161.27	159.04	164.67	176.68	191.82	206.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.14	35.14	35.14	35.14	35.14	35.14	35.14	35.14	35.14	35.14	35.14	35.14	(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)	-97.09	-97.09	-97.09	-97.09	-97.09	-97.09	-97.09	-97.09	-97.09	-97.09	-97.09	-97.09	(71)
Water heating gains (Table 5)	75.99	73.87	69.46	63.47	59.59	54.11	49.46	55.42	57.54	63.74	70.74	73.88	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	375.51	373.21	359.60	337.83	315.82	294.74	281.17	287.30	298.63	320.61	345.73	364.48	(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	
SouthWest	0.77	x	0.84	x	36.79	x 0.9 x	0.72	x	0.70	=	10.79	(79)
NorthWest	0.77	x	4.08	x	11.28	x 0.9 x	0.72	x	0.70	=	16.08	(8(
NorthWest	0.54	x	5.04	x	11.28	x 0.9 x	0.72	x	0.70	=	13.93	(81)

Solar gains in watts ∑(74)m...(82)m

40.80	79.47	135.21	211.90	277.86	293.66	275.71	223.78	161.34	94.97	50.69	33.74	(83)

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

416.31	452.68	494.81	549.74	593.68	588.40	556.88	511.08	459.97	415.58	396.42	398.22	(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	1.00	0.98	0.94	0.83	0.68	0.75	0.93	0.99	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.63	19.74	19.97	20.30	20.64	20.88	20.97	20.95	20.75	20.34	19.93	19.60	(87)

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

	19.92	19.92	19.92	19.93	19.93	19.93	19.93	19.94	19.93	19.93	19.93	19.92	(88)

Utilisation factor for gains for rest of dwelling n2,m

	1.00	1.00	0.99	0.98	0.92	0.75	0.54	0.61	0.89	0.99	1.00	1.00	(89)

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

	18.09	18.25	18.59	19.07	19.54	19.84	19.92	19.91	19.70	19.13	18.53	18.05	(90)

Living area fraction — Living area ÷ (4) = 0.41 (91)

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

	18.72	18.86	19.15	19.58	19.99	20.27	20.35	20.34	20.13	19.63	19.10	18.69	(92)

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

	18.57	18.71	19.00	19.43	19.84	20.12	20.20	20.19	19.98	19.48	18.95	18.54	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	0.99	0.97	0.91	0.77	0.58	0.65	0.89	0.98	1.00	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	415.32	450.90	490.45	534.93	542.40	451.03	321.48	330.46	410.60	408.25	394.71	397.47	(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]	1340.49	1295.70	1171.32	979.71	756.75	509.93	332.64	349.50	544.83	824.90	1104.45	1339.72	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	688.33	567.71	506.57	320.24	159.48	0.00	0.00	0.00	0.00	309.99	511.01	701.03	

∑(98)1...5, 10...12 = 3764.35 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 48.16 (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 (%) — 89.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	765.66	631.49	563.48	356.22	177.39	0.00	0.00	0.00	0.00	344.81	568.42	779.79	

∑(211)1...5, 10...12 = 4187.27 (211)

Water heating

Efficiency of water heater

	89.38	89.35	89.28	89.10	88.69	87.30	87.30	87.30	87.30	89.06	89.29	89.39	(217)

Water heating fuel, kWh/month

	189.18	165.99	173.92	154.68	152.75	141.61	134.40	149.68	150.11	160.81	171.13	183.85	

∑(219a)1...12 = 1928.11 (219)

Annual totals

Space heating fuel - main system 1 — 4187.27

Water heating fuel — 1928.11

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	(23
Electricity for lighting (Appendix L)		380.29	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	6570.67	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4187.27	x	3.48	x 0.01 =	145.72	(240)
Water heating	1928.11	x	3.48	x 0.01 =	67.10	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	380.29	x	13.19	x 0.01 =	50.16	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		392.87	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.34	(257)
SAP value	81.31	(
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	4187.27	x	0.22	=	904.45	(261)
Water heating	1928.11	x	0.22	=	416.47	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1320.92	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	380.29	x	0.52	=	197.37	(268)
Total CO_2, kg/year				(265)...(271) =	1557.22	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	19.92	(273)
EI value					83.06	
EI rating (section 14)					83	(27
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	4187.27	x	1.22	=	5108.47	(261)
Water heating	1928.11	x	1.22	=	2352.29	(264)
Space and water heating			(261) + (262) + (263) + (264) =		7460.76	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	380.29	x	3.07	=	1167.50	(268)
Primary energy kWh/year					8858.51	(272)
Dwelling primary energy rate kWh/m2/year					113.92	(273)

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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 2 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m^2)		Average storey height (m)		Volume (m^3)	
Lowest occupied		52.55	(1a) x	2.50	(2a) =	131.38	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	52.55	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	131.38	(5)

2. Ventilation rate

			m^3 per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	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) =	0.15	(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)		0.30 (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) =	0.26 (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	0.33	0.32	0.31	0.28	0.28	0.24	0.24	0.24	0.26	0.28	0.29	0.30	(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

0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.55	(24d)

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

0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.55	(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			1.80	x	1.00	=	1.80			(26)
Window			10.16	x	1.33	=	13.47			(27)
Ground floor			52.55	x	0.15	=	7.88			(28a)
External wall			47.14	x	0.20	=	9.43			(29a)
Party wall			13.30	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			111.65							(31)

Fabric heat loss, W/K = ∑(A x U)	(26)...(30) + (32) =	32.58 (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		10.46 (36)
Total fabric heat loss	(33) + (36) =	43.05 (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)	24.00	23.91	23.82	23.41	23.33	22.97	22.97	22.90	23.11	23.33	23.49	23.65	(38)
Heat transfer coefficient, W/K (37)m + (38)m	67.05	66.96	66.87	66.45	66.38	66.01	66.01	65.95	66.15	66.38	66.53	66.70	
Average = ∑(39)1...12/12 = 66.45 (39)													
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.28	1.27	1.27	1.26	1.26	1.26	1.26	1.25	1.26	1.26	1.27	1.27	
Average = ∑(40)1...12/12 = 1.26 (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	1.77 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	76.13 (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)	83.74	80.69	77.65	74.60	71.56	68.51	68.51	71.56	74.60	77.65	80.69	83.74	
∑(44)1...12 = 913.51 (44)													
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	124.18	108.61	112.08	97.71	93.76	80.90	74.97	86.03	87.06	101.46	110.75	120.26	
∑(45)1...12 = 1197.75 (45)													
Distribution loss 0.15 x (45)m	18.63	16.29	16.81	14.66	14.06	12.14	11.25	12.90	13.06	15.22	16.61	18.04	(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	26.88	24.28	26.88	26.01	26.88	26.01	26.88	26.88	26.01	26.88	26.01	26.88	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	151.06	132.89	138.96	123.72	120.64	106.92	101.85	112.91	113.07	128.34	136.76	147.14	(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)

gas heat recovery system 1 input (Appendix G1)

-6.54	-6.09	-5.93	-4.48	-1.88	0.00	0.00	0.00	0.00	-4.52	-6.02	-6.55	(63)

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

144.53	126.80	133.03	119.24	118.75	106.92	101.85	112.91	113.07	123.82	130.74	140.60	

∑(64)1...12 = 1472.25 (64)

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

48.01	42.18	43.99	38.99	37.89	33.40	31.65	35.32	35.45	40.45	43.33	46.71	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.08	12.50	10.17	7.70	5.75	4.86	5.25	6.82	9.16	11.63	13.57	14.47	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	153.85	155.45	151.43	142.86	132.05	121.89	115.10	113.50	117.53	126.09	136.90	147.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	(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)	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	(71)
Water heating gains (Table 5)	64.53	62.77	59.12	54.16	50.93	46.39	42.54	47.48	49.24	54.37	60.18	62.78	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	284.94	283.20	273.19	257.19	241.22	225.62	215.36	220.28	228.40	244.57	263.13	276.79	(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	
NorthWest	0.77	x	2.24	x	11.28	x 0.9 x	0.72	x	0.70	=	8.83	(81)
SE East	0.77	x	2.88	x	36.79	x 0.9 x	0.72	x	0.70	=	37.01	(77)
SouthEast	0.54	x	5.04	x	36.79	x 0.9 x	0.72	x	0.70	=	45.42	(77)

Solar gains in watts ∑(74)m...(82)m

91.26	158.38	224.50	291.22	338.10	340.90	326.48	290.70	247.48	177.15	109.84	77.75	(83)

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

376.20	441.59	497.69	548.41	579.32	566.52	541.84	510.98	475.87	421.72	372.97	354.54	(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	0.85	0.69	0.52	0.57	0.81	0.96	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.70	19.88	20.16	20.49	20.78	20.94	20.99	20.98	20.87	20.50	20.03	19.66	(87)

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

19.86	19.86	19.86	19.87	19.87	19.88	19.88	19.88	19.87	19.87	19.87	19.87	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.99	0.97	0.92	0.80	0.59	0.40	0.44	0.72	0.94	0.99	1.00	(89)

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

18.15	18.41	18.81	19.29	19.66	19.84	19.87	19.87	19.78	19.31	18.63	18.09	(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

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

18.98	19.20	19.53	19.94	20.26	20.43	20.47	20.47	20.37	19.95	19.38	18.93	(92)

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

18.83	19.05	19.38	19.79	20.11	20.28	20.32	20.32	20.22	19.80	19.23	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	0.98	0.97	0.92	0.81	0.63	0.45	0.50	0.75	0.94	0.99	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	373.36	434.63	480.41	502.33	468.08	354.73	242.29	252.94	357.45	395.25	367.40	352.47	(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]	974.27	947.57	861.49	723.52	558.37	375.02	245.62	256.26	404.56	610.51	807.30	972.73	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	447.08	344.69	283.52	159.25	67.17	0.00	0.00	0.00	0.00	160.15	316.73	461.47	

∑(98)1...5, 10...12 = 2240.07 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 42.63 (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 (%) — 89.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	497.31	383.42	315.37	177.15	74.72	0.00	0.00	0.00	0.00	178.15	352.31	513.32	

∑(211)1...5, 10...12 = 2491.74 (211)

Water heating

Efficiency of water heater

89.25	89.19	89.05	88.77	88.22	87.30	87.30	87.30	87.30	88.75	89.12	89.28	(217)

Water heating fuel, kWh/month

161.93	142.18	149.38	134.33	134.61	122.47	116.67	129.33	129.52	139.52	146.69	157.48	

∑(219a)1...12 = 1664.10 (219)

Annual totals

Space heating fuel - main system 1 — 2491.74

Water heating fuel — 1664.10

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)
al electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		248.59	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4479.43	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2491.74	x	3.48	x 0.01 =	86.71	(240)
Water heating	1664.10	x	3.48	x 0.01 =	57.91	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	248.59	x	13.19	x 0.01 =	32.79	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		307.31	(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)
P value	81.54	
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	2491.74	x	0.22	=	538.22	(261)
Water heating	1664.10	x	0.22	=	359.45	(264)
Space and water heating			(261) + (262) + (263) + (264) =		897.66	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	248.59	x	0.52	=	129.02	(268)
Total CO_2, kg/year			(265)...(271) =		1065.61	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		20.28	(273)
EI value					85.36	
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	2491.74	x	1.22	=	3039.92	(261)
Water heating	1664.10	x	1.22	=	2030.21	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5070.13	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	248.59	x	3.07	=	763.18	(268)
Primary energy kWh/year					6063.56	(272)
Dwelling primary energy rate kWh/m2/year					115.39	(273)

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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 3 4 & 4a Oaklands Road , Bromley, BR2 9SL		

1. Overall dwelling dimensions

		Area (m^2)		Average storey height (m)		Volume (m^3)	
Lowest occupied		57.70	(1a) x	2.50	(2a) =	144.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	57.70	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	144.25	(5)

2. Ventilation rate

				m^3 per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		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) =	0.14	(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)	0.29	(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) = 0.25	(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	0.31	0.31	0.30	0.27	0.26	0.23	0.23	0.23	0.25	0.26	0.28	0.29	(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	
	0.55	0.55	0.55	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54	(24d)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.55	0.55	0.55	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54	(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			10.78	x	1.33	=	14.29			(27)
Door			1.80	x	1.00	=	1.80			(26)
Ground floor			57.70	x	0.15	=	8.66			(28a)
External wall			54.82	x	0.20	=	10.96			(29a)
Party wall			13.30	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			125.10							(31)

Fabric heat loss, W/K = ∑(A x U)	(26)...(30) + (32) =	35.71 (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		11.88 (36)
Total fabric heat loss	(33) + (36) =	47.59 (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)	26.13	26.04	25.95	25.53	25.46	25.09	25.09	25.03	25.23	25.46	25.61	25.78	(38)
Heat transfer coefficient, W/K (37)m + (38)m	73.72	73.63	73.55	73.13	73.05	72.69	72.69	72.62	72.83	73.05	73.21	73.37	
Average = ∑(39)1...12/12 = 73.13 (39)													
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.28	1.28	1.27	1.27	1.27	1.26	1.26	1.26	1.26	1.27	1.27	1.27	
Average = ∑(40)1...12/12 = 1.27 (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	1.92 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	79.70 (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)	87.67	84.49	81.30	78.11	74.92	71.73	71.73	74.92	78.11	81.30	84.49	87.67	
∑(44)1...12 = 956.44 (44)													
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	130.02	113.71	117.34	102.30	98.16	84.71	78.49	90.07	91.15	106.22	115.95	125.91	
∑(45)1...12 = 1254.04 (45)													
Distribution loss 0.15 x (45)m	19.50	17.06	17.60	15.35	14.72	12.71	11.77	13.51	13.67	15.93	17.39	18.89	(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	26.88	24.28	26.88	26.01	26.88	26.01	26.88	26.88	26.01	26.88	26.01	26.88	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	156.90	137.99	144.22	128.32	125.04	110.72	105.37	116.95	117.16	133.10	141.96	152.79	(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)

Flue gas heat recovery system 1 input (Appendix G1)

-6.68	-6.15	-5.94	-4.20	-1.66	0.00	0.00	0.00	0.00	-4.30	-6.09	-6.71	(63)

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

150.22	131.84	138.28	124.12	123.38	110.72	105.37	116.95	117.16	128.80	135.87	146.09	

∑(64)1..12 = 1528.80 (64)

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

49.95	43.88	45.74	40.52	39.36	34.67	32.82	36.67	36.81	42.04	45.06	48.59	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.13	13.44	10.93	8.27	6.19	5.22	5.64	7.33	9.84	12.50	14.59	15.55	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	167.11	168.85	164.48	155.17	143.43	132.39	125.02	123.28	127.65	136.96	148.70	159.74	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	(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)	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	(71)
Water heating gains (Table 5)	67.14	65.30	61.47	56.28	52.90	48.15	44.11	49.29	51.12	56.50	62.58	65.30	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	304.12	302.32	291.62	274.46	257.25	240.50	229.51	234.64	243.36	260.70	280.61	295.33	(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	1.36	x	46.75	x 0.9 x	0.72	x	0.70	=	22.21	(78)
East	0.77	x	1.36	x	19.64	x 0.9 x	0.72	x	0.70	=	9.33	(
SouthEast	0.77	x	5.24	x	36.79	x 0.9 x	0.72	x	0.70	=	67.34	(77)
SouthWest	0.77	x	2.82	x	36.79	x 0.9 x	0.72	x	0.70	=	36.24	(79)

Solar gains in watts ∑(74)m...(82)m

135.12	231.05	317.79	395.31	443.32	440.11	424.33	388.67	344.74	255.88	162.02	115.50	(83)

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

439.24	533.37	609.41	669.77	700.57	680.61	653.84	623.31	588.10	516.58	442.63	410.84	(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	0.99	0.97	0.92	0.81	0.64	0.48	0.52	0.75	0.94	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.74	19.95	20.24	20.57	20.82	20.96	20.99	20.99	20.91	20.56	20.08	19.69	(87)

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

19.86	19.86	19.86	19.87	19.87	19.87	19.87	19.87	19.87	19.87	19.87	19.86	(88)

Utilisation factor for gains for rest of dwelling h2,m

0.99	0.98	0.96	0.89	0.75	0.55	0.36	0.40	0.66	0.91	0.98	0.99	(89)

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

18.20	18.51	18.93	19.38	19.70	19.84	19.87	19.87	19.80	19.39	18.70	18.14	(90)

Living area fraction — Living area ÷ (4) = 0.53 (91)

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

19.01	19.27	19.62	20.01	20.29	20.43	20.46	20.46	20.38	20.01	19.43	18.95	(92)

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

18.86	19.12	19.47	19.86	20.14	20.28	20.31	20.31	20.23	19.86	19.28	18.80	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.95	0.89	0.77	0.58	0.41	0.45	0.70	0.91	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	435.04	521.58	579.38	594.85	537.41	396.21	267.17	279.64	409.02	472.10	433.86	407.86	(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]	1073.49	1047.14	953.85	801.33	616.78	412.88	269.71	283.78	446.69	676.32	891.34	1071.57	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	475.01	353.18	278.60	148.66	59.06	0.00	0.00	0.00	0.00	151.94	329.39	493.80	

Σ(98)1...5, 10...12 = 2289.64 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 39.68 (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 (%) = 89.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	528.37	392.85	309.91	165.37	65.69	0.00	0.00	0.00	0.00	169.01	366.40	549.28	

Σ(211)1...5, 10...12 = 2546.88 (211)

Water heating

Efficiency of water heater

89.26	89.18	89.02	88.70	88.13	87.30	87.30	87.30	87.30	88.69	89.12	89.29	(217)

Water heating fuel, kWh/month

168.29	147.84	155.93	139.93	140.01	126.83	120.70	133.96	134.20	145.23	152.45	163.60	

Σ(219a)1...12 = 1728.38 (219)

Annual totals

Space heating fuel - main system 1 = 2546.88

Water heating fuel = 1728.38

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)		267.21	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4617.47	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2546.88	x	3.48	x 0.01 =	88.63	(240)
Water heating	1728.38	x	3.48	x 0.01 =	60.15	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	267.21	x	13.19	x 0.01 =	35.25	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		313.92	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.28	(257)
SAP value	82.09	
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	2546.88	x	0.22	=	550.13	(261)
Water heating	1728.38	x	0.22	=	373.33	(264)
Space and water heating			(261) + (262) + (263) + (264) =		923.46	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	267.21	x	0.52	=	138.68	(268)
Total CO_2, kg/year			(265)...(271) =		1101.06	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		19.08	(273)
EI value					85.63	
EI rating (section 14)					86	(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	2546.88	x	1.22	=	3107.19	(261)
Water heating	1728.38	x	1.22	=	2108.63	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5215.82	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	267.21	x	3.07	=	820.34	(268)
Primary energy kWh/year					6266.41	(272)
Dwelling primary energy rate kWh/m2/year					108.60	(273)

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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 4 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		74.27	(1a) x	2.50	(2a) =	185.68	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	74.27	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	185.68	(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) =	0.16	(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	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.31	(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) = 0.26	(21)

