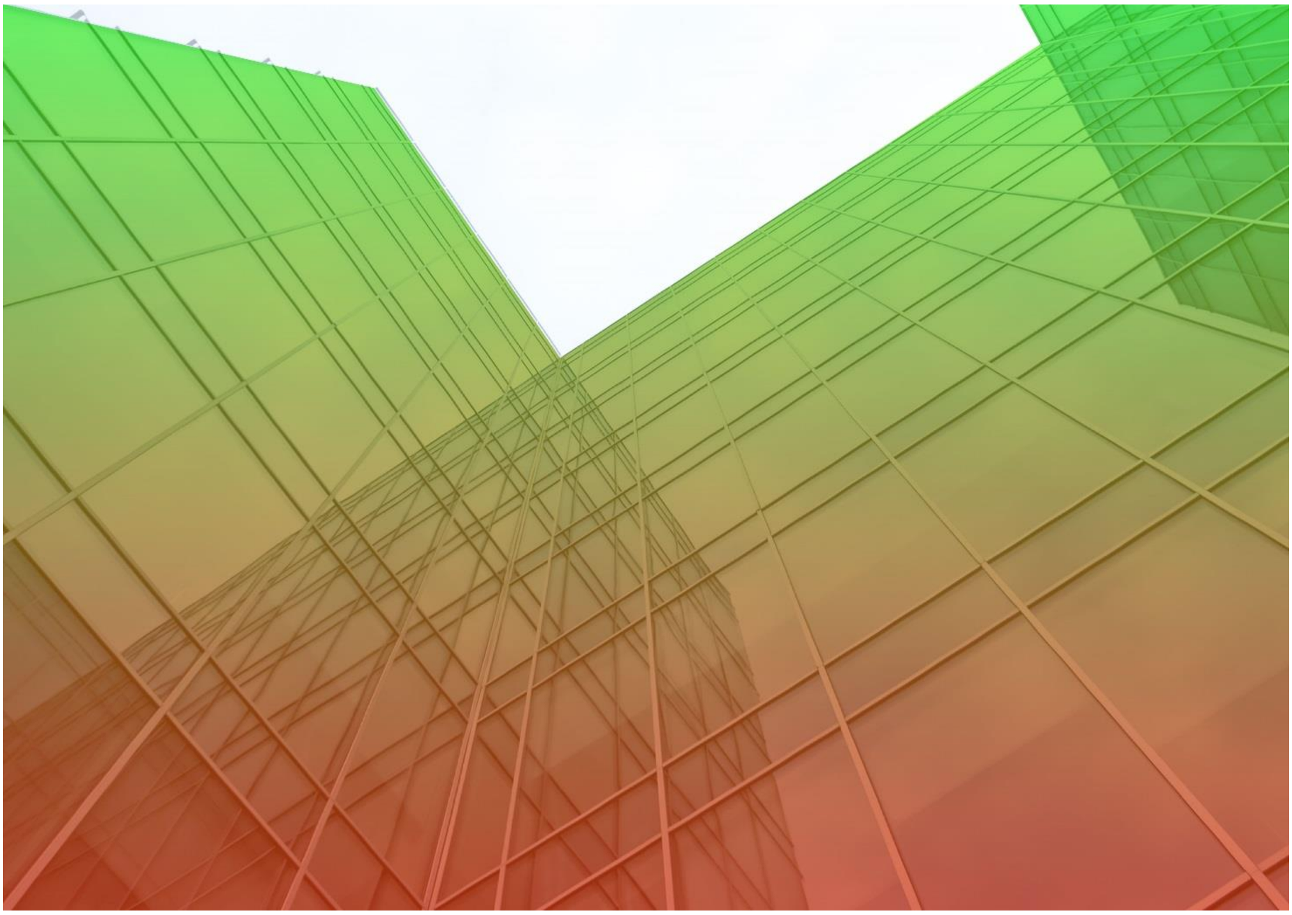
Energy Statement

Centric Close, Camden

On Behalf of Fairview Ventures Limited



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Contents

Preface

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Executive Summary

This Energy Statement supports the planning application for the proposed development of Centric Close, in the London Borough of Camden.

The Energy Strategy follows the London Plan Energy Hierarchy: Be Lean, Be Clean and Be Green. The overriding objective in the formulation of the strategy is to maximise the reductions in total CO_2 emissions through the application of the hierarchy with a cost-effective and technically appropriate approach, and to minimise the emission of other pollutants.

The development site will be built under Part L 2013 of the Building Regulations and in line with the London Plan target to achieve a 35% CO_2 reduction over the Part L 2013 baseline.

The development will reduce regulated CO_2 emissions by incorporating a range of passive design and energy efficiency measures throughout the site, including improved building fabric standards beyond the requirements of Part L of the Building Regulations and energy efficient mechanical and electrical plants. These measures enable the proposed development to exceed Part L 2013 Target Emission Rates (TER) and Target Fabric Energy Efficiency (TFEE) minimum standards through energy efficiency measures alone.

