Marine Ices, Haverstock Hill, London, NW3 2BL

Energy Statement – Retail Scheme

January 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 submission	16/01/2015	J Simpson CEng MCIBSE

2 Contents

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 air source heat pumps proposed for the commercial unit, and photovoltaic panels proposed for the development at roof level to generate electricity for the site. It has been estimated that the proposed air source heat pumps would reduce the annual carbon dioxide emissions of the site by 19,862 $kgCO_2$, which equates to a reduction of 23.7% against the TER 2013. It has been estimated that the proposed photovoltaic systems would reduce the annual carbon dioxide emissions of the site by 9,036 $kgCO_2$, which equates to a reduction of 10.8% against the TER 2013.

The incorporation of the energy efficiency measures, air source heat pumps and photovoltaic panels equates to a reduction of 44.2% 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 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)	83,665	73,084
Energy Efficiency Measures ('Be Lean')	75,613	73,084
Proposed Development with ASHPs ('Be Green')	55,751	73,084
Proposed Development with PVs ('Be Green')	46,715	73,084

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

Stage	Regulated carbon dioxide savings	
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	8,053	9.6
Savings from ASHPs	19,862	23.7
Savings from PVs	9,036	10.8
Total Cumulative Savings	**36,950**	**44.2**

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

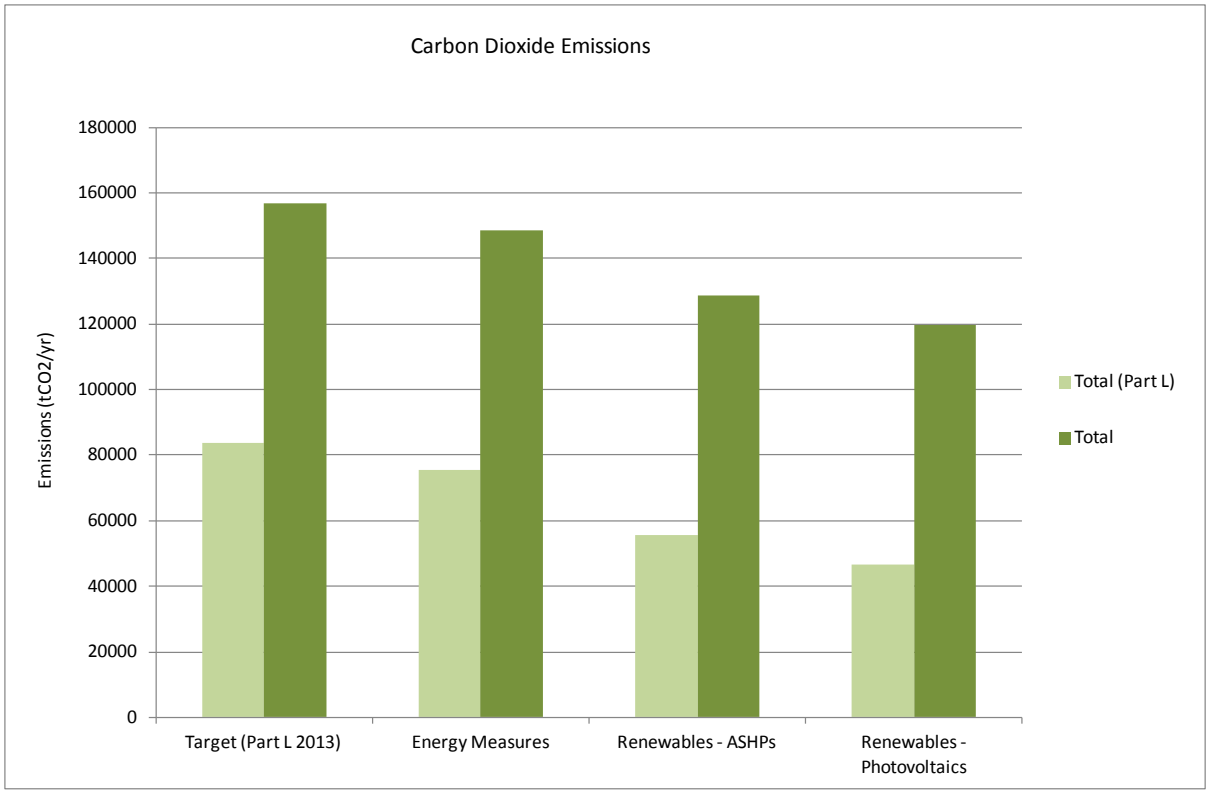


Figure 1 – Summary of carbon dioxide emissions

4 Introduction

4.1 Proposed Development

The Proposed Development comprises the redevelopment of the site to provide a retail shell at basement and ground floor level, with 19 new residential apartments above. Cycle and refuse stores are located along the Crogsland Road facade.

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 London Plan 2011 was published on 22 July 2011.

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 2011 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 Core Strategy was adopted by the London Borough of Camden on 8 November 2010, and sets out the key vision for the borough up to 2025.

Policy CS13 states that:

"**Reducing the effects of and adapting to climate change**

The Council will require all development to take measures to minimise the effects of, and adapt to, climate change and encourage all development to meet the highest feasible environmental standards that are financially viable during construction and occupation by:

a) ensuring patterns of land use that minimise the need to travel by car and help support local energy networks;
b) promoting the efficient use of land and buildings
c) minimising carbon emissions from the redevelopment, construction and occupation of buildings by implementing, in order, all of the elements of the following energy hierarchy:
   1. ensuring developments use less energy,
   2. making use of energy from efficient sources, such as the King's Cross, Gower Street, Bloomsbury and proposed Euston Road decentralized energy networks;
   3. generating renewable energy on-site;
   and
d) ensuring buildings and spaces are designed to cope with, and minimise the effects of, climate change.

The Council will have regard to the cost of installing measures to tackle climate change as well as the cumulative future costs of delaying reductions in carbon dioxide emissions.

Local energy generation

The Council will promote local energy generation and networks by:

e) working with our partners and developers to implement local energy networks in the parts of Camden most likely to support them, i.e. in the vicinity of:
   – housing estates with community heating or the potential for community heating and other uses with large heating loads;
   – the growth areas of King's Cross; Euston; Tottenham Court Road; West Hampstead Interchange and Holborn;
   – schools to be redeveloped as part of Building Schools for the Future programme;
   – existing or approved combined heat and power/local energy networks (see Map 4);

   and other locations where land ownership would facilitate their implementation.

f) protecting existing local energy networks where possible (e.g. at Gower Street and Bloomsbury) and safeguarding potential network routes (e.g. Euston Road)."

Development Policy DP22 on 'Promoting sustainable design and construction' states that:

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

a) demonstrate how sustainable development principles, including the relevant measures set out in paragraph 22.5 below, have been incorporated into the design and proposed implementation; and
b) incorporate green or brown roofs and green walls wherever suitable.

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

c) expecting new build housing to meet Code for Sustainable Homes Level 3 by 2010 and Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016.;
d) expecting developments (except new build) of 500 sq m of residential floorspace or above or 5 or more dwellings to achieve "very good" in EcoHomes assessments prior to 2013 and encouraging "excellent" from 2013;
e) expecting non-domestic developments of 500sqm of floorspace or above to achieve "very good" in BREEAM assessments and "excellent" from 2016 and encouraging zero carbon from 2019.

The Council will require development to be resilient to climate change by ensuring schemes include appropriate climate change adaptation measures, such as:

f) summer shading and planting;
g) limiting run-off;
h) reducing water consumption;
i) reducing air pollution; and
j) not locating vulnerable uses in basements in flood-prone areas."

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.

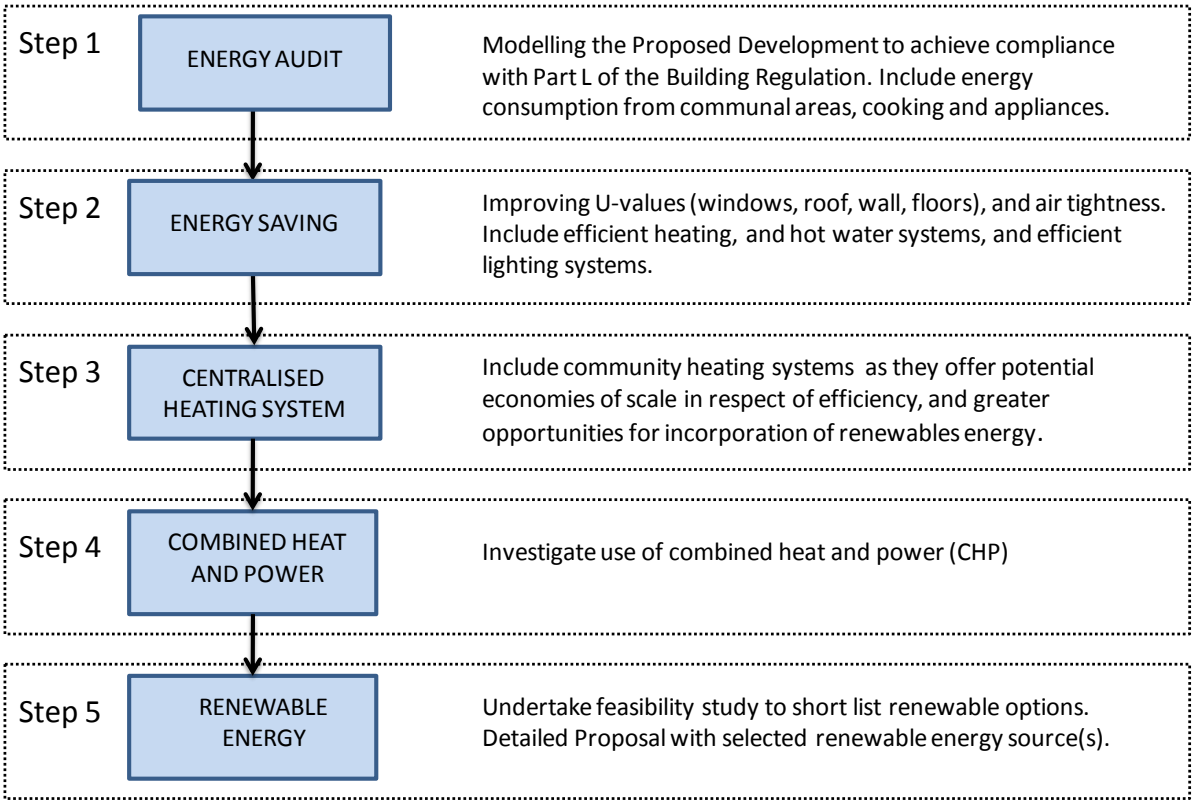


Figure 2 – Flow diagram of methodology

6 Energy Demand

6.1 Residential

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 door U-value	1.10 W/m².K	2.00 W/m².K
Party wall U-value	0.00 W/m².K (equivalent U-value with fully-filled party walls)	0.20 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. Ideal Code Combi boilers are proposed for the single bathroom apartments, with a system boiler and hot water cylinder for dwellings with two bathrooms. It has been assumed that underfloor heating is provided to each dwelling, with design flow temperature between 35 and 45°C. Time and temperature zone control would be provided for each dwelling.

Mechanical ventilation systems with heat recovery are proposed for each dwelling, in order to recover extracted heat from bathrooms and kitchens and reuse this for fresh air supply into habitable rooms. This also enables the external grille locations for fresh air intake and exhaust to be positioned sympathetically on the external facades, eliminates the requirement for trickle vents above windows and enables high levels of air tightness to be achieved.

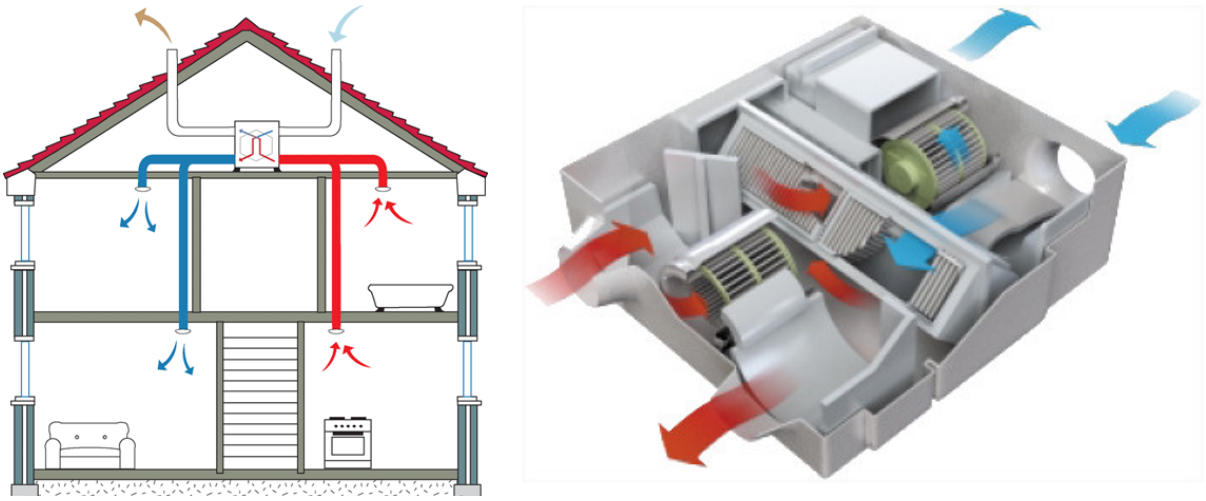


Figure 3 - Typical MVHR installations

6.2 Commercial

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 commercial element of the scheme has been assessed under Part L2A, with SBEM calculations undertaken using Part L2A 2013 methodology.

The minimum requirements for compliance with Part L2A 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 L2A calculations, and exceed the requirements of Part L2A. The proposed fabric performance is compared against the Part L2A 2013 requirements in Table 5 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
Basement/ground floor U-value	0.15 W/m².K	0.25 W/m².K
Window & glazed door U-value	1.60 W/m².K	2.00 W/m².K
Solid door U-value	1.80 W/m².K	2.00 W/m².K
Air permeability	5 m³/hr/m² @ 50 Pa	10 m³/hr/m² @ 50 Pa

Table 5 – Comparison of proposed residential performance

The retail element of the scheme would be constructed as a shell, with the future fit-out to be undertaken by the retail tenant. As such, reasonable assumptions have been made within the Energy Strategy for the heating, ventilation, air conditioning and lighting systems, with the following included:

- Heating and cooling by fan coil units to all areas to provide heating and comfort cooling;
- Mechanical supply and extract ventilation with heat recovery via plate heat exchanger, and system specific fan power of 1.5 W/l/s;
- Lighting efficacy of 85 lumens per circuit Watt, and display lighting efficacy of 65 lumens per circuit Watt;
- Local electric point-of-use water heaters (due to limited hot water demand).

These design parameters have been used to demonstrate that the future fit-out could achieve a 6.2% improvement against Part L 2013, without any reliance on renewable technology.

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 6 (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 6 – 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 4 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 residential element 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. Air source heat pumps are considered to be more appropriate for the commercial element of the scheme than ground source, with only a small decrease in efficiency but a significant reduction in capital cost.

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:

- Air source heat pumps; and
- Photovoltaic panels.

9.1 Air Source Heat Pumps

It is proposed that air source heat pumps are installed within the ground floor plantroom for the retail unit, to provide heating and cooling to the scheme. This would increase the efficiency of the heating and cooling systems for the development, and would reduce the annual carbon dioxide emissions of the Proposed Development by 19,862 $kgCO_2$ – this equates to a reduction of 23.7% against the regulated emissions (2013).

9.2 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.

It has been estimated that a total photovoltaic area of 100.8 m^2 can be installed at roof level, facing due south at an elevation of 15°, to provide a total annual output of 16,870 kWh. This equates to a system size of 9.60 kWp to be connected to the residential Landlord systems, and a system size of 10.56 kWp to be connected to the retail unit at ground and basement level.

The incorporation of the photovoltaic cells within the scheme would reduce the annual carbon dioxide emissions of the Proposed Development by 9,036 $kgCO_2$, which equates to a reduction of 10.8% 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.