Ventilation 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	0.34	0.33	0.32	0.29	0.28	0.25	0.25	0.24	0.26	0.28	0.30	0.31	(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	
	0.56	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.54	0.55	(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	
	0.56	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.54	0.55	(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			1.80	x 1.00	= 1.80			(26)
Window			13.30	x 1.33	= 17.63			(27)
Exposed floor			7.50	x 0.15	= 1.13			(28b
External wall			76.20	x 0.20	= 15.24			(29a)
Party wall			4.50	x 0.00	= 0.00			(32)
Total area of external elements ∑A, m²			98.80					(31)

Fabric heat loss, W/K = ∑(A x U) (26)...(30) + (32) = 35.80 (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 14.51 (36)

Total fabric heat loss (33) + (36) = 50.31 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
34.13	33.99	33.86	33.24	33.12	32.58	32.58	32.47	32.79	33.12	33.36	33.60	(38)

Heat transfer coefficient, W/K (37)m + (38)m

84.44	84.30	84.17	83.55	83.43	82.89	82.89	82.78	83.09	83.43	83.67	83.91	

Average = ∑(39)1...12/12 = 83.55 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.14	1.14	1.13	1.12	1.12	1.12	1.12	1.11	1.12	1.12	1.13	1.13	

Average = ∑(40)1...12/12 = 1.12 (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 2.35 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 89.90 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
98.89	95.29	91.70	88.10	84.50	80.91	80.91	84.50	88.10	91.70	95.29	98.89	

∑(44)1...12 = 1078.78 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

146.65	128.26	132.35	115.39	110.72	95.54	88.53	101.59	102.81	119.81	130.78	142.02	

∑(45)1...12 = 1414.44 (45)

Distribution loss 0.15 x (45)m

22.00	19.24	19.85	17.31	16.61	14.33	13.28	15.24	15.42	17.97	19.62	21.30	(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

26.88	24.28	26.88	26.01	26.88	26.01	26.88	26.88	26.01	26.88	26.01	26.88	(61)

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

173.53	152.54	159.23	141.40	137.60	121.55	115.41	128.47	128.82	146.69	156.79	168.90	(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)

e gas heat recovery system 1 input (Appendix G1)

	-7.27	-6.70	-6.49	-5.81	-2.79	0.00	0.00	0.00	0.00	-5.86	-6.56	-7.28 (63)

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

	166.26	145.84	152.74	135.59	134.81	121.55	115.41	128.47	128.82	140.83	150.23	161.62

∑(64)1...12 = 1682.18 (64)

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

	55.48	48.72	50.73	44.87	43.53	38.27	36.16	40.50	40.69	46.56	49.99	53.94 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.37	17.20	13.99	10.59	7.92	6.68	7.22	9.39	12.60	16.00	18.67	19.91	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	207.05	209.20	203.79	192.26	177.71	164.03	154.90	152.75	158.16	169.69	184.24	197.92	(68)
oking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	(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)	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	(71)
Water heating gains (Table 5)	74.57	72.49	68.18	62.32	58.51	53.15	48.60	54.43	56.51	62.58	69.43	72.50	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	362.17	360.07	347.14	326.35	305.32	285.05	271.90	277.75	288.45	309.44	333.52	351.50	(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	
SouthWest	0.77	x	0.84	x	36.79	x 0.9 x	0.72	x	0.70	=	10.79	(79)
thWest	0.77	x	3.36	x	11.28	x 0.9 x	0.72	x	0.70	=	13.24	(81)
NorthWest	0.54	x	5.04	x	11.28	x 0.9 x	0.72	x	0.70	=	13.93	(81)
North	0.54	x	0.84	x	10.63	x 0.9 x	0.72	x	0.70	=	2.19	(74)
NorthEast	0.54	x	2.38	x	11.28	x 0.9 x	0.72	x	0.70	=	6.58	(75)
East	0.54	x	0.84	x	19.64	x 0.9 x	0.72	x	0.70	=	4.04	(76)

Solar gains in watts ∑(74)m...(82)m

	50.77	99.17	169.05	264.83	346.78	366.22	343.95	279.53	201.74	118.63	63.13	41.95 (83)

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

	412.94	459.24	516.18	591.18	652.10	651.27	615.85	557.28	490.19	428.07	396.65	393.45 (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	0.99	0.97	0.90	0.74	0.58	0.65	0.90	0.99	1.00	1.00	(86)

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

	19.74	19.86	20.10	20.45	20.76	20.94	20.99	20.98	20.83	20.43	20.03	19.71	(87)

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

	19.97	19.97	19.97	19.98	19.98	19.99	19.99	19.99	19.99	19.98	19.98	19.98	(88)

Utilisation factor for gains for rest of dwelling n2,m

	1.00	1.00	0.99	0.96	0.86	0.65	0.45	0.52	0.84	0.98	1.00	1.00	(89)

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

	18.28	18.46	18.82	19.32	19.74	19.95	19.98	19.98	19.84	19.30	18.71	18.25	(90)

Living area fraction — Living area ÷ (4) = 0.42 (91)

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

	18.89	19.05	19.36	19.79	20.17	20.36	20.40	20.40	20.25	19.78	19.26	18.86	(92)

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

	18.74	18.90	19.21	19.64	20.02	20.21	20.25	20.25	20.10	19.63	19.11	18.71	(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	0.99	0.96	0.86	0.67	0.49	0.56	0.84	0.98	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	411.81	456.91	509.53	565.31	561.80	438.35	298.88	310.64	413.91	417.52	394.57	392.61	(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]	1219.40	1180.21	1069.51	897.32	693.98	465.28	302.92	318.54	498.93	753.31	1005.05	1217.66	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	600.84	486.05	416.62	239.05	98.34	0.00	0.00	0.00	0.00	249.83	439.55	613.84	

∑(98)1...5, 10...12 = 3144.13 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 42.33 (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 (203)

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 (%) = 89.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	668.35	540.66	463.43	265.90	109.39	0.00	0.00	0.00	0.00	277.90	488.93	682.80	

∑(211)1...5, 10...12 = 3497.36 (211)

Water heating

Efficiency of water heater

	89.32	89.29	89.19	88.94	88.38	87.30	87.30	87.30	87.30	88.95	89.22	89.35	(217)

Water heating fuel, kWh/month

	186.14	163.34	171.26	152.45	152.53	139.24	132.20	147.16	147.56	158.33	168.38	180.90	

∑(219a)1...12 = 1899.48 (219)

Annual totals

Space heating fuel - main system 1		3497.36	
Water heating fuel		1899.48	
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)		342.07	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5813.90	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3497.36	x	3.48	x 0.01 =	121.71	(240)
Water heating	1899.48	x	3.48	x 0.01 =	66.10	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	342.07	x	13.19	x 0.01 =	45.12	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		362.82	(255)

13a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.28	(257)
SAP value	82.18	
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	3497.36	x	0.22	=	755.43	(261)
Water heating	1899.48	x	0.22	=	410.29	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1165.72	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	342.07	x	0.52	=	177.53	(268)
Total CO_2, kg/year				(265)...(271) =	1382.17	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	16.61	(273)
EI value					84.47	
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	3497.36	x	1.22	=	4266.78	(261)
Water heating	1899.48	x	1.22	=	2317.36	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6584.14	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	342.07	x	3.07	=	1050.14	(268)
Primary energy kWh/year					7864.54	(272)
Dwelling primary energy rate kWh/m2/year					105.89	(273)

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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 5 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		52.55	(1a) x	2.50	(2a) =	131.38	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	52.55	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	131.38	(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) =	0.15	(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)	0.30	(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) = 0.26	(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	0.33	0.32	0.31	0.28	0.28	0.24	0.24	0.24	0.26	0.28	0.29	0.30	(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	
	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.55	(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	
	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.55	(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			1.80	x 1.00	= 1.80			(26)
Window			8.96	x 1.33	= 11.88			(27)
External wall			43.90	x 0.20	= 8.78			(29a)
Party wall			17.60	x 0.00	= 0.00			(32)
Total area of external elements ∑A, m²			54.66					(31)

Fabric heat loss, W/K = ∑(A x U) (26)...(30) + (32) = 22.46 (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 8.18 (36)

Total fabric heat loss (33) + (36) = 30.64 (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)	24.00	23.91	23.82	23.41	23.33	22.97	22.97	22.90	23.11	23.33	23.49	23.65	(38)
Heat transfer coefficient, W/K (37)m + (38)m	54.64	54.55	54.46	54.05	53.97	53.61	53.61	53.54	53.75	53.97	54.13	54.29	

Average = ∑(39)1...12/12 = 54.05 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	1.04	1.04	1.04	1.03	1.03	1.02	1.02	1.02	1.02	1.03	1.03	1.03	

Average = ∑(40)1...12/12 = 1.03 (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 1.77 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 76.13 (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)	83.74	80.69	77.65	74.60	71.56	68.51	68.51	71.56	74.60	77.65	80.69	83.74	

∑(44)1...12 = 913.51 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	124.18	108.61	112.08	97.71	93.76	80.90	74.97	86.03	87.06	101.46	110.75	120.26	

∑(45)1...12 = 1197.75 (45)

Distribution loss 0.15 x (45)m													
	18.63	16.29	16.81	14.66	14.06	12.14	11.25	12.90	13.06	15.22	16.61	18.04	(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	26.88	24.28	26.88	26.01	26.88	26.01	26.88	26.88	26.01	26.88	26.01	26.88	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	151.06	132.89	138.96	123.72	120.64	106.92	101.85	112.91	113.07	128.34	136.76	147.14	(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)

Flue gas heat recovery system 1 input (Appendix G1)

	-6.18	-5.84	-5.69	-2.91	-1.00	0.00	0.00	0.00	0.00	-3.01	-5.78	-6.20 (63)

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

	144.88	127.05	133.27	120.81	119.63	106.92	101.85	112.91	113.07	125.32	130.98	140.94

∑(64)1...12 = 1477.64 (64)

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

	48.01	42.18	43.99	38.99	37.89	33.40	31.65	35.32	35.45	40.45	43.33	46.71 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.46	12.84	10.44	7.91	5.91	4.99	5.39	7.01	9.41	11.94	13.94	14.86	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	153.85	155.45	151.43	142.86	132.05	121.89	115.10	113.50	117.53	126.09	136.90	147.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	(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)	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	(71)
Water heating gains (Table 5)	64.53	62.77	59.12	54.16	50.93	46.39	42.54	47.48	49.24	54.37	60.18	62.78	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	285.32	283.54	273.47	257.40	241.37	225.75	215.51	220.47	228.65	244.89	263.50	277.18	(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	
NorthWest	0.77	x	2.24	x	11.28	x 0.9 x	0.72	x	0.70	=	8.83	(81)
SouthEast	0.77	x	1.68	x	36.79	x 0.9 x	0.72	x	0.70	=	21.59	(77)
SouthEast	0.54	x	5.04	x	36.79	x 0.9 x	0.72	x	0.70	=	45.42	(7(

Solar gains in watts ∑(74)m...(82)m

	75.84	132.12	188.55	246.68	288.22	291.38	278.74	246.95	208.56	148.12	91.37	64.56 (83)

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

	361.16	415.66	462.02	504.08	529.59	517.13	494.24	467.42	437.21	393.00	354.87	341.74 (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	0.93	0.82	0.64	0.47	0.52	0.77	0.95	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.99	20.15	20.38	20.66	20.88	20.98	21.00	20.99	20.94	20.66	20.27	19.96	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	20.05	20.05	20.05	20.06	20.06	20.07	20.07	20.07	20.06	20.06	20.06	20.06	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.99	0.99	0.97	0.91	0.77	0.56	0.37	0.42	0.69	0.93	0.99	1.00 (89)

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

	18.71	18.94	19.28	19.67	19.95	20.05	20.07	20.07	20.02	19.68	19.12	18.66 (90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

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

	19.40	19.59	19.87	20.21	20.45	20.55	20.57	20.56	20.51	20.20	19.74	19.36 (92)

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

	19.25	19.44	19.72	20.06	20.30	20.40	20.42	20.41	20.36	20.05	19.59	19.21 (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	0.91	0.79	0.59	0.41	0.46	0.72	0.93	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	358.80	409.76	446.51	459.23	415.93	303.18	203.64	213.35	314.25	366.77	349.90	340.04	(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]	816.86	793.19	720.08	602.97	464.01	310.86	204.55	214.93	336.59	510.24	675.88	814.84	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	340.80	257.66	203.54	103.49	35.77	0.00	0.00	0.00	0.00	106.74	234.70	353.25	

Σ(98)1...5, 10...12 = 1635.97 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 31.13 (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 (%) — 89.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	379.09	286.61	226.40	115.12	39.79	0.00	0.00	0.00	0.00	118.73	261.07	392.94	

Σ(211)1...5, 10...12 = 1819.76 (211)

Water heating

Efficiency of water heater

	89.11	89.02	88.85	88.48	87.89	87.30	87.30	87.30	87.30	88.48	88.95	89.14 (217)

Water heating fuel, kWh/month

	162.59	142.72	149.98	136.54	136.12	122.47	116.67	129.33	129.52	141.65	147.25	158.11

Σ(219a)1...12 = 1672.95 (219)

Annual totals

Space heating fuel - main system 1 — 1819.76

Water heating fuel — 1672.95

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)		255.35	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	9823.06	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1819.76	x	3.48	x 0.01 =	63.33	(240)
Water heating	1672.95	x	3.48	x 0.01 =	58.22	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	255.35	x	13.19	x 0.01 =	33.68	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		285.12	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.23	(257)
SAP value	82.88	
SAP rating (section 13)	83	(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	1819.76	x	0.22	=	393.07	(261)
Water heating	1672.95	x	0.22	=	361.36	(264)
Space and water heating			(261) + (262) + (263) + (264) =		754.43	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	255.35	x	0.52	=	132.53	(268)
Total CO_2, kg/year				(265)...(271) =	925.88	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	17.62	(273)
EI value					87.28	
EI rating (section 14)					87	(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	1819.76	x	1.22	=	2220.11	(261)
Water heating	1672.95	x	1.22	=	2041.00	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4261.11	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	255.35	x	3.07	=	783.92	(268)
Primary energy kWh/year					5275.28	(272)
Dwelling primary energy rate kWh/m2/year					100.39	(273)

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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 6 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		57.70	(1a) x	2.50	(2a) =	144.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	57.70	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	144.25	(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) =	0.14	(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)	0.29	(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) = 0.25	(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	0.31	0.31	0.30	0.27	0.26	0.23	0.23	0.23	0.25	0.26	0.28	0.29	(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	
	0.55	0.55	0.55	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54	(24d)

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

0.55	0.55	0.55	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54	(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			9.75	x	1.33	=	12.93			(27)
Door			1.80	x	1.00	=	1.80			(26)
External wall			55.85	x	0.20	=	11.17			(29a)
Party wall			13.30	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			67.40							(31)

Fabric heat loss, W/K = ∑(A x U)	(26)...(30) + (32) =	25.90 (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		8.50 (36)
Total fabric heat loss	(33) + (36) =	34.40 (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)	26.13	26.04	25.95	25.53	25.46	25.09	25.09	25.03	25.23	25.46	25.61	25.78	(38)
Heat transfer coefficient, W/K (37)m + (38)m	60.53	60.44	60.35	59.93	59.85	59.49	59.49	59.42	59.63	59.85	60.01	60.18	
Average = ∑(39)1...12/12 = 59.93 (39)													
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.05	1.05	1.05	1.04	1.04	1.03	1.03	1.03	1.03	1.04	1.04	1.04	
Average = ∑(40)1...12/12 = 1.04 (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	1.92 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	79.70 (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)	87.67	84.49	81.30	78.11	74.92	71.73	71.73	74.92	78.11	81.30	84.49	87.67	
∑(44)1...12 = 956.44 (44)													
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	130.02	113.71	117.34	102.30	98.16	84.71	78.49	90.07	91.15	106.22	115.95	125.91	
∑(45)1...12 = 1254.04 (45)													
Distribution loss 0.15 x (45)m	19.50	17.06	17.60	15.35	14.72	12.71	11.77	13.51	13.67	15.93	17.39	18.89	(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	26.88	24.28	26.88	26.01	26.88	26.01	26.88	26.88	26.01	26.88	26.01	26.88	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	156.90	137.99	144.22	128.32	125.04	110.72	105.37	116.95	117.16	133.10	141.96	152.79	(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)

Flue gas heat recovery system 1 input (Appendix G1)

	-6.28	-5.86	-5.41	-2.49	-0.78	0.00	0.00	0.00	0.00	-2.66	-5.82	-6.31 (63)

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

	150.62	132.13	138.82	125.83	124.27	110.72	105.37	116.95	117.16	130.44	136.15	146.48

∑(64)1...12 = 1534.94 (64)

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

	49.95	43.88	45.74	40.52	39.36	34.67	32.82	36.67	36.81	42.04	45.06	48.59 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.38	13.66	11.11	8.41	6.29	5.31	5.74	7.46	10.01	12.71	14.83	15.81	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	167.11	168.85	164.48	155.17	143.43	132.39	125.02	123.28	127.65	136.96	148.70	159.74	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	(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)	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	(71)
Water heating gains (Table 5)	67.14	65.30	61.47	56.28	52.90	48.15	44.11	49.29	51.12	56.50	62.58	65.30	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	304.37	302.54	291.80	274.60	257.36	240.59	229.60	234.77	243.53	260.91	280.85	295.59	(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	1.12	x	46.75	x 0.9 x	0.72	x	0.70	=	18.29	(78)
East	0.77	x	1.12	x	19.64	x 0.9 x	0.72	x	0.70	=	7.68	(76)
SouthEast	0.77	x	4.69	x	36.79	x 0.9 x	0.72	x	0.70	=	60.27	(77)
SouthWest	0.77	x	2.82	x	36.79	x 0.9 x	0.72	x	0.70	=	36.24	(79)

Solar gains in watts ∑(74)m...(82)m

	122.48	209.38	287.84	357.92	401.34	398.44	384.16	351.89	312.20	231.83	146.86	104.71 (83)

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

	426.85	511.92	579.64	632.52	658.70	639.03	613.76	586.65	555.72	492.74	427.71	400.31 (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	0.99	0.96	0.90	0.77	0.58	0.42	0.46	0.70	0.93	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.03	20.22	20.47	20.74	20.91	20.98	21.00	21.00	20.96	20.72	20.32	19.98	(87)

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

20.04	20.04	20.05	20.05	20.05	20.06	20.06	20.06	20.06	20.05	20.05	20.05	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.98	0.95	0.87	0.71	0.50	0.33	0.37	0.62	0.90	0.98	0.99	(89)

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

18.76	19.04	19.40	19.76	19.97	20.05	20.06	20.06	20.03	19.75	19.18	18.70	(90)

Living area fraction — Living area ÷ (4) = 0.53 (91)

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

19.43	19.66	19.96	20.28	20.47	20.54	20.55	20.55	20.52	20.26	19.78	19.38	(92)

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

19.28	19.51	19.81	20.13	20.32	20.39	20.40	20.40	20.37	20.11	19.63	19.23	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.95	0.87	0.73	0.53	0.37	0.40	0.65	0.90	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	422.99	500.37	548.34	550.27	478.83	339.11	225.63	236.83	358.73	443.17	418.96	397.64	(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]	906.52	883.18	803.44	672.74	515.91	344.55	226.23	237.83	373.82	569.43	751.90	904.16	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	359.75	257.25	189.79	88.19	27.59	0.00	0.00	0.00	0.00	93.94	239.72	376.85	