After reduction of the energy demand, the strategy proposes implementation of a gas-fired Combined Heat and Power (CHP) engine and efficient gas-fired boilers connected to a site-wide district heating network (DHN). The DHN will supply hot water and space heating for the entire development.

A Variable Refrigerant Flow (VRF) system has been proposed for the shell only non-residential units to supply space cooling demands.

Photovoltaic Panels (PV) will be provided to supply renewable energy to the development and to reduce the regulated CO_2 emissions of the site.

The regulated energy CO_2 savings expressed in terms of actual and percentage reduction after each stage of the energy hierarchy for residential and non-residential parts of the development are presented below.

Residential

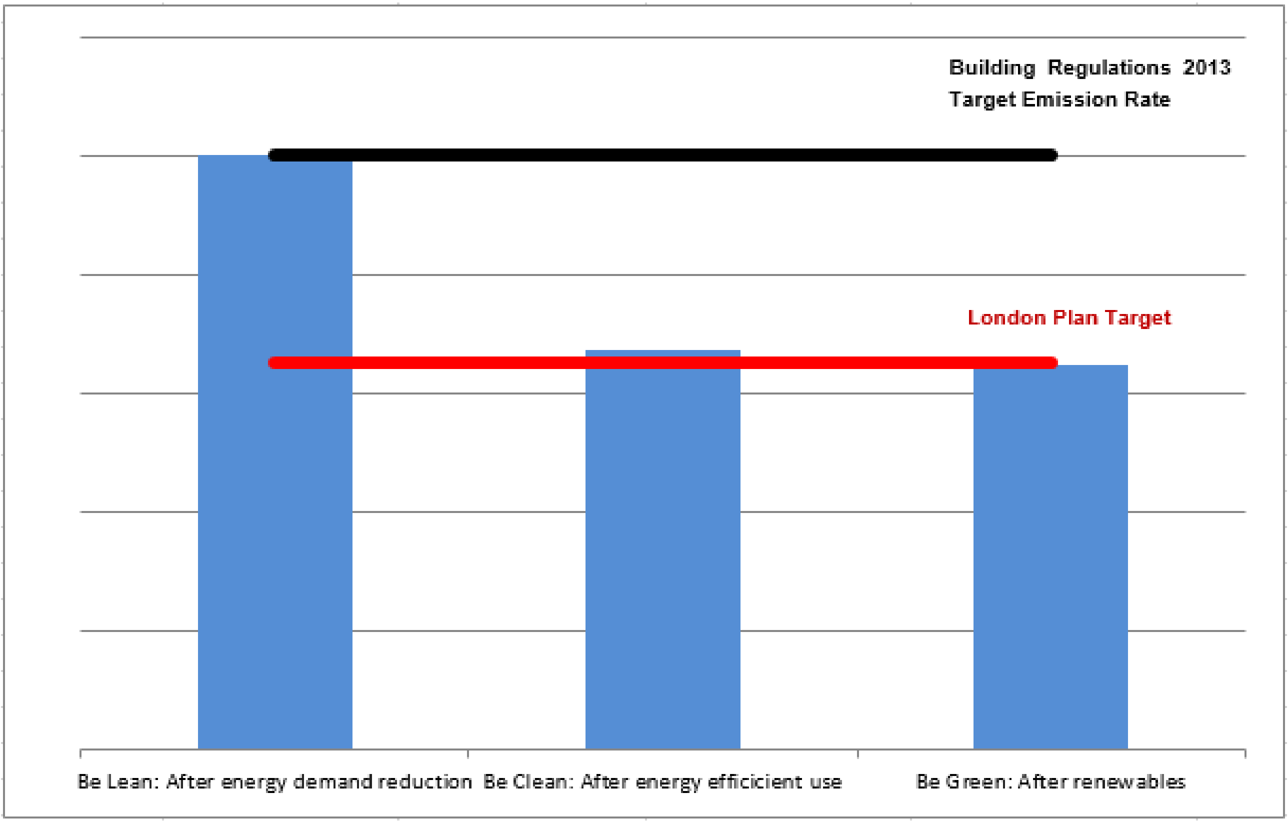
	CO_2 emissions (tonnes/year)		
	Regulated	**Unregulated**	**Total**
Residential Baseline	70.62	83.04	153.66
After energy demand reduction	70.60	83.04	153.63
After use of CHP technology	47.64	83.04	130.67
After use of PV technology	45.78	83.04	128.82

The energy strategy shows that the overall CO_2 emissions from both regulated and unregulated energy can be reduced by circa 24.84 tCO_2 per annum which is equivalent to circa 16.2% reduction.