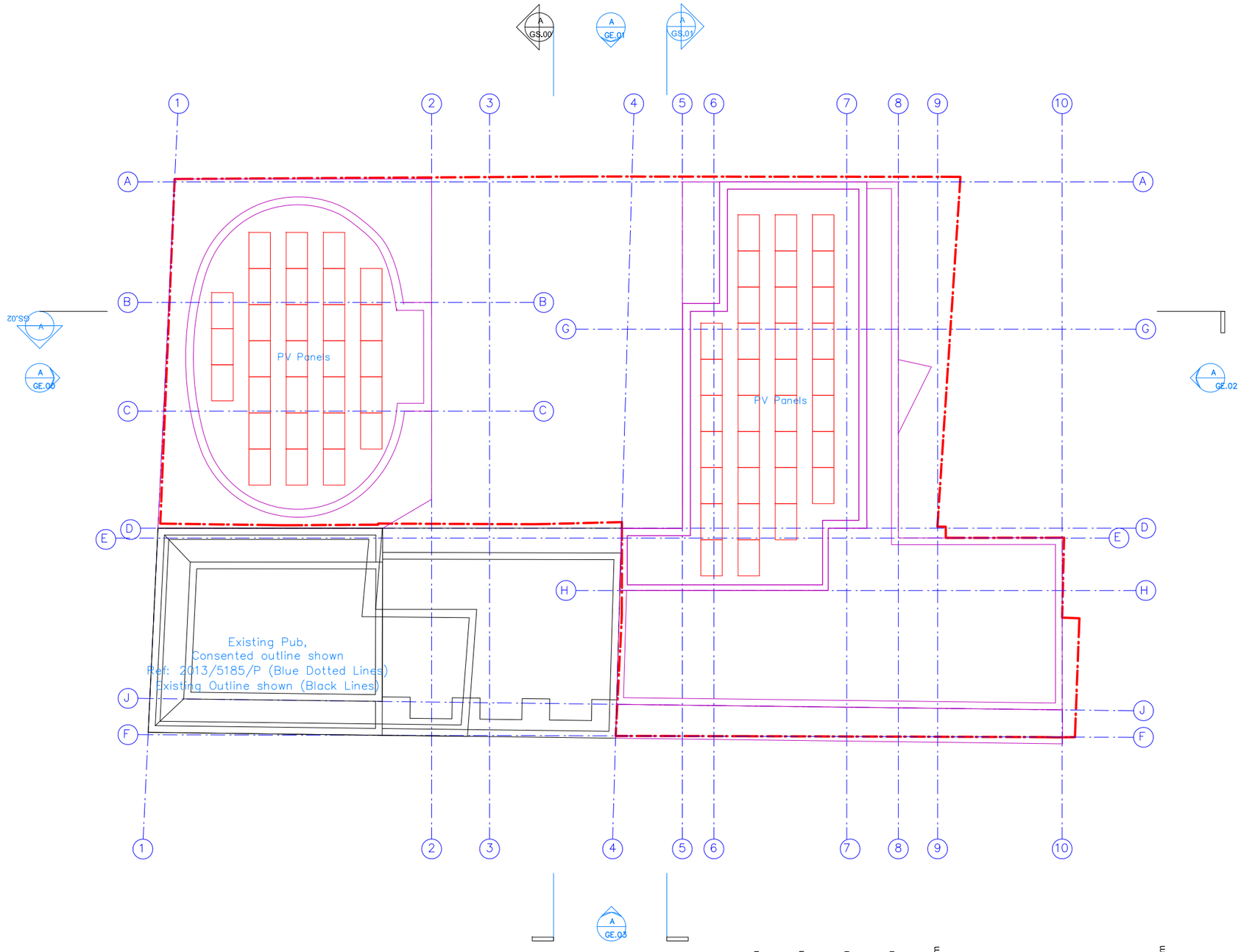
CHP has been assessed in terms of feasibility. There is no economic or sustainable justification for over-sizing the CHP plant, and therefore the CHP unit size needs to be carefully matched to the demands of the development. The smallest commercially available CHP unit is too large for the scheme due 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 air source heat pumps proposed for the commercial unit, and photovoltaic panels proposed for the development at roof level to generate electricity for the site. It has been estimated that the proposed air source heat pumps would reduce the annual carbon dioxide emissions of the site by 19,862 $kgCO_2$, which equates to a reduction of 23.7% against the TER 2013. It has been estimated that the proposed photovoltaic systems would reduce the annual carbon dioxide emissions of the site by 9,036 $kgCO_2$, which equates to a reduction of 10.8% against the TER 2013.

The incorporation of the energy efficiency measures, air source heat pumps and photovoltaic panels equates to a reduction of 44.2% against the TER 2013 for the scheme, which exceeds the local policy requirements.

11 Appendix A – Proposed PV Layout

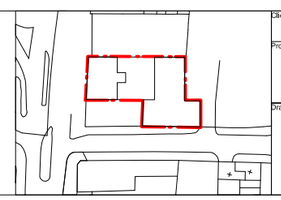
The attached roof plan shows the currently proposed photovoltaic panel layout for scheme – these are preliminary layouts and are subject to revisions in the event of changes in standard panel sizes and outputs.



A GA.05 **Roof Plan**

1:200@A3_1:100@A1

Revisions		
A	08/10/14	General drawing revisions
B	02/10/14	Amendment to Staircase arrangement
C	07/11/14	Amendment to drawings generally



Client: LRP

Project: Marine Ices, Haverstock Hill, London, NW3 2BL

Drawing Title: Proposed Roof Plan, General Arrangement

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www.21starchitecture.com

Status	Drawn	Checked
Planning	JSP	TJS

Scale	Date
1:100 @ A1 1:200 @ A3	Aug 2014

Drwg. No.	Revision
177_GA_05	C

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

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

The following dwellings are included as a sample – worksheets for all dwellings can be provided upon request:

1.01
1.02
2.04
2.05
3.05
4.01
4.02

DER Worksheet
Design - Draft

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

Assessor name	Mr John Simpson	Assessor number	3722
Client		Last modified	19/11/2014
Address	Unit 1.01 Marine Ices Haverstock Hill, London, NW3 2BL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.20	(1a) x	2.60	(2a) =	182.52	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	182.52	(5)

2. Ventilation rate

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

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

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

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

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

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

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(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			19.48	x	1.33	=	25.83			(27)
Door			2.14	x	1.10	=	2.35			(26)
Exposed floor			70.20	x	0.10	=	7.02			(28b
External wall			45.95	x	0.20	=	9.19			(29a)
Party wall			32.68	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			137.77							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	44.39 (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		11.06 (36)
Total fabric heat loss	(33) + (36) =	55.45 (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)													
	15.84	15.65	15.46	14.50	14.31	13.35	13.35	13.16	13.73	14.31	14.69	15.08	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	71.30	71.11	70.91	69.95	69.76	68.80	68.80	68.61	69.19	69.76	70.15	70.53	
Average = ∑(39)1...12/12 =												69.91	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	1.02	1.01	1.01	1.00	0.99	0.98	0.98	0.98	0.99	0.99	1.00	1.00	
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	2.25 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	87.66 (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)													
	96.43	92.92	89.41	85.91	82.40	78.89	78.89	82.40	85.91	89.41	92.92	96.43	
∑(44)1...12 =												1051.93	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	143.00	125.07	129.06	112.52	107.96	93.16	86.33	99.06	100.25	116.83	127.53	138.49	
∑(45)1...12 =												1379.24	(45)
Distribution loss 0.15 x (45)m													
	21.45	18.76	19.36	16.88	16.19	13.97	12.95	14.86	15.04	17.52	19.13	20.77	(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													
	169.88	149.35	155.94	138.53	134.84	119.18	113.21	125.94	126.26	143.71	153.54	165.37	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

Flue gas heat recovery system 1 input (Appendix G1)

-6.39	-5.79	-3.44	-0.87	-0.13	0.00	0.00	0.00	0.00	-1.40	-5.79	-6.47	(63)

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

163.48	143.55	152.50	137.66	134.71	119.18	113.21	125.94	126.26	142.31	147.75	158.90	

∑(64)1...12 = 1665.45 (64)

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

54.27	47.65	49.63	43.91	42.62	37.48	35.42	39.66	39.84	45.57	48.91	52.77	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	112.55	112.55	112.55	112.55	112.55	112.55	112.55	112.55	112.55	112.55	112.55	112.55	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.63	15.66	12.74	9.64	7.21	6.08	6.57	8.55	11.47	14.56	17.00	18.12	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	197.76	199.82	194.64	183.63	169.74	156.68	147.95	145.90	151.07	162.08	175.98	189.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.25	34.25	34.25	34.25	34.25	34.25	34.25	34.25	34.25	34.25	34.25	34.25	(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)	-90.04	-90.04	-90.04	-90.04	-90.04	-90.04	-90.04	-90.04	-90.04	-90.04	-90.04	-90.04	(71)
Water heating gains (Table 5)	72.94	70.91	66.71	60.99	57.28	52.06	47.61	53.30	55.33	61.24	67.92	70.92	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	348.10	346.15	333.85	314.03	293.99	274.58	261.90	267.51	277.63	297.65	320.66	337.85	(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	14.79	x	36.79	x 0.9 x	0.72	x	0.80	=	217.22	(79)
NorthEast	0.77	x	4.69	x	11.28	x 0.9 x	0.72	x	0.80	=	21.12	(75)

Solar gains in watts ∑(74)m...(82)m

238.34	413.00	583.72	754.50	873.61	879.84	843.04	752.25	642.56	461.48	286.76	203.14	(83)

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

586.44	759.16	917.58	1068.53	1167.60	1154.42	1104.94	1019.77	920.19	759.13	607.42	540.99	(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)	0.99	0.96	0.89	0.74	0.55	0.38	0.27	0.31	0.51	0.83	0.97	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.32	20.53	20.74	20.89	20.94	20.95	20.95	20.95	20.95	20.85	20.56	20.28	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.07	20.07	20.07	20.09	20.09	20.10	20.10	20.10	20.10	20.09	20.08	20.08	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.95	0.87	0.69	0.50	0.33	0.22	0.25	0.45	0.79	0.96	0.99

(89)

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

19.18	19.47	19.75	19.95	20.01	20.03	20.03	20.03	20.02	19.92	19.52	19.13

(90)

Living area fraction — Living area ÷ (4) = 0.37 (91)

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

19.60	19.86	20.12	20.30	20.35	20.37	20.37	20.37	20.36	20.26	19.90	19.55

(92)

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

19.45	19.71	19.97	20.15	20.20	20.22	20.22	20.22	20.21	20.11	19.75	19.40

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.95	0.86	0.70	0.50	0.33	0.23	0.26	0.46	0.79	0.96	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	577.28	720.39	793.21	744.48	586.80	386.16	249.06	262.15	420.19	597.73	582.79	535.15	(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]	1080.16	1052.87	954.87	786.91	593.19	386.65	249.10	262.23	422.94	663.72	887.55	1072.35	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	374.14	223.43	120.27	30.55	4.76	0.00	0.00	0.00	0.00	49.10	219.43	399.68	

∑(98)1...5, 10...12 = 1421.35 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 20.25 (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	416.18	248.53	133.79	33.98	5.29	0.00	0.00	0.00	0.00	54.62	244.08	444.58	

∑(211)1...5, 10...12 = 1581.04 (211)

Water heating

Efficiency of water heater	89.09	88.86	88.43	87.76	87.39	87.30	87.30	87.30	87.30	87.95	88.84	89.14	(217)
Water heating fuel, kWh/month	183.50	161.54	172.45	156.86	154.15	136.51	129.68	144.27	144.63	161.80	166.32	178.25	

∑(219a)1...12 = 1889.96 (219)

Annual totals

Space heating fuel - main system 1 — 1581.04

Water heating fuel — 1889.96

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside — 111.34 (230a)

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					186.34	(231)
Electricity for lighting (Appendix L)					311.36	(232)
Total delivered energy for all uses				(211)...(221) + (231) + (232)...(237b) =	3968.70	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1581.04	x	3.48	x 0.01 =	55.02	(240)
Water heating	1889.96	x	3.48	x 0.01 =	65.77	(247)
Pumps and fans	186.34	x	13.19	x 0.01 =	24.58	(249)
Electricity for lighting	311.36	x	13.19	x 0.01 =	41.07	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	306.44	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.12	(257)
SAP value	84.41	
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	1581.04	x	0.22	=	341.50	(261)
Water heating	1889.96	x	0.22	=	408.23	(264)
Space and water heating			(261) + (262) + (263) + (264) =		749.73	(265)
Pumps and fans	186.34	x	0.52	=	96.71	(267)
Electricity for lighting	311.36	x	0.52	=	161.60	(268)
Total CO_2, kg/year				(265)...(271) =	1008.04	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	14.36	(273)
EI value					88.27	
EI 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	1581.04	x	1.22	=	1928.86	(261)
Water heating	1889.96	x	1.22	=	2305.75	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4234.61	(265)
Pumps and fans	186.34	x	3.07	=	572.06	(267)
Electricity for lighting	311.36	x	3.07	=	955.89	(268)
Primary energy kWh/year					5762.56	(272)
Dwelling primary energy rate kWh/m2/year					82.09	(273)

DER Worksheet
Design - Draft

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

Assessor name	Mr John Simpson	Assessor number	3722
Client		Last modified	19/11/2014
Address	Unit 1.02 Marine Ices Haverstock Hill, London, NW3 2BL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		49.80	(1a) x	2.60	(2a) =	129.48	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	49.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	129.48	(5)

2. Ventilation rate

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

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

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

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

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

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

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(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			15.32	x	1.33	=	20.31			(27)
Door			2.14	x	1.10	=	2.35			(26)
Exposed floor			49.80	x	0.10	=	4.98			(28b
External wall			46.53	x	0.20	=	9.31			(29a)
Party wall			13.34	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			113.79							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	36.95 (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		8.52 (36)
Total fabric heat loss	(33) + (36) =	45.47 (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)													
	11.24	11.10	10.97	10.29	10.15	9.47	9.47	9.33	9.74	10.15	10.42	10.70	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	56.71	56.57	56.44	55.76	55.62	54.94	54.94	54.80	55.21	55.62	55.89	56.16	

Average = ∑(39)1...12/12 = 55.72 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	1.14	1.14	1.13	1.12	1.12	1.10	1.10	1.10	1.11	1.12	1.12	1.13	

Average = ∑(40)1...12/12 = 1.12 (40)

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

4. Water heating energy requirement

Assumed occupancy, N	1.68 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.20 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
	81.62	78.65	75.68	72.72	69.75	66.78	66.78	69.75	72.72	75.68	78.65	81.62	

∑(44)1...12 = 890.40 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	121.04	105.86	109.24	95.24	91.38	78.86	73.07	83.85	84.85	98.89	107.94	117.22	

∑(45)1...12 = 1167.46 (45)

Distribution loss 0.15 x (45)m													
	18.16	15.88	16.39	14.29	13.71	11.83	10.96	12.58	12.73	14.83	16.19	17.58	(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													
	147.92	130.14	136.12	121.25	118.26	104.87	99.95	110.73	110.87	125.77	133.96	144.10	(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)

-6.06	-5.46	-3.18	-0.92	-0.17	0.00	0.00	0.00	0.00	-1.41	-5.32	-6.10	(63)

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

141.86	124.68	132.94	120.33	118.09	104.87	99.95	110.73	110.87	124.36	128.63	138.00	

∑(64)1...12 = 1455.32 (64)

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

46.97	41.27	43.04	38.17	37.11	32.72	31.02	34.60	34.72	39.60	42.39	45.70	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.08	11.62	9.45	7.15	5.35	4.51	4.88	6.34	8.51	10.80	12.61	13.44	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	146.71	148.24	144.40	136.23	125.92	116.23	109.76	108.24	112.07	120.24	130.55	140.24	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	(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)	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	(71)
Water heating gains (Table 5)	63.13	61.41	57.85	53.01	49.87	45.45	41.69	46.51	48.22	53.23	58.88	61.42	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	274.18	272.53	262.96	247.66	232.41	217.46	207.59	212.35	220.06	235.54	253.31	266.37	(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	
SouthWest	0.77	x	10.63	x	36.79	x 0.9 x	0.72	x	0.80	=	156.12	(79)
NorthEast	0.77	x	4.69	x	11.28	x 0.9 x	0.72	x	0.80	=	21.12	(75)

Solar gains in watts ∑(74)m...(82)m

177.24	308.93	441.33	578.06	675.99	683.64	653.89	578.91	488.38	346.46	213.58	150.86	(83)

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

451.43	581.46	704.29	825.73	908.40	901.10	861.47	791.26	708.44	581.99	466.88	417.22	(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)	0.99	0.96	0.89	0.74	0.56	0.39	0.28	0.32	0.53	0.83	0.97	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.24	20.45	20.68	20.86	20.93	20.95	20.95	20.95	20.94	20.82	20.49	20.19	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.97	19.97	19.97	19.98	19.99	20.00	20.00	20.00	19.99	19.99	19.98	19.98	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.95	0.87	0.70	0.50	0.33	0.22	0.25	0.45	0.79	0.96	0.99

(89)

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

18.97	19.27	19.58	19.82	19.90	19.92	19.92	19.92	19.91	19.78	19.34	18.91

(90)