Σ(98)1...5, 10...12 = 1633.06 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 28.30 (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 (%) — 89.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	400.16	286.15	211.11	98.09	30.69	0.00	0.00	0.00	0.00	104.49	266.65	419.19	

Σ(211)1...5, 10...12 = 1816.53 (211)

Water heating

Efficiency of water heater

89.12	89.00	88.78	88.35	87.76	87.30	87.30	87.30	87.30	88.37	88.94	89.16	(217)

Water heating fuel, kWh/month

169.01	148.46	156.36	142.41	141.60	126.83	120.70	133.96	134.20	147.61	153.08	164.30	

Σ(219a)1...12 = 1738.52 (219)

Annual totals

Space heating fuel - main system 1 — 1816.53

Water heating fuel — 1738.52

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)
al electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		271.66	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	3901.71	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1816.53	x	3.48	x 0.01 =	63.22	(240)
Water heating	1738.52	x	3.48	x 0.01 =	60.50	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	271.66	x	13.19	x 0.01 =	35.83	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		289.44	(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)
P value	83.49	
SAP rating (section 13)	83	(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	1816.53	x	0.22	=	392.37	(261)
Water heating	1738.52	x	0.22	=	375.52	(264)
Space and water heating			(261) + (262) + (263) + (264) =		767.89	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	271.66	x	0.52	=	140.99	(268)
Total CO_2, kg/year			(265)...(271) =		947.81	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		16.43	(273)
EI value					87.63	
rating (section 14)					88	(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	1816.53	x	1.22	=	2216.17	(261)
Water heating	1738.52	x	1.22	=	2120.99	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4337.17	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	271.66	x	3.07	=	833.98	(268)
Primary energy kWh/year					5401.40	(272)
Dwelling primary energy rate kWh/m2/year					93.61	(273)

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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 7 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		74.27	(1a) x	2.50	(2a) =	185.68	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	74.27	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	185.68	(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) =	0.16	(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	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.31	(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) = 0.26	(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	0.34	0.33	0.32	0.29	0.28	0.25	0.25	0.24	0.26	0.28	0.30	0.31	(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

	0.56	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.54	0.55	(24d)

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

	0.56	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.54	0.55	(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			1.80	x	1.00	=	1.80			(26)
Window			12.36	x	1.33	=	16.39			(27)
External wall			77.14	x	0.20	=	15.43			(29a)
Party wall			4.50	x	0.00	=	0.00			(32)
Roof			22.60	x	0.15	=	3.39			(30)
Total area of external elements ∑A, m²			113.90							(31)

Fabric heat loss, W/K = ∑(A x U)	(26)...(30) + (32) =	37.00 (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		11.78 (36)
Total fabric heat loss	(33) + (36) =	48.78 (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)	34.13	33.99	33.86	33.24	33.12	32.58	32.58	32.47	32.79	33.12	33.36	33.60	(38)
Heat transfer coefficient, W/K (37)m + (38)m	82.91	82.77	82.64	82.02	81.90	81.36	81.36	81.25	81.56	81.90	82.14	82.38	
Average = ∑(39)1...12/12 = 82.02 (39)													
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.12	1.11	1.11	1.10	1.10	1.10	1.10	1.09	1.10	1.10	1.11	1.11	
Average = ∑(40)1...12/12 = 1.10 (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	2.35 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	89.90 (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)	98.89	95.29	91.70	88.10	84.50	80.91	80.91	84.50	88.10	91.70	95.29	98.89	
∑(44)1...12 = 1078.78 (44)													
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	146.65	128.26	132.35	115.39	110.72	95.54	88.53	101.59	102.81	119.81	130.78	142.02	
∑(45)1...12 = 1414.44 (45)													
Distribution loss 0.15 x (45)m	22.00	19.24	19.85	17.31	16.61	14.33	13.28	15.24	15.42	17.97	19.62	21.30	(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	26.88	24.28	26.88	26.01	26.88	26.01	26.88	26.88	26.01	26.88	26.01	26.88	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	173.53	152.54	159.23	141.40	137.60	121.55	115.41	128.47	128.82	146.69	156.79	168.90	(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)

Flue gas heat recovery system 1 input (Appendix G1)

-7.22	-6.67	-6.47	-5.81	-2.86	0.00	0.00	0.00	0.00	-5.85	-6.53	-7.23	(63)

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

166.31	145.86	152.76	135.59	134.74	121.55	115.41	128.47	128.82	140.84	150.26	161.67	

∑(64)1...12 = 1682.29 (64)

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

55.48	48.72	50.73	44.67	43.53	38.27	36.16	40.50	40.69	46.56	49.99	53.94	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.68	17.48	14.22	10.76	8.05	6.79	7.34	9.54	12.81	16.26	18.98	20.23	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	207.05	209.20	203.79	192.26	177.71	164.03	154.90	152.75	158.16	169.69	184.24	197.92	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	(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)	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	(71)
Water heating gains (Table 5)	74.57	72.49	68.18	62.32	58.51	53.15	48.60	54.43	56.51	62.58	69.43	72.50	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	362.48	360.35	347.36	326.52	305.45	285.16	272.01	277.90	288.66	309.70	333.82	351.83	(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	
SouthWest	0.77	x	0.84	x	36.79	x 0.9 x	0.72	x	0.70	=	10.79	(79)
NorthWest	0.77	x	2.88	x	11.28	x 0.9 x	0.72	x	0.70	=	11.35	(8
NorthWest	0.54	x	5.04	x	11.28	x 0.9 x	0.72	x	0.70	=	13.93	(81)
North	0.54	x	0.72	x	10.63	x 0.9 x	0.72	x	0.70	=	1.88	(74)
NorthEast	0.54	x	2.16	x	11.28	x 0.9 x	0.72	x	0.70	=	5.97	(75)
East	0.54	x	0.72	x	19.64	x 0.9 x	0.72	x	0.70	=	3.46	(76)

Solar gains in watts ∑(74)m...(82)m

47.38	92.35	157.01	245.43	321.02	338.89	318.33	258.91	187.18	110.36	58.88	39.17	(83)

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

409.86	452.71	504.37	571.95	626.47	624.05	590.35	536.82	475.84	420.06	392.70	390.99	(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	0.99	0.97	0.91	0.76	0.59	0.66	0.90	0.99	1.00	1.00	(86)

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

	19.76	19.88	20.11	20.45	20.75	20.94	20.99	20.98	20.83	20.44	20.04	19.73	(87)

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

	19.99	19.99	19.99	20.00	20.00	20.00	20.00	20.01	20.00	20.00	20.00	19.99	(88)

Utilisation factor for gains for rest of dwelling n2,m

	1.00	1.00	0.99	0.96	0.87	0.67	0.46	0.54	0.84	0.98	1.00	1.00	(89)

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

	18.33	18.50	18.84	19.33	19.75	19.96	20.00	19.99	19.85	19.33	18.75	18.29	(90)

Living area fraction — Living area ÷ (4) = 0.42 (91)

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

	18.93	19.08	19.38	19.80	20.17	20.37	20.41	20.41	20.26	19.80	19.29	18.90	(92)

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

	18.78	18.93	19.23	19.65	20.02	20.22	20.26	20.26	20.11	19.65	19.14	18.75	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	0.99	0.96	0.87	0.69	0.50	0.57	0.85	0.98	0.99	1.00	(94)
( )eful gains, ηmGm, W (94)m x (84)m	408.79	450.55	496.39	549.13	546.15	429.17	293.88	305.31	405.19	410.25	390.73	390.19	(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]	1200.38	1161.34	1051.73	881.48	681.48	457.28	298.09	313.40	490.45	740.96	989.16	1198.61	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	588.94	477.65	411.69	239.29	100.69	0.00	0.00	0.00	0.00	246.05	430.87	601.46	

∑(98)1...5, 10...12 = 3096.64 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 41.69 (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 (%) = 89.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	655.11	531.31	457.94	266.17	112.00	0.00	0.00	0.00	0.00	273.69	479.28	669.04	

∑(211)1...5, 10...12 = 3444.53 (211)

Water heating

Efficiency of water heater

	89.31	89.28	89.16	88.94	88.39	87.30	87.30	87.30	87.30	88.94	89.21	89.34	(217)

Water heating fuel, kWh/month

	186.21	163.38	171.29	152.45	152.43	139.24	132.20	147.16	147.56	158.36	168.43	180.97	

∑(219a)1...12 = 1899.68 (219)

Annual totals

Space heating fuel - main system 1		3444.53	
Water heating fuel		1899.68	
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)		347.60	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5766.81	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3444.53	x	3.48	x 0.01 =	119.87	(240)
Water heating	1899.68	x	3.48	x 0.01 =	66.11	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	347.60	x	13.19	x 0.01 =	45.85	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		361.72	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.27	(257)
SAP value	82.23	
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	3444.53	x	0.22	=	744.02	(261)
Water heating	1899.68	x	0.22	=	410.33	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1154.35	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	347.60	x	0.52	=	180.41	(268)
Total CO_2, kg/year				(265)...(271) =	1373.68	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	18.50	(273)
EI value					84.57	
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	3444.53	x	1.22	=	4202.33	(261)
Water heating	1899.68	x	1.22	=	2317.61	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6519.94	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	347.60	x	3.07	=	1067.14	(268)
Primary energy kWh/year					7817.33	(272)
Dwelling primary energy rate kWh/m2/year					105.26	(273)

DER Worksheet

[illegible]sign - 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 John Simpson	Assessor number	3722
Client		Date created	25/09/2015
Address	Flat 8 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		52.55	(1a)	2.50	(2a)	131.38	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	52.55	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	131.38	(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) =	0.15	(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)	0.30	(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) = 0.26	(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	0.33	0.32	0.31	0.28	0.28	0.24	0.24	0.24	0.26	0.28	0.29	0.30	(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	
	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.55	(24d)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.55	(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			1.80	x	1.00	=	1.80			(26)
Window			7.98	x	1.33	=	10.59			(27)
External wall			44.88	x	0.20	=	8.98			(29a)
Party wall			17.80	x	0.00	=	0.00			(32)
Roof			15.60	x	0.15	=	2.34			(30)
Total area of external elements ∑A, m²			70.26							(31)

Fabric heat loss, W/K = ∑(A x U)	(26)...(30) + (32) =	23.70 (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		8.31 (36)
Total fabric heat loss	(33) + (36) =	32.00 (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)	24.00	23.91	23.82	23.41	23.33	22.97	22.97	22.90	23.11	23.33	23.49	23.65	(38)
Heat transfer coefficient, W/K (37)m + (38)m	56.00	55.91	55.83	55.41	55.33	54.97	54.97	54.90	55.11	55.33	55.49	55.65	
Average = ∑(39)1...12/12 =												55.41	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.07	1.06	1.06	1.05	1.05	1.05	1.05	1.04	1.05	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	1.77 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	76.13 (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)	83.74	80.69	77.65	74.60	71.56	68.51	68.51	71.56	74.60	77.65	80.69	83.74	
∑(44)1...12 =												913.51	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	124.18	108.61	112.08	97.71	93.76	80.90	74.97	86.03	87.06	101.46	110.75	120.26	
∑(45)1...12 =												1197.75	(45)
Distribution loss 0.15 x (45)m	18.63	16.29	16.81	14.66	14.06	12.14	11.25	12.90	13.06	15.22	16.61	18.04	(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	26.88	24.28	26.88	26.01	26.88	26.01	26.88	26.88	26.01	26.88	26.01	26.88	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	151.06	132.89	138.96	123.72	120.64	106.92	101.85	112.91	113.07	128.34	136.76	147.14	(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)

e gas heat recovery system 1 input (Appendix G1)

-6.24	-5.89	-5.76	-3.46	-1.34	0.00	0.00	0.00	0.00	-3.43	-5.83	-6.25	(63)

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

144.82	127.00	133.20	120.26	119.29	106.92	101.85	112.91	113.07	124.90	130.93	140.89	

∑(64)1...12 = 1476.04 (64)

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

48.01	42.18	43.99	38.99	37.89	33.40	31.65	35.32	35.45	40.45	43.33	46.71	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.83	13.18	10.72	8.11	6.06	5.12	5.53	7.19	9.65	12.25	14.30	15.25	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	153.85	155.45	151.43	142.86	132.05	121.89	115.10	113.50	117.53	126.09	136.90	147.06	(68)
ooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	(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)	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	(71)
Water heating gains (Table 5)	64.53	62.77	59.12	54.16	50.93	46.39	42.54	47.48	49.24	54.37	60.18	62.78	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	285.70	283.88	273.74	257.61	241.52	225.88	215.65	220.65	228.89	245.20	263.86	277.57	(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	
NorthWest	0.77	x	1.92	x	11.28	x 0.9 x	0.72	x	0.70	=	7.57	(81)
uthEast	0.77	x	1.44	x	36.79	x 0.9 x	0.72	x	0.70	=	18.51	(77)
SouthEast	0.54	x	4.62	x	36.79	x 0.9 x	0.72	x	0.70	=	41.64	(77)

Solar gains in watts ∑(74)m...(82)m

67.71	117.85	167.92	219.25	255.79	258.43	247.29	219.34	185.59	132.05	81.56	57.65	(83)

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

353.41	401.72	441.66	476.86	497.32	484.31	462.94	439.99	414.48	377.24	345.42	335.22	(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	0.51	0.56	0.81	0.96	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.94	20.09	20.32	20.60	20.84	20.96	20.99	20.99	20.92	20.61	20.22	19.91	(87)

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

20.03	20.03	20.03	20.04	20.04	20.05	20.05	20.05	20.04	20.04	20.04	20.03	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.98	0.93	0.81	0.60	0.41	0.45	0.73	0.95	0.99	1.00	(89)

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

18.62	18.84	19.17	19.58	19.88	20.02	20.04	20.04	19.98	19.60	19.04	18.58	(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

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

19.33	19.51	19.79	20.13	20.40	20.53	20.55	20.55	20.48	20.14	19.67	19.29	(92)

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

19.18	19.36	19.64	19.98	20.25	20.38	20.40	20.40	20.33	19.99	19.52	19.14	(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	0.82	0.63	0.45	0.49	0.76	0.94	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	351.32	396.88	429.57	442.79	408.67	305.77	207.56	217.15	313.07	356.19	341.19	333.69	(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]	833.44	808.58	733.35	613.82	472.97	317.65	209.11	219.71	343.43	519.78	689.34	831.66	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	358.70	276.66	226.01	123.14	47.84	0.00	0.00	0.00	0.00	121.71	250.67	370.48	

∑(98)1...5, 10...12 = 1775.22 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 33.78 (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 (%) — 89.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	399.00	307.74	251.40	136.98	53.22	0.00	0.00	0.00	0.00	135.39	278.83	412.11	

∑(211)1...5, 10...12 = 1974.66 (211)

Water heating

Efficiency of water heater

89.14	89.07	88.92	88.60	88.03	87.30	87.30	87.30	87.30	88.56	88.99	89.17	(217)

Water heating fuel, kWh/month

162.47	142.59	149.80	135.74	135.52	122.47	116.67	129.33	129.52	141.03	147.13	158.00	

∑(219a)1...12 = 1670.27 (219)

Annual totals

Space heating fuel - main system 1 — 1974.66

Water heating fuel — 1670.27

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)
al electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		261.98	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	3981.92	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1974.66	x	3.48	x 0.01 =	68.72	(240)
Water heating	1670.27	x	3.48	x 0.01 =	58.13	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	261.98	x	13.19	x 0.01 =	34.56	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		291.29	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.25	(257)
S value	82.50	
SAP rating (section 13)	83	(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	1974.66	x	0.22	=	426.53	(261)
Water heating	1670.27	x	0.22	=	360.78	(264)
Space and water heating			(261) + (262) + (263) + (264) =		787.31	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	261.98	x	0.52	=	135.97	(268)
Total CO_2, kg/year			(265)...(271) =		962.20	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		18.31	(273)
EI value					86.78	
E ing (section 14)					87	(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	1974.66	x	1.22	=	2409.09	(261)
Water heating	1670.27	x	1.22	=	2037.73	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4446.82	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	261.98	x	3.07	=	804.29	(268)
Primary energy kWh/year					5481.36	(272)
Dwelling primary energy rate kWh/m2/year					104.31	(273)

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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 9 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m^2)		Average storey height (m)		Volume (m^3)	
Lowest occupied		57.70	(1a) x	2.50	(2a) =	144.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	57.70	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	144.25	(5)

2. Ventilation rate

				m^3 per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		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) =	0.14	(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)	0.29	(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) = 0.25	(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	0.31	0.31	0.30	0.27	0.26	0.23	0.23	0.23	0.25	0.26	0.28	0.29	(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	
	0.55	0.55	0.55	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54	(24d)

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

0.55	0.55	0.55	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54	(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			9.15	x	1.33	=	12.13			(27)
Door			1.80	x	1.00	=	1.80			(26)
External wall			56.45	x	0.20	=	11.29			(29a)
Party wall			13.30	x	0.00	=	0.00			(32)
Roof			19.90	x	0.15	=	2.99			(30)
Total area of external elements ∑A, m²			87.30							(31)
Fabric heat loss, W/K = ∑(A x U)							(26)...(30) + (32) =		28.21	(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									9.03	(36)
Total fabric heat loss							(33) + (36) =		37.23	(37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
26.13	26.04	25.95	25.53	25.46	25.09	25.09	25.03	25.23	25.46	25.61	25.78	(38)

Heat transfer coefficient, W/K (37)m + (38)m

63.36	63.27	63.18	62.77	62.69	62.33	62.33	62.26	62.47	62.69	62.85	63.01	

Average = ∑(39)1...12/12 = 62.77 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.10	1.10	1.10	1.09	1.09	1.08	1.08	1.08	1.08	1.09	1.09	1.09	

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 1.92 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 79.70 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
87.67	84.49	81.30	78.11	74.92	71.73	71.73	74.92	78.11	81.30	84.49	87.67	

∑(44)1...12 = 956.44 (44)

gy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

130.02	113.71	117.34	102.30	98.16	84.71	78.49	90.07	91.15	106.22	115.95	125.91	

∑(45)1...12 = 1254.04 (45)

Distribution loss 0.15 x (45)m

19.50	17.06	17.60	15.35	14.72	12.71	11.77	13.51	13.67	15.93	17.39	18.89	(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

26.88	24.28	26.88	26.01	26.88	26.01	26.88	26.88	26.01	26.88	26.01	26.88	(61)

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

156.90	137.99	144.22	128.32	125.04	110.72	105.37	116.95	117.16	133.10	141.96	152.79	(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)

Flue gas heat recovery system 1 input (Appendix G1)

	-6.39	-5.95	-5.76	-3.14	-1.11	0.00	0.00	0.00	0.00	-3.23	-5.90	-6.42 (63)

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

	150.51	132.04	138.46	125.17	123.93	110.72	105.37	116.95	117.16	129.87	136.07	146.38

$\sum(64)1..12 =$ 1532.64 (64)