	Regulated Energy CO_2 savings	
	Tonnes per annum	%
Savings from energy demand reduction	0.02	0%
Savings from CHP	22.96	32.5%
Savings from renewables	1.86	3.9%
Total cumulative savings	**24.84**	**35.2%**
Annual Savings from off-set payment	**45.8**	
Cumulative savings for off-set payment (tonnes for 30 years)	**1,373.49**	

The table shows that the proposed strategy can achieve regulated CO_2 savings of circa 24.84 tCO_2 which is equivalent to circa 35.2% reduction when compared to the baseline. To achieve the zero carbon homes standard, an off-set payment will be made to for the outstanding regulated CO_2 emissions based on the carbon off-set price of £60 per tonne over a 30 year period.

The overall reduction in regulated carbon emissions associated with the proposed design is graphically illustrated in the figure below.



Non-residential

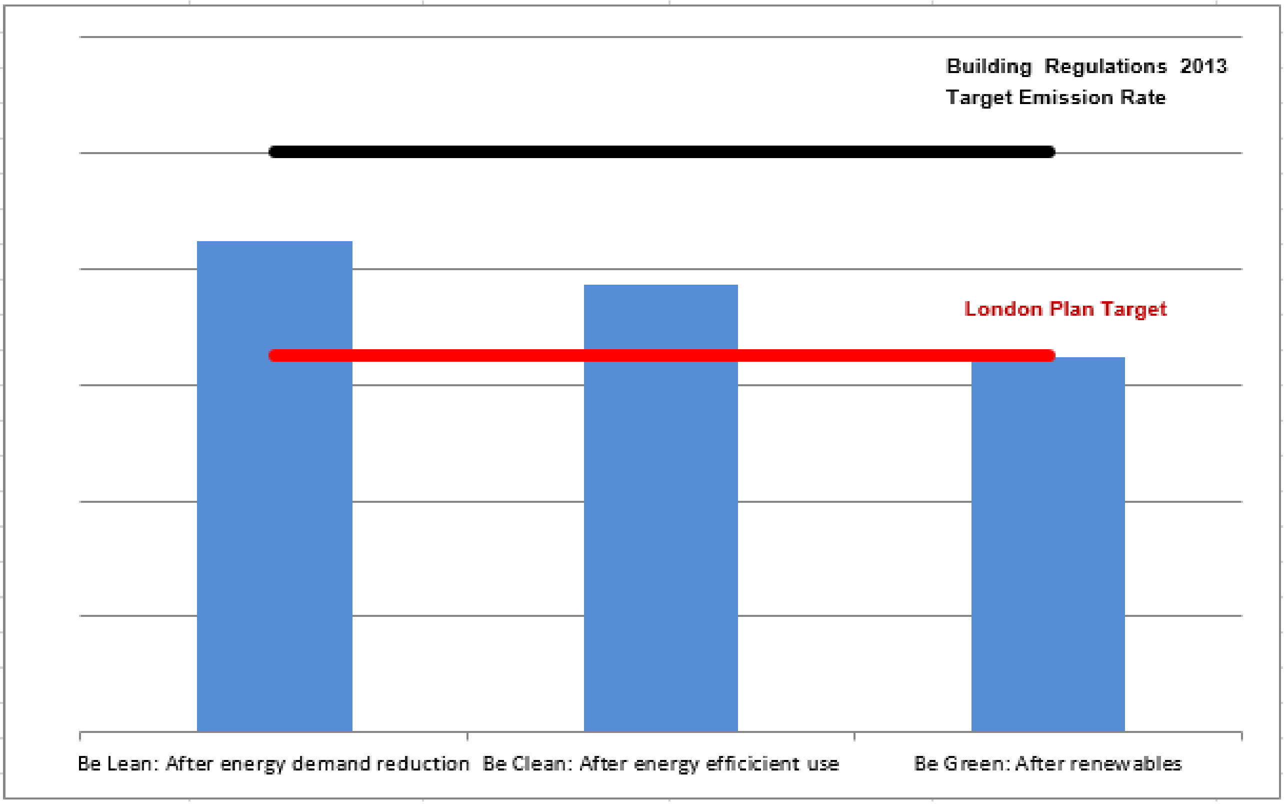
	CO_2 emissions (tonnes/year)		
	Regulated	**Unregulated**	**Total**
Non-residential Baseline	22.19	26.32	48.50
After energy demand reduction	19.14	26.32	45.46
After use of CHP technology	17.19	26.32	43.51
After use of PV technology	14.38	26.32	40.70

The energy strategy shows that the overall CO_2 emissions from both regulated and unregulated energy can be reduced by circa 7.8 tCO_2 per annum which is equivalent to circa 16.1% reduction.

	Regulated Energy CO_2 savings	
	Tonnes per annum	**%**
Savings from energy demand reduction	3.05	13.7%
Savings from CHP	1.95	10.2%
Savings from renewables	2.80	16.3%
Total cumulative savings	7.80	**35.2%**

The table above shows that the proposed strategy can achieve regulated CO_2 savings of circa 7.8 tCO_2 which is equivalent to circa 35.2% reduction when compared to the baseline.