Living area fraction — Living area ÷ (4) = 0.50 (91)

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

19.60	19.85	20.13	20.34	20.41	20.43	20.43	20.43	20.42	20.29	19.91	19.55

(92)

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

19.45	19.70	19.98	20.19	20.26	20.28	20.28	20.28	20.27	20.14	19.76	19.40

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, ηm	0.98	0.95	0.87	0.71	0.51	0.35	0.23	0.27	0.48	0.80	0.96	0.99
												(94)
Useful gains, ηmGm, W (94)m x (84)m	443.03	550.14	609.92	583.51	467.69	311.16	202.11	212.55	336.59	463.50	446.41	411.64
												(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]	858.98	837.46	760.50	629.22	475.99	311.99	202.20	212.71	340.63	530.76	707.45	853.67
												(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	309.47	193.08	112.03	32.92	6.18	0.00	0.00	0.00	0.00	50.04	187.95	328.87

∑(98)1...5, 10...12 = 1220.53 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 24.51 (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	344.23	214.77	124.62	36.61	6.87	0.00	0.00	0.00	0.00	55.67	209.06	365.82

∑(211)1...5, 10...12 = 1357.66 (211)

Water heating

Efficiency of water heater

89.07	88.86	88.47	87.85	87.43	87.30	87.30	87.30	87.30	88.03	88.83	89.12

(217)

Water heating fuel, kWh/month

159.27	140.31	150.27	136.98	135.08	120.13	114.49	126.84	127.00	141.27	144.82	154.86

∑(219a)1...12 = 1651.30 (219)

Annual totals

Space heating fuel - main system 1 — 1357.66

Water heating fuel — 1651.30

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside — 78.98 (230a)

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		153.98	(231)
Electricity for lighting (Appendix L)		230.99	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	3393.93	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1357.66	x	3.48	x 0.01 =	47.25	(240)
Water heating	1651.30	x	3.48	x 0.01 =	57.47	(247)
Pumps and fans	153.98	x	13.19	x 0.01 =	20.31	(249)
Electricity for lighting	230.99	x	13.19	x 0.01 =	30.47	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		275.49	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.22	(257)
SAP value	82.97	
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	1357.66	x	0.22	=	293.25	(261)
Water heating	1651.30	x	0.22	=	356.68	(264)
Space and water heating			(261) + (262) + (263) + (264) =		649.94	(265)
Pumps and fans	153.98	x	0.52	=	79.92	(267)
Electricity for lighting	230.99	x	0.52	=	119.88	(268)
Total CO_2, kg/year				(265)...(271) =	849.74	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	17.06	(273)
EI value					87.99	
EI 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	1357.66	x	1.22	=	1656.34	(261)
Water heating	1651.30	x	1.22	=	2014.59	(264)
Space and water heating			(261) + (262) + (263) + (264) =		3670.93	(265)
Pumps and fans	153.98	x	3.07	=	472.73	(267)
Electricity for lighting	230.99	x	3.07	=	709.14	(268)
Primary energy kWh/year					4852.80	(272)
Dwelling primary energy rate kWh/m2/year					97.45	(273)

DER Worksheet
Design - Draft

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

Assessor name	Mr John Simpson	Assessor number	3722
Client		Last modified	19/11/2014
Address	Unit 2.04 Marine Ices Haverstock Hill, London, NW3 2BL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		69.20	(1a) x	2.60	(2a) =	179.92	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	69.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	179.92	(5)

2. Ventilation rate

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

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

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

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

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

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

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(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			20.05	x	1.33	=	26.58			(27)
Door			2.14	x	1.10	=	2.35			(26)
External wall			42.52	x	0.20	=	8.50			(29a)
Party wall			30.52	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			64.71							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	37.44 (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		11.11 (36)
Total fabric heat loss	(33) + (36) =	48.55 (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	
15.62	15.43	15.24	14.29	14.10	13.16	13.16	12.97	13.54	14.10	14.48	14.86	(38)

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

64.17	63.98	63.79	62.84	62.65	61.71	61.71	61.52	62.08	62.65	63.03	63.41	

Average = ∑(39)1...12/12 = 62.79 (39)

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

0.93	0.92	0.92	0.91	0.91	0.89	0.89	0.89	0.90	0.91	0.91	0.92	

Average = ∑(40)1...12/12 = 0.91 (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: 2.23 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36: 87.08 (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	
95.79	92.31	88.82	85.34	81.86	78.37	78.37	81.86	85.34	88.82	92.31	95.79	

∑(44)1...12 = 1044.97 (44)

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

142.05	124.24	128.20	111.77	107.25	92.55	85.76	98.41	99.58	116.05	126.68	137.57	

∑(45)1...12 = 1370.12 (45)

Distribution loss 0.15 x (45)m

21.31	18.64	19.23	16.77	16.09	13.88	12.86	14.76	14.94	17.41	19.00	20.64	(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

12.64	11.42	12.64	12.23	12.64	12.23	12.64	12.64	12.23	12.64	12.23	12.64	(61)

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

154.69	135.66	140.84	124.00	119.89	104.78	98.40	111.05	111.82	128.70	138.92	150.21	(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

154.69	135.66	140.84	124.00	119.89	104.78	98.40	111.05	111.82	128.70	138.92	150.21	

∑(64)1...12 = 1518.95 (64)

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

50.39	44.16	45.79	40.22	38.82	33.83	31.67	35.88	36.17	41.75	45.18	48.90	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.42	15.47	12.58	9.53	7.12	6.01	6.50	8.44	11.33	14.39	16.80	17.91	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	195.42	197.45	192.34	181.46	167.73	154.82	146.20	144.17	149.28	160.16	173.89	186.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	(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)	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	(71)
Water heating gains (Table 5)	67.73	65.72	61.54	55.86	52.18	46.99	42.57	48.23	50.24	56.11	62.75	65.73	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	339.97	338.04	325.87	306.25	286.43	267.22	254.67	260.24	270.25	290.06	312.84	329.83	(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	6.28	x	36.79	x 0.9 x	0.72	x	0.80	=	92.23	(79)
NorthEast	0.77	x	13.77	x	11.28	x 0.9 x	0.72	x	0.80	=	62.02	(75)

Solar gains in watts ∑(74)m...(82)m

154.25	283.35	442.40	639.87	800.42	831.45	786.29	660.88	509.90	327.91	188.51	129.58	(83)

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

494.23	621.39	768.27	946.12	1086.85	1098.67	1040.95	921.12	780.15	617.97	501.35	459.41	(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	0.98	0.92	0.75	0.53	0.36	0.26	0.31	0.54	0.88	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.34	20.51	20.73	20.90	20.95	20.96	20.96	20.96	20.95	20.84	20.55	20.31	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.14	20.15	20.15	20.16	20.16	20.17	20.17	20.18	20.17	20.16	20.16	20.15	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.99	0.97	0.91	0.71	0.48	0.31	0.21	0.25	0.48	0.85	0.98	1.00	(89)

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

19.26	19.51	19.81	20.04	20.09	20.11	20.11	20.11	20.10	19.98	19.58	19.22

(90)

Living area fraction — Living area ÷ (4) = 0.37 (91)

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

19.66	19.88	20.15	20.36	20.41	20.43	20.43	20.43	20.42	20.30	19.94	19.63

(92)

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

19.51	19.73	20.00	20.21	20.26	20.28	20.28	20.28	20.27	20.15	19.79	19.48

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.97	0.90	0.71	0.49	0.32	0.22	0.26	0.49	0.85	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	490.06	603.61	692.74	675.32	532.84	350.07	226.86	238.54	380.57	522.33	490.02	456.76	(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]	976.25	948.82	861.34	710.94	536.49	350.27	226.88	238.58	383.03	598.41	799.85	968.93	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	361.72	231.98	125.44	25.65	2.72	0.00	0.00	0.00	0.00	56.61	223.08	381.05	

∑(98)1...5, 10...12 = 1408.25 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 20.35 (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 (%) — 92.30 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	391.90	251.34	135.90	27.79	2.94	0.00	0.00	0.00	0.00	61.33	241.69	412.84	

∑(211)1...5, 10...12 = 1525.73 (211)

Water heating

Efficiency of water heater

89.11	88.92	88.51	87.73	87.36	87.30	87.30	87.30	87.30	88.08	88.88	89.15

(217)

Water heating fuel, kWh/month

173.61	152.56	159.14	141.34	137.24	120.02	112.71	127.20	128.08	146.11	156.29	168.49

∑(219a)1...12 = 1722.79 (219)

Annual totals

Space heating fuel - main system 1 — 1525.73

Water heating fuel — 1722.79

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	109.75	(230a)
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 — 184.75 (231)

Electricity for lighting (Appendix L)		307.68	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	3740.95	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1525.73	x	3.48	x 0.01 =	53.10	(240)
Water heating	1722.79	x	3.48	x 0.01 =	59.95	(247)
Pumps and fans	184.75	x	13.19	x 0.01 =	24.37	(249)
Electricity for lighting	307.68	x	13.19	x 0.01 =	40.58	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		298.00	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.10	(257)
SAP value	84.71	
SAP rating (section 13)	85	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	1525.73	x	0.22	=	329.56	(261)
Water heating	1722.79	x	0.22	=	372.12	(264)
Space and water heating			(261) + (262) + (263) + (264) =		701.68	(265)
Pumps and fans	184.75	x	0.52	=	95.89	(267)
Electricity for lighting	307.68	x	0.52	=	159.69	(268)
Total CO_2, kg/year			(265)...(271) =		957.25	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		13.83	(273)
EI value					88.77	
EI rating (section 14)					89	(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	1525.73	x	1.22	=	1861.39	(261)
Water heating	1722.79	x	1.22	=	2101.81	(264)
Space and water heating			(261) + (262) + (263) + (264) =		3963.20	(265)
Pumps and fans	184.75	x	3.07	=	567.19	(267)
Electricity for lighting	307.68	x	3.07	=	944.58	(268)
Primary energy kWh/year					5474.96	(272)
Dwelling primary energy rate kWh/m2/year					79.12	(273)

DER Worksheet
Design - Draft

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

Assessor name	Mr John Simpson	Assessor number	3722
Client		Last modified	19/11/2014
Address	Unit 2.05 Marine Ices Haverstock Hill, London, NW3 2BL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		78.70	(1a) x	2.60	(2a) =	204.62	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	78.70	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	204.62	(5)

2. Ventilation rate

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

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

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

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

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

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

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(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			10.25	x	1.33	=	13.59			(27)
Door			2.14	x	1.10	=	2.35			(26)
External wall			60.77	x	0.20	=	12.15			(29a)
Party wall			32.47	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			73.16							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	28.10 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		9.59 (36)
Total fabric heat loss	(33) + (36) =	37.69 (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	
17.76	17.55	17.33	16.26	16.04	14.97	14.97	14.75	15.40	16.04	16.47	16.90	(38)

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

55.45	55.24	55.02	53.94	53.73	52.65	52.65	52.44	53.08	53.73	54.16	54.59	

Average = ∑(39)1...12/12 = 53.89 (39)

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

0.70	0.70	0.70	0.69	0.68	0.67	0.67	0.67	0.67	0.68	0.69	0.69	

Average = ∑(40)1...12/12 = 0.68 (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: 2.44 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36: 92.10 (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	
101.31	97.62	93.94	90.25	86.57	82.89	82.89	86.57	90.25	93.94	97.62	101.31	

∑(44)1...12 = 1105.15 (44)

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

150.23	131.40	135.59	118.21	113.42	97.88	90.70	104.08	105.32	122.74	133.98	145.49	

∑(45)1...12 = 1449.03 (45)

Distribution loss 0.15 x (45)m

22.54	19.71	20.34	17.73	17.01	14.68	13.60	15.61	15.80	18.41	20.10	21.82	(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

12.64	11.42	12.64	12.23	12.64	12.23	12.64	12.64	12.23	12.64	12.23	12.64	(61)

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

162.87	142.81	148.23	130.44	126.06	110.11	103.34	116.72	117.55	135.38	146.21	158.13	(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

162.87	142.81	148.23	130.44	126.06	110.11	103.34	116.72	117.55	135.38	146.21	158.13	

∑(64)1...12 = 1597.86 (64)

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

53.11	46.54	48.24	42.36	40.87	35.60	33.32	37.77	38.08	43.97	47.61	51.54	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	121.89	121.89	121.89	121.89	121.89	121.89	121.89	121.89	121.89	121.89	121.89	121.89	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.46	18.17	14.78	11.19	8.36	7.06	7.63	9.91	13.31	16.90	19.72	21.02	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	216.70	218.95	213.28	201.22	185.99	171.68	162.12	159.87	165.54	177.60	192.83	207.14	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.19	35.19	35.19	35.19	35.19	35.19	35.19	35.19	35.19	35.19	35.19	35.19	(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)	-97.51	-97.51	-97.51	-97.51	-97.51	-97.51	-97.51	-97.51	-97.51	-97.51	-97.51	-97.51	(71)
Water heating gains (Table 5)	71.39	69.26	64.84	58.84	54.94	49.45	44.78	50.76	52.88	59.10	66.12	69.27	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	371.11	368.95	355.47	333.81	311.86	290.75	277.09	283.11	294.29	316.16	341.24	360.00	(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	6.87	x	36.79	x 0.9 x	0.72	x	0.80	=	100.90	(77)
NorthWest	0.77	x	3.38	x	11.28	x 0.9 x	0.72	x	0.80	=	15.22	(81)

Solar gains in watts ∑(74)m...(82)m

116.12	202.86	290.99	383.06	449.60	455.39	435.28	384.26	322.65	227.82	140.01	98.78	(83)

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

487.23	571.80	646.45	716.87	761.46	746.14	712.38	667.37	616.95	543.98	481.24	458.78	(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	0.95	0.84	0.65	0.45	0.33	0.36	0.59	0.90	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.53	20.65	20.79	20.92	20.96	20.97	20.97	20.97	20.96	20.90	20.69	20.52	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.34	20.34	20.34	20.35	20.36	20.37	20.37	20.37	20.36	20.36	20.35	20.35	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.98	0.94	0.81	0.61	0.41	0.28	0.31	0.54	0.87	0.98	1.00	(89)

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

19.71	19.87	20.07	20.25	20.30	20.32	20.32	20.32	20.31	20.23	19.95	19.69

(90)

Living area fraction — Living area ÷ (4) = 0.44 (91)

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

20.07	20.21	20.39	20.54	20.59	20.60	20.60	20.60	20.60	20.52	20.28	20.05

(92)

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

19.92	20.06	20.24	20.39	20.44	20.45	20.45	20.45	20.45	20.37	20.13	19.90

(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	0.81	0.61	0.41	0.28	0.32	0.54	0.87	0.98	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	484.48	561.42	608.04	582.15	465.26	307.94	202.80	212.53	335.59	473.18	472.99	457.01	(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]	866.15	837.50	755.76	619.89	469.50	308.10	202.81	212.55	336.91	525.08	705.51	857.12	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	283.97	185.52	109.90	27.18	3.15	0.00	0.00	0.00	0.00	38.61	167.41	297.68	

∑(98)1...5, 10...12 = 1113.43 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 14.15 (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 (%) — 92.30 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	307.65	201.00	119.07	29.44	3.42	0.00	0.00	0.00	0.00	41.84	181.38	322.52	

∑(211)1...5, 10...12 = 1206.31 (211)

Water heating

Efficiency of water heater	88.93	88.75	88.39	87.74	87.36	87.30	87.30	87.30	87.30	87.86	88.67	88.98	(217)
Water heating fuel, kWh/month	183.14	160.91	167.70	148.67	144.30	126.13	118.37	133.70	134.65	154.08	164.90	177.72	

∑(219a)1...12 = 1814.27 (219)

Annual totals

Space heating fuel - main system 1 — 1206.31

Water heating fuel — 1814.27

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside — 124.82 (230a)

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 — 199.82 (231)

Electricity for lighting (Appendix L)		361.25	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	3581.65	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1206.31	x	3.48	x 0.01 =	41.98	(240)
Water heating	1814.27	x	3.48	x 0.01 =	63.14	(247)
Pumps and fans	199.82	x	13.19	x 0.01 =	26.36	(249)
Electricity for lighting	361.25	x	13.19	x 0.01 =	47.65	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		299.12	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.02	(257)
SAP value	85.83	
SAP rating (section 13)	86	(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	1206.31	x	0.22	=	260.56	(261)
Water heating	1814.27	x	0.22	=	391.88	(264)
Space and water heating			(261) + (262) + (263) + (264) =		652.45	(265)
Pumps and fans	199.82	x	0.52	=	103.71	(267)
Electricity for lighting	361.25	x	0.52	=	187.49	(268)
Total CO_2, kg/year			(265)...(271) =		943.64	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		11.99	(273)
EI value					89.78	
EI rating (section 14)					90	(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	1206.31	x	1.22	=	1471.70	(261)
Water heating	1814.27	x	1.22	=	2213.41	(264)
Space and water heating			(261) + (262) + (263) + (264) =		3685.11	(265)
Pumps and fans	199.82	x	3.07	=	613.44	(267)
Electricity for lighting	361.25	x	3.07	=	1109.03	(268)
Primary energy kWh/year					5407.59	(272)
Dwelling primary energy rate kWh/m2/year					68.71	(273)