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

	49.95	43.88	45.74	40.52	39.36	34.67	32.82	36.67	36.81	42.04	45.06	48.59 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.57	13.83	11.25	8.51	6.36	5.37	5.81	7.55	10.13	12.86	15.01	16.00	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	167.11	168.85	164.48	155.17	143.43	132.39	125.02	123.28	127.65	136.96	148.70	159.74	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	(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)	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	(71)
Water heating gains (Table 5)	67.14	65.30	61.47	56.28	52.90	48.15	44.11	49.29	51.12	56.50	62.58	65.30	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	304.56	302.71	291.93	274.70	257.43	240.65	229.68	234.86	243.65	261.06	281.03	295.78	(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	×	0.96	×	46.75	× 0.9 ×	0.72	×	0.70	=	15.68	(78)
East	0.77	×	0.96	×	19.64	× 0.9 ×	0.72	×	0.70	=	6.59	(7
SouthEast	0.77	×	4.41	×	36.79	× 0.9 ×	0.72	×	0.70	=	56.67	(77)
SouthWest	0.77	×	2.82	×	36.79	× 0.9 ×	0.72	×	0.70	=	36.24	(79)

Solar gains in watts $\sum(74)m...(82)m$

	115.17	196.82	270.46	336.21	376.97	374.24	360.82	330.53	293.31	217.89	138.08	98.48 (83)

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

	419.73	499.53	562.40	610.92	634.40	614.90	590.50	565.38	536.96	478.96	419.11	394.26 (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	0.97	0.92	0.80	0.62	0.46	0.50	0.74	0.94	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.95	20.14	20.39	20.67	20.88	20.97	21.00	20.99	20.94	20.67	20.24	19.90	(87)

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

	20.00	20.00	20.00	20.01	20.01	20.02	20.02	20.02	20.02	20.01	20.01	20.01 (88)

(sation factor for gains for rest of dwelling n2,m

	0.99	0.98	0.96	0.89	0.75	0.54	0.36	0.40	0.66	0.91	0.98	1.00 (89)

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

	18.61	18.89	19.25	19.64	19.90	20.00	20.02	20.02	19.97	19.64	19.05	18.55 (90)

Living area fraction — Living area ÷ (4) = 0.53 (91)

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

	19.32	19.55	19.85	20.18	20.42	20.51	20.53	20.53	20.48	20.18	19.68	19.27 (92)

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

	19.17	19.40	19.70	20.03	20.27	20.36	20.38	20.38	20.33	20.03	19.53	19.12 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.95	0.89	0.76	0.57	0.40	0.44	0.68	0.91	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	416.28	489.78	536.86	544.26	484.04	350.26	234.63	246.08	366.72	437.99	411.57	391.83	(95)
(nthly 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]	941.95	917.15	834.00	698.85	536.98	359.29	235.74	247.86	389.36	591.38	781.13	939.86	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	391.10	287.19	221.08	111.30	39.39	0.00	0.00	0.00	0.00	114.12	266.08	407.73	

∑(98)1...5, 10...12 = 1837.99 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 31.85 (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)

(ction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) = 89.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	435.04	319.45	245.91	123.80	43.81	0.00	0.00	0.00	0.00	126.95	295.98	453.54	

∑(211)1...5, 10...12 = 2044.49 (211)

Water heating

Efficiency of water heater

	89.16	89.06	88.86	88.50	87.91	87.30	87.30	87.30	87.30	88.50	89.00	89.20 (217)

Water heating fuel, kWh/month

	168.80	148.25	155.78	141.43	140.97	126.83	120.70	133.96	134.20	146.75	152.88	164.10

∑(219a)1...12 = 1734.67 (219)

Annual totals

Space heating fuel - main system 1 = 2044.49

Water heating fuel = 1734.67

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		(230
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		274.98	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4129.14	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2044.49	x	3.48	x 0.01 =	71.15	(240)
Water heating	1734.67	x	3.48	x 0.01 =	60.37	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	274.98	x	13.19	x 0.01 =	36.27	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		297.68	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.22	(25
SAP value	83.02	
SAP rating (section 13)	83	(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	2044.49	x	0.22	=	441.61	(261)
Water heating	1734.67	x	0.22	=	374.69	(264)
Space and water heating			(261) + (262) + (263) + (264) =		816.30	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	274.98	x	0.52	=	142.71	(268)
Total CO_2, kg/year			(265)...(271) =		997.94	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		17.30	(273)
EI value					86.98	
EI rating (section 14)					87	(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	2044.49	x	1.22	=	2494.27	(261)
Water heating	1734.67	x	1.22	=	2116.30	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4610.58	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	274.98	x	3.07	=	844.18	(268)
Primary energy kWh/year					5685.01	(272)
Dwelling primary energy rate kWh/m2/year					98.53	(273)

DER Worksheet
ɔsign - 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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 10 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		51.40	(1a) x	2.21	(2a) =	113.59	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	51.40	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	113.59	(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) =	0.18	(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)	0.33	(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) = 0.28	(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	0.35	0.35	0.34	0.30	0.30	0.26	0.26	0.26	0.28	0.30	0.31	0.33	(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

0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

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

0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(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			1.80	x 1.00	= 1.80			(26)
Window			7.92	x 1.33	= 10.50			(27)
Roof window			5.04	x 1.33	= 6.68			(27a)
External wall			40.18	x 0.20	= 8.04			(29a)
Party wall			3.60	x 0.00	= 0.00			(32)
Roof			56.56	x 0.15	= 8.48			(30)
Total area of external elements ∑A, m²			111.50					(31)

Fabric heat loss, W/K = ∑(A x U)	(26)...(30) + (32) =	35.50 (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		11.01 (36)
Total fabric heat loss	(33) + (36) =	46.52 (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)	21.08	20.99	20.90	20.49	20.41	20.04	20.04	19.97	20.18	20.41	20.57	20.73	(38)
Heat transfer coefficient, W/K (37)m + (38)m	67.60	67.51	67.42	67.00	66.92	66.56	66.56	66.49	66.70	66.92	67.08	67.25	
											Average = ∑(39)1...12/12 =	67.00	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.32	1.31	1.31	1.30	1.30	1.29	1.29	1.29	1.30	1.30	1.31	1.31	
											Average = ∑(40)1...12/12 =	1.30	(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		1.73 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		79.32 (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)	82.85	79.84	76.83	73.81	70.80	67.79	67.79	70.80	73.81	76.83	79.84	82.85	
											∑(44)1...12 =	903.84	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	122.87	107.46	110.89	96.68	92.76	80.05	74.18	85.12	86.13	100.38	109.57	118.99	
											∑(45)1...12 =	1185.08	(45)
Distribution loss 0.15 x (45)m	18.43	16.12	16.63	14.50	13.91	12.01	11.13	12.77	12.92	15.06	16.44	17.85	(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	26.88	24.28	26.88	26.01	26.88	26.01	26.88	26.88	26.01	26.88	26.01	26.88	(61)

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

	149.75	131.74	137.77	122.69	119.64	106.06	101.06	112.00	112.15	127.26	135.59	145.87 (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)

Flue gas heat recovery system 1 input (Appendix G1)

	-6.55	-6.06	-5.82	-2.81	-0.70	0.00	0.00	0.00	0.00	-4.15	-6.02	-6.56 (63)

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

	143.20	125.68	131.95	119.88	118.94	106.06	101.06	112.00	112.15	123.11	129.57	139.31

Σ(64)1...12 = 1462.91 (64)

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

	47.57	41.80	43.59	38.65	37.56	33.12	31.38	35.02	35.14	40.10	42.94	46.28 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	86.57	86.57	86.57	86.57	86.57	86.57	86.57	86.57	86.57	86.57	86.57	86.57	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.45	11.95	9.72	7.36	5.50	4.64	5.02	6.52	8.75	11.11	12.97	13.82	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	150.87	152.43	148.49	140.09	129.49	119.52	112.87	111.30	115.25	123.65	134.25	144.21	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.66	31.66	31.66	31.66	31.66	31.66	31.66	31.66	31.66	31.66	31.66	31.66	(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)	-69.25	-69.25	-69.25	-69.25	-69.25	-69.25	-69.25	-69.25	-69.25	-69.25	-69.25	-69.25	(71)
Water heating gains (Table 5)	63.94	62.20	58.59	53.68	50.49	46.00	42.18	47.07	48.81	53.89	59.63	62.21	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	280.23	278.55	268.77	253.09	237.45	222.14	212.04	216.86	224.78	240.62	258.82	272.22	(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	
(hWest	0.77	x	7.92	x	11.28	x 0.9 x	0.72	x	0.70	=	31.21	(81)
SouthWest	1.00	x	2.24	x	39.98	x 0.9 x	0.72	x	0.70	=	40.62	(79)
NorthEast	1.00	x	2.80	x	16.37	x 0.9 x	0.72	x	0.70	=	20.79	(75)

Solar gains in watts ∑(74)m...(82)m

	92.62	180.98	307.28	477.46	620.70	653.37	614.50	502.38	365.61	216.30	115.21	76.47 (83)

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

	372.85	459.53	576.05	730.56	858.15	875.51	826.54	719.24	590.39	456.92	374.03	348.68 (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	0.99	0.96	0.86	0.67	0.48	0.35	0.42	0.71	0.94	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.66	19.88	20.25	20.68	20.92	20.99	21.00	20.99	20.92	20.53	20.00	19.61	(87)

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

19.83	19.83	19.83	19.84	19.84	19.84	19.84	19.85	19.84	19.84	19.84	19.83	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.98	0.95	0.82	0.60	0.40	0.26	0.32	0.61	0.92	0.99	1.00	(89)

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

18.06	18.39	18.91	19.49	19.77	19.84	19.84	19.84	19.79	19.32	18.57	18.00	(90)

Living area fraction — Living area ÷ (4) = 0.55 (91)

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

18.93	19.20	19.64	20.14	20.39	20.46	20.47	20.47	20.41	19.98	19.35	18.88	(92)

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

18.78	19.05	19.49	19.99	20.24	20.31	20.32	20.32	20.26	19.83	19.20	18.73	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.94	0.83	0.63	0.43	0.30	0.36	0.65	0.92	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	369.90	450.68	543.27	603.93	538.29	375.51	247.12	259.14	383.26	419.88	368.00	346.59	(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]	979.06	955.26	875.89	742.91	571.82	380.29	247.82	260.74	410.74	617.80	811.89	977.12	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	453.22	339.08	247.47	100.06	24.95	0.00	0.00	0.00	0.00	147.25	319.60	469.12	

Σ(98)1...5, 10...12 = 2100.74 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 40.87 (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 (%) = 89.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	504.14	377.17	275.27	111.30	27.75	0.00	0.00	0.00	0.00	163.79	355.50	521.82	

Σ(211)1...5, 10...12 = 2336.75 (211)

Water heating

Efficiency of water heater

89.26	89.18	88.98	88.46	87.74	87.30	87.30	87.30	87.30	88.70	89.13	89.29	(217)

Water heating fuel, kWh/month

160.43	140.92	148.30	135.51	135.57	121.49	115.76	128.29	128.46	138.80	145.36	156.02	

Σ(219a)1...12 = 1654.90 (219)

Annual totals

Space heating fuel - main system 1 = 2336.75

Water heating fuel = 1654.90

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)		237.53	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4304.19	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2336.75	x	3.48	x 0.01 =	81.32	(240)
Water heating	1654.90	x	3.48	x 0.01 =	57.59	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	237.53	x	13.19	x 0.01 =	31.33	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		300.13	(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	81.76	
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	2336.75	x	0.22	=	504.74	(261)
Water heating	1654.90	x	0.22	=	357.46	(264)
Space and water heating			(261) + (262) + (263) + (264) =		862.20	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	237.53	x	0.52	=	123.28	(268)
Total CO_2, kg/year				(265)...(271) =	1024.40	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	19.93	(273)
EI value					85.76	
EI rating (section 14)					86	(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	2336.75	x	1.22	=	2850.83	(261)
Water heating	1654.90	x	1.22	=	2018.98	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4869.82	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	237.53	x	3.07	=	729.23	(268)
Primary energy kWh/year					5829.29	(272)
Dwelling primary energy rate kWh/m2/year					113.41	(273)

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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 11 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		78.10	(1a) x	2.20	(2a) =	171.82	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	78.10	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	171.82	(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) =	0.17	(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)	0.32	(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) = 0.28	(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	0.35	0.34	0.34	0.30	0.30	0.26	0.26	0.26	0.28	0.30	0.31	0.32	(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

0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

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

0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(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			1.80	x	1.00	=	1.80			(26)
Window			7.50	x	1.33	=	9.94			(27)
Roof window			4.20	x	1.33	=	5.57			(27a)
External wall			60.00	x	0.20	=	12.00			(29a)
Party wall			3.60	x	0.00	=	0.00			(32)
Roof			90.30	x	0.15	=	13.55			(30)
Total area of external elements ∑A, m²			163.80							(31)

Fabric heat loss, W/K = ∑(A x U)	(26)...(30) + (32) =	42.86 (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		13.51 (36)
Total fabric heat loss	(33) + (36) =	56.37 (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)	31.86	31.72	31.59	30.96	30.84	30.30	30.30	30.20	30.51	30.84	31.08	31.33	(38)
t transfer coefficient, W/K (37)m + (38)m	88.23	88.09	87.96	87.33	87.21	86.67	86.67	86.57	86.88	87.21	87.45	87.70	

Average = ∑(39)1...12/12 = 87.33 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.13	1.13	1.13	1.12	1.12	1.11	1.11	1.11	1.11	1.12	1.12	1.12	

Average = ∑(40)1...12/12 = 1.12 (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	2.43 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	91.81 (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)	100.99	97.32	93.65	89.98	86.30	82.63	82.63	86.30	89.98	93.65	97.32	100.99	

∑(44)1...12 = 1101.76 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	149.77	130.99	135.17	117.85	113.08	97.58	90.42	103.76	105.00	122.36	133.57	145.05	

∑(45)1...12 = 1444.58 (45)

Distribution loss 0.15 x (45)m	22.47	19.65	20.28	17.68	16.96	14.64	13.56	15.56	15.75	18.35	20.04	21.76	(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	26.88	24.28	26.88	26.01	26.88	26.01	26.88	26.88	26.01	26.88	26.01	26.88	(61)

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

176.65	155.27	162.05	143.86	139.96	123.59	117.30	130.64	131.01	149.24	159.58	171.93	(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)

Flue gas heat recovery system 1 input (Appendix G1)

-7.17	-6.49	-6.14	-4.11	-1.24	0.00	0.00	0.00	0.00	-4.86	-6.41	-7.22	(63)

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

169.49	148.78	155.91	139.75	138.72	123.59	117.30	130.64	131.01	144.38	153.17	164.71	

∑(64)1..12 = 1717.45 (64)

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

56.52	49.62	51.66	45.69	44.32	38.95	36.78	41.22	41.41	47.41	50.91	54.95	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	121.29	121.29	121.29	121.29	121.29	121.29	121.29	121.29	121.29	121.29	121.29	121.29	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.02	17.78	14.46	10.95	8.18	6.91	7.46	9.70	13.02	16.53	19.30	20.57	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	215.42	217.66	212.03	200.03	184.90	170.67	161.16	158.93	164.56	176.55	191.69	205.92	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.13	35.13	35.13	35.13	35.13	35.13	35.13	35.13	35.13	35.13	35.13	35.13	(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)	-97.03	-97.03	-97.03	-97.03	-97.03	-97.03	-97.03	-97.03	-97.03	-97.03	-97.03	-97.03	(71)
Water heating gains (Table 5)	75.97	73.85	69.44	63.45	59.57	54.09	49.44	55.40	57.52	63.72	70.71	73.85	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	373.79	371.67	358.31	336.82	315.03	294.06	280.45	286.42	297.49	319.19	344.09	362.73	(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	
SouthEast	0.77	x	7.50	x	36.79	x 0.9 x	0.72	x	0.70	=	96.38	(75)
NorthWest	1.00	x	1.68	x	16.37	x 0.9 x	0.72	x	0.70	=	12.47	(81)
SouthEast	1.00	x	1.40	x	39.98	x 0.9 x	0.72	x	0.70	=	25.39	(77)
SouthWest	1.00	x	1.12	x	39.98	x 0.9 x	0.72	x	0.70	=	20.31	(79)

Solar gains in watts ∑(74)m...(82)m

154.55	273.84	400.13	534.07	629.99	638.57	610.24	537.23	446.58	309.77	187.11	130.94	(83)

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

528.34	645.51	758.44	870.89	945.02	932.63	890.70	823.65	744.07	628.96	531.20	493.67	(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	0.97	0.91	0.77	0.58	0.43	0.48	0.74	0.95	0.99	1.00	(86)

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

19.86	20.06	20.35	20.68	20.90	20.98	21.00	20.99	20.94	20.62	20.17	19.81	(87)

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

19.98	19.98	19.98	19.99	19.99	19.99	19.99	19.99	19.99	19.99	19.98	19.98	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.96	0.88	0.71	0.49	0.33	0.38	0.65	0.93	0.99	1.00	(89)

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

18.46	18.76	19.17	19.63	19.89	19.98	19.99	19.99	19.95	19.57	18.92	18.40	(90)

Living area fraction — Living area ÷ (4) = 0.43 (91)

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

19.07	19.32	19.68	20.08	20.33	20.42	20.43	20.43	20.38	20.03	19.46	19.02	(92)

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

18.92	19.17	19.53	19.93	20.18	20.27	20.28	20.28	20.23	19.88	19.31	18.87	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.96	0.88	0.72	0.52	0.36	0.41	0.67	0.92	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	525.03	634.88	724.65	763.16	680.97	482.38	317.75	333.69	501.42	580.28	523.69	491.41	(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]	1289.63	1257.20	1146.27	963.41	739.44	490.97	318.76	335.60	532.19	809.02	1067.86	1286.18	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	568.86	418.20	313.69	144.18	43.50	0.00	0.00	0.00	0.00	170.18	391.80	591.30	

∑(98)1...5, 10...12 = 2641.72 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 33.82 (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 (%) = 89.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	632.77	465.18	348.93	160.38	48.39	0.00	0.00	0.00	0.00	189.30	435.82	657.74	

∑(211)1...5, 10...12 = 2938.51 (211)

Water heating

Efficiency of water heater

89.29	89.20	89.02	88.60	87.91	87.30	87.30	87.30	87.30	88.69	89.15	89.32	(217)

Water heating fuel, kWh/month

189.82	166.79	175.14	157.73	157.80	141.57	134.36	149.64	150.07	162.80	171.80	184.40	

∑(219a)1...12 = 1941.93 (219)

Annual totals

Space heating fuel - main system 1 = 2938.51

Water heating fuel		1941.93	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(23(
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		353.49	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5308.93	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2938.51	x	3.48	x 0.01 =	102.26	(240)
Water heating	1941.93	x	3.48	x 0.01 =	67.58	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	353.49	x	13.19	x 0.01 =	46.63	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		346.36	(255)

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

Energy cost deflator (Table 12)	0.42	(25
Energy cost factor (ECF)	1.18	(257)
SAP value	83.51	
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	2938.51	x	0.22	=	634.72	(261)
Water heating	1941.93	x	0.22	=	419.46	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1054.17	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	353.49	x	0.52	=	183.46	(268)
Total CO_2, kg/year				(265)...(271) =	1276.56	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	16.35	(27
EI value					86.10	
EI rating (section 14)					86	(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	2938.51	x	1.22	=	3584.98	(261)
Water heating	1941.93	x	1.22	=	2369.16	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5954.14	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	353.49	x	3.07	=	1085.22	(268)
Primary energy kWh/year					7269.61	(272)
Dwelling primary energy rate kWh/m2/year					93.08	(273)

13 Appendix C – TER Worksheets (Part L 2013)

The following SAP TER worksheets are taken from the SAP 2012 software for the modelled dwellings in accordance with current London Plan policy.