The overall reduction in regulated carbon emissions associated with the proposed design is graphically illustrated in the figure below.



Entire Development

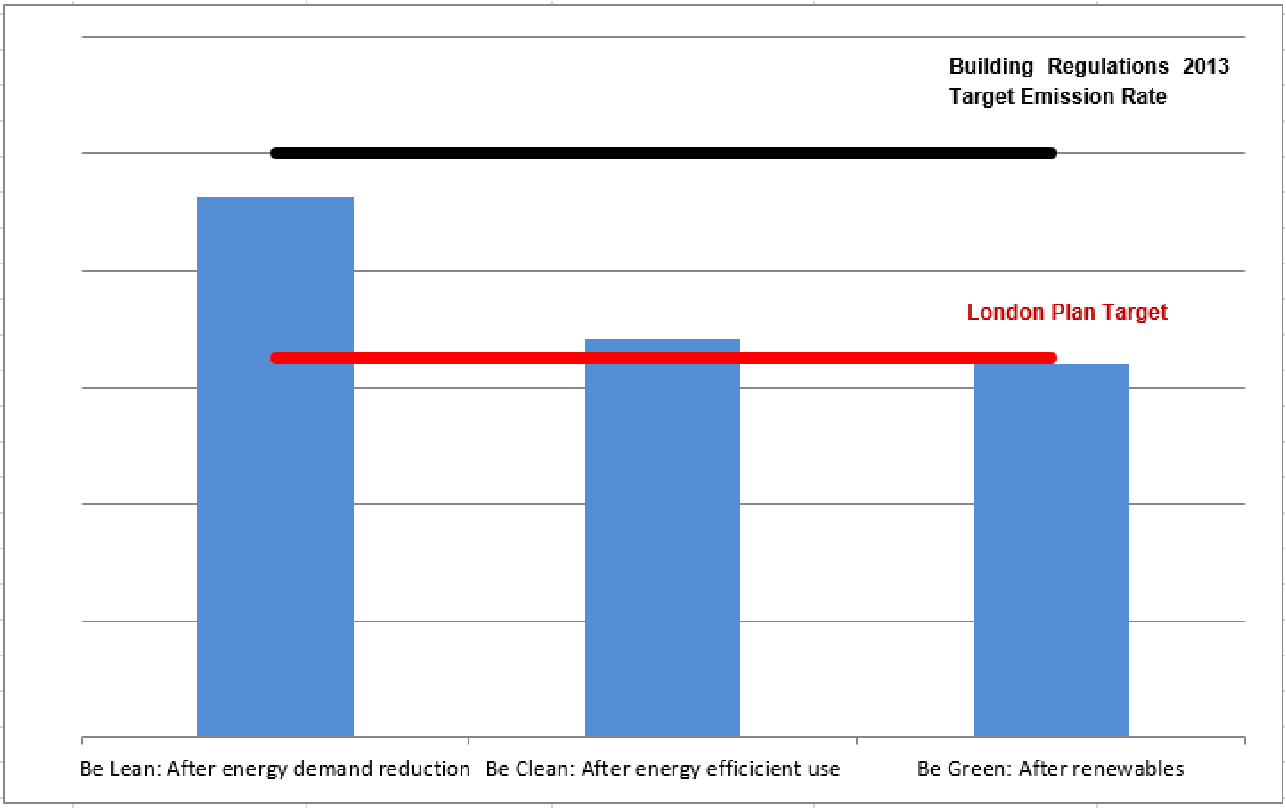
	CO_2 emissions (tonnes/year)		
	Regulated	Unregulated	Total
Total CO_2 Emissions Baseline	92.81	109.35	202.16
After energy demand reduction	89.74	109.35	199.09
After use of CHP technology	64.83	109.35	174.18
After use of PV technology	60.17	109.35	169.52

The energy strategy shows that the overall CO_2 emissions from both regulated and unregulated energy can be reduced by circa 32.64 tCO_2 per annum which is equivalent to circa 16.1% reduction.

	Regulated Energy CO_2 savings	
	Tonnes per annum	%
Savings from energy demand reduction	3.07	3.3%
Savings from CHP	24.91	27.8%
Savings from renewables	4.66	7.2%
Total cumulative savings	**32.64**	**35.2%**

The table above shows that the proposed strategy can achieve regulated CO_2 savings of circa 32.64 tCO_2 which is equivalent to circa 35.2% reduction when compared to the baseline.

The overall reduction in regulated carbon emissions associated with the proposed design is graphically illustrated in the figure below.