DER Worksheet
Design - Draft

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

Assessor name	Mr John Simpson	Assessor number	3722
Client		Last modified	19/11/2014
Address	Unit 3.05 Marine Ices Haverstock Hill, London, NW3 2BL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		106.40	(1a) x	2.60	(2a) =	276.64	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	106.40	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	276.64	(5)

2. Ventilation rate

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

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

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

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

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

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

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(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			20.23	x	1.33	=	26.82			(27)
Door			2.14	x	1.10	=	2.35			(26)
External wall			103.05	x	0.20	=	20.61			(29a)
Party wall			12.30	x	0.00	=	0.00			(32)
Roof			106.40	x	0.15	=	15.96			(30)
Total area of external elements ∑A, m²			231.82							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	65.74 (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		15.65 (36)
Total fabric heat loss	(33) + (36) =	81.40 (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)													
	24.02	23.72	23.43	21.98	21.69	20.23	20.23	19.94	20.81	21.69	22.27	22.85	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	105.41	105.12	104.83	103.37	103.08	101.63	101.63	101.34	102.21	103.08	103.66	104.25	
Average = ∑(39)1...12/12 =												103.30	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	0.99	0.99	0.99	0.97	0.97	0.96	0.96	0.95	0.96	0.97	0.97	0.98	
Average = ∑(40)1...12/12 =												0.97	(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	2.79 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	100.50 (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)													
	110.55	106.53	102.51	98.49	94.47	90.45	90.45	94.47	98.49	102.51	106.53	110.55	
∑(44)1...12 =												1205.95	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	163.94	143.38	147.95	128.99	123.77	106.80	98.97	113.57	114.92	133.93	146.20	158.76	
∑(45)1...12 =												1581.19	(45)
Distribution loss 0.15 x (45)m													
	24.59	21.51	22.19	19.35	18.57	16.02	14.85	17.04	17.24	20.09	21.93	23.81	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	150.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	1.31 (48)
Temperature factor from Table 2b	0.54 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.71 (50)
Enter (50) or (54) in (55)	0.71 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m													
	21.93	19.81	21.93	21.22	21.93	21.22	21.93	21.93	21.22	21.93	21.22	21.93	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)													
	21.93	19.81	21.93	21.22	21.93	21.22	21.93	21.93	21.22	21.93	21.22	21.93	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

209.13	184.20	193.15	172.72	168.96	150.54	144.16	158.76	158.66	179.13	189.93	203.95	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

209.13	184.20	193.15	172.72	168.96	150.54	144.16	158.76	158.66	179.13	189.93	203.95	

∑(64)1...12 = 2113.29 (64)

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

90.66	80.33	85.35	77.88	77.31	70.50	69.06	73.91	73.20	80.69	83.60	88.94	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	139.57	139.57	139.57	139.57	139.57	139.57	139.57	139.57	139.57	139.57	139.57	139.57	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.76	21.10	17.16	12.99	9.71	8.20	8.86	11.52	15.46	19.63	22.91	24.42	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	266.28	269.04	262.08	247.26	228.54	210.96	199.21	196.44	203.41	218.23	236.94	254.53	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	(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)	-111.66	-111.66	-111.66	-111.66	-111.66	-111.66	-111.66	-111.66	-111.66	-111.66	-111.66	-111.66	(71)
Water heating gains (Table 5)	121.86	119.54	114.72	108.16	103.91	97.92	92.82	99.35	101.67	108.45	116.11	119.55	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	479.77	477.55	461.83	436.28	410.03	384.94	368.76	375.18	388.40	414.18	443.83	466.36	(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	3.38	x	11.28	x 0.9 x	0.72	x	0.80	=	15.22	(81)
SouthEast	0.77	x	16.85	x	36.79	x 0.9 x	0.72	x	0.80	=	247.47	(77)

Solar gains in watts ∑(74)m...(82)m

262.70	452.53	632.60	806.33	923.71	926.07	889.06	800.12	692.55	503.76	315.57	224.22	(83)

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

742.46	930.08	1094.42	1242.61	1333.74	1311.01	1257.83	1175.30	1080.95	917.94	759.40	690.58	(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	0.98	0.95	0.85	0.69	0.49	0.35	0.40	0.63	0.91	0.99	1.00	(86)

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

20.26	20.42	20.63	20.82	20.92	20.95	20.95	20.95	20.94	20.79	20.48	20.23

(87)

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

20.09	20.09	20.10	20.11	20.11	20.12	20.12	20.12	20.12	20.11	20.10	20.10

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.98	0.94	0.82	0.63	0.43	0.28	0.32	0.56	0.88	0.98	1.00

(89)

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

19.10	19.34	19.63	19.90	20.01	20.05	20.05	20.05	20.04	19.87	19.43	19.06

(90)

Living area fraction — Living area ÷ (4) = 0.40 (91)

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

19.56	19.77	20.02	20.27	20.37	20.41	20.41	20.41	20.40	20.23	19.85	19.52

(92)

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

19.41	19.62	19.87	20.12	20.22	20.26	20.26	20.26	20.25	20.08	19.70	19.37

(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	0.93	0.82	0.64	0.44	0.30	0.33	0.57	0.88	0.98	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	737.21	908.84	1022.14	1020.37	850.19	572.39	371.80	390.93	616.70	805.90	744.98	687.19	(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]	1592.44	1547.30	1401.99	1159.52	878.78	575.01	372.02	391.35	628.16	977.64	1306.13	1581.83	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	636.30	429.05	282.61	100.19	21.27	0.00	0.00	0.00	0.00	127.78	404.03	665.62	

∑(98)1...5, 10...12 = 2666.83 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 25.06 (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 (%) — 92.70 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	686.40	462.83	304.87	108.08	22.95	0.00	0.00	0.00	0.00	137.84	435.85	718.03	

∑(211)1...5, 10...12 = 2876.84 (211)

Water heating

Efficiency of water heater	87.39	86.80	85.63	83.22	80.67	79.60	79.60	79.60	79.60	83.73	86.58	87.54	(217)
Water heating fuel, kWh/month	239.29	212.22	225.57	207.55	209.45	189.12	181.11	199.45	199.32	213.93	219.38	232.98	

∑(219a)1...12 = 2529.36 (219)

Annual totals

Space heating fuel - main system 1		2876.84	
Water heating fuel		2529.36	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	181.41		(230a)
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		256.41	(231)
Electricity for lighting (Appendix L)		419.57	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	6082.19	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2876.84	x	3.48	x 0.01 =	100.11	(240)
Water heating	2529.36	x	3.48	x 0.01 =	88.02	(247)
Pumps and fans	256.41	x	13.19	x 0.01 =	33.82	(249)
Electricity for lighting	419.57	x	13.19	x 0.01 =	55.34	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		397.30	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.10	(257)
SAP value	84.63	
SAP rating (section 13)	85	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	2876.84	x	0.22	=	621.40	(261)
Water heating	2529.36	x	0.22	=	546.34	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1167.74	(265)
Pumps and fans	256.41	x	0.52	=	133.08	(267)
Electricity for lighting	419.57	x	0.52	=	217.76	(268)
Total CO_2, kg/year				(265)...(271) =	1518.58	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	14.27	(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	2876.84	x	1.22	=	3509.75	(261)
Water heating	2529.36	x	1.22	=	3085.82	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6595.57	(265)
Pumps and fans	256.41	x	3.07	=	787.17	(267)
Electricity for lighting	419.57	x	3.07	=	1288.09	(268)
Primary energy kWh/year					8670.84	(272)

Dwelling primary energy rate kWh/m2/year	81.49	(273)

DER Worksheet
Design - Draft

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

Assessor name	Mr John Simpson	Assessor number	3722
Client		Last modified	19/11/2014
Address	Unit 4.01 Marine Ices Haverstock Hill, London, NW3 2BL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		98.00	(1a) x	2.60	(2a) =	254.80	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	98.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	254.80	(5)

2. Ventilation rate

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

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

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

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

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

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

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			50.50	x	1.33	=	66.95			(27)
Door			2.14	x	1.10	=	2.35			(26)
External wall			58.64	x	0.20	=	11.73			(29a)
Roof			98.00	x	0.15	=	14.70			(30)
Total area of external elements ∑A, m²			209.28							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	95.73 (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		19.94 (36)
Total fabric heat loss	(33) + (36) =	115.68 (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	
22.12	21.85	21.58	20.24	19.98	18.64	18.64	18.37	19.17	19.98	20.51	21.05	(38)

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

137.80	137.53	137.26	135.92	135.65	134.31	134.31	134.04	134.85	135.65	136.19	136.72	

Average = ∑(39)1...12/12 = 135.85 (39)

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

1.41	1.40	1.40	1.39	1.38	1.37	1.37	1.37	1.38	1.38	1.39	1.40	

Average = ∑(40)1...12/12 = 1.39 (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	2.72 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	98.81 (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	
108.69	104.73	100.78	96.83	92.88	88.92	88.92	92.88	96.83	100.78	104.73	108.69	

∑(44)1...12 = 1185.66 (44)

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

161.18	140.97	145.47	126.82	121.69	105.01	97.30	111.66	112.99	131.68	143.74	156.09	

∑(45)1...12 = 1554.59 (45)

Distribution loss 0.15 x (45)m

24.18	21.15	21.82	19.02	18.25	15.75	14.60	16.75	16.95	19.75	21.56	23.41	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	150.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	1.31 (48)
Temperature factor from Table 2b	0.54 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.71 (50)
Enter (50) or (54) in (55)	0.71 (55)

Water storage loss calculated for each month (55) x (41)m

21.93	19.81	21.93	21.22	21.93	21.22	21.93	21.93	21.22	21.93	21.22	21.93	(56)

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

21.93	19.81	21.93	21.22	21.93	21.22	21.93	21.93	21.22	21.93	21.22	21.93	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

206.37	181.79	190.66	170.55	166.88	148.74	142.50	156.85	156.73	176.87	187.47	201.28	(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

206.37	181.79	190.66	170.55	166.88	148.74	142.50	156.85	156.73	176.87	187.47	201.28	

∑(64)1...12 = 2086.69 (64)

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

89.75	79.53	84.52	77.15	76.61	69.90	68.51	73.28	72.56	79.94	82.78	88.05	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.56	20.04	16.30	12.34	9.22	7.79	8.41	10.93	14.68	18.64	21.75	23.19	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	253.05	255.68	249.06	234.97	217.19	200.48	189.31	186.69	193.31	207.39	225.17	241.89	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.60	36.60	36.60	36.60	36.60	36.60	36.60	36.60	36.60	36.60	36.60	36.60	(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)	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	(71)
Water heating gains (Table 5)	120.63	118.34	113.60	107.16	102.98	97.09	92.08	98.49	100.77	107.44	114.97	118.35	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	463.04	460.86	445.76	421.27	396.19	372.15	356.61	362.92	375.56	400.27	428.70	450.23	(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	19.59	x	36.79	x 0.9 x	0.72	x	0.80	=	287.72	(77)
South	0.77	x	10.60	x	46.75	x 0.9 x	0.72	x	0.80	=	197.82	(78)
NorthEast	0.77	x	9.80	x	11.28	x 0.9 x	0.72	x	0.80	=	44.14	(75)
NorthWest	0.77	x	10.51	x	11.28	x 0.9 x	0.72	x	0.80	=	47.33	(81)

Solar gains in watts ∑(74)m...(82)m

577.01	1000.25	1418.71	1848.20	2157.22	2181.15	2086.32	1848.92	1565.94	1118.63	694.19	491.86	(83)

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

1040.05	1461.12	1864.47	2269.48	2553.41	2553.31	2442.93	2211.84	1941.50	1518.90	1122.90	942.09	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

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

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

0.98	0.94	0.84	0.66	0.48	0.33	0.24	0.28	0.47	0.78	0.95	0.99

(86)

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

20.06	20.36	20.64	20.84	20.92	20.93	20.94	20.94	20.92	20.78	20.37	20.00

(87)

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

19.76	19.76	19.76	19.77	19.78	19.79	19.79	19.79	19.78	19.78	19.77	19.77

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.92	0.80	0.61	0.42	0.27	0.18	0.21	0.39	0.72	0.94	0.98

(89)

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

18.54	18.96	19.34	19.59	19.67	19.69	19.70	19.70	19.68	19.54	19.00	18.46

(90)

Living area fraction — Living area ÷ (4) = 0.37 (91)

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

19.10	19.47	19.82	20.05	20.13	20.15	20.15	20.15	20.14	19.99	19.50	19.03

(92)

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

18.95	19.32	19.67	19.90	19.98	20.00	20.00	20.00	19.99	19.84	19.35	18.88

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.91	0.80	0.62	0.43	0.28	0.19	0.22	0.40	0.73	0.93	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	1009.88	1332.20	1489.19	1401.63	1104.65	722.96	456.46	482.28	784.37	1105.63	1047.80	922.65	(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]	2018.57	1983.58	1807.53	1495.18	1122.58	725.06	456.70	482.75	793.92	1254.04	1668.95	2006.49	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	750.47	437.73	236.85	67.35	13.34	0.00	0.00	0.00	0.00	110.42	447.23	806.38	

∑(98)1...5, 10...12 = 2869.76 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 29.28 (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 (%) — 92.70 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	809.56	472.20	255.50	72.66	14.39	0.00	0.00	0.00	0.00	119.11	482.45	869.88	

∑(211)1...5, 10...12 = 3095.75 (211)

Water heating

Efficiency of water heater

87.76	86.87	85.19	82.36	80.30	79.60	79.60	79.60	79.60	83.40	86.85	87.94

(217)

Water heating fuel, kWh/month

235.16	209.25	223.80	207.08	207.81	186.86	179.02	197.05	196.89	212.08	215.86	228.89

∑(219a)1...12 = 2499.74 (219)

Annual totals

Space heating fuel - main system 1		3095.75	
Water heating fuel		2499.74	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	167.09		(230a)
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		242.09	(231)
Electricity for lighting (Appendix L)		398.41	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	6235.99	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3095.75	x	3.48	x 0.01 =	107.73	(240)
Water heating	2499.74	x	3.48	x 0.01 =	86.99	(247)
Pumps and fans	242.09	x	13.19	x 0.01 =	31.93	(249)
Electricity for lighting	398.41	x	13.19	x 0.01 =	52.55	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		399.21	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.17	(257)
SAP value	83.64	
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	3095.75	x	0.22	=	668.68	(261)
Water heating	2499.74	x	0.22	=	539.94	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1208.63	(265)
Pumps and fans	242.09	x	0.52	=	125.64	(267)
Electricity for lighting	398.41	x	0.52	=	206.78	(268)
Total CO_2, kg/year				(265)...(271) =	1541.05	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	15.72	(273)
EI value					85.56	
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	3095.75	x	1.22	=	3776.82	(261)
Water heating	2499.74	x	1.22	=	3049.68	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6826.50	(265)
Pumps and fans	242.09	x	3.07	=	743.20	(267)
Electricity for lighting	398.41	x	3.07	=	1223.13	(268)

Primary energy kWh/year	8792.84	(272)
Dwelling primary energy rate kWh/m2/year	89.72	(273)

DER Worksheet
Design - Draft

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

Assessor name	Mr John Simpson	Assessor number	3722
Client		Last modified	19/11/2014
Address	Unit 4.02 Marine Ices Haverstock Hill, London, NW3 2BL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		100.90	(1a) x	2.60	(2a) =	262.34	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	100.90	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	262.34	(5)

2. Ventilation rate

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

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

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

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

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

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

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(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			31.68	x	1.33	=	42.00			(27)
Door			2.14	x	1.10	=	2.35			(26)
External wall			81.67	x	0.20	=	16.33			(29a)
Roof			100.90	x	0.15	=	15.14			(30)
Total area of external elements ∑A, m²			216.39							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	75.82 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		16.94 (36)
Total fabric heat loss	(33) + (36) =	92.76 (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	
22.77	22.50	22.22	20.84	20.57	19.19	19.19	18.91	19.74	20.57	21.12	21.67	(38)