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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 1 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m^2)		Average storey height (m)		Volume (m^3)	
Lowest occupied		78.17	(1a) x	2.50	(2a) =	195.43	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	78.17	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	195.43	(5)

2. Ventilation rate

			m^3 per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	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) =	0.15	(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)	0.40	(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) = 0.34	(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	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.40	(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	0.57	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	0.57	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	
Door			1.80	x	1.00	=	1.80			(26)
Window			9.96	x	1.33	=	13.20			(27)
Ground floor			78.17	x	0.13	=	10.16			(28a)
External wall			80.64	x	0.18	=	14.52			(29a)
Roof			11.30	x	0.13	=	1.47			(30)
Total area of external elements ∑A, m²			181.87							(31)

Fabric heat loss, W/K = ∑(A x U)	(26)...(30) + (32) =	41.15 (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		12.61 (36)
Total fabric heat loss	(33) + (36) =	53.76 (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)	38.41	38.17	37.94	36.83	36.63	35.67	35.67	35.49	36.04	36.63	37.05	37.48	(38)
Heat transfer coefficient, W/K (37)m + (38)m	92.17	91.93	91.70	90.60	90.39	89.43	89.43	89.25	89.80	90.39	90.81	91.24	
Average = ∑(39)1...12/12 = 90.59 (39)													
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.18	1.18	1.17	1.16	1.16	1.14	1.14	1.14	1.15	1.16	1.16	1.17	
Average = ∑(40)1...12/12 = 1.16 (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	2.43 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	91.85 (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)	101.03	97.36	93.68	90.01	86.34	82.66	82.66	86.34	90.01	93.68	97.36	101.03	
∑(44)1...12 = 1102.16 (44)													
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	149.83	131.04	135.22	117.89	113.12	97.61	90.45	103.79	105.03	122.41	133.62	145.10	
∑(45)1...12 = 1445.10 (45)													
Distribution loss 0.15 x (45)m	22.47	19.66	20.28	17.68	16.97	14.64	13.57	15.57	15.76	18.36	20.04	21.76	(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	44.81	47.74	44.39	44.00	40.76	42.12	44.00	44.39	47.74	48.01	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	200.79	175.85	182.96	162.28	157.11	138.38	132.57	147.79	149.42	170.15	181.63	196.06	(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

200.79	175.85	182.96	162.28	157.11	138.38	132.57	147.79	149.42	170.15	181.63	196.06	

∑(64)1..12 = 1994.98 (64)

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

62.56	54.77	56.90	50.30	48.61	42.65	40.61	45.51	46.02	52.64	56.43	60.99	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	121.36	121.36	121.36	121.36	121.36	121.36	121.36	121.36	121.36	121.36	121.36	121.36	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.53	19.13	15.55	11.78	8.80	7.43	8.03	10.44	14.01	17.79	20.76	22.13	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	215.57	217.81	212.17	200.17	185.02	170.79	161.27	159.04	164.67	176.68	191.82	206.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.14	35.14	35.14	35.14	35.14	35.14	35.14	35.14	35.14	35.14	35.14	35.14	(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)	-97.09	-97.09	-97.09	-97.09	-97.09	-97.09	-97.09	-97.09	-97.09	-97.09	-97.09	-97.09	(71)
Water heating gains (Table 5)	84.08	81.51	76.47	69.85	65.34	59.23	54.58	61.17	63.92	70.75	78.38	81.97	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	383.60	380.85	366.61	344.21	321.57	299.66	286.29	293.05	305.01	327.62	353.37	372.57	(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	
SouthWest	0.77	x	0.84	x	36.79	x 0.9 x	0.63	x	0.70	=	9.45	(79)
NorthWest	0.77	x	4.08	x	11.28	x 0.9 x	0.63	x	0.70	=	14.07	(81)
NorthWest	0.54	x	5.04	x	11.28	x 0.9 x	0.63	x	0.70	=	12.19	(81)

Solar gains in watts ∑(74)m...(82)m

35.70	69.54	118.31	185.42	243.12	256.95	241.24	195.81	141.17	83.10	44.35	29.53	(83)

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

419.30	450.39	484.92	529.63	564.69	556.81	527.53	488.86	446.18	410.72	397.72	402.10	(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	1.00	0.99	0.95	0.85	0.69	0.75	0.94	0.99	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.66	19.77	19.99	20.31	20.64	20.88	20.97	20.95	20.76	20.36	19.96	19.65	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	19.94	19.94	19.94	19.95	19.96	19.97	19.97	19.97	19.96	19.96	19.95	19.95	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	1.00	0.99	0.98	0.93	0.77	0.56	0.62	0.89	0.99	1.00	1.00	(89)

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

18.15	18.30	18.63	19.11	19.56	19.87	19.95	19.94	19.74	19.18	18.60	18.13	(90)

Living area fraction — Living area ÷ (4) = 0.41 (91)

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

18.77	18.90	19.18	19.60	20.00	20.28	20.37	20.36	20.16	19.66	19.16	18.75	(92)

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

18.77	18.90	19.18	19.60	20.00	20.28	20.37	20.36	20.16	19.66	19.16	18.75	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	0.99	0.98	0.93	0.79	0.61	0.68	0.90	0.98	1.00	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	418.34	448.74	481.16	517.57	523.55	442.37	323.38	331.07	403.70	404.14	396.09	401.35	(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]	1333.54	1287.49	1163.15	969.41	750.47	508.39	336.96	353.07	543.85	819.34	1094.93	1327.76	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	680.91	563.64	507.39	325.32	168.83	0.00	0.00	0.00	0.00	308.91	503.16	689.24	

Σ(98)1...5, 10...12 = 3747.40 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 47.94 (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 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	729.03	603.47	543.25	348.31	180.76	0.00	0.00	0.00	0.00	330.73	538.72	737.95	

Σ(211)1...5, 10...12 = 4012.21 (211)

Water heating

Efficiency of water heater

87.88	87.77	87.48	86.77	85.23	80.30	80.30	80.30	80.30	86.53	87.48	87.96	(217)

Water heating fuel, kWh/month

228.47	200.34	209.14	187.02	184.33	172.32	165.10	184.05	186.08	196.62	207.62	222.92	

Σ(219a)1...12 = 2344.02 (219)

Annual totals

Space heating fuel - main system 1 — 4012.21

Water heating fuel — 2344.02

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)		380.29	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	6811.52	(23

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4012.21	x	3.48	x 0.01 =	139.62	(240)
Water heating	2344.02	x	3.48	x 0.01 =	81.57	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	380.29	x	13.19	x 0.01 =	50.16	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		401.25	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.37	(257)
SAP value	80.91	
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	4012.21	x	0.22	=	866.64	(261)
Water heating	2344.02	x	0.22	=	506.31	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1372.95	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	380.29	x	0.52	=	197.37	(268)
Total CO_2, kg/year			(265)...(271) =		1609.24	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		20.59	(273)
EI value					82.49	
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	4012.21	x	1.22	=	4894.90	(261)
Water heating	2344.02	x	1.22	=	2859.70	(264)
Space and water heating			(261) + (262) + (263) + (264) =		7754.60	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	380.29	x	3.07	=	1167.50	(268)
Primary energy kWh/year					9152.35	(272)
Dwelling primary energy rate kWh/m2/year					117.08	(273)

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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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 2 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		52.55	(1a) x	2.50	(2a) =	131.38	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	52.55	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	131.38	(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) =	0.15	(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)	0.40	(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) = 0.34	(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	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.40	(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	
	0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(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	
	0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	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	
Door			1.80	x	1.00	=	1.80			(26)
Window			10.16	x	1.33	=	13.47			(27)
Ground floor			52.55	x	0.13	=	6.83			(28a)
External wall			47.14	x	0.18	=	8.49			(29a)
Party wall			13.30	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			111.65							(31)

Fabric heat loss, W/K = ∑(A x U)	(26)...(30) + (32) =	30.59 (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		8.34 (36)
Total fabric heat loss	(33) + (36) =	38.92 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
25.80	25.64	25.48	24.74	24.61	23.96	23.96	23.84	24.21	24.61	24.88	25.18	(38)

Heat transfer coefficient, W/K (37)m + (38)m

64.72	64.56	64.40	63.67	63.53	62.89	62.89	62.77	63.13	63.53	63.81	64.10	

Average = ∑(39)1...12/12 = 63.67 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.23	1.23	1.23	1.21	1.21	1.20	1.20	1.19	1.20	1.21	1.21	1.22	

Average = ∑(40)1...12/12 = 1.21 (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		1.77 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		76.13 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
83.74	80.69	77.65	74.60	71.56	68.51	68.51	71.56	74.60	77.65	80.69	83.74	

∑(44)1...12 = 913.51 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

124.18	108.61	112.08	97.71	93.76	80.90	74.97	86.03	87.06	101.46	110.75	120.26	

∑(45)1...12 = 1197.75 (45)

Distribution loss 0.15 x (45)m

18.63	16.29	16.81	14.66	14.06	12.14	11.25	12.90	13.06	15.22	16.61	18.04	(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

42.67	37.14	39.57	36.79	36.47	33.79	34.91	36.47	36.79	39.57	39.79	42.67	(61)

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

166.85	145.75	151.64	134.50	130.22	114.69	109.88	122.49	123.85	141.02	150.54	162.94	(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)

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

166.85	145.75	151.64	134.50	130.22	114.69	109.88	122.49	123.85	141.02	150.54	162.94

∑(64)1...12 = 1654.38 (64)

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

51.96	45.40	47.16	41.69	40.29	35.35	33.66	37.72	38.14	43.63	46.77	50.66 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.08	12.50	10.17	7.70	5.75	4.86	5.25	6.82	9.16	11.63	13.57	14.47	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	153.85	155.45	151.43	142.86	132.05	121.89	115.10	113.50	117.53	126.09	136.90	147.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	(69)
P[illegible]p 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)	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	(71)
Water heating gains (Table 5)	69.84	67.56	63.38	57.90	54.15	49.09	45.24	50.70	52.98	58.64	64.96	68.09	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	290.24	287.99	277.46	260.94	244.44	228.32	218.06	223.51	232.14	248.84	267.91	282.10	(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	
NorthWest	0.77	x	2.24	x	11.28	x 0.9 x	0.63	x	0.70	=	7.72	(81)
SouthEast	0.77	x	2.88	x	36.79	x 0.9 x	0.63	x	0.70	=	32.38	(77)
SouthEast	0.54	x	5.04	x	36.79	x 0.9 x	0.63	x	0.70	=	39.74	(77)

S[illegible] gains in watts ∑(74)m...(82)m

79.85	138.59	196.43	254.81	295.84	298.28	285.67	254.36	216.54	155.00	96.11	68.04 (83)

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

370.10	426.57	473.89	515.75	540.27	526.60	503.73	477.87	448.68	403.84	364.03	350.13 (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	0.99	0.98	0.95	0.86	0.70	0.54	0.58	0.82	0.96	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.75	19.91	20.17	20.50	20.78	20.94	20.99	20.98	20.88	20.52	20.07	19.72	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	19.89	19.90	19.90	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.90	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.99	0.99	0.97	0.93	0.81	0.61	0.41	0.46	0.74	0.94	0.99	1.00	(89)

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

	18.24	18.49	18.86	19.33	19.70	19.89	19.92	19.92	19.82	19.37	18.73	18.20	(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

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

	19.05	19.25	19.57	19.96	20.28	20.45	20.49	20.49	20.39	19.99	19.45	19.02	(92)

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

	19.05	19.25	19.57	19.96	20.28	20.45	20.49	20.49	20.39	19.99	19.45	19.02	(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	0.83	0.66	0.48	0.52	0.77	0.95	0.99	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	367.59	420.81	460.07	479.02	449.58	346.04	241.02	250.79	347.71	381.71	359.21	348.28	(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]	954.61	926.69	841.54	704.28	545.12	368.12	244.83	256.69	397.13	596.30	787.93	949.71	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	436.74	339.95	283.81	162.19	71.08	0.00	0.00	0.00	0.00	159.65	308.68	447.46	

∑(98)1...5, 10...12 = 2209.56 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 42.05 (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 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	467.60	363.97	303.87	173.65	76.10	0.00	0.00	0.00	0.00	170.93	330.49	479.08	

∑(211)1...5, 10...12 = 2365.70 (211)

Water heating

Efficiency of water heater

	87.36	87.11	86.61	85.52	83.60	80.30	80.30	80.30	80.30	85.36	86.82	87.46	(217)

Water heating fuel, kWh/month

	190.99	167.31	175.10	157.27	155.77	142.83	136.84	152.54	154.23	165.20	173.39	186.29	

∑(219a)1...12 = 1957.77 (219)

Annual totals

Space heating fuel - main system 1 — 2365.70

Water heating fuel — 1957.77

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)		248.59	(232)
al delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4647.06	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2365.70	x	3.48	x 0.01 =	82.33	(240)
Water heating	1957.77	x	3.48	x 0.01 =	68.13	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	248.59	x	13.19	x 0.01 =	32.79	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		313.14	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.35	(257)
SAP value	81.19	
SAP rating (section 13)	81	(258)
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	2365.70	x	0.22	=	510.99	(261)
Water heating	1957.77	x	0.22	=	422.88	(264)
Space and water heating			(261) + (262) + (263) + (264) =		933.87	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	248.59	x	0.52	=	129.02	(268)
Total CO_2, kg/year				(265)...(271) =	1101.81	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	20.97	(273)
EI value					84.86	
EI rating (section 14)					85	(274)
EI band					B	

d. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2365.70	x	1.22	=	2886.15	(261)
Water heating	1957.77	x	1.22	=	2388.48	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5274.63	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	248.59	x	3.07	=	763.18	(268)
Primary energy kWh/year					6268.06	(272)
Dwelling primary energy rate kWh/m2/year					119.28	(273)

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Design - Draft

NHER

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Assessor name	Mr John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 3 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m^2)		Average storey height (m)		Volume (m^3)	
Lowest occupied		57.70	(1a) x	2.50	(2a) =	144.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	57.70	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	144.25	(5)

2. Ventilation rate

			m^3 per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	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) =	0.14	(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)	0.39	(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) = 0.33	(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	0.42	0.41	0.40	0.36	0.36	0.31	0.31	0.31	0.33	0.36	0.37	0.39	(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

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

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

	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	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			10.78	x	1.33	=	14.29			(27)
Door			1.80	x	1.00	=	1.80			(26)
Ground floor			57.70	x	0.13	=	7.50			(28a)
External wall			54.82	x	0.18	=	9.87			(29a)
Party wall			13.30	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			125.10							(31)

Fabric heat loss, W/K = ∑(A x U)	(26)...(30) + (32) =	33.46 (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		9.51 (36)
Total fabric heat loss	(33) + (36) =	42.98 (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)	28.02	27.86	27.70	26.94	26.80	26.15	26.15	26.02	26.40	26.80	27.09	27.39	(38)
Heat transfer coefficient, W/K (37)m + (38)m	71.00	70.83	70.67	69.92	69.78	69.12	69.12	69.00	69.37	69.78	70.06	70.36	

Average = ∑(39)1...12/12 = 69.92 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.23	1.23	1.22	1.21	1.21	1.20	1.20	1.20	1.20	1.21	1.21	1.22	

Average = ∑(40)1...12/12 = 1.21 (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	1.92 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	79.70 (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)	87.67	84.49	81.30	78.11	74.92	71.73	71.73	74.92	78.11	81.30	84.49	87.67	

∑(44)1...12 = 956.44 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	130.02	113.71	117.34	102.30	98.16	84.71	78.49	90.07	91.15	106.22	115.95	125.91	

∑(45)1...12 = 1254.04 (45)

Distribution loss 0.15 x (45)m	19.50	17.06	17.60	15.35	14.72	12.71	11.77	13.51	13.67	15.93	17.39	18.89	(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	44.68	38.89	41.43	38.52	38.18	35.38	36.55	38.18	38.52	41.43	41.66	44.68	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	174.69	152.60	158.77	140.82	136.34	120.08	115.05	128.25	129.67	147.65	157.61	170.59	(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

174.69	152.60	158.77	140.82	136.34	120.08	115.05	128.25	129.67	147.65	157.61	170.59	

∑(64)1..12 = 1732.12 (64)

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

54.40	47.53	49.37	43.65	42.18	37.01	35.24	39.49	39.94	45.68	48.97	53.04	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.13	13.44	10.93	8.27	6.19	5.22	5.64	7.33	9.84	12.50	14.59	15.55	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	167.11	168.85	164.48	155.17	143.43	132.39	125.02	123.28	127.65	136.96	148.70	159.74	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	(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)	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	(71)
Water heating gains (Table 5)	73.12	70.73	66.36	60.62	56.70	51.40	47.36	53.08	55.47	61.39	68.01	71.28	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	310.10	307.75	296.51	278.80	261.05	243.75	232.76	238.44	247.70	265.59	286.04	301.31	(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	1.36	x	46.75	x 0.9 x	0.63	x	0.70	=	19.43	(78)
East	0.77	x	1.36	x	19.64	x 0.9 x	0.63	x	0.70	=	8.16	(76)
SouthEast	0.77	x	5.24	x	36.79	x 0.9 x	0.63	x	0.70	=	58.92	(77)
SouthWest	0.77	x	2.82	x	36.79	x 0.9 x	0.63	x	0.70	=	31.71	(7

Solar gains in watts ∑(74)m...(82)m

118.23	202.17	278.07	345.90	387.90	385.10	371.29	340.09	301.65	223.90	141.77	101.07	(83)

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

428.33	509.93	574.57	624.70	648.95	628.85	604.05	578.53	549.35	489.48	427.81	402.38	(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	0.99	0.97	0.93	0.83	0.66	0.49	0.53	0.77	0.95	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.78	19.98	20.25	20.57	20.82	20.96	20.99	20.99	20.91	20.58	20.11	19.74	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	19.90	19.90	19.90	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.90	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.99	0.98	0.96	0.90	0.77	0.57	0.38	0.42	0.68	0.92	0.98	0.99	(89)

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

	18.29	18.58	18.97	19.42	19.74	19.89	19.92	19.92	19.85	19.44	18.79	18.25	(90)

Living area fraction — Living area ÷ (4) = 0.53 (91)

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

	19.08	19.32	19.65	20.03	20.31	20.45	20.48	20.48	20.41	20.04	19.49	19.04	(92)

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

	19.08	19.32	19.65	20.03	20.31	20.45	20.48	20.48	20.41	20.04	19.49	19.04	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.96	0.91	0.80	0.61	0.44	0.48	0.72	0.93	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	424.75	500.47	551.07	565.47	515.98	386.36	265.56	277.25	397.45	453.06	420.48	399.81	(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]	1049.24	1021.25	929.11	778.09	600.92	404.63	268.47	281.65	437.60	658.82	867.85	1043.88	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	464.62	349.96	281.26	153.09	63.20	0.00	0.00	0.00	0.00	153.08	322.11	479.19	