Summary

In summary, the proposed energy strategy for the development:

1 Informs the built form and orientation of the buildings to respond to daylight and indoor comfort levels;

2 Includes optimal building fabric standards, energy efficient design of building services and energy efficient appliances;

3 Complies with Part L 2013 Building Regulations and meets TFEE requirements;

4 Includes on-site CHP system connected to site-wide heating network to supply hot water and space heating to the residential development;

5 Includes renewable energy technologies;

6 Meets the 35% regulated energy CO_2 emissions reduction requirement on-site;

7 Achieves the zero carbon homes standard for the residential development by making an off-set payment the outstanding regulated CO_2 emissions based on the carbon off-set price of £60 per tonne over a 30 year period.

8 Achieves BREEAM Excellent ENE 01 mandatory requirement.

1 Introduction

1.1 Background

Low Energy Consultancy Limited (LEC) has been instructed by Fairview Ventures Limited (Fairview) to prepare an Energy Statement focusing on the proposed energy strategy for the proposed development of Centric Close, Camden. The Energy Statement has been prepared to support the full planning application in response to the local, regional and national legislation.

To support the planning application this document identifies and describes the energy efficiency design and low carbon/renewable technology options that have been explored and the preferred options for achieving a reduction in carbon emissions. This document has been produced to demonstrate how the proposed development can fulfil the relevant requirements of the National Planning Policy Framework, the London Plan and Camden's Local Plan policies.

In order to achieve the energy and sustainability objectives defined by national, regional and local policies, an assessment has been carried out to identify the most appropriate and viable strategies and technologies to achieve the carbon and renewable reductions. The energy options presented in this report have been considered at a strategic level.

1.2 Description of the Development

The proposed development comprises the demolition of existing buildings and the erection of 76 residential units and 1,139 sqm of commercial floorspace (Use Class B1) over 4, 5, 6 and 7 storeys providing a mix of 1, 2 and 3 bed apartments. The development includes a landscaped courtyard and communal amenity areas.

The redevelopment of the site will make a positive enhancement to the visual appearance of the area, providing much needed homes for the local area, including commercial floorspace to reflect the Council's aspirations for the area.

2 Planning Policies

This section summarises the relevant energy policy context for the development. The national, regional and local policies and regulations related to energy and sustainability are summarised below.

2.1 National Planning Policy Framework (2012)

The National Planning Policy Framework (NPPF) document sets out the Government's planning policies for England and was published on the 27th March 2012.

The NPPF is designed to consolidate all policy statements, circulars and guidance documents into a single, simpler National Planning Policy Framework, making the planning system more user-friendly and transparent. The framework's primary objective is a sustainable development, therefore focussing on the 3 pillars of sustainability. The framework is split into three sections; planning for prosperity (Economic), planning for people (Social) and planning for places (Environmental), each of which outlines guidance to tackle issues such as housing, transport infrastructure, climate change, business and economic development, etc.

In regard to climate change, the NPPF supports a reduction in greenhouse gas emissions and the delivery of renewable and low carbon energy. Climate change is covered in Section 10 '*Meeting the challenge of climate change, flooding and coastal change'*. In summary the framework advises:

To support the move to a low carbon future, local planning authorities should:

- plan for new developments in locations and ways which reduce greenhouse gas emissions;
- actively support energy efficiency improvements to existing buildings; and
- adopting nationally described standards when setting any local requirement for a building's sustainability.

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

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

2.2 The London Plan

The London Plan requires all developments to actively tackle climate change through their design as an integral part of sustainable development. Chapter 5: London's Response to Climate Change contains the following crosscutting policies supporting London as an exemplar city in adapting to climate change.

1. Policy 5.1 - Climate change mitigation
2. Policy 5.2 - Minimising carbon dioxide emissions
3. Policy 5.3 - Sustainable design and construction
4. Policy 5.5 - Decentralised energy networks

5 Policy 5.6 - Decentralised energy in development proposals

6 Policy 5.7 - Renewable energy

7 Policy 5.8 - Innovative energy technologies

8 Policy 5.9 - Overheating and cooling

The London Plan requires that developments include energy assessments with the planning applications explaining the strategy for carbon emissions reduction based on the energy hierarchy.

The London Plan requires that major development proposals include a detailed energy assessment to demonstrate how the targets for carbon dioxide emission reduction outlined below are to be met within the framework of the energy hierarchy.

Policy 5.2 of the London Plan requires developments to minimise carbon dioxide emissions in accordance with the energy hierarchy:

1 Be lean: use less energy

2 Be clean: supply energy efficiently

3 Be green: use renewable energy

Policy 5.2 also requires major developments to meet the following targets for carbon dioxide emission reduction in buildings. The targets are expressed in the tables below as minimum improvements over Target Emission Rate (TER) outlined in the National Building Regulations.