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

115.53	115.26	114.98	113.60	113.33	111.95	111.95	111.67	112.50	113.33	113.88	114.43	

Average = ∑(39)1...12/12 = 113.53 (39)

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

1.15	1.14	1.14	1.13	1.12	1.11	1.11	1.11	1.11	1.12	1.13	1.13	

Average = ∑(40)1...12/12 = 1.13 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.75 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		99.46 (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	
109.40	105.43	101.45	97.47	93.49	89.51	89.51	93.49	97.47	101.45	105.43	109.40	

∑(44)1...12 = 1193.50 (44)

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

162.24	141.90	146.43	127.66	122.49	105.70	97.95	112.40	113.74	132.55	144.69	157.12	

∑(45)1...12 = 1564.86 (45)

Distribution loss 0.15 x (45)m

24.34	21.28	21.96	19.15	18.37	15.86	14.69	16.86	17.06	19.88	21.70	23.57	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		150.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		1.31 (48)
Temperature factor from Table 2b		0.54 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.71 (50)
Enter (50) or (54) in (55)		0.71 (55)

Water storage loss calculated for each month (55) x (41)m

21.93	19.81	21.93	21.22	21.93	21.22	21.93	21.93	21.22	21.93	21.22	21.93	(56)

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

21.93	19.81	21.93	21.22	21.93	21.22	21.93	21.93	21.22	21.93	21.22	21.93	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

207.43	182.72	191.62	171.39	167.68	149.43	143.14	157.59	157.47	177.74	188.42	202.32	(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

207.43	182.72	191.62	171.39	167.68	149.43	143.14	157.59	157.47	177.74	188.42	202.32	

∑(64)1...12 = 2096.96 (64)

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

90.10	79.84	84.84	77.43	76.88	70.13	68.72	73.52	72.81	80.23	83.10	88.40	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.98	20.41	16.60	12.57	9.39	7.93	8.57	11.14	14.95	18.98	22.16	23.62	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	257.77	260.45	253.71	239.36	221.24	204.22	192.85	190.17	196.91	211.26	229.38	246.40	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	(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)	-109.91	-109.91	-109.91	-109.91	-109.91	-109.91	-109.91	-109.91	-109.91	-109.91	-109.91	-109.91	(71)
Water heating gains (Table 5)	121.10	118.80	114.03	107.55	103.34	97.41	92.37	98.82	101.12	107.83	115.41	118.81	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	469.07	466.88	451.56	426.69	401.19	376.77	361.00	367.35	380.20	405.29	434.16	456.05	(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	18.44	x	11.28	x 0.9 x	0.72	x	0.80	=	83.05	(81)
SouthEast	0.77	x	13.24	x	36.79	x 0.9 x	0.72	x	0.80	=	194.45	(77)

Solar gains in watts ∑(74)m...(82)m

277.50	500.28	757.78	1061.74	1301.34	1341.24	1272.57	1086.28	861.85	572.67	337.41	234.24	(83)

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

746.58	967.16	1209.33	1488.43	1702.53	1718.01	1633.57	1453.63	1242.05	977.96	771.57	690.28	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.98	0.94	0.80	0.60	0.41	0.30	0.35	0.60	0.90	0.99	1.00	(86)

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

20.12	20.31	20.57	20.82	20.92	20.94	20.95	20.95	20.93	20.74	20.37	20.08

(87)

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

19.96	19.97	19.97	19.98	19.98	19.99	19.99	20.00	19.99	19.98	19.98	19.97

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.98	0.92	0.76	0.54	0.35	0.23	0.28	0.52	0.87	0.98	1.00

(89)

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

18.79	19.08	19.44	19.77	19.88	19.91	19.92	19.92	19.90	19.69	19.17	18.75

(90)

Living area fraction — Living area ÷ (4) = 0.33 (91)

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

19.23	19.49	19.82	20.12	20.23	20.26	20.26	20.26	20.24	20.04	19.57	19.19

(92)

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

19.08	19.34	19.67	19.97	20.08	20.11	20.11	20.11	20.09	19.89	19.42	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	0.97	0.91	0.76	0.54	0.36	0.24	0.28	0.53	0.87	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	740.06	940.04	1104.46	1129.30	927.74	614.44	392.56	413.81	660.39	846.63	754.70	686.05	(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]	1707.82	1663.97	1514.06	1257.38	949.44	616.41	392.75	414.26	673.92	1052.32	1402.97	1698.29	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	720.01	486.49	304.74	92.22	16.15	0.00	0.00	0.00	0.00	153.04	466.76	753.11	

∑(98)1...5, 10...12 = 2992.50 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 29.66 (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 (%) — 92.70 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	776.71	524.80	328.74	99.48	17.42	0.00	0.00	0.00	0.00	165.09	503.51	812.42	

∑(211)1...5, 10...12 = 3228.16 (211)

Water heating

Efficiency of water heater	87.66	87.10	85.85	83.04	80.44	79.60	79.60	79.60	79.60	84.22	86.94	87.80	(217)
Water heating fuel, kWh/month	236.62	209.77	223.21	206.39	208.46	187.73	179.82	197.97	197.83	211.05	216.73	230.43	

∑(219a)1...12 = 2506.03 (219)

Annual totals

Space heating fuel - main system 1 — 3228.16

Water heating fuel		2506.03	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	172.03		(230a)
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		247.03	(231)
Electricity for lighting (Appendix L)		405.85	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	6387.06	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3228.16	x	3.48	x 0.01 =	112.34	(240)
Water heating	2506.03	x	3.48	x 0.01 =	87.21	(247)
Pumps and fans	247.03	x	13.19	x 0.01 =	32.58	(249)
Electricity for lighting	405.85	x	13.19	x 0.01 =	53.53	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		405.66	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.17	(257)
SAP value	83.71	
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	3228.16	x	0.22	=	697.28	(261)
Water heating	2506.03	x	0.22	=	541.30	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1238.58	(265)
Pumps and fans	247.03	x	0.52	=	128.21	(267)
Electricity for lighting	405.85	x	0.52	=	210.64	(268)
Total CO_2, kg/year				(265)...(271) =	1577.43	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	15.63	(273)
EI value					85.51	
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	3228.16	x	1.22	=	3938.35	(261)
Water heating	2506.03	x	1.22	=	3057.36	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6995.71	(265)
Pumps and fans	247.03	x	3.07	=	758.38	(267)
Electricity for lighting	405.85	x	3.07	=	1245.95	(268)
Primary energy kWh/year					9000.04	(272)
Dwelling primary energy rate kWh/m2/year					89.20	(273)

13 Appendix C – TER Worksheets (Part L 2013)

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

The following dwellings are included as a sample – worksheets for all dwellings can be provided upon request:

1.01
1.02
2.04
2.05
3.05
4.01
4.02

TER Worksheet
Design - Draft

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

Assessor name	Mr John Simpson	Assessor number	3722
Client		Last modified	19/11/2014
Address	Unit 1.01 Marine Ices Haverstock Hill, London, NW3 2BL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.20	(1a) x	2.60	(2a) =	182.52	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	182.52	(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	0.39	0.38	0.33	0.33	0.33	0.35	0.38	0.40	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	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

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

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

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			15.40	x	1.33	=	20.42			(27)
Door			2.14	x	1.00	=	2.14			(26)
Exposed floor			70.20	x	0.13	=	9.13			(28b
External wall			50.02	x	0.18	=	9.00			(29a)
Party wall			32.68	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			137.76							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	40.69 (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		6.46 (36)
Total fabric heat loss	(33) + (36) =	47.14 (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)													
	36.19	35.95	35.72	34.64	34.43	33.49	33.49	33.31	33.85	34.43	34.84	35.27	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	83.33	83.10	82.87	81.78	81.58	80.63	80.63	80.46	81.00	81.58	81.99	82.42	
Average = ∑(39)1...12/12 =												81.78	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	1.19	1.18	1.18	1.16	1.16	1.15	1.15	1.15	1.15	1.16	1.17	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	2.25 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	87.66 (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)													
	96.43	92.92	89.41	85.91	82.40	78.89	78.89	82.40	85.91	89.41	92.92	96.43	
∑(44)1...12 =												1051.93	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	143.00	125.07	129.06	112.52	107.96	93.16	86.33	99.06	100.25	116.83	127.53	138.49	
∑(45)1...12 =												1379.24	(45)
Distribution loss 0.15 x (45)m													
	21.45	18.76	19.36	16.88	16.19	13.97	12.95	14.86	15.04	17.52	19.13	20.77	(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													
	49.14	42.77	45.56	42.37	41.99	38.91	40.20	41.99	42.37	45.56	45.82	49.14	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m													
	192.14	167.84	174.62	154.88	149.95	132.07	126.53	141.05	142.61	162.39	173.35	187.62	(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

	192.14	167.84	174.62	154.88	149.95	132.07	126.53	141.05	142.61	162.39	173.35	187.62

∑(64)1...12 = 1905.06 (64)

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

	59.83	52.28	54.30	48.00	46.39	40.70	38.76	43.44	43.92	50.24	53.86	58.33 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	112.55	112.55	112.55	112.55	112.55	112.55	112.55	112.55	112.55	112.55	112.55	112.55	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.64	15.67	12.74	9.65	7.21	6.09	6.58	8.55	11.48	14.57	17.01	18.13	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	197.76	199.82	194.64	183.63	169.74	156.68	147.95	145.90	151.07	162.08	175.98	189.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.25	34.25	34.25	34.25	34.25	34.25	34.25	34.25	34.25	34.25	34.25	34.25	(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)	-90.04	-90.04	-90.04	-90.04	-90.04	-90.04	-90.04	-90.04	-90.04	-90.04	-90.04	-90.04	(71)
Water heating gains (Table 5)	80.42	77.79	72.99	66.67	62.36	56.53	52.09	58.38	61.00	67.52	74.80	78.40	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	355.58	353.04	340.14	319.72	299.07	279.06	266.38	272.59	283.31	303.94	327.55	345.33	(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	
SouthWest	0.77	x	11.69	x	36.79	x 0.9 x	0.63	x	0.70	=	131.45	(79)
NorthEast	0.77	x	3.71	x	11.28	x 0.9 x	0.63	x	0.70	=	12.79	(75)

Solar gains in watts ∑(74)m...(82)m

	144.24	249.95	353.28	456.65	528.75	532.52	510.25	455.29	388.89	279.29	173.54	122.94 (83)

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

	499.83	602.99	693.41	776.36	827.82	811.58	776.63	727.89	672.21	583.23	501.09	468.27 (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	0.92	0.79	0.61	0.45	0.50	0.75	0.95	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.81	20.01	20.30	20.63	20.87	20.97	20.99	20.99	20.93	20.60	20.14	19.78	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.93	19.93	19.94	19.95	19.95	19.96	19.96	19.96	19.96	19.95	19.95	19.94	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.99	0.99	0.96	0.89	0.74	0.52	0.35	0.39	0.66	0.92	0.99	1.00	(89)

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

18.36	18.66	19.06	19.53	19.83	19.94	19.96	19.96	19.90	19.51	18.85	18.32

(90)

Living area fraction — Living area ÷ (4) = 0.37 (91)

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

18.90	19.16	19.52	19.94	20.21	20.32	20.34	20.34	20.28	19.91	19.33	18.86

(92)

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

18.90	19.16	19.52	19.94	20.21	20.32	20.34	20.34	20.28	19.91	19.33	18.86

(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	0.75	0.55	0.39	0.43	0.69	0.92	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	496.04	592.05	663.07	689.86	622.66	449.47	300.10	314.33	465.44	537.58	492.95	465.62	(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]	1216.44	1184.79	1078.85	902.53	694.23	461.51	301.69	317.07	500.57	759.85	1002.68	1208.04	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	535.98	398.32	309.34	153.12	53.25	0.00	0.00	0.00	0.00	165.36	367.00	552.36	

∑(98)1...5, 10...12 = 2534.74 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 36.11 (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	573.86	426.47	331.20	163.94	57.01	0.00	0.00	0.00	0.00	177.05	392.94	591.40	

∑(211)1...5, 10...12 = 2713.86 (211)

Water heating

Efficiency of water heater

87.50	87.15	86.48	85.02	82.72	80.30	80.30	80.30	80.30	85.10	86.89	87.61

(217)

Water heating fuel, kWh/month

219.59	192.58	201.93	182.16	181.27	164.47	157.57	175.66	177.60	190.83	199.50	214.17

∑(219a)1...12 = 2257.34 (219)

Annual totals

Space heating fuel - main system 1 — 2713.86

Water heating fuel — 2257.34

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)		311.50	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5357.70	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2713.86	x	3.48	x 0.01 =	94.44	(240)
Water heating	2257.34	x	3.48	x 0.01 =	78.56	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	311.50	x	13.19	x 0.01 =	41.09	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		343.98	(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	82.51	
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	2713.86	x	0.22	=	586.19	(261)
Water heating	2257.34	x	0.22	=	487.59	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1073.78	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	311.50	x	0.52	=	161.67	(268)
Total CO_2, kg/year			(265)...(271) =		1274.37	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		18.15	(273)
EI value					85.18	
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	2713.86	x	1.22	=	3310.90	(261)
Water heating	2257.34	x	1.22	=	2753.96	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6064.86	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	311.50	x	3.07	=	956.31	(268)
Primary energy kWh/year					7251.42	(272)
Dwelling primary energy rate kWh/m2/year					103.30	(273)

TER Worksheet
Design - Draft

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

Assessor name	Mr John Simpson	Assessor number	3722
Client		Last modified	19/11/2014
Address	Unit 1.02 Marine Ices Haverstock Hill, London, NW3 2BL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		49.80	(1a) x	2.60	(2a) =	129.48	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	49.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	129.48	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	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	0.33	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

	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	
Window			10.31	x	1.33	=	13.67			(27)
Door			2.14	x	1.00	=	2.14			(26)
Exposed floor			49.80	x	0.13	=	6.47			(28b
External wall			51.54	x	0.18	=	9.28			(29a)
Party wall			13.34	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			113.79							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	31.56 (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		5.02 (36)
Total fabric heat loss	(33) + (36) =	36.58 (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)	25.47	25.31	25.15	24.42	24.28	23.64	23.64	23.52	23.89	24.28	24.56	24.85	(38)
Heat transfer coefficient, W/K (37)m + (38)m	62.05	61.89	61.73	61.00	60.86	60.22	60.22	60.11	60.47	60.86	61.14	61.43	

Average = ∑(39)1...12/12 = 61.00 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.25	1.24	1.24	1.22	1.22	1.21	1.21	1.21	1.21	1.22	1.23	1.23	

Average = ∑(40)1...12/12 = 1.22 (40)

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

4. Water heating energy requirement

Assumed occupancy, N	1.68 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.20 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	81.62	78.65	75.68	72.72	69.75	66.78	66.78	69.75	72.72	75.68	78.65	81.62	

∑(44)1...12 = 890.40 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	121.04	105.86	109.24	95.24	91.38	78.86	73.07	83.85	84.85	98.89	107.94	117.22	

∑(45)1...12 = 1167.46 (45)

Distribution loss 0.15 x (45)m	18.16	15.88	16.39	14.29	13.71	11.83	10.96	12.58	12.73	14.83	16.19	17.58	(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	41.59	36.20	38.57	35.86	35.54	32.93	34.03	35.54	35.86	38.57	38.79	41.59	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	162.63	142.06	147.81	131.10	126.93	111.79	107.10	119.40	120.71	137.46	146.73	158.81	(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

	162.63	142.06	147.81	131.10	126.93	111.79	107.10	119.40	120.71	137.46	146.73	158.81

∑(64)1...12 = 1612.53 (64)

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

	50.64	44.25	45.96	40.63	39.27	34.45	32.80	36.77	37.18	42.52	45.59	49.37 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	84.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.13	11.66	9.48	7.18	5.37	4.53	4.90	6.36	8.54	10.85	12.66	13.49	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	146.71	148.24	144.40	136.23	125.92	116.23	109.76	108.24	112.07	120.24	130.55	140.24	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	31.42	(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)	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	-67.37	(71)
Water heating gains (Table 5)	68.07	65.85	61.78	56.43	52.78	47.85	44.09	49.42	51.64	57.15	63.32	66.36	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	279.18	277.01	266.93	251.11	235.34	219.88	210.01	215.28	223.52	239.50	257.79	271.36	(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	7.15	x	36.79	x 0.9 x	0.63	x	0.70	=	80.40	(79)
NorthEast	0.77	x	3.16	x	11.28	x 0.9 x	0.63	x	0.70	=	10.90	(75)

Solar gains in watts ∑(74)m...(82)m

	91.30	159.13	227.34	297.80	348.27	352.22	336.89	298.25	251.59	178.46	110.01	77.70 (83)