Σ(98)1...5, 10...12 = 2266.51 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 39.28 (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 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	497.45	374.69	301.14	163.91	67.66	0.00	0.00	0.00	0.00	163.90	344.87	513.05	

Σ(211)1...5, 10...12 = 2426.67 (211)

Water heating

Efficiency of water heater

	87.40	87.07	86.48	85.26	83.25	80.30	80.30	80.30	80.30	85.14	86.81	87.51	(217)

Water heating fuel, kWh/month

	199.89	175.25	183.60	165.16	163.78	149.54	143.27	159.71	161.48	173.42	181.56	194.94	

Σ(219a)1...12 = 2051.60 (219)

Annual totals

Space heating fuel - main system 1 — 2426.67

Water heating fuel — 2051.60

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)		267.21	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4620.48	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2426.67	x	3.48	x 0.01 =	84.45	(240)
Water heating	2051.60	x	3.48	x 0.01 =	71.40	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	267.21	x	13.19	x 0.01 =	35.25	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		320.98	(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	81.69	
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	2426.67	x	0.22	=	524.16	(261)
Water heating	2051.60	x	0.22	=	443.15	(264)
Space and water heating			(261) + (262) + (263) + (264) =		967.31	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	267.21	x	0.52	=	138.68	(268)
Total CO_2, kg/year			(265)...(271) =		1144.91	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		19.94	(273)
EI value					85.06	
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	2426.67	x	1.22	=	2960.54	(261)
Water heating	2051.60	x	1.22	=	2502.95	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5463.49	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	267.21	x	3.07	=	820.34	(268)
Primary energy kWh/year					6514.08	(272)
Dwelling primary energy rate kWh/m2/year					112.90	(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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 4 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		74.27	(1a) x	2.50	(2a) =	185.68	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	74.27	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	185.68	(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) =	0.16	(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	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(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	0.45	0.44	0.43	0.38	0.38	0.33	0.33	0.32	0.35	0.38	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	0.60	0.59	0.57	0.57	0.56	0.56	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	0.60	0.59	0.57	0.57	0.56	0.56	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	
Door			1.80	x	1.00	=	1.80			(26)
Window			13.30	x	1.33	=	17.68			(27)
Exposed floor			7.50	x	0.13	=	0.98			(28b
External wall			76.20	x	0.18	=	13.72			(29a)
Party wall			4.50	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			98.80							(31)
Fabric heat loss, W/K = ∑(A x U)								(26)...(30) + (32) =	34.12	(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									12.02	(36)
Total fabric heat loss								(33) + (36) =	46.14	(37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
36.73	36.49	36.26	35.17	34.97	34.02	34.02	33.84	34.39	34.97	35.38	35.81	(38)

Heat transfer coefficient, W/K (37)m + (38)m

82.87	82.64	82.41	81.32	81.11	80.16	80.16	79.99	80.53	81.11	81.52	81.96	

Average = ∑(39)1...12/12 = 81.31 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.12	1.11	1.11	1.09	1.09	1.08	1.08	1.08	1.08	1.09	1.10	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 2.35 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 89.90 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
98.89	95.29	91.70	88.10	84.50	80.91	80.91	84.50	88.10	91.70	95.29	98.89	

∑(44)1...12 = 1079.78 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

146.65	128.26	132.35	115.39	110.72	95.54	88.53	101.59	102.81	119.81	130.78	142.02	

∑(45)1...12 = 1414.44 (45)

Distribution loss 0.15 x (45)m

22.00	19.24	19.85	17.31	16.61	14.33	13.28	15.24	15.42	17.97	19.62	21.30	(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

50.39	43.86	46.73	43.45	43.06	39.90	41.23	43.06	43.45	46.73	46.99	50.39	(61)

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

197.04	172.12	179.08	158.83	153.78	135.44	129.76	144.65	146.25	166.54	177.77	192.41	(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)

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

	197.04	172.12	179.08	158.83	153.78	135.44	129.76	144.65	146.25	166.54	177.77	192.41

∑(64)1...12 = 1953.68 (64)

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

	61.36	58.61	55.69	49.23	47.58	41.74	39.74	44.54	45.04	51.52	55.23	59.82 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.37	17.20	13.99	10.59	7.92	6.68	7.22	9.39	12.60	16.00	18.67	19.91	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	207.05	209.20	203.79	192.26	177.71	164.09	154.90	152.75	158.16	169.69	184.24	197.92	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	(69)
(ap 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)	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	(71)
Water heating gains (Table 5)	82.47	79.78	74.85	68.37	63.95	57.98	53.42	59.87	62.56	69.25	76.71	80.40	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	370.07	367.36	353.80	332.40	310.75	289.87	276.72	283.19	294.50	316.11	340.81	359.40	(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	
SouthWest	0.77	x	0.84	x	36.79	x0.9x	0.63	x	0.70	=	9.45	(79)
NorthWest	0.77	x	3.36	x	11.28	x0.9x	0.63	x	0.70	=	11.59	(81)
NorthWest	0.54	x	5.04	x	11.28	x0.9x	0.63	x	0.70	=	12.19	(81)
(h	0.54	x	0.84	x	10.63	x0.9x	0.63	x	0.70	=	1.91	(74)
NorthEast	0.54	x	2.38	x	11.28	x0.9x	0.63	x	0.70	=	5.76	(75)
East	0.54	x	0.84	x	19.64	x0.9x	0.63	x	0.70	=	3.54	(76)

Solar gains in watts ∑(74)m...(82)m

44.43	86.77	147.92	231.73	303.43	320.44	300.96	244.59	176.52	103.80	55.24	36.70	(83)

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

414.49	454.13	501.72	564.13	614.19	610.32	577.67	527.77	471.02	419.91	396.04	396.11	(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	0.99	0.98	0.91	0.76	0.59	0.66	0.90	0.99	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.77	19.88	20.11	20.45	20.75	20.94	20.99	20.98	20.83	20.45	20.06	19.75	(87)

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

19.99	19.99	19.99	20.01	20.01	20.02	20.02	20.02	20.01	20.01	20.00	20.00	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	1.00	0.99	0.97	0.88	0.67	0.47	0.54	0.85	0.98	1.00	1.00	(89)

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

18.34	18.51	18.85	19.34	19.75	19.97	20.01	20.01	19.87	19.35	18.77	18.32	(90)

Living area fraction — Living area ÷ (4) = 0.42 (91)

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

18.94	19.09	19.38	19.80	20.17	20.38	20.42	20.42	20.27	19.81	19.31	18.92	(92)

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

18.94	19.09	19.38	19.80	20.17	20.38	20.42	20.42	20.27	19.81	19.31	18.92	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	0.99	0.96	0.88	0.71	0.52	0.59	0.86	0.98	1.00	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	413.41	452.04	496.18	543.59	542.30	431.69	301.24	311.74	406.13	410.68	394.10	395.29	(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]	1213.00	1172.32	1061.25	886.52	687.25	463.22	306.36	321.20	497.07	747.23	985.66	1206.33	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	594.90	484.02	420.41	246.91	107.85	0.00	0.00	0.00	0.00	250.40	433.13	603.42	

∑(98)1...5, 10...12 = 3141.03 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 42.29 (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 (20[illegible]

Efficiency of main system 1 (%) = 93.40 (20[illegible]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	636.94	518.23	450.12	264.35	115.47	0.00	0.00	0.00	0.00	268.09	463.74	646.06	

∑(211)1...5, 10...12 = 3362.99 (211)

Water heating

Efficiency of water heater

87.66	87.51	87.13	86.16	84.18	80.30	80.30	80.30	80.30	86.08	87.21	87.73	(217)

Water heating fuel, kWh/month

224.79	196.68	205.54	184.35	182.69	168.67	161.60	180.14	182.13	193.48	203.85	219.32	

∑(219a)1...12 = 2303.23 (219)

Annual totals

Space heating fuel - main system 1 = 3362.99

Water heating fuel = 2303.23

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)		342.07	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	6083.29	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3362.99	x	3.48	x 0.01 =	117.03	(240)
Water heating	2303.23	x	3.48	x 0.01 =	80.15	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	342.07	x	13.19	x 0.01 =	45.12	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		372.20	(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	81.72	
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	3362.99	x	0.22	=	726.41	(261)
Water heating	2303.23	x	0.22	=	497.50	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1223.90	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	342.07	x	0.52	=	177.53	(268)
Total CO_2, kg/year				(265)...(271) =	1440.36	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	19.39	(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	3362.99	x	1.22	=	4102.85	(261)
Water heating	2303.23	x	1.22	=	2809.94	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6912.79	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	342.07	x	3.07	=	1050.14	(268)
Primary energy kWh/year					8193.18	(272)
Dwelling primary energy rate kWh/m2/year					110.32	(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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 5 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		52.55	(1a) x	2.50	(2a) =	131.38	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	52.55	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	131.38	(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) =	0.15	(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)	0.40	(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) = 0.34	(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	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.40	(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	
	0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	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	0.57	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	
Door			1.80	x	1.00	=	1.80			(26)
Window			8.96	x	1.33	=	11.88			(27)
External wall			43.90	x	0.18	=	7.90			(29a)
Party wall			17.80	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			54.66							(31)

Fabric heat loss, W/K = ∑(A x U)	(26)...(30) + (32) =	21.58 (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		6.18 (36)
Total fabric heat loss	(33) + (36) =	27.76 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
25.80	25.64	25.48	24.74	24.61	23.96	23.96	23.84	24.21	24.61	24.88	25.18	(38)

Heat transfer coefficient, W/K (37)m + (38)m

53.56	53.40	53.24	52.50	52.36	51.72	51.72	51.60	51.97	52.36	52.64	52.93	

Average = ∑(39)1...12/12 = 52.50 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.02	1.02	1.01	1.00	1.00	0.98	0.98	0.98	0.99	1.00	1.00	1.01	

Average = ∑(40)1...12/12 = 1.00 (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: 1.77 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36: 76.13 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
83.74	80.69	77.65	74.60	71.56	68.51	68.51	71.56	74.60	77.65	80.69	83.74	

∑(44)1...12 = 913.51 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

124.18	108.61	112.08	97.71	93.76	80.90	74.97	86.03	87.06	101.46	110.75	120.26	

∑(45)1...12 = 1197.75 (45)

Distribution loss 0.15 x (45)m

18.63	16.29	16.81	14.66	14.06	12.14	11.25	12.90	13.06	15.22	16.61	18.04	(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

42.67	37.14	39.57	36.79	36.47	33.79	34.91	36.47	36.79	39.57	39.79	42.67	(61)

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

166.85	145.75	151.64	134.50	130.22	114.69	109.88	122.49	123.85	141.02	150.54	162.94	(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 (69)

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

	166.85	145.75	151.64	134.50	130.22	114.69	109.88	122.49	123.85	141.02	150.54	162.94

∑(64)1...12 = 1654.38 (64)

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

	51.96	45.40	47.16	41.69	40.29	35.35	33.66	37.72	38.14	43.63	46.77	50.66 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.46	12.84	10.44	7.91	5.91	4.99	5.39	7.01	9.41	11.94	13.94	14.86	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	153.85	155.45	151.43	142.86	132.05	121.89	115.10	113.50	117.53	126.09	136.90	147.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	(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)	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	(71)
Water heating gains (Table 5)	69.84	67.56	63.38	57.90	54.15	49.09	45.24	50.70	52.98	58.64	64.96	68.09	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	290.63	288.33	277.73	261.14	244.59	228.45	218.21	223.69	232.39	249.15	268.28	282.49	(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	
NorthWest	0.77	x	2.24	x	11.28	x 0.9 x	0.63	x	0.70	=	7.72	(81)
SouthEast	0.77	x	1.68	x	36.79	x 0.9 x	0.63	x	0.70	=	18.89	(77)
SouthEast	0.54	x	5.04	x	36.79	x 0.9 x	0.63	x	0.70	=	39.74	(77)

Solar gains in watts ∑(74)m...(82)m

	66.36	115.60	164.99	215.85	252.19	254.95	243.90	216.08	182.49	129.60	79.95	56.49 (8(

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

	356.99	403.93	442.72	476.99	496.78	483.41	462.10	439.77	414.88	378.75	348.23	338.98 (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	0.66	0.49	0.53	0.78	0.96	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.01	20.16	20.38	20.66	20.87	20.98	21.00	20.99	20.94	20.67	20.29	19.99	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	20.07	20.07	20.07	20.08	20.09	20.10	20.10	20.10	20.09	20.09	20.08	20.08	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.99	0.97	0.92	0.79	0.58	0.39	0.43	0.71	0.94	0.99	1.00	(89)

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

18.76	18.97	19.29	19.69	19.96	20.08	20.10	20.10	20.04	19.71	19.17	18.73

(90)

ig area fraction — Living area ÷ (4) = 0.54 (91)

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

19.43	19.61	19.88	20.21	20.45	20.56	20.58	20.58	20.52	20.22	19.77	19.40

(92)

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

19.43	19.61	19.88	20.21	20.45	20.56	20.58	20.58	20.52	20.22	19.77	19.40

(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	0.49	0.75	0.94	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	354.85	398.99	430.31	441.33	404.03	299.33	204.69	213.75	309.09	356.66	343.87	337.42	(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]	810.40	785.38	712.13	593.76	458.32	308.37	205.83	215.64	333.87	503.82	667.10	804.86	(97)
ace heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	338.92	259.66	209.67	109.75	40.39	0.00	0.00	0.00	0.00	109.49	232.73	347.77	

∑(98)1...5, 10...12 = 1648.39 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 31.37 (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 (%) = 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	362.87	278.01	224.49	117.51	43.25	0.00	0.00	0.00	0.00	117.23	249.17	372.35	

∑(211)1...5, 10...12 = 1764.87 (211)

Water heating

Efficiency of water heater

86.80	86.49	85.87	84.54	82.48	80.30	80.30	80.30	80.30	84.42	86.14	86.91	(217)

Water heating fuel, kWh/month

192.23	168.52	176.60	159.09	157.88	142.83	136.84	152.54	154.23	167.05	174.75	187.47

∑(219a)1...12 = 1970.03 (219)

Annual totals

Space heating fuel - main system 1 = 1764.87

Water heating fuel = 1970.03

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)		255.35	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4065.25	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1764.87	x	3.48	x 0.01 =	61.42	(240)
Water heating	1970.03	x	3.48	x 0.01 =	68.56	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	255.35	x	13.19	x 0.01 =	33.68	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		293.55	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.26	(257)
SAP value	82.37	
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	1764.87	x	0.22	=	391.21	(261)
Water heating	1970.03	x	0.22	=	425.53	(264)
Space and water heating			(261) + (262) + (263) + (264) =		806.74	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	255.35	x	0.52	=	132.53	(268)
Total CO_2, kg/year				(265)...(271) =	978.19	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	18.61	(273)
EI value					86.56	
EI rating (section 14)					87	(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	1764.87	x	1.22	=	2153.14	(261)
Water heating	1970.03	x	1.22	=	2403.44	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4556.59	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	255.35	x	3.07	=	783.92	(268)
Primary energy kWh/year					5570.75	(272)
Dwelling primary energy rate kWh/m2/year					106.01	(273)

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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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 6 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		57.70 (1a)	x	2.50 (2a)	=	144.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)..(1n) =	57.70 (4)					
Dwelling volume					(3a) + (3b) + (3c) + (3d)..(3n) =	144.25	(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) =	0.14	(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)		0.39 (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) =	0.33 (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	0.42	0.41	0.40	0.36	0.36	0.31	0.31	0.31	0.33	0.36	0.37	0.39	(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	
	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

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

0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	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			9.75	x	1.33	=	12.93			(27)
Door			1.80	x	1.00	=	1.80			(26)
External wall			55.85	x	0.18	=	10.05			(29a)
Party wall			13.30	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			67.40							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.78 (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		6.56 (36)
Total fabric heat loss	(33) + (36) =	31.34 (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)	28.02	27.86	27.70	26.94	26.80	26.15	26.15	26.02	26.40	26.80	27.09	27.39	(38)
Heat transfer coefficient, W/K (37)m + (38)m	59.36	59.20	59.04	58.28	58.14	57.48	57.48	57.36	57.74	58.14	58.43	58.73	

Average = ∑(39)1...12/12 = 58.28 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.03	1.03	1.02	1.01	1.01	1.00	1.00	0.99	1.00	1.01	1.01	1.02	

Average = ∑(40)1...12/12 = 1.01 (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	1.92 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	79.70 (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)	87.67	84.49	81.30	78.11	74.92	71.73	71.73	74.92	78.11	81.30	84.49	87.67	

∑(44)1...12 = 956.44 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	130.02	113.71	117.34	102.30	98.16	84.71	78.49	90.07	91.15	106.22	115.95	125.91	

∑(45)1...12 = 1254.04 (45)

Distribution loss 0.15 x (45)m	19.50	17.06	17.60	15.35	14.72	12.71	11.77	13.51	13.67	15.93	17.39	18.89	(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	44.68	38.89	41.43	38.52	38.18	35.38	36.55	38.18	38.52	41.43	41.66	44.68	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	174.69	152.60	158.77	140.82	136.34	120.08	115.05	128.25	129.67	147.65	157.61	170.59	(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

( )	174.69	152.60	158.77	140.82	136.34	120.08	115.05	128.25	129.67	147.65	157.61	170.59

∑(64)1...12 = 1732.12 (64)

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

	54.40	47.53	49.37	43.65	42.18	37.01	35.24	39.49	39.94	45.68	48.97	53.04 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.38	13.66	11.11	8.41	6.29	5.31	5.74	7.46	10.01	12.71	14.83	15.81	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	167.11	168.85	164.48	155.17	143.43	132.39	125.02	123.28	127.65	136.96	148.70	159.74	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	(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)	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	(71)
Water heating gains (Table 5)	73.12	70.73	66.36	60.62	56.70	51.40	47.36	53.08	55.47	61.39	68.01	71.28	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	310.35	307.98	296.69	278.94	261.15	243.84	232.86	238.56	247.87	265.80	286.28	301.57	(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	1.12	x	46.75	x 0.9 x	0.63	x	0.70	=	16.00	(78)
East	0.77	x	1.12	x	19.64	x 0.9 x	0.63	x	0.70	=	6.72	(76)
SouthEast	0.77	x	4.69	x	36.79	x 0.9 x	0.63	x	0.70	=	52.74	(77)
SouthWest	0.77	x	2.82	x	36.79	x 0.9 x	0.63	x	0.70	=	31.71	(79)

( ) gains in watts ∑(74)m...(82)m

	107.17	183.20	251.86	313.18	351.18	348.64	336.14	307.90	273.17	202.85	128.50	91.69 (83)

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

	417.52	491.18	548.54	592.12	612.33	592.48	568.99	546.46	521.04	468.65	414.78	393.20 (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	0.97	0.91	0.79	0.60	0.44	0.48	0.72	0.93	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.04	20.22	20.46	20.72	20.91	20.98	21.00	21.00	20.96	20.72	20.33	20.01	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	20.06	20.06	20.06	20.07	20.08	20.09	20.09	20.09	20.08	20.08	20.07	20.07	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.99	0.98	0.96	0.89	0.74	0.53	0.35	0.38	0.64	0.91	0.98	1.00 (89)

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

	18.79	19.05	19.39	19.76	19.99	20.08	20.09	20.09	20.05	19.77	19.22	18.75 (90)

Living area fraction — Living area ÷ (4) = 0.53 (91)