Residential Buildings

Year	Improvement on 2010 Building Regulations
2013 - 2016	40 % CO_2 emissions reduction
2016 - 2031	Zero Carbon (from 1st October 2016)

Non-Residential Buildings

Year	Improvement on 2010 Building Regulations
2013 - 2016	40 % CO_2 emissions reduction
2016 - 2019	As per the Building Regulation requirements
2019 - 2031	Zero Carbon

Policy 5.6 requires development proposals to select energy systems in accordance with the following hierarchy:

1. Connection to existing heating or cooling networks
2. Connection to site wide CHP network
3. Development of communal heating and cooling networks.

Policy 5.7 requires major developments to provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation where feasible.

In April 2014 the GLA published a revised Sustainable Design and Construction SPG and Energy Planning Guidance which provides direction on how the energy targets need to be assessed and met over new Part L 2013 which came into force on the 6th of April 2014.

As outlined in the Sustainable, Design and Construction SPG, from the 6th April 2014, the Mayor requires a 35% carbon reduction target beyond Part L 2013 of the Building Regulations, which is deemed to be broadly equivalent to the 40% target beyond Part L 2010 (London Plan Policy 5.2 for 2013-2016). This target applies to all Stage 1 applications received by the Mayor on or after 6th April 2014.

The GLA Guidance on Preparing Energy Assessments published in March 2016 states that the zero carbon target for major residential developments will be implemented for Stage 1 schemes on or after the 1st October 2016.

'Zero carbon' homes are defined as homes forming part of major development applications where the residential element of the application achieves at least a 35% reduction in regulated carbon dioxide emissions beyond Part L 2013 on-site. The remaining regulated carbon dioxide emissions, to 100%, are to be off-set through a cash in lieu contribution to the relevant borough to secure delivery of carbon dioxide savings elsewhere

The Mayor's Housing Standard's Viability Assessment assumed a carbon off-set price of £60 per tonne of carbon dioxide for a period of 30 years.

For the period 2016 to 2019, London Plan Policy 5.2 sets the carbon dioxide emissions target for non-residential development to be in line with Part L of the Building Regulations. This target was intended to align with the then expected improvement to Part L of the Building Regulations. However, the Government announced (in July 2015) that it does not intend to proceed with the proposed 2016 increase in on-site energy efficiency standards, but will keep energy efficiency standards under review.

The GLA Guidance on Preparing Energy Assessments states that the GLA will continue to require that non-domestic development seek to achieve a 35% reduction against Part L 2013.

2.3 Camden Planning Policy

The site falls within the London Borough of Camden therefore the development should also comply with the local planning policies. These are set out in the Camden Core Strategy 2010 and Development Plan Policies 2010.

2.3.1 Camden Local Plan

The Local Development Framework document is the Core Strategy and the key policies relating to energy and sustainability are identified below.

Policy CS13 Reducing the effects of and adapting to climate change requires 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:

- minimising carbon emissions from the redevelopment, construction and occupation of buildings by implementing, in order, all of the elements of the following energy hierarchy:
  - ensuring developments use less energy,
  - making use of energy from efficient sources, such as the King's Cross, Gower Street, Bloomsbury and proposed Euston Road decentralised energy networks;
  - generating renewable energy on-site; and
- 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.

2.3.2 Development Policies

Development Policy DP22 - Promoting sustainable design and construction will require development to incorporate sustainable design and construction measures. Schemes must:

- demonstrate sustainable development principles
- expect 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.
- expect 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.

2.4 Sustainability Requirements

2.4.1 Code for Sustainable Homes

Camden's Core Strategy Policy DP22 requires all new residential developments to be rated against Code for Sustainable Homes Level 4. However, the Deregulation Act 2015, which received Royal Assent on the 26th March 2015, has withdrawn the Code for Sustainable Homes standard, therefore this policy is no longer applicable.

2.4.2 BREEAM

BREEAM (Building Research Establishment's Environmental Assessment Method) is an assessment method established by the Building Research Establishment (BRE) and is used to assess the environmental impact of non-domestic buildings. BREEAM covers a range of issues which are awarded where a building achieves a benchmark performance and is a voluntary standard, although some planning authorities require compliance.

Camden's Development Policy DP22 requires all new non-residential development to be built to at least BREEAM "Excellent" standard.

2.5 Part L Building Regulations

The development will need to comply with the current version of Part L (Part L 2013) which came into force on the 6th April 2014. The residential units will need to comply with Part L1A 2013 and non-residential will need to comply Part L2A 2013.

2.5.1 Part L1A 2013

Approved Document Part L1A 2013 incorporates a number of changes and additions compared to Part L1A 2010. Part L1A 2013 requires new homes to reduce their carbon emissions by a further 6% across the build mix, compared to Part L1A 2010. In addition to achieving an overall carbon emission target, (i.e. TER or Target Emission Rate), there is a further requirement to achieve or better fabric energy efficiency targets (TFEE: "Target Fabric Energy Efficiency"). This means the thermal performance of the building fabric now has its own standards which cannot be compensated by services strategy or renewable features.