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

	370.47	436.14	494.27	548.91	583.61	572.10	546.90	513.53	475.10	417.97	367.80	349.07 (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	0.53	0.77	0.95	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.76	19.95	20.23	20.57	20.83	20.96	20.99	20.99	20.90	20.56	20.10	19.73	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	19.88	19.89	19.89	19.90	19.90	19.91	19.91	19.91	19.91	19.90	19.90	19.89	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.99	0.98	0.96	0.90	0.76	0.54	0.36	0.41	0.68	0.93	0.99	0.99	(89)

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

18.26	18.53	18.94	19.42	19.75	19.89	19.91	19.91	19.84	19.41	18.75	18.22

(90)

Living area fraction — Living area ÷ (4) = 0.50 (91)

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

19.00	19.24	19.58	19.99	20.28	20.42	20.45	20.44	20.37	19.98	19.42	18.97

(92)

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

19.00	19.24	19.58	19.99	20.28	20.42	20.45	20.44	20.37	19.98	19.42	18.97

(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	0.90	0.78	0.59	0.42	0.47	0.72	0.93	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	367.32	428.27	474.30	494.51	454.34	337.01	229.54	239.61	343.64	387.88	361.54	346.76	(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]	912.38	887.31	807.35	676.40	522.45	350.54	231.66	243.09	378.96	571.04	753.24	907.09	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	405.53	308.48	247.79	130.96	50.68	0.00	0.00	0.00	0.00	136.27	282.02	416.88	

∑(98)1...5, 10...12 = 1978.60 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 39.73 (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	434.18	330.27	265.30	140.21	54.26	0.00	0.00	0.00	0.00	145.90	301.95	446.34	

∑(211)1...5, 10...12 = 2118.42 (211)

Water heating

Efficiency of water heater	87.26	86.95	86.34	85.05	82.94	80.30	80.30	80.30	80.30	85.03	86.67	87.37	(217)
Water heating fuel, kWh/month	186.38	163.38	171.19	154.15	153.03	139.22	133.38	148.69	150.33	161.66	169.30	181.77	

∑(219a)1...12 = 1912.47 (219)

Annual totals

Space heating fuel - main system 1 — 2118.42

Water heating fuel — 1912.47

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)		231.87	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4337.76	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2118.42	x	3.48	x 0.01 =	73.72	(240)
Water heating	1912.47	x	3.48	x 0.01 =	66.55	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	231.87	x	13.19	x 0.01 =	30.58	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		300.75	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.33	(257)
SAP value	81.41	
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	2118.42	x	0.22	=	457.58	(261)
Water heating	1912.47	x	0.22	=	413.09	(264)
Space and water heating			(261) + (262) + (263) + (264) =		870.67	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	231.87	x	0.52	=	120.34	(268)
Total CO_2, kg/year			(265)...(271) =		1029.94	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		20.68	(273)
EI value					85.44	
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	2118.42	x	1.22	=	2584.47	(261)
Water heating	1912.47	x	1.22	=	2333.21	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4917.68	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	231.87	x	3.07	=	711.86	(268)
Primary energy kWh/year					5859.78	(272)
Dwelling primary energy rate kWh/m2/year					117.67	(273)

TER Worksheet
Design - Draft

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

Assessor name	Mr John Simpson	Assessor number	3722
Client		Last modified	19/11/2014
Address	Unit 2.04 Marine Ices Haverstock Hill, London, NW3 2BL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		69.20	(1a) x	2.60	(2a) =	179.92	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	69.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	179.92	(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) =	0.11	(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)	0.36	(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) = 0.31	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.39	0.38	0.38	0.34	0.33	0.29	0.29	0.28	0.31	0.33	0.35	0.36	(22b)

Calculate effective air change rate for the applicable case:

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

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

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

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			15.16	x	1.33	=	20.10			(27)
Door			2.14	x	1.00	=	2.14			(26)
External wall			47.42	x	0.18	=	8.54			(29a)
Party wall			30.52	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			64.72							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	30.77 (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		6.39 (36)
Total fabric heat loss	(33) + (36) =	37.17 (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	
34.23	34.06	33.89	33.07	32.92	32.21	32.21	32.08	32.48	32.92	33.23	33.55	(38)

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

71.40	71.22	71.05	70.24	70.09	69.38	69.38	69.25	69.65	70.09	70.39	70.72	

Average = ∑(39)1...12/12 = 70.24 (39)

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

1.03	1.03	1.03	1.01	1.01	1.00	1.00	1.00	1.01	1.01	1.02	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	2.23 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	87.08 (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	
95.79	92.31	88.82	85.34	81.86	78.37	78.37	81.86	85.34	88.82	92.31	95.79	

∑(44)1...12 = 1044.97 (44)

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

142.05	124.24	128.20	111.77	107.25	92.55	85.76	98.41	99.58	116.05	126.68	137.57	

∑(45)1...12 = 1370.12 (45)

Distribution loss 0.15 x (45)m

21.31	18.64	19.23	16.77	16.09	13.88	12.86	14.76	14.94	17.41	19.00	20.64	(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

48.81	42.49	45.26	42.08	41.71	38.65	39.94	41.71	42.08	45.26	45.52	48.81	(61)

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

190.86	166.72	173.47	153.86	148.96	131.20	125.70	140.12	141.67	161.32	172.20	186.38	(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

190.86	166.72	173.47	153.86	148.96	131.20	125.70	140.12	141.67	161.32	172.20	186.38	

∑(64)1...12 = 1892.45 (64)

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

59.44	51.93	53.94	47.69	46.09	40.43	38.50	43.15	43.63	49.90	53.50	57.95	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.43	15.48	12.59	9.53	7.13	6.02	6.50	8.45	11.34	14.40	16.81	17.92	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	195.42	197.45	192.34	181.46	167.73	154.82	146.20	144.17	149.28	160.16	173.89	186.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	(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)	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	(71)
Water heating gains (Table 5)	79.89	77.28	72.50	66.23	61.95	56.16	51.75	58.00	60.60	67.08	74.31	77.88	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	352.14	349.61	336.83	316.62	296.20	276.39	263.84	270.01	280.62	301.03	324.41	342.00	(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	4.74	x	36.79	x 0.9 x	0.63	x	0.70	=	53.30	(79)
NorthEast	0.77	x	10.42	x	11.28	x 0.9 x	0.63	x	0.70	=	35.93	(75)

Solar gains in watts ∑(74)m...(82)m

89.23	163.93	255.99	370.32	463.29	481.27	455.12	382.50	295.07	189.72	109.05	74.96	(83)

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

441.37	513.54	592.83	686.94	759.49	757.67	718.96	652.51	575.69	490.75	433.46	416.95	(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	0.78	0.57	0.42	0.48	0.76	0.96	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.96	20.12	20.38	20.70	20.91	20.99	21.00	21.00	20.94	20.64	20.24	19.93	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.06	20.06	20.06	20.07	20.07	20.08	20.08	20.08	20.08	20.07	20.07	20.07	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.99	0.97	0.90	0.72	0.50	0.34	0.39	0.69	0.94	0.99	1.00	(89)

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

	18.66	18.90	19.27	19.73	19.99	20.07	20.08	20.08	20.03	19.66	19.08	18.63	(90)

Living area fraction — Living area ÷ (4) = 0.37 (91)

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

	19.15	19.35	19.69	20.09	20.34	20.42	20.42	20.42	20.37	20.03	19.52	19.11	(92)

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

	19.15	19.35	19.69	20.09	20.34	20.42	20.42	20.42	20.37	20.03	19.52	19.11	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.97	0.90	0.74	0.53	0.37	0.42	0.71	0.94	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	439.26	507.85	574.39	617.22	560.56	397.88	264.67	277.28	410.16	462.72	428.96	415.46	(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]	1060.18	1029.52	936.90	786.09	605.39	403.44	265.29	278.62	437.00	660.89	874.04	1054.67	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	461.96	350.56	269.70	121.59	33.35	0.00	0.00	0.00	0.00	147.43	320.46	475.57	

∑(98)1...5, 10...12 = 2180.63 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 31.51 (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	494.61	375.34	288.76	130.18	35.71	0.00	0.00	0.00	0.00	157.85	343.11	509.18	

∑(211)1...5, 10...12 = 2334.72 (211)

Water heating

Efficiency of water heater

	87.19	86.88	86.16	84.47	81.98	80.30	80.30	80.30	80.30	84.83	86.59	87.31	(217)

Water heating fuel, kWh/month

	218.90	191.91	201.33	182.15	181.71	163.38	156.53	174.50	176.42	190.18	198.87	213.48	

∑(219a)1...12 = 2249.36 (219)

Annual totals

Space heating fuel - main system 1 — 2334.72

Water heating fuel — 2249.36

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) — 307.83 (232)

Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4966.91	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2334.72	x	3.48	x 0.01 =	81.25	(240)
Water heating	2249.36	x	3.48	x 0.01 =	78.28	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	307.83	x	13.19	x 0.01 =	40.60	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	330.02	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.21	(257)
SAP value	83.07	
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	2334.72	x	0.22	=	504.30	(261)
Water heating	2249.36	x	0.22	=	485.86	(264)
Space and water heating				(261) + (262) + (263) + (264) =	990.16	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	307.83	x	0.52	=	159.76	(268)
Total CO_2, kg/year				(265)...(271) =	1188.85	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	17.18	(273)
EI value					86.05	
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	2334.72	x	1.22	=	2848.36	(261)
Water heating	2249.36	x	1.22	=	2744.21	(264)
Space and water heating				(261) + (262) + (263) + (264) =	5592.58	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	307.83	x	3.07	=	945.04	(268)
Primary energy kWh/year					6767.86	(272)
Dwelling primary energy rate kWh/m2/year					97.80	(273)

TER Worksheet
Design - Draft

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

Assessor name	Mr John Simpson	Assessor number	3722
Client		Last modified	19/11/2014
Address	Unit 2.05 Marine Ices Haverstock Hill, London, NW3 2BL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		78.70	(1a) x	2.60	(2a) =	204.62	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	78.70	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	204.62	(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		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	0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	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

0.59	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)

0.59	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	
Window			10.25	x	1.33	=	13.59			(27)
Door			2.14	x	1.00	=	2.14			(26)
External wall			60.77	x	0.18	=	10.94			(29a)
Party wall			32.47	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			73.16							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	26.67 (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		6.63 (36)
Total fabric heat loss	(33) + (36) =	33.29 (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	
40.00	39.76	39.52	38.41	38.20	37.23	37.23	37.05	37.60	38.20	38.62	39.06	(38)

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

73.29	73.05	72.81	71.70	71.49	70.52	70.52	70.34	70.89	71.49	71.91	72.35	

Average = ∑(39)1...12/12 = 71.70 (39)

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

0.93	0.93	0.93	0.91	0.91	0.90	0.90	0.89	0.90	0.91	0.91	0.92	

Average = ∑(40)1...12/12 = 0.91 (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		2.44 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		92.10 (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	
101.31	97.62	93.94	90.25	86.57	82.89	82.89	86.57	90.25	93.94	97.62	101.31	

∑(44)1...12 = 1105.15 (44)

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

150.23	131.40	135.59	118.21	113.42	97.88	90.70	104.08	105.32	122.74	133.98	145.49	

∑(45)1...12 = 1449.03 (45)

Distribution loss 0.15 x (45)m

22.54	19.71	20.34	17.73	17.01	14.68	13.60	15.61	15.80	18.41	20.10	21.82	(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	44.93	47.87	44.51	44.12	40.88	42.24	44.12	44.51	47.87	48.14	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

201.19	176.33	183.46	162.72	157.54	138.75	132.94	148.19	149.83	170.61	182.12	196.45	(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

201.19	176.33	183.46	162.72	157.54	138.75	132.94	148.19	149.83	170.61	182.12	196.45	

∑(64)1...12 = 2000.13 (64)

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

62.69	54.92	57.05	50.43	48.74	42.76	40.72	45.63	46.15	52.78	56.58	61.12	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	121.89	121.89	121.89	121.89	121.89	121.89	121.89	121.89	121.89	121.89	121.89	121.89	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.06	18.70	15.21	11.52	8.61	7.27	7.85	10.21	13.70	17.39	20.30	21.64	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	216.70	218.95	213.28	201.22	185.99	171.68	162.12	159.87	165.54	177.60	192.83	207.14	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.19	35.19	35.19	35.19	35.19	35.19	35.19	35.19	35.19	35.19	35.19	35.19	(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)	-97.51	-97.51	-97.51	-97.51	-97.51	-97.51	-97.51	-97.51	-97.51	-97.51	-97.51	-97.51	(71)
Water heating gains (Table 5)	84.26	81.73	76.68	70.04	65.51	59.39	54.73	61.34	64.09	70.94	78.59	82.15	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	384.59	381.95	367.74	345.35	322.68	300.91	287.26	293.98	305.89	328.50	354.29	373.49	(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	
SouthEast	0.77	x	6.87	x	36.79	x 0.9 x	0.63	x	0.70	=	77.25	(77)
NorthWest	0.77	x	3.38	x	11.28	x 0.9 x	0.63	x	0.70	=	11.65	(81)

Solar gains in watts ∑(74)m...(82)m

88.91	155.31	222.79	293.28	344.23	348.66	333.26	294.20	247.03	174.42	107.19	75.63	(83)

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

473.50	537.26	590.53	638.62	666.91	649.56	620.53	588.17	552.93	502.92	461.48	449.12	(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	0.99	0.95	0.86	0.67	0.50	0.54	0.80	0.97	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.07	20.20	20.41	20.68	20.88	20.98	21.00	21.00	20.94	20.68	20.33	20.04	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.14	20.14	20.15	20.16	20.16	20.17	20.17	20.17	20.17	20.16	20.16	20.15	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.99	0.98	0.94	0.81	0.59	0.40	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)

	18.89	19.09	19.39	19.78	20.05	20.16	20.17	20.17	20.12	19.79	19.28	18.86 (90)

Living area fraction — Living area ÷ (4) = 0.44 (91)

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

	19.40	19.58	19.84	20.17	20.41	20.52	20.53	20.53	20.48	20.18	19.74	19.38 (92)

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

	19.40	19.58	19.84	20.17	20.41	20.52	20.53	20.53	20.48	20.18	19.74	19.38 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.98	0.94	0.83	0.63	0.45	0.49	0.76	0.95	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	471.79	532.94	578.49	599.19	552.33	407.18	276.25	288.77	420.90	480.02	457.73	447.92	(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]	1107.02	1072.12	971.24	808.21	622.97	417.36	277.32	290.66	452.43	684.80	908.80	1098.41	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	472.61	362.32	292.21	150.49	52.56	0.00	0.00	0.00	0.00	152.36	324.77	483.96	

∑(98)1...5, 10...12 = 2291.29 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 29.11 (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	506.01	387.93	312.86	161.13	56.27	0.00	0.00	0.00	0.00	163.13	347.72	518.16	

∑(211)1...5, 10...12 = 2453.20 (211)

Water heating

Efficiency of water heater	87.13	86.83	86.22	84.86	82.61	80.30	80.30	80.30	80.30	84.77	86.49	87.23 (217)
Water heating fuel, kWh/month	230.92	203.08	212.78	191.76	190.71	172.79	165.55	184.55	186.59	201.27	210.57	225.21

∑(219a)1...12 = 2375.76 (219)

Annual totals

Space heating fuel - main system 1 — 2453.20

Water heating fuel — 2375.76

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) — 371.89 (232)

Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5275.85	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2453.20	x	3.48	x 0.01 =	85.37	(240)
Water heating	2375.76	x	3.48	x 0.01 =	82.68	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	371.89	x	13.19	x 0.01 =	49.05	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		346.99	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.18	(257)
SAP value	83.56	
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	2453.20	x	0.22	=	529.89	(261)
Water heating	2375.76	x	0.22	=	513.16	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1043.06	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	371.89	x	0.52	=	193.01	(268)
Total CO_2, kg/year				(265)...(271) =	1274.99	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	16.20	(273)
EI value					86.19	
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	2453.20	x	1.22	=	2992.91	(261)
Water heating	2375.76	x	1.22	=	2898.43	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5891.34	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	371.89	x	3.07	=	1141.69	(268)
Primary energy kWh/year					7263.27	(272)
Dwelling primary energy rate kWh/m2/year					92.29	(273)

TER Worksheet
Design - Draft

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

Assessor name	Mr John Simpson	Assessor number	3722
Client		Last modified	19/11/2014
Address	Unit 3.05 Marine Ices Haverstock Hill, London, NW3 2BL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		106.40	(1a) x	2.60	(2a) =	276.64	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	106.40	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	276.64	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	40	÷ (5) =	0.14 (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) =	0.34 (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	0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	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	0.57	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)