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

	19.45	19.67	19.95	20.27	20.47	20.55	20.57	20.57	20.53	20.27	19.80	19.41 (92)

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

	19.45	19.67	19.95	20.27	20.47	20.55	20.57	20.57	20.53	20.27	19.80	19.41 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.99	0.98	0.96	0.89	0.76	0.57	0.40	0.44	0.68	0.91	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	414.21	482.00	524.43	527.88	466.30	335.58	227.22	237.73	353.53	428.36	407.47	390.87	(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]													
	899.31	874.19	794.27	662.67	510.06	342.28	228.00	238.98	371.25	562.29	742.20	893.34	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	360.91	263.55	200.76	97.05	32.56	0.00	0.00	0.00	0.00	99.64	241.01	373.84	

∑(98)1...5, 10...12 = 1669.32 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 28.93 (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 (%) = 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month													
	386.42	282.18	214.94	103.91	34.86	0.00	0.00	0.00	0.00	106.68	258.04	400.26	

∑(211)1...5, 10...12 = 1787.28 (211)

Water heating

Efficiency of water heater

	86.84	86.41	85.64	84.14	82.07	80.30	80.30	80.30	80.30	84.09	86.12	86.97 (217)

Water heating fuel, kWh/month

	201.17	176.59	185.39	167.38	166.19	149.54	143.27	159.71	161.48	175.60	183.02	196.14

∑(219a)1...12 = 2065.42 (219)

Annual totals

Space heating fuel - main system 1 = 1787.28

Water heating fuel = 2065.42

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)	271.66	(232)
( )l delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	4199.35	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1787.28	x	3.48	x 0.01 =	62.20	(240)
Water heating	2065.42	x	3.48	x 0.01 =	71.88	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	271.66	x	13.19	x 0.01 =	35.83	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	299.80	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.23	(257)
SAP value	82.90	
SAP rating (section 13)	83	(258)
( ) 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	1787.28	x	0.22	=	386.05	(261)
Water heating	2065.42	x	0.22	=	446.13	(264)
Space and water heating			(261) + (262) + (263) + (264) =		832.18	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	271.66	x	0.52	=	140.99	(268)
Total CO_2, kg/year				(265)...(271) =	1012.10	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	17.54	(273)
EI value					86.79	
EI rating (section 14)					87	(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	1787.28	x	1.22	=	2180.48	(261)
Water heating	2065.42	x	1.22	=	2519.82	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4700.29	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	271.66	x	3.07	=	833.98	(268)
Primary energy kWh/year					5764.53	(272)
Dwelling primary energy rate kWh/m2/year					99.91	(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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 7 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		74.27	(1a) x	2.50	(2a) =	185.68	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	74.27	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	185.68	(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) =	0.16	(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	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(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	0.45	0.44	0.43	0.38	0.38	0.33	0.33	0.32	0.35	0.38	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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.60	0.60	0.59	0.57	0.57	0.56	0.56	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	0.60	0.59	0.57	0.57	0.56	0.56	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	
Door			1.80	x	1.00	=	1.80			(26)
Window			12.36	x	1.33	=	16.39			(27)
External wall			77.14	x	0.18	=	13.89			(29a)
Party wall			4.50	x	0.00	=	0.00			(32)
Roof			22.60	x	0.13	=	2.94			(30)
Total area of external elements ∑A, m²			113.90							(31)

Fabric heat loss, W/K = ∑(A x U)	(26)...(30) + (32) =	35.01 (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		9.28 (36)
Total fabric heat loss	(33) + (36) =	44.29 (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)	36.73	36.49	36.26	35.17	34.97	34.02	34.02	33.84	34.39	34.97	35.38	35.81	(38)
Heat transfer coefficient, W/K (37)m + (38)m	81.02	80.79	80.55	79.46	79.26	78.31	78.31	78.14	78.68	79.26	79.67	80.10	
Average = ∑(39)1...12/12 = 79.46 (39)													
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.09	1.09	1.08	1.07	1.07	1.05	1.05	1.05	1.06	1.07	1.07	1.08	
Average = ∑(40)1...12/12 = 1.07 (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	2.35 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	89.90 (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)	98.89	95.29	91.70	88.10	84.50	80.91	80.91	84.50	88.10	91.70	95.29	98.89	
∑(44)1...12 = 1078.78 (44)													
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	146.65	128.26	132.35	115.39	110.72	95.54	88.53	101.59	102.81	119.81	130.78	142.02	
∑(45)1...12 = 1414.44 (45)													
Distribution loss 0.15 x (45)m	22.00	19.24	19.85	17.31	16.61	14.33	13.28	15.24	15.42	17.97	19.62	21.30	(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	50.39	43.86	46.73	43.45	43.06	39.90	41.23	43.06	43.45	46.73	46.99	50.39	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	197.04	172.12	179.08	158.83	153.78	135.44	129.76	144.65	146.25	166.54	177.77	192.41	(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

197.04	172.12	179.08	158.83	153.78	135.44	129.76	144.65	146.25	166.54	177.77	192.41	

∑(64)1...12 = 1953.68 (64)

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

61.36	53.61	55.69	49.23	47.58	41.74	39.74	44.54	45.04	51.52	55.23	59.82	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	117.26	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.68	17.48	14.22	10.76	8.05	6.79	7.34	9.54	12.81	16.26	18.98	20.23	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	207.05	209.20	203.79	192.26	177.71	164.03	154.90	152.75	158.16	169.69	184.24	197.92	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	(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)	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	-93.81	(71)
Water heating gains (Table 5)	82.47	79.78	74.85	68.37	63.95	57.98	53.42	59.87	62.56	69.25	76.71	80.40	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	370.38	367.64	354.03	332.57	310.88	289.98	276.84	283.34	294.71	316.37	341.11	359.73	(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	
SouthWest	0.77	x	0.84	x	36.79	x 0.9 x	0.63	x	0.70	=	9.45	(79)
NorthWest	0.77	x	2.88	x	11.28	x 0.9 x	0.63	x	0.70	=	9.93	(81)
NorthWest	0.54	x	5.04	x	11.28	x 0.9 x	0.63	x	0.70	=	12.19	(81)
North	0.54	x	0.72	x	10.63	x 0.9 x	0.63	x	0.70	=	1.64	(74)
NorthEast	0.54	x	2.16	x	11.28	x 0.9 x	0.63	x	0.70	=	5.22	(75)
East	0.54	x	0.72	x	19.64	x 0.9 x	0.63	x	0.70	=	3.03	(76)

Solar gains in watts ∑(74)m...(82)m

41.46	80.81	137.38	214.75	280.89	296.53	278.54	226.55	163.78	96.57	51.52	34.27	(83)

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

411.84	448.45	491.41	547.33	591.78	586.51	555.38	509.89	458.49	412.94	392.63	394.00	(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	0.99	0.98	0.92	0.77	0.60	0.67	0.90	0.99	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.80	19.91	20.13	20.45	20.75	20.94	20.99	20.98	20.84	20.47	20.08	19.78	(87)

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

	20.01	20.01	20.01	20.03	20.03	20.04	20.04	20.04	20.03	20.03	20.02	20.02	(88)

(sation factor for gains for rest of dwelling n2,m

	1.00	1.00	0.99	0.97	0.88	0.69	0.48	0.55	0.85	0.98	1.00	1.00	(89)

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

	18.40	18.56	18.89	19.36	19.77	19.99	20.03	20.03	19.89	19.38	18.82	18.38	(90)

Living area fraction — Living area ÷ (4) = 0.42 (91)

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

	18.98	19.13	19.41	19.82	20.18	20.39	20.43	20.43	20.29	19.84	19.35	18.97	(92)

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

	18.98	19.13	19.41	19.82	20.18	20.39	20.43	20.43	20.29	19.84	19.35	18.97	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	0.99	0.97	0.89	0.72	0.59	0.60	0.87	0.98	1.00	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	410.81	446.50	486.37	528.98	527.10	421.56	295.11	305.40	397.56	404.25	390.77	393.22	(95)
( )thly 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]	1189.73	1149.39	1039.89	867.72	672.36	453.40	300.22	314.71	486.77	732.24	976.20	1182.96	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	579.52	472.34	411.82	243.90	108.07	0.00	0.00	0.00	0.00	244.03	421.51	587.57	

∑(98)1...5, 10...12 = 3068.75 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 41.32 (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)

F tion of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	620.47	505.72	440.92	261.13	115.71	0.00	0.00	0.00	0.00	261.27	451.29	629.09	

∑(211)1...5, 10...12 = 3285.60 (211)

Water heating

Efficiency of water heater

	87.60	87.46	87.08	86.13	84.18	80.30	80.30	80.30	80.30	86.01	87.15	87.68	(217)

Water heating fuel, kWh/month

	224.92	196.79	205.65	184.42	182.68	168.67	161.60	180.14	182.13	193.62	203.99	219.45	

∑(219a)1...12 = 2304.06 (219)

Annual totals

Space heating fuel - main system 1 — 3285.60

Water heating fuel — 2304.06

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)		347.60	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	6012.26	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3285.60	x	3.48	x 0.01 =	114.34	(240)
Water heating	2304.06	x	3.48	x 0.01 =	80.18	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	347.60	x	13.19	x 0.01 =	45.85	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		370.26	(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	81.81	
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	3285.60	x	0.22	=	709.69	(261)
Water heating	2304.06	x	0.22	=	497.68	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1207.37	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	347.60	x	0.52	=	180.41	(268)
Total CO_2, kg/year				(265)...(271) =	1426.70	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	19.21	(273)
EI value					83.97	
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	3285.60	x	1.22	=	4008.43	(261)
Water heating	2304.06	x	1.22	=	2810.95	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6819.38	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	347.60	x	3.07	=	1067.14	(268)
Primary energy kWh/year					8116.77	(272)
Dwelling primary energy rate kWh/m2/year					109.29	(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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat B 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		52.55	(1a) x	2.50	(2a) =	131.38	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	52.55	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	131.38	(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) =	0.15	(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)	0.40	(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) = 0.34	(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	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.40	(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	
	0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	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	0.57	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	
Door			1.80	x	1.00	=	1.80			(26)
Window			7.98	x	1.33	=	10.58			(27)
External wall			44.88	x	0.16	=	6.08			(29a)
Party wall			17.80	x	0.00	=	0.00			(32)
Roof			15.60	x	0.13	=	2.03			(30)
Total area of external elements ∑A, m²			70.26							(31)

Fabric heat loss, W/K = ∑(A x U)	(26)...(30) + (32) =	22.49 (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		6.31 (36)
Total fabric heat loss	(33) + (36) =	28.79 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
25.80	25.64	25.48	24.74	24.61	23.96	23.96	23.84	24.21	24.61	24.88	25.18	(38)

Heat transfer coefficient, W/K (37)m + (38)m

54.59	54.43	54.27	53.53	53.40	52.76	52.76	52.64	53.00	53.40	53.68	53.97	

Average = ∑(39)1...12/12 = 53.53 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.04	1.04	1.03	1.02	1.02	1.00	1.00	1.00	1.01	1.02	1.02	1.03	

Average = ∑(40)1...12/12 = 1.02 (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	1.77 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	76.13 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
83.74	80.69	77.65	74.60	71.56	68.51	68.51	71.56	74.60	77.65	80.69	83.74	

∑(44)1...12 = 913.51 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

124.18	108.61	112.08	97.71	93.76	80.90	74.97	86.03	87.06	101.46	110.75	120.26	

∑(45)1...12 = 1197.75 (45)

Distribution loss 0.15 x (45)m

18.63	16.29	16.81	14.66	14.06	12.14	11.25	12.90	13.06	15.22	16.61	18.04	(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

42.67	37.14	39.57	36.79	36.47	33.79	34.91	36.47	36.79	39.57	39.79	42.67	(61)

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

166.85	145.75	151.64	134.50	130.22	114.69	109.88	122.49	123.85	141.02	150.54	162.94	(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)

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

	166.85	145.75	151.64	134.50	130.22	114.69	109.88	122.49	123.85	141.02	150.54	162.94

∑(64)1...12 = 1654.38 (64)

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

	51.96	45.40	47.16	41.69	40.29	35.35	33.66	37.72	38.14	43.63	46.77	50.66 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	88.26	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.83	13.18	10.72	8.11	6.06	5.12	5.53	7.19	9.65	12.25	14.30	15.25	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	153.85	155.45	151.43	142.86	132.05	121.89	115.10	113.50	117.53	126.09	136.90	147.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	(69)
[·p 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)	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	-70.61	(71)
Water heating gains (Table 5)	69.84	67.56	63.38	57.90	54.15	49.09	45.24	50.70	52.98	58.64	64.96	68.09	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	291.00	288.66	278.00	261.35	244.75	228.58	218.35	223.87	232.63	249.46	268.64	282.88	(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	
NorthWest	0.77	x	1.92	x	11.28	x 0.9 x	0.63	x	0.70	=	6.62	(81)
SouthEast	0.77	x	1.44	x	36.79	x 0.9 x	0.63	x	0.70	=	16.19	(77)
SouthEast	0.54	x	4.62	x	36.79	x 0.9 x	0.63	x	0.70	=	36.43	(77)

(: gains in watts ∑(74)m...(82)m

	59.25	103.12	146.93	191.84	223.82	226.13	216.38	191.92	162.39	115.54	71.36	50.44 (83)

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

	350.25	391.78	424.93	453.19	468.56	454.71	434.72	415.79	395.02	365.00	340.01	333.32 (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)	1.00	0.99	0.98	0.95	0.87	0.70	0.53	0.57	0.81	0.96	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.97	20.11	20.33	20.61	20.84	20.97	20.99	20.99	20.92	20.63	20.25	19.95	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	20.05	20.05	20.06	20.07	20.07	20.08	20.08	20.08	20.08	20.07	20.07	20.06	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.98	0.94	0.83	0.62	0.42	0.46	0.74	0.95	0.99	1.00	(89)

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

18.69	18.89	19.20	19.60	19.91	20.06	20.08	20.08	20.01	19.64	19.10	18.66	(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

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

19.38	19.54	19.81	20.14	20.41	20.54	20.57	20.57	20.50	20.17	19.72	19.35	(92)

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

19.38	19.54	19.81	20.14	20.41	20.54	20.57	20.57	20.50	20.17	19.72	19.35	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.98	0.94	0.84	0.66	0.48	0.52	0.78	0.95	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	348.34	387.64	415.06	425.68	395.58	300.39	207.64	216.54	306.91	346.94	336.23	331.91	(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]	823.08	797.09	722.12	601.87	465.03	313.63	209.46	219.43	339.19	511.11	677.43	817.76	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	353.21	275.15	228.45	126.86	51.67	0.00	0.00	0.00	0.00	122.14	245.66	361.48	

∑(98)1...5, 10...12 = 1764.61 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 33.58 (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 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	378.17	294.59	244.60	135.82	55.32	0.00	0.00	0.00	0.00	130.77	263.02	387.02	

∑(211)1...5, 10...12 = 1889.30 (211)

Water heating

Efficiency of water heater

86.89	86.63	86.08	84.90	82.93	80.30	80.30	80.30	80.30	84.69	86.28	87.00	(217)

Water heating fuel, kWh/month

192.02	168.25	176.17	158.41	157.02	142.83	136.84	152.54	154.23	166.51	174.49	187.28	

∑(219a)1...12 = 1966.60 (219)

Annual totals

Space heating fuel - main system 1 — 1889.30

Water heating fuel — 1966.60

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)		261.98	(232)
( ) delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4192.89	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1889.30	x	3.48	x 0.01 =	65.75	(240)
Water heating	1966.60	x	3.48	x 0.01 =	68.44	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	261.98	x	13.19	x 0.01 =	34.56	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		298.63	(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	82.06	
SAP rating (section 13)	82	(258)
( ) 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	1889.30	x	0.22	=	408.09	(261)
Water heating	1966.60	x	0.22	=	424.79	(264)
Space and water heating			(261) + (262) + (263) + (264) =		832.87	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	261.98	x	0.52	=	135.97	(268)
Total CO_2, kg/year				(265)...(271) =	1007.77	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	19.18	(273)
EI value					86.16	
EI rating (section 14)					86	(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	1889.30	x	1.22	=	2304.95	(261)
Water heating	1966.60	x	1.22	=	2399.25	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4704.20	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	261.98	x	3.07	=	804.29	(268)
Primary energy kWh/year					5738.74	(272)
Dwelling primary energy rate kWh/m2/year					109.21	(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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 9 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		57.70	(1a) x	2.50	(2a) =	144.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	57.70	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	144.25	(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) =	0.14	(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)	0.39	(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) = 0.33	(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	0.42	0.41	0.40	0.36	0.36	0.31	0.31	0.31	0.33	0.36	0.37	0.39	(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

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

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

0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	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			9.15	x	1.33	=	12.13			(27)
Door			1.80	x	1.00	=	1.80			(26)
External wall			56.45	x	0.18	=	10.16			(29a)
Party wall			13.30	x	0.00	=	0.00			(32)
Roof			19.90	x	0.13	=	2.59			(30)
Total area of external elements ∑A, m²			87.30							(31)

Fabric heat loss, W/K = ∑(A x U)	(26)...(30) + (32) =	26.68 (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		7.09 (36)
Total fabric heat loss	(33) + (36) =	33.76 (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)	28.02	27.86	27.70	26.94	26.80	26.15	26.15	26.02	26.40	26.80	27.09	27.39	(38)
Heat transfer coefficient, W/K (37)m + (38)m	61.79	61.62	61.46	60.71	60.57	59.91	59.91	59.79	60.16	60.57	60.85	61.15	
Average = ∑(39)1...12/12 = 60.71 (39)													
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.07	1.07	1.07	1.05	1.05	1.04	1.04	1.04	1.04	1.05	1.05	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	1.92 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	79.70 (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)	87.67	84.49	81.30	78.11	74.92	71.73	71.73	74.92	78.11	81.30	84.49	87.67	
∑(44)1...12 = 956.44 (44)													
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	130.02	113.71	117.34	102.30	98.16	84.71	78.49	90.07	91.15	106.22	115.95	125.91	
∑(45)1...12 = 1254.04 (45)													
Distribution loss 0.15 x (45)m	19.50	17.06	17.60	15.35	14.72	12.71	11.77	13.51	13.67	15.93	17.39	18.89	(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	44.68	38.89	41.43	38.52	38.18	35.38	36.55	38.18	38.52	41.43	41.66	44.68	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	174.69	152.60	158.77	140.82	136.34	120.08	115.05	128.25	129.67	147.65	157.61	170.59	(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

174.69	152.60	158.77	140.82	136.34	120.08	115.05	128.25	129.67	147.65	157.61	170.59	

∑(64)1...12 = 1732.12 (64)