2.5.2 Part L2A 2013

Approved Document Part L2A 2013 incorporates a number of changes and additions compared to Part L2A 2010. Part L2A 2013 requires new non-domestic buildings to reduce their carbon emissions by a further 9% across the build mix, compared to Part L2A 2010.

Part L2A 2010 was based on comparing the actual building against a notional building. This approach remains the same for Part L2A 2013, however the notional building has been modified to have more energy efficient building fabric and reduced air permeability. Similar to Part L 2010, the notional building standards will change depending on the type of non-domestic building use.

2.6 Summary of Policy Requirements

The following section provides a summary of local and national planning policy requirements which should be met to achieve compliance.

- Part L 2013 Building Regulations.
- Achieve a minimum of 35% reduction in carbon emissions on-site for residential and non-residential parts of the development (against current 2013 Building Regulations) by following Lean, Clean and Green principles.
- Achieve zero carbon target for residential development through a cash in lieu contribution.
- Expect to select energy systems in accordance with the following hierarchy:
    1. Connection to existing heating or cooling networks
    2. Connection to site wide CHP network
    3. Development of communal heating and cooling networks
- Provide a 20% reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.
- Meet BREEAM Excellent standard for the shell only non-residential units.

3 Energy Strategy Approach

The proposed energy strategy for the development will follow the London Plan Energy Hierarchy approach of Be Lean, Be Clean and Be Green to enable the maximum viable reductions in regulated and total CO_2 emissions over the baseline.

- Be Lean - Use less energy;
- Be Clean - Supply energy efficiently;
- Be Green - Use renewable energy systems.

The proposed energy supply solutions aim to match energy profiles of the development ensuring effective use. The proposed solutions also take into consideration viability and flexibility of the scheme from a technical and economic point of view by identifying an optimal combination of energy efficiency measures as well as decentralised and renewable energy supply solutions. Applying these principles, Fairview is aiming to achieve the following objectives:

- Comply with the relevant regulatory requirements;
- Improve viability of the scheme by developing a technically robust and viable energy strategy;
- Improve feasibility, operation and management of the energy systems by promoting holistic design methods and solutions.

3.1 Energy and Carbon Assessment Methodology

The CO_2 emissions reduction methodology requires separate energy assessments for the residential and non-residential floor space. The results from these assessments will be combined to provide an overall CO_2 emissions reduction for the entire development.

3.1.1 Residential

NHER software, which uses the Standard Assessment Procedure (SAP) 2012 methodology to assess compliance with Part L1A, has been used to evaluate an initial CO_2 performance of representative residential dwellings. To assess energy performance of the entire residential development, an energy and carbon assessment model has been produced, which extrapolates the results of the SAP analysis using the weighted average method provided in Part L1A to predict the energy consumption and CO_2 performance of the residential development.

Since the NHER software does not include unregulated energy use (for appliances and cooking), the unregulated CO_2 emissions have been calculated separately using BREDEM methodology.

Although the produced data by the NHER software provides estimations of possible energy and carbon performance of the residential development for assessment purposes, it is not intended to be used as a detailed design tool.

3.1.2 Non-residential

An initial assessment of CO_2 performance of the non-residential unit is carried out using IES VE software. IES VE is an approved tool for calculating compliance with Part L2A which uses the standard National Calculation Methodology (NCM).

An assessment of the energy performance of the development considers regulated energy usage for different building services such as cooling, heating, lighting and ventilation. An estimate is also provided of unregulated electricity use (equipment) associated with computers, small power, and security systems, etc.

Although the produced data by the IES VE software provides estimations of possible energy and carbon performance of the non-residential development for assessment purposes, again it is not intended to be used as a detailed design tool.

4 Baseline CO_2 Emissions

In order to assess CO_2 performance of the proposed energy strategy, a CO_2 emissions baseline needs to be established. This section sets out the approach taken to calculating the baseline CO_2 emissions for the residential and the non-residential parts of the development.

The total baseline CO_2 emissions for the proposed development is defined as regulated CO_2 emissions covered by Building regulations Part L as well as the unregulated CO_2 emissions not covered by Part L. The unregulated CO_2 emissions should be excluded when compliance with the planning policy is calculated.

4.1 Residential Baseline

The regulated CO_2 emissions baseline is based on the Part L1A 2013 Target Emission Rate (TER) performance of representative dwellings. The baseline CO_2 performance has been determined by carrying out SAP 2012 modelling to establish the TERs of sample dwellings. The representative dwellings presented in Table 4.1 were used to carry out the SAP assessment.