	0.59	0.59	0.58	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	
Window			20.23	x	1.33	=	26.82			(27)
Door			2.14	x	1.00	=	2.14			(26)
External wall			103.05	x	0.18	=	18.55			(29a)
Party wall			12.30	x	0.00	=	0.00			(32)
Roof			106.40	x	0.13	=	13.83			(30)
Total area of external elements ∑A, m²			231.82							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	61.34 (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		10.91 (36)
Total fabric heat loss	(33) + (36) =	72.25 (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	
53.99	53.67	53.35	51.86	51.58	50.28	50.28	50.04	50.78	51.58	52.14	52.74	(38)

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

126.24	125.92	125.60	124.11	123.83	122.53	122.53	122.29	123.03	123.83	124.39	124.98	

Average = ∑(39)1...12/12 = 124.11 (39)

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

1.19	1.18	1.18	1.17	1.16	1.15	1.15	1.15	1.16	1.16	1.17	1.17	

Average = ∑(40)1...12/12 = 1.17 (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	2.79 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	100.50 (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	
110.55	106.53	102.51	98.49	94.47	90.45	90.45	94.47	98.49	102.51	106.53	110.55	

∑(44)1...12 = 1205.95 (44)

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

163.94	143.38	147.95	128.99	123.77	106.80	98.97	113.57	114.92	133.93	146.20	158.76	

∑(45)1...12 = 1581.19 (45)

Distribution loss 0.15 x (45)m

24.59	21.51	22.19	19.35	18.57	16.02	14.85	17.04	17.24	20.09	21.93	23.81	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	150.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	1.39 (48)
Temperature factor from Table 2b	0.54 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.75 (50)
Enter (50) or (54) in (55)	0.75 (55)

Water storage loss calculated for each month (55) x (41)m

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

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

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss for each month from Table 3

	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26 (59)

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

	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (61)

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

	210.53	185.46	194.55	174.08	170.36	151.90	145.56	160.16	160.02	180.53	191.29	205.36 (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

	210.53	185.46	194.55	174.08	170.36	151.90	145.56	160.16	160.02	180.53	191.29	205.36

∑(64)1...12 = 2129.81 (64)

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

	91.78	81.34	86.47	78.96	78.43	71.59	70.18	75.04	74.29	81.81	84.68	90.06 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	139.57	139.57	139.57	139.57	139.57	139.57	139.57	139.57	139.57	139.57	139.57	139.57	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.05	21.36	17.37	13.15	9.83	8.30	8.97	11.66	15.65	19.87	23.19	24.72	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	266.28	269.04	262.08	247.26	228.54	210.96	199.21	196.44	203.41	218.23	236.94	254.53	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	(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)	-111.66	-111.66	-111.66	-111.66	-111.66	-111.66	-111.66	-111.66	-111.66	-111.66	-111.66	-111.66	(71)
Water heating gains (Table 5)	123.37	121.04	116.22	109.67	105.42	99.42	94.33	100.86	103.17	109.96	117.62	121.05	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	481.57	479.32	463.55	437.95	411.66	386.55	370.38	376.83	390.10	415.93	445.62	468.17	(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	3.38	x	11.28	x 0.9 x	0.63	x	0.70	=	11.65	(81)
SouthEast	0.77	x	16.85	x	36.79	x 0.9 x	0.63	x	0.70	=	189.47	(77)

Solar gains in watts ∑(74)m...(82)m

	201.13	346.47	484.33	617.35	707.21	709.02	680.69	612.59	530.23	385.69	241.61	171.67 (83)

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

	682.69	825.79	947.88	1055.30	1118.87	1095.57	1051.07	989.42	920.33	801.62	687.23	639.84 (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)	1.00	0.99	0.98	0.94	0.84	0.67	0.50	0.55	0.80	0.96	0.99	1.00	(86)

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

19.75	19.94	20.22	20.55	20.82	20.96	20.99	20.99	20.90	20.55	20.08	19.72

(87)

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

19.93	19.93	19.94	19.95	19.95	19.96	19.96	19.96	19.96	19.95	19.94	19.94

(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	0.44	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)

18.27	18.55	18.95	19.43	19.78	19.93	19.96	19.96	19.88	19.43	18.76	18.23

(90)

Living area fraction — Living area ÷ (4) = 0.40 (91)

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

18.86	19.10	19.46	19.88	20.19	20.34	20.37	20.37	20.28	19.87	19.29	18.82

(92)

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

18.86	19.10	19.46	19.88	20.19	20.34	20.37	20.37	20.28	19.87	19.29	18.82

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.97	0.92	0.81	0.62	0.44	0.48	0.75	0.94	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	679.34	815.70	919.01	969.84	901.54	674.03	457.47	478.01	686.12	755.86	679.74	637.51	(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]	1837.82	1788.53	1627.18	1362.41	1051.30	703.26	461.66	484.96	760.82	1148.50	1516.00	1827.35	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	861.91	653.75	526.87	282.65	111.42	0.00	0.00	0.00	0.00	292.12	602.11	885.24	

∑(98)1...5, 10...12 = 4216.07 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 39.62 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

Fraction of space heat from main system(s) — 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

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

Efficiency of main system 1 (%) — 93.50 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	921.83	699.19	563.50	302.30	119.17	0.00	0.00	0.00	0.00	312.43	643.96	946.78	

∑(211)1...5, 10...12 = 4509.16 (211)

Water heating

Efficiency of water heater

88.18	87.90	87.34	86.10	83.71	79.80	79.80	79.80	79.80	86.09	87.67	88.27

(217)

Water heating fuel, kWh/month

238.75	211.01	222.74	202.19	203.51	190.34	182.41	200.71	200.52	209.70	218.20	232.64

∑(219a)1...12 = 2512.73 (219)

Annual totals

Space heating fuel - main system 1		4509.16	
Water heating fuel		2512.73	
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)		424.75	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	7521.64	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4509.16	x	3.48	x 0.01 =	156.92	(240)
Water heating	2512.73	x	3.48	x 0.01 =	87.44	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	424.75	x	13.19	x 0.01 =	56.02	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		430.28	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.19	(257)
SAP value	83.35	
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	4509.16	x	0.22	=	973.98	(261)
Water heating	2512.73	x	0.22	=	542.75	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1516.73	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	424.75	x	0.52	=	220.45	(268)
Total CO_2, kg/year				(265)...(271) =	1776.10	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	16.69	(273)
EI value					84.28	
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	4509.16	x	1.22	=	5501.18	(261)
Water heating	2512.73	x	1.22	=	3065.53	(264)
Space and water heating			(261) + (262) + (263) + (264) =		8566.71	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	424.75	x	3.07	=	1303.99	(268)
Primary energy kWh/year					10100.95	(272)
Dwelling primary energy rate kWh/m2/year					94.93	(273)

TER Worksheet
Design - Draft

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

Assessor name	Mr John Simpson	Assessor number	3722
Client		Last modified	19/11/2014
Address	Unit 4.01 Marine Ices Haverstock Hill, London, NW3 2BL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		98.00	(1a) x	2.60	(2a) =	254.80	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	98.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	254.80	(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) =	0.12	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.37	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.31	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.40	0.39	0.38	0.34	0.34	0.30	0.30	0.29	0.31	0.34	0.35	0.37	(22b)

Calculate effective air change rate for the applicable case:

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

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

	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

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

	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			22.35	x	1.33	=	29.63			(27)
Door			2.14	x	1.00	=	2.14			(26)
External wall			86.79	x	0.18	=	15.62			(29a)
Roof			98.00	x	0.13	=	12.74			(30)
Total area of external elements ∑A, m²			209.28							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	60.13 (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		10.03 (36)
Total fabric heat loss	(33) + (36) =	70.16 (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	
48.72	48.46	48.21	47.01	46.79	45.75	45.75	45.56	46.15	46.79	47.24	47.71	(38)

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

118.88	118.62	118.37	117.17	116.95	115.91	115.91	115.72	116.31	116.95	117.40	117.87	

Average = ∑(39)1...12/12 = 117.17 (39)

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

1.21	1.21	1.21	1.20	1.19	1.18	1.18	1.18	1.19	1.19	1.20	1.20	

Average = ∑(40)1...12/12 = 1.20 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.72 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	98.81 (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	
108.69	104.73	100.78	96.83	92.88	88.92	88.92	92.88	96.83	100.78	104.73	108.69	

∑(44)1...12 = 1185.66 (44)

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

161.18	140.97	145.47	126.82	121.69	105.01	97.30	111.66	112.99	131.68	143.74	156.09	

∑(45)1...12 = 1554.59 (45)

Distribution loss 0.15 x (45)m

24.18	21.15	21.82	19.02	18.25	15.75	14.60	16.75	16.95	19.75	21.56	23.41	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	150.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	1.39 (48)
Temperature factor from Table 2b	0.54 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.75 (50)
Enter (50) or (54) in (55)	0.75 (55)

Water storage loss calculated for each month (55) x (41)m

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

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

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

207.77	183.05	192.06	171.91	168.28	150.10	143.90	158.25	158.08	178.28	188.83	202.69	(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

207.77	183.05	192.06	171.91	168.28	150.10	143.90	158.25	158.08	178.28	188.83	202.69	

∑(64)1...12 = 2103.21 (64)

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

90.87	80.54	85.64	78.24	77.74	70.99	69.63	74.40	73.64	81.06	83.87	89.18	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	136.01	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.56	20.04	16.30	12.34	9.22	7.79	8.41	10.93	14.68	18.64	21.75	23.19	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	253.05	255.68	249.06	234.97	217.19	200.48	189.31	186.69	193.31	207.39	225.17	241.89	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.60	36.60	36.60	36.60	36.60	36.60	36.60	36.60	36.60	36.60	36.60	36.60	(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)	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	-108.81	(71)
Water heating gains (Table 5)	122.13	119.85	115.11	108.67	104.49	98.59	93.59	100.00	102.28	108.95	116.48	119.86	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	464.55	462.37	447.27	422.78	397.70	373.66	358.12	364.43	377.07	401.78	430.21	451.74	(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	8.67	x	36.79	x 0.9 x	0.63	x	0.70	=	97.49	(77)
South	0.77	x	4.69	x	46.75	x 0.9 x	0.63	x	0.70	=	67.01	(78)
NorthEast	0.77	x	4.34	x	11.28	x 0.9 x	0.63	x	0.70	=	14.97	(75)
NorthWest	0.77	x	4.65	x	11.28	x 0.9 x	0.63	x	0.70	=	16.03	(81)

Solar gains in watts ∑(74)m...(82)m

195.50	338.91	480.70	626.24	730.96	739.07	706.93	626.49	530.59	379.02	235.21	166.65	(83)

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

660.05	801.28	927.97	1049.02	1128.66	1112.73	1065.05	990.92	907.66	780.80	665.42	618.39	(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	0.93	0.81	0.63	0.47	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)

19.74	19.94	20.23	20.58	20.84	20.96	20.99	20.99	20.91	20.55	20.08	19.71

(87)

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

19.91	19.91	19.91	19.92	19.93	19.93	19.93	19.94	19.93	19.93	19.92	19.92

(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.97	0.90	0.76	0.54	0.36	0.41	0.69	0.94	0.99	1.00

(89)

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

18.25	18.54	18.96	19.44	19.78	19.91	19.93	19.93	19.86	19.42	18.74	18.20

(90)

Living area fraction — Living area ÷ (4) = 0.37 (91)

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

18.79	19.05	19.42	19.86	20.17	20.30	20.32	20.32	20.24	19.84	19.23	18.75

(92)

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

18.79	19.05	19.42	19.86	20.17	20.30	20.32	20.32	20.24	19.84	19.23	18.75

(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	0.77	0.57	0.40	0.45	0.72	0.93	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	656.03	789.31	893.50	945.86	870.64	638.73	428.19	448.13	652.32	728.68	656.57	615.57	(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]	1723.09	1678.84	1529.63	1284.16	990.08	660.39	431.23	453.44	714.58	1080.29	1424.28	1715.17	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	793.89	597.76	473.28	243.58	88.86	0.00	0.00	0.00	0.00	261.60	552.76	818.10	

∑(98)1...5, 10...12 = 3829.82 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 39.08 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

Fraction of space heat from main system(s) — 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

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

Efficiency of main system 1 (%) — 93.50 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	849.08	639.32	506.18	260.51	95.04	0.00	0.00	0.00	0.00	279.79	591.18	874.97	

∑(211)1...5, 10...12 = 4096.07 (211)

Water heating

Efficiency of water heater	88.05	87.74	87.13	85.74	83.20	79.80	79.80	79.80	79.80	85.84	87.51	88.15	(217)
Water heating fuel, kWh/month	235.97	208.63	220.44	200.50	202.26	188.09	180.32	198.31	198.10	207.69	215.78	229.93	

∑(219a)1...12 = 2486.02 (219)

Annual totals

Space heating fuel - main system 1		4096.07	
Water heating fuel		2486.02	
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)		398.41	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	7055.51	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4096.07	x	3.48	x 0.01 =	142.54	(240)
Water heating	2486.02	x	3.48	x 0.01 =	86.51	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	398.41	x	13.19	x 0.01 =	52.55	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		411.50	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.21	(257)
SAP value	83.14	
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	4096.07	x	0.22	=	884.75	(261)
Water heating	2486.02	x	0.22	=	536.98	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1421.73	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	398.41	x	0.52	=	206.78	(268)
Total CO_2, kg/year				(265)...(271) =	1667.43	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	17.01	(273)
EI value					84.38	
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	4096.07	x	1.22	=	4997.20	(261)
Water heating	2486.02	x	1.22	=	3032.95	(264)
Space and water heating			(261) + (262) + (263) + (264) =		8030.15	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	398.41	x	3.07	=	1223.13	(268)
Primary energy kWh/year					9483.53	(272)

Dwelling primary energy rate kWh/m2/year	96.77	(273)

TER Worksheet
Design - Draft

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

Assessor name	Mr John Simpson	Assessor number	3722
Client		Last modified	19/11/2014
Address	Unit 4.02 Marine Ices Haverstock Hill, London, NW3 2BL		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		100.90	(1a) x	2.60	(2a) =	262.34	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	100.90	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	262.34	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		4	x 10 =	40 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	40	÷ (5) =	0.15 (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	
Window			23.08	x	1.33	=	30.60			(27)
Door			2.14	x	1.00	=	2.14			(26)
External wall			90.29	x	0.18	=	16.25			(29a)
Roof			100.90	x	0.13	=	13.12			(30)
Total area of external elements ∑A, m²			216.41							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	62.11 (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		10.62 (36)
Total fabric heat loss	(33) + (36) =	72.73 (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	
51.52	51.20	50.89	49.42	49.14	47.86	47.86	47.62	48.35	49.14	49.70	50.28	(38)

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

124.25	123.93	123.61	122.14	121.87	120.58	120.58	120.35	121.08	121.87	122.42	123.01	

Average = ∑(39)1...12/12 = 122.14 (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	2.75 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	99.46 (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	
109.40	105.43	101.45	97.47	93.49	89.51	89.51	93.49	97.47	101.45	105.43	109.40	

∑(44)1...12 = 1193.50 (44)

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

162.24	141.90	146.43	127.66	122.49	105.70	97.95	112.40	113.74	132.55	144.69	157.12	

∑(45)1...12 = 1564.86 (45)

Distribution loss 0.15 x (45)m

24.34	21.28	21.96	19.15	18.37	15.86	14.69	16.86	17.06	19.88	21.70	23.57	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	150.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	1.39 (48)
Temperature factor from Table 2b	0.54 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.75 (50)
Enter (50) or (54) in (55)	0.75 (55)

Water storage loss calculated for each month (55) x (41)m

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

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

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

208.84	183.98	193.02	172.75	169.09	150.79	144.54	158.99	158.83	179.15	189.78	203.72	(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

208.84	183.98	193.02	172.75	169.09	150.79	144.54	158.99	158.83	179.15	189.78	203.72	

∑(64)1...12 = 2113.48 (64)

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

91.22	80.85	85.96	78.52	78.00	71.22	69.84	74.65	73.89	81.35	84.18	89.52	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	137.39	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.98	20.41	16.60	12.57	9.39	7.93	8.57	11.14	14.95	18.98	22.16	23.62	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	257.77	260.45	253.71	239.36	221.24	204.22	192.85	190.17	196.91	211.26	229.38	246.40	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	36.74	(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)	-109.91	-109.91	-109.91	-109.91	-109.91	-109.91	-109.91	-109.91	-109.91	-109.91	-109.91	-109.91	(71)
Water heating gains (Table 5)	122.61	120.31	115.54	109.06	104.84	98.92	93.88	100.33	102.63	109.34	116.92	120.32	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	470.58	468.39	453.07	428.20	402.70	378.28	362.51	368.86	381.70	406.80	435.67	457.56	(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	13.43	x	11.28	x 0.9 x	0.63	x	0.70	=	46.31	(81)
SouthEast	0.77	x	9.65	x	36.79	x 0.9 x	0.63	x	0.70	=	108.51	(77)