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

54.40	47.53	49.37	43.65	42.18	37.01	35.24	39.49	39.94	45.68	48.97	53.04	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	95.80	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.57	13.83	11.25	8.51	6.36	5.37	5.81	7.55	10.13	12.86	15.01	16.00	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	167.11	168.85	164.48	155.17	143.43	132.39	125.02	123.28	127.65	136.96	148.70	159.74	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	32.58	(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)	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	-76.64	(71)
Water heating gains (Table 5)	73.12	70.73	66.36	60.62	56.70	51.40	47.36	53.08	55.47	61.39	68.01	71.28	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	310.54	308.14	296.82	279.04	261.23	243.91	232.93	238.65	247.99	265.95	286.46	301.76	(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	
South	0.77	x	0.96	x	46.75	x 0.9 x	0.63	x	0.70	=	13.72	(78)
East	0.77	x	0.96	x	19.64	x 0.9 x	0.63	x	0.70	=	5.76	(76)
SouthEast	0.77	x	4.41	x	36.79	x 0.9 x	0.63	x	0.70	=	49.59	(77)
SouthWest	0.77	x	2.82	x	36.79	x 0.9 x	0.63	x	0.70	=	31.71	(79)

Solar gains in watts ∑(74)m...(82)m

100.78	172.22	236.66	294.19	329.85	327.46	315.72	289.21	256.65	190.66	120.82	86.17	(83)

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

411.32	480.36	533.48	573.23	591.08	571.37	548.64	527.86	504.64	456.61	407.29	387.93	(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	0.97	0.93	0.82	0.64	0.48	0.51	0.75	0.94	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.97	20.15	20.38	20.66	20.87	20.97	21.00	20.99	20.94	20.67	20.27	19.94	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	20.02	20.03	20.03	20.04	20.04	20.05	20.05	20.05	20.05	20.04	20.04	20.03	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.99	0.99	0.96	0.90	0.77	0.56	0.38	0.41	0.67	0.92	0.99	1.00	(89)

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

	18.66	18.92	19.26	19.66	19.92	20.04	20.05	20.05	20.00	19.68	19.10	18.62	(90)

Living area fraction — Living area ÷ (4) = 0.53 (91)

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

	19.35	19.56	19.85	20.19	20.42	20.53	20.55	20.55	20.50	20.20	19.72	19.32	(92)

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

	19.35	19.56	19.85	20.19	20.42	20.53	20.55	20.55	20.50	20.20	19.72	19.32	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.96	0.91	0.79	0.60	0.43	0.47	0.71	0.93	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	408.32	472.49	513.52	520.75	468.76	344.75	235.19	245.87	359.56	422.95	400.90	385.79	(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)
(_t loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	930.13	903.71	820.78	685.27	528.34	355.28	236.56	248.00	384.93	581.47	767.73	924.45	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	388.23	289.78	228.60	118.45	44.33	0.00	0.00	0.00	0.00	117.94	264.12	400.76	

∑(98)1...5, 10...12 = 1952.19 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 32.10 (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 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(Space heating fuel (main system 1), kWh/month	415.66	310.25	244.75	126.82	47.46	0.00	0.00	0.00	0.00	126.27	282.78	429.08	

∑(211)1...5, 10...12 = 1983.08 (211)

Water heating

Efficiency of water heater

	87.00	86.64	85.97	84.62	82.56	80.30	80.30	80.30	80.30	84.49	86.34	87.13	(217)

Water heating fuel, kWh/month

	200.79	176.13	184.69	166.42	165.13	149.54	143.27	159.71	161.48	174.75	182.55	195.79	

∑(219a)1...12 = 2060.25 (219)

Annual totals

Space heating fuel - main system 1 — 1983.08

Water heating fuel — 2060.25

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)		274.98	(23
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4393.30	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1983.08	x	3.48	x 0.01 =	69.01	(240)
Water heating	2060.25	x	3.48	x 0.01 =	71.70	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	274.98	x	13.19	x 0.01 =	36.27	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		306.87	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.25	(257)
SAP value	82.49	
SAP rating (section 13)	82	(25
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	1983.08	x	0.22	=	428.34	(261)
Water heating	2060.25	x	0.22	=	445.01	(264)
Space and water heating			(261) + (262) + (263) + (264) =		873.36	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	274.98	x	0.52	=	142.71	(268)
Total CO_2, kg/year				(265)...(271) =	1055.00	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	18.28	(273)
EI value					86.23	
EI rating (section 14)					86	(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	1983.08	x	1.22	=	2419.35	(261)
Water heating	2060.25	x	1.22	=	2513.50	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4932.86	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	274.98	x	3.07	=	844.18	(268)
Primary energy kWh/year					6007.29	(272)
Dwelling primary energy rate kWh/m2/year					104.11	(273)

TER Worksheet
[D]esign - 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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 10 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		51.40	(1a) x	2.21	(2a) =	113.59	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	51.40	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	113.59	(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) =	0.18	(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)	0.43	(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) = 0.36	(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	0.46	0.45	0.44	0.40	0.39	0.34	0.34	0.33	0.36	0.39	0.41	0.43	(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	
	0.61	0.60	0.60	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

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

0.61	0.60	0.60	0.58	0.58	0.56	0.56	0.56	0.57	0.58	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	
Door			1.80	x	1.00	=	1.80			(26)
Window			6.76	x	1.33	=	8.96			(27)
Roof window			4.28	x	1.59	=	6.81			(27a)
External wall			41.34	x	0.18	=	7.44			(29a)
Party wall			3.60	x	0.00	=	0.00			(32)
Roof			57.32	x	0.13	=	7.45			(30)
Total area of external elements ∑A, m²			111.50							(31)

Fabric heat loss, W/K = ∑(A x U)	(26)...(30) + (32) =	32.47 (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		10.19 (36)
Total fabric heat loss	(33) + (36) =	42.66 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
22.74	22.58	22.43	21.72	21.58	20.96	20.96	20.85	21.20	21.58	21.85	22.14	(38)

Heat transfer coefficient, W/K (37)m + (38)m

65.40	65.24	65.09	64.38	64.24	63.62	63.62	63.50	63.86	64.24	64.51	64.80	

Average = ∑(39)1...12/12 = 64.38 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.27	1.27	1.27	1.25	1.25	1.24	1.24	1.24	1.24	1.25	1.26	1.26	

Average = ∑(40)1...12/12 = 1.25 (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		1.73 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		75.32 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
82.85	79.84	76.83	73.81	70.80	67.79	67.79	70.80	73.81	76.83	79.84	82.85	

∑(44)1...12 = 903.84 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

122.87	107.46	110.89	96.68	92.76	80.05	74.18	85.12	86.13	100.38	109.57	118.99	

∑(45)1...12 = 1185.08 (45)

Distribution loss 0.15 x (45)m

18.43	16.12	16.63	14.50	13.91	12.01	11.13	12.77	12.92	15.06	16.44	17.85	(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

42.22	38.15	39.15	36.40	36.08	33.43	34.54	36.08	36.40	39.15	39.37	42.22	(61)

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

	165.09	144.21	150.04	133.08	128.84	113.48	108.72	121.20	122.54	139.53	148.95	161.21 (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

	165.09	144.21	150.04	133.08	128.84	113.48	108.72	121.20	122.54	139.53	148.95	161.21

$\Sigma(64)1...12 =$ 1636.87 (64)

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

	51.41	44.92	46.66	41.25	39.86	34.97	33.30	37.32	37.74	43.16	46.28	50.12 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	86.57	86.57	86.57	86.57	86.57	86.57	86.57	86.57	86.57	86.57	86.57	86.57	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.45	11.95	9.72	7.36	5.50	4.64	5.02	6.52	8.75	11.11	12.97	13.82	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	150.87	152.43	148.49	140.09	129.49	119.52	112.87	111.30	115.25	123.65	134.25	144.21	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.66	31.66	31.66	31.66	31.66	31.66	31.66	31.66	31.66	31.66	31.66	31.66	(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)	-69.25	-69.25	-69.25	-69.25	-69.25	-69.25	-69.25	-69.25	-69.25	-69.25	-69.25	-69.25	(71)
Water heating gains (Table 5)	69.10	66.84	62.71	57.28	53.58	48.97	44.76	50.16	52.42	58.02	64.27	67.36	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	285.39	283.19	272.89	256.70	240.54	224.71	214.61	219.96	228.39	244.74	263.46	277.37	(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	
NorthWest	0.77	x	6.76	x	11.28	x 0.9 x	0.63	x	0.70	=	23.31	(81)
SouthWest	1.00	x	1.90	x	39.98	x 0.9 x	0.63	x	0.70	=	30.15	(79)
rthEast	1.00	x	2.38	x	16.37	x 0.9 x	0.63	x	0.70	=	15.46	(75)

Solar gains in watts $\Sigma(74)m...(82)m$

	68.92	134.68	228.72	355.45	462.14	486.48	457.54	374.02	272.15	160.98	85.73	56.90 (83)

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

	354.30	417.87	501.61	612.15	702.68	711.19	672.15	593.97	500.54	405.72	349.19	334.27 (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	0.97	0.91	0.75	0.55	0.41	0.48	0.77	0.96	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.68	19.86	20.19	20.60	20.88	20.98	21.00	20.99	20.90	20.50	20.01	19.65	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	19.86	19.86	19.87	19.88	19.88	19.89	19.89	19.89	19.89	19.88	19.88	19.87	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.97	0.88	0.69	0.47	0.31	0.37	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)

18.12	18.39	18.86	19.43	19.77	19.88	19.89	19.89	19.81	19.32	18.62	18.08

(90)

Living area fraction — Living area ÷ (4) = 0.55 (91)

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

18.97	19.19	19.58	20.07	20.37	20.48	20.49	20.49	20.41	19.96	19.38	18.94

(92)

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

18.97	19.19	19.58	20.07	20.37	20.48	20.49	20.49	20.41	19.96	19.38	18.94

(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	0.96	0.88	0.72	0.51	0.37	0.43	0.73	0.94	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	352.10	412.29	483.14	540.96	504.43	365.27	246.27	256.83	363.17	382.55	344.96	332.65	(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]	959.49	932.57	851.54	719.08	557.24	373.90	247.65	259.74	402.71	601.49	792.25	954.85	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	451.90	349.63	274.09	128.24	39.29	0.00	0.00	0.00	0.00	162.89	322.05	462.91	

∑(98)1...5, 10...12 = 2191.01 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 42.63 (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 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	483.83	374.34	293.46	137.31	42.07	0.00	0.00	0.00	0.00	174.40	344.81	495.62	

∑(211)1...5, 10...12 = 2345.83 (211)

Water heating

Efficiency of water heater

87.46	87.20	86.55	84.96	82.45	80.30	80.30	80.30	80.30	85.44	86.94	87.56

(217)

Water heating fuel, kWh/month

188.77	165.38	173.36	156.64	156.26	141.32	135.39	150.93	152.60	163.31	171.32	184.12

∑(219a)1...12 = 1939.39 (219)

Annual totals

Space heating fuel - main system 1 — 2345.83

Water heating fuel — 1939.39

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)
(tricity for lighting (Appendix L)		237.53	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4597.75	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2345.83	x	3.48	x 0.01 =	81.63	(240)
Water heating	1939.39	x	3.48	x 0.01 =	67.49	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	237.53	x	13.19	x 0.01 =	31.33	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		310.35	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.35	(257)
SAP value	81.14	
(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	2345.83	x	0.22	=	506.70	(261)
Water heating	1939.39	x	0.22	=	418.91	(264)
Space and water heating			(261) + (262) + (263) + (264) =		925.61	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	237.53	x	0.52	=	123.28	(268)
Total CO_2, kg/year			(265)...(271) =		1087.81	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		21.16	(273)
EI value					84.88	
EI rating (section 14)					85	(274)
(and					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2345.83	x	1.22	=	2861.91	(261)
Water heating	1939.39	x	1.22	=	2366.05	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5227.97	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	237.53	x	3.07	=	729.23	(268)
Primary energy kWh/year					6187.44	(272)
Dwelling primary energy rate kWh/m2/year					120.98	(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 John Simpson	Assessor number	3722
Client		Last modified	25/09/2015
Address	Flat 11 4 & 4a Oaklands Road , Bromley, BR2 3SL		

1. Overall dwelling dimensions

		Area (m^2)		Average storey height (m)		Volume (m^3)	
Lowest occupied		78.10	(1a) x	2.20	(2a) =	171.82	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	78.10	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	171.82	(5)

2. Ventilation rate

			m^3 per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	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) =	0.17	(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)	0.42	(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) = 0.36	(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	0.46	0.45	0.44	0.40	0.39	0.34	0.34	0.33	0.36	0.39	0.41	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)

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

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

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

0.61	0.60	0.60	0.58	0.58	0.56	0.56	0.56	0.57	0.58	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	
Door			1.80	x	1.00	=	1.80			(26)
Window			7.50	x	1.33	=	9.94			(27)
Roof window			4.20	x	1.59	=	6.69			(27a)
External wall			60.00	x	0.18	=	10.80			(29a)
Party wall			3.60	x	0.00	=	0.00			(32)
Roof			90.30	x	0.13	=	11.74			(30)
Total area of external elements ∑A, m²			163.80							(31)

Fabric heat loss, W/K = ∑(A x U)	(26)...(30) + (32) =	40.97 (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		12.33 (36)
Total fabric heat loss	(33) + (36) =	53.30 (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)	34.35	34.12	33.89	32.82	32.62	31.68	31.68	31.51	32.04	32.62	33.02	33.45	(38)
transfer coefficient, W/K (37)m + (38)m	87.66	87.42	87.19	86.12	85.92	84.99	84.99	84.81	85.35	85.92	86.33	86.75	
Average = ∑(39)1...12/12 = 86.12 (39)													
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.12	1.12	1.12	1.10	1.10	1.09	1.09	1.09	1.09	1.10	1.11	1.11	
Average = ∑(40)1...12/12 = 1.10 (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	2.43 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	91.81 (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)	100.99	97.32	93.65	89.98	86.30	82.63	82.63	86.30	89.98	93.65	97.32	100.99	
∑(44)1...12 = 1101.76 (44)													
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	149.77	130.99	135.17	117.85	113.08	97.58	90.42	103.76	105.00	122.36	133.57	145.05	
∑(45)1...12 = 1444.58 (45)													
Distribution loss 0.15 x (45)m	22.47	19.65	20.28	17.68	16.96	14.64	13.56	15.56	15.75	18.35	20.04	21.76	(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	44.79	47.72	44.37	43.98	40.75	42.11	43.98	44.37	47.72	47.99	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

200.73	175.79	182.89	162.22	157.06	138.33	132.53	147.74	149.37	170.09	181.56	196.01	(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

200.73	175.79	182.89	162.22	157.06	138.33	132.53	147.74	149.37	170.09	181.56	196.01	

∑(64)1...12 = 1994.29 (64)

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

62.54	54.75	56.88	50.28	48.59	42.63	40.59	45.49	46.00	52.62	56.41	60.97	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	121.29	121.29	121.29	121.29	121.29	121.29	121.29	121.29	121.29	121.29	121.29	121.29	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.02	17.78	14.46	10.95	8.18	6.91	7.46	9.70	13.02	16.53	19.30	20.57	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	215.42	217.66	212.03	200.03	184.90	170.67	161.16	158.93	164.56	176.55	191.69	205.92	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.13	35.13	35.13	35.13	35.13	35.13	35.13	35.13	35.13	35.13	35.13	35.13	(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)	-97.03	-97.03	-97.03	-97.03	-97.03	-97.03	-97.03	-97.03	-97.03	-97.03	-97.03	-97.03	(71)
Water heating gains (Table 5)	84.06	81.48	76.45	69.83	65.31	59.21	54.56	61.15	63.89	70.72	78.35	81.95	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	381.88	379.30	365.32	343.20	320.78	299.17	285.57	292.16	303.86	326.19	351.72	370.82	(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	
SouthEast	0.77	x	7.50	x	36.79	x 0.9 x	0.63	x	0.70	=	84.34	(77)
NorthWest	1.00	x	1.68	x	16.37	x 0.9 x	0.63	x	0.70	=	10.91	(81)
SouthEast	1.00	x	1.40	x	39.98	x 0.9 x	0.63	x	0.70	=	22.21	(77)
SouthWest	1.00	x	1.12	x	39.98	x 0.9 x	0.63	x	0.70	=	17.77	(79)

Solar gains in watts ∑(74)m...(82)m

135.23	239.61	350.11	467.31	551.24	558.75	533.96	470.08	390.76	271.05	163.72	114.57	(83)

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

517.12	618.91	715.43	810.50	872.02	857.92	819.54	762.24	694.62	597.25	515.44	485.39	(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	0.80	0.61	0.45	0.50	0.76	0.96	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.85	20.04	20.32	20.64	20.88	20.98	21.00	20.99	20.93	20.61	20.17	19.82	(87)

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

	19.98	19.99	19.99	20.00	20.00	20.01	20.01	20.01	20.01	20.00	20.00	19.99	(88)

Utilisation factor for gains for rest of dwelling n2,m

	1.00	0.99	0.97	0.90	0.74	0.53	0.35	0.40	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)

	18.46	18.73	19.13	19.60	19.89	20.00	20.01	20.01	19.95	19.56	18.93	18.42	(90)

Living area fraction — Living area ÷ (4) = 0.43 (91)

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

	19.07	19.30	19.64	20.05	20.32	20.42	20.44	20.44	20.38	20.01	19.46	19.03	(92)

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

	19.07	19.30	19.64	20.05	20.32	20.42	20.44	20.44	20.38	20.01	19.46	19.03	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.96	0.90	0.76	0.56	0.40	0.45	0.71	0.94	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	514.29	610.60	690.27	730.01	665.66	482.75	324.57	339.53	496.50	559.28	509.27	483.43	(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]	1294.27	1258.94	1146.16	960.30	740.35	494.75	326.13	342.34	535.70	808.88	1067.33	1286.38	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	580.31	435.68	339.18	165.81	55.58	0.00	0.00	0.00	0.00	185.70	401.80	597.40	

∑(98)1...5, 10...12 = 2761.46 (98)

Space heating requirement kWh/m²/year (98) ÷ (4) = 35.36 (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 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	621.32	466.47	363.15	177.52	59.50	0.00	0.00	0.00	0.00	198.83	430.20	639.61	

∑(211)1...5, 10...12 = 2956.60 (211)

Water heating

Efficiency of water heater

	87.57	87.25	86.58	85.11	82.72	80.30	80.30	80.30	80.30	85.27	86.99	87.68	(217)

Water heating fuel, kWh/month

	229.23	201.49	211.23	190.61	189.87	172.26	165.04	183.98	186.01	199.46	208.71	223.56	

∑(219a)1...12 = 2361.44 (219)

Annual totals

Space heating fuel - main system 1 — 2956.60

Water heating fuel — 2361.44

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	(
Electricity for lighting (Appendix L)		353.49	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5746.53	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2956.60	x	3.48	x 0.01 =	102.89	(240)
Water heating	2361.44	x	3.48	x 0.01 =	82.18	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	353.49	x	13.19	x 0.01 =	46.63	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		361.59	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.23	(257)
SAP value	82.79	(
SAP rating (section 13)	83	(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	2956.60	x	0.22	=	638.62	(261)
Water heating	2361.44	x	0.22	=	510.07	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1148.70	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	353.49	x	0.52	=	183.46	(268)
Total CO_2, kg/year				(265)...(271) =	1371.08	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	17.56	(273)
EI value					85.08	
EI rating (section 14)					85	(27
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	2956.60	x	1.22	=	3607.05	(261)
Water heating	2361.44	x	1.22	=	2880.96	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6488.00	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	353.49	x	3.07	=	1085.22	(268)
Primary energy kWh/year					7803.47	(272)
Dwelling primary energy rate kWh/m2/year					99.92	(273)