Solar gains in watts ∑(74)m...(82)m

154.82	279.10	422.73	592.27	725.90	748.15	709.85	605.95	480.78	319.48	188.24	130.68	(83)

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

625.40	747.49	875.80	1020.47	1128.60	1126.43	1072.36	974.81	862.49	726.28	623.91	588.24	(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	0.83	0.65	0.49	0.55	0.82	0.97	0.99	1.00	(86)

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

19.67	19.85	20.14	20.52	20.82	20.96	20.99	20.99	20.88	20.48	20.01	19.64

(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	19.93	19.92	19.91	19.91	19.90

(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.98	0.92	0.78	0.55	0.37	0.43	0.74	0.96	0.99	1.00

(89)

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

18.13	18.40	18.82	19.36	19.74	19.90	19.92	19.92	19.83	19.32	18.63	18.09

(90)

Living area fraction — Living area ÷ (4) = 0.33 (91)

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

18.64	18.88	19.26	19.75	20.10	20.25	20.28	20.27	20.18	19.70	19.09	18.61

(92)

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

18.64	18.88	19.26	19.75	20.10	20.25	20.28	20.27	20.18	19.70	19.09	18.61

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.97	0.92	0.79	0.58	0.41	0.47	0.76	0.95	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	622.61	739.71	851.59	935.37	886.90	656.93	439.81	459.48	653.21	690.94	618.04	586.26	(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]	1781.80	1732.40	1577.54	1325.16	1023.79	681.45	443.34	466.21	735.60	1109.53	1467.51	1772.20	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	862.43	667.09	540.11	280.65	101.84	0.00	0.00	0.00	0.00	311.43	611.62	882.34	

∑(98)1...5, 10...12 = 4257.51 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 42.20 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

Fraction of space heat from main system(s) — 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

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

Efficiency of main system 1 (%) — 93.50 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	922.39	713.46	577.66	300.16	108.92	0.00	0.00	0.00	0.00	333.08	654.14	943.68	

∑(211)1...5, 10...12 = 4553.49 (211)

Water heating

Efficiency of water heater	88.19	87.95	87.41	86.10	83.51	79.80	79.80	79.80	79.80	86.28	87.71	88.28	(217)
Water heating fuel, kWh/month	236.79	209.19	220.81	200.64	202.47	188.96	181.13	199.24	199.03	207.64	216.36	230.76	

∑(219a)1...12 = 2493.03 (219)

Annual totals

Space heating fuel - main system 1 — 4553.49

Water heating fuel		2493.03	
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)		405.85	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	7527.37	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4553.49	x	3.48	x 0.01 =	158.46	(240)
Water heating	2493.03	x	3.48	x 0.01 =	86.76	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	405.85	x	13.19	x 0.01 =	53.53	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		428.64	(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	4553.49	x	0.22	=	983.55	(261)
Water heating	2493.03	x	0.22	=	538.50	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1522.05	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	405.85	x	0.52	=	210.64	(268)
Total CO_2, kg/year				(265)...(271) =	1771.61	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	17.56	(273)
EI value					83.73	
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	4553.49	x	1.22	=	5555.25	(261)
Water heating	2493.03	x	1.22	=	3041.50	(264)
Space and water heating			(261) + (262) + (263) + (264) =		8596.76	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	405.85	x	3.07	=	1245.95	(268)
Primary energy kWh/year					10072.96	(272)
Dwelling primary energy rate kWh/m2/year					99.83	(273)

14 Appendix D – BRUKL Report (Efficiency)

The following BRUKL Report is taken from the SBEM software for the retail unit in accordance with current London Plan policy – this is following inclusion of the energy efficiency measures, but before inclusion of the air source heat pump and photovoltaic systems proposed.

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Marine Ices

As designed

Date: Thu Jan 15 20:25:45 2015

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.d.2

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v4.2.0

BRUKL compliance check version: v5.2.d.2

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: John Simpson

Telephone number: 01206 266755

Address: , Colchester, CO2 8JX

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	49.8
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	49.8
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	46.7
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	Basement 1 - Screen 2_W_4
Floor	0.25	0.15	0.15	Basement 1 - Screen 2_S_3
Roof	0.25	0.15	0.15	Basement 2 - Circulation 1_R_9
Windows***, roof windows, and rooflights	2.2	1.6	1.6	Grd Floor - Bar_G_11
Personnel doors	2.2	1.8	1.8	Grd Floor - Circ_D_11
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

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

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

1- Retail AC System

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.92	2.8	-	1.5	0.65
Standard value	0.91*	N/A	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

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

1- Central DHW

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	-
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
Basement 1 - Screen 2	-	-	-	-	-	-	-	0.8	-	-	N/A
Basement 2 - Screen 1	-	-	-	-	-	-	-	0.8	-	-	N/A
Basement 2 - Circulation 1	-	-	-	-	-	-	-	0.8	-	-	N/A
Basement 2 - Projector 1	-	-	-	-	-	-	-	0.8	-	-	N/A
Basement 2 - Projector	-	-	-	-	-	-	-	0.8	-	-	N/A
Basement 2 - Shower room	-	-	0.4	-	-	-	-	0.8	-	-	N/A
Basement 2 - WCs 1	-	-	0.4	-	-	-	-	0.8	-	-	N/A
Basement 2 - WCs	-	-	0.4	-	-	-	-	0.8	-	-	N/A
Basement 2 - Circulation	-	-	-	-	-	-	-	0.8	-	-	N/A
Basement 3 - Screen 3	-	-	-	-	-	-	-	0.8	-	-	N/A
Basement 3 - Projector	-	-	-	-	-	-	-	0.8	-	-	N/A
Grd Floor - Circ	-	-	-	-	-	-	-	0.8	-	-	N/A
Grd Floor - Projector	-	-	-	-	-	-	-	0.8	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
Grd Floor - Kitchen	-	-	-	-	-	-	-	0.8	-	-	N/A
Grd Floor - WCs	-	-	0.4	-	-	-	-	0.8	-	-	N/A
Grd Floor - Bar	-	-	-	-	-	-	-	0.8	-	-	N/A
Grd Floor - Circ	-	-	-	-	-	-	-	0.8	-	-	N/A
Grd Floor - Stores	-	-	-	-	-	-	-	0.8	-	-	N/A
Grd Floor - Circ	-	-	-	-	-	-	-	0.8	-	-	N/A
Grd Floor - Circ	-	-	-	-	-	-	-	0.8	-	-	N/A
Basement 2 - Plant Room 1	-	-	-	1.5	-	-	-	-	-	0.65	0.5
Basement 2 - Plant Room	-	-	-	1.5	-	-	-	-	-	0.65	0.5
Basement 3 - Plant Room	-	-	-	1.5	-	-	-	-	-	0.65	0.5

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Basement 1 - Screen 2	-	85	65	1274
Basement 2 - Screen 1	-	85	65	2018
Basement 2 - Circulation 1	-	85	65	3119
Basement 2 - Projector 1	85	-	-	23
Basement 2 - Projector	-	85	65	115
Basement 2 - Shower room	-	85	-	34
Basement 2 - WCs 1	-	85	-	85
Basement 2 - WCs	-	85	-	68
Basement 2 - Circulation	-	85	65	197
Basement 3 - Screen 3	-	85	65	1754
Basement 3 - Projector	-	85	65	221
Grd Floor - Circ	-	85	65	1270
Grd Floor - Projector	-	85	65	143
Grd Floor - Kitchen	-	85	65	412
Grd Floor - WCs	-	85	-	98
Grd Floor - Bar	-	85	65	2136
Grd Floor - Circ	-	85	65	151
Grd Floor - Stores	-	85	65	259
Grd Floor - Circ	-	85	65	91
Grd Floor - Circ	-	85	65	540
Basement 2 - Plant Room 1	85	-	-	117
Basement 2 - Plant Room	85	-	-	47
Basement 3 - Plant Room	85	-	-	391

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Basement 1 - Screen 2	N/A	N/A
Basement 2 - Screen 1	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Basement 2 - Circulation 1	N/A	N/A
Basement 2 - Projector	N/A	N/A
Basement 2 - Circulation	N/A	N/A
Basement 3 - Screen 3	N/A	N/A
Basement 3 - Projector	N/A	N/A
Grd Floor - Circ	N/A	N/A
Grd Floor - Projector	N/A	N/A
Grd Floor - Kitchen	N/A	N/A
Grd Floor - Bar	NO (-1.2%)	NO
Grd Floor - Circ	N/A	N/A
Grd Floor - Stores	N/A	N/A
Grd Floor - Circ	NO (-7.7%)	NO
Grd Floor - Circ	N/A	N/A

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	1218.5	1218.5
External area [m²]	2587.3	2587.3
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	5	3
Average conductance [W/K]	567.33	753.41
Average U-value [W/m²K]	0.22	0.29
Alpha value* [%]	14.97	10.62

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

Building Use

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

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	3.49	2.96
Cooling	19.84	14.56
Auxiliary	29.18	16.02
Lighting	40.32	65.43
Hot water	1.44	1.66
Equipment*	43.47	43.47
TOTAL**	**94.26**	**100.64**

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

Energy Production by Technology [kWh/m²]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	143.85	197.46
Primary energy* [kWh/m²]	275.96	292.83
Total emissions [kg/m²]	46.7	49.8

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	10.8	148	3.9	21.9	31.9	0.78	1.88	0.92	2.5
	Notional	9.6	208.4	3.3	16.1	17.6	0.82	3.6	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	3.2	0	0	0	0
	Notional	0	0	0	0	1.2	0	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.2	Basement 1 - Screen 2_W_4
Floor	0.2	0.15	Basement 1 - Screen 2_S_3
Roof	0.15	0.15	Basement 2 - Circulation 1_R_9
Windows, roof windows, and rooflights	1.5	1.6	Grd Floor - Bar_G_11
Personnel doors	1.5	1.8	Grd Floor - Circ_D_11
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

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

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

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

15 Appendix E – BRUKL Report (ASHPs)

The following BRUKL Report is taken from the SBEM software for the retail unit in accordance with current London Plan policy – this is following inclusion of the proposed air source heat pump system, but without the photovoltaic panels included.

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Marine Ices

As designed

Date: Thu Jan 15 19:39:12 2015

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.d.2

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v4.2.0

BRUKL compliance check version: v5.2.d.2

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: John Simpson

Telephone number: 01206 266755

Address: , Colchester, CO2 8JX

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	43.7
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	43.7
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	30.4
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	Basement 1 - Screen 2_W_4
Floor	0.25	0.15	0.15	Basement 1 - Screen 2_S_3
Roof	0.25	0.15	0.15	Basement 2 - Circulation 1_R_9
Windows***, roof windows, and rooflights	2.2	1.6	1.6	Grd Floor - Bar_G_11
Personnel doors	2.2	1.8	1.8	Grd Floor - Circ_D_11
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

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

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

1- VRF System

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	3.6	-	-	-
Standard value	2.5*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

1- Central DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
Basement 1 - Screen 2	-	-	-	1.5	-	-	-	-	-	0.65	0.5
Basement 2 - Screen 1	-	-	-	1.5	-	-	-	-	-	0.65	0.5
Basement 2 - Circulation 1	-	-	-	1.5	-	-	-	-	-	0.65	0.5
Basement 2 - Projector 1	-	-	-	1.5	-	-	-	-	-	0.65	0.5
Basement 2 - Projector	-	-	-	1.5	-	-	-	-	-	0.65	0.5
Basement 2 - Shower room	-	-	0.4	-	-	-	-	-	-	-	N/A
Basement 2 - WCs 1	-	-	0.4	-	-	-	-	-	-	-	N/A
Basement 2 - WCs	-	-	0.4	-	-	-	-	-	-	-	N/A
Basement 2 - Circulation	-	-	-	1.5	-	-	-	-	-	0.65	0.5
Basement 3 - Screen 3	-	-	-	1.5	-	-	-	-	-	0.65	0.5
Basement 3 - Projector	-	-	-	1.5	-	-	-	-	-	0.65	0.5
Grd Floor - Circ	-	-	-	1.5	-	-	-	-	-	0.65	0.5
Grd Floor - Projector	-	-	-	1.5	-	-	-	-	-	0.65	0.5
Grd Floor - Kitchen	-	-	-	1.5	-	-	-	-	-	0.65	0.5
Grd Floor - WCs	-	-	0.4	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
Grd Floor - Bar	-	-	-	1.5	-	-	-	-	-	0.65	0.5
Grd Floor - Circ	-	-	-	1.5	-	-	-	-	-	0.65	0.5
Grd Floor - Stores	-	-	-	1.5	-	-	-	-	-	0.65	0.5
Grd Floor - Circ	-	-	-	1.5	-	-	-	-	-	0.65	0.5
Grd Floor - Circ	-	-	-	-	-	-	-	-	-	-	N/A
Basement 2 - Plant Room 1	-	-	-	1.5	-	-	-	-	-	0.65	0.5
Basement 2 - Plant Room	-	-	-	1.5	-	-	-	-	-	0.65	0.5
Basement 3 - Plant Room	-	-	-	1.5	-	-	-	-	-	0.65	0.5

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Basement 1 - Screen 2	-	85	65	1274
Basement 2 - Screen 1	-	85	65	2018
Basement 2 - Circulation 1	-	85	65	3119
Basement 2 - Projector 1	85	-	-	23
Basement 2 - Projector	-	85	65	115
Basement 2 - Shower room	-	85	-	34
Basement 2 - WCs 1	-	85	-	85
Basement 2 - WCs	-	85	-	68
Basement 2 - Circulation	-	85	65	197
Basement 3 - Screen 3	-	85	65	1754
Basement 3 - Projector	-	85	65	221
Grd Floor - Circ	-	85	65	1270
Grd Floor - Projector	-	85	65	143
Grd Floor - Kitchen	-	85	65	412
Grd Floor - WCs	-	85	-	98
Grd Floor - Bar	-	85	65	2136
Grd Floor - Circ	-	85	65	151
Grd Floor - Stores	-	85	65	259
Grd Floor - Circ	-	85	65	91
Grd Floor - Circ	-	85	65	540
Basement 2 - Plant Room 1	85	-	-	117
Basement 2 - Plant Room	85	-	-	47
Basement 3 - Plant Room	85	-	-	391

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Basement 1 - Screen 2	N/A	N/A
Basement 2 - Screen 1	N/A	N/A
Basement 2 - Circulation 1	N/A	N/A
Basement 2 - Projector	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Basement 2 - Circulation	N/A	N/A
Basement 3 - Screen 3	N/A	N/A
Basement 3 - Projector	N/A	N/A
Grd Floor - Circ	N/A	N/A
Grd Floor - Projector	N/A	N/A
Grd Floor - Kitchen	N/A	N/A
Grd Floor - Bar	NO (-1.2%)	NO
Grd Floor - Circ	N/A	N/A
Grd Floor - Stores	N/A	N/A
Grd Floor - Circ	NO (-7.7%)	NO
Grd Floor - Circ	N/A	N/A

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	1218.5	1218.5
External area [m²]	2587.3	2587.3
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	5	3
Average conductance [W/K]	567.33	753.41
Average U-value [W/m²K]	0.22	0.29
Alpha value* [%]	14.97	10.62

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

Building Use

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

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	0.95	1.45
Cooling	10.92	14.55
Auxiliary	6.48	3.84
Lighting	40.32	65.43
Hot water	1.44	1.66
Equipment*	43.47	43.47
TOTAL**	**60.09**	**86.93**

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

Energy Production by Technology [kWh/m²]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	145.54	201.29
Primary energy* [kWh/m²]	179.88	257.06
Total emissions [kg/m²]	30.4	43.7

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	14.8	146	1	12.1	6.8	3.92	3.36	4	4.5
	Notional	14	208.3	1.6	16.1	4.1	2.43	3.6	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	3.2	0	0	0	0
	Notional	0	0	0	0	1.2	0	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.2	Basement 1 - Screen 2_W_4
Floor	0.2	0.15	Basement 1 - Screen 2_S_3
Roof	0.15	0.15	Basement 2 - Circulation 1_R_9
Windows, roof windows, and rooflights	1.5	1.6	Grd Floor - Bar_G_11
Personnel doors	1.5	1.8	Grd Floor - Circ_D_11
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

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

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

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