Table 4.1 Representative sample dwellings

Reference	Type	Location
B-L00-05	1 Bed, 2 People	Block B, Ground Floor
A-L04-60	1 Bed, 2 People	Block A, Mid Floor
B-L04-26	1 Bed, 2 People	Block B, Top Floor
A-L00-28	2 Bed, 3 People	Block A, Ground Floor
A-L04-65	2 Bed, 4 People	Block A, Mid Floor
A-L06-73	2 Bed, 3 People	Block A, Top Floor
B-L00-02	3 Bed, 4 People	Block B, Ground Floor
A-L03-48	3 Bed, 5 People	Block A, Mid Floor
B-L03-19	3 Bed, 5 People	Block B, Top Floor

The DER reports for the sample dwellings for each stage of the energy hierarchy have been provided in Appendix D. The TER results of the SAP assessments from the representative dwellings have been extrapolated using a weighted average method to predict the residential CO_2 emissions baseline.

Since SAP and therefore TERs do not include the energy use for appliances and cooking, the unregulated CO_2 emissions have been calculated separately using BREDEM methodology. The regulated, unregulated and total baseline CO_2 emissions for the residential units are summarised in Table 4.2.

Table 4.2 Residential baseline CO_2 emissions

	CO_2 emissions (tonnes/year)		
	Regulated	**Unregulated**	**Total**
Residential Baseline	70.62	83.04	153.66

4.2 Non-residential Baseline

For the non-residential units, the CO_2 emissions baseline is determined based on the TER for building services plus other unregulated energy use calculated using IES VE software.

The baseline CO_2 emissions calculated using IES VE software are based on the calculation of the energy consumption of a 'notional' building under the standard National Calculation Methodology (NCM). The IES VE modelling results in the form of BRUKL reports have been provided in Appendix D. The regulated, unregulated and total baseline CO_2 emissions for the non-residential floor spaces are summarised in Table 4.3.

Table 4.3 Non-residential baseline CO_2 emissions

	CO_2 emissions (tonnes/year)		
	Regulated	**Unregulated**	**Total**
Non-residential Baseline	22.19	26.32	48.50

4.3 Total Baseline

For the entire development (residential and non-residential), the CO_2 emissions baseline is determined by combining the residential and non-residential CO_2 baselines together. The total baseline CO_2 emissions for the development as a whole is summarised in Table 4.4.

Table 4.4 Total baseline CO_2 emissions

	CO_2 emissions (tonnes/year)		
	Regulated	**Unregulated**	**Total**
Total Baseline	92.81	109.35	202.16

5 Energy Efficiency (Be Lean)

In accordance with the London Plan Energy Hierarchy, the key focus for the proposed energy strategy is to reduce the energy demands of the development as far as practically possible and viable by implementing various energy demand reduction measures. The aim is to achieve Part L 2013 Building Regulations compliance without contribution from low carbon or renewable energy sources.

The proposed design of the development follows sustainable design principals and standards, aiming to use natural resources efficiently, reduce energy consumption and avoid internal overheating as well as contribution to the urban heat island effect.

A range of measures to reduce CO_2 emissions and increase resilience to climate change are proposed to be incorporated into the building design including good building fabric standards as well as energy efficient M&E systems and lighting.

Through adopting best practice in design, and in response to the planning policies, the development has considered sustainable design and construction standards to reduce potential overheating and reliance on air conditioning systems through the following approaches and measures.

5.1 Residential

5.1.1 Passive Design

The development will incorporate passive solar design measures. The buildings incorporate balconies and overhangs for the top floors which help to provide shading, minimising the risk of overheating of the units. The proposed windows aim to maximise daylight and at the same time minimise overheating. The glazing specification will be selected to provide a balance of solar control and access to passive solar gain. The GLA Domestic Overheating Checklist has been completed and included in Appendix B.

Natural ventilation has been considered but due to the high energy efficiency requirements and CO_2 reduction targets as well as noise sources arising from the railway, implementation of a natural ventilation strategy is considered to be inappropriate.

In this case, taking into consideration noise issues, energy efficiency requirements and proposed building fabric standards, it is considered to be more appropriate to implement a mechanical ventilation strategy to ensure compliance with regulations and standards.

Openable windows are proposed albeit they will not be essential to provide a fresh air supply. Nonetheless, they will provide a further allowance to residents and occupiers to control their indoor environment. The openable windows can also be used for purge ventilation.

The ventilation strategy will be reviewed as the design progresses to ensure compliance with all the relevant regulations and standards.

5.1.2 Building Fabric

In order to achieve the Part L 2013 TER and Target Fabric Energy Efficiency (TFEE) targets, good building fabric standards will be used. The minimum building fabric requirements for Part L1A 2013 and the proposed specification for individual building elements for the residential part of the development are presented in Table 5.1.

Table 5.1 Proposed fabric energy efficiency targets for individual building elements

Element	U-values (W/m²K)	
	Part L1A 2013 minimum fabric requirements	Proposed specification for the development
External walls	0.30	0.18
Roof	0.20	0.16
Ground floor	0.25	0.20
Windows [1]	2.00	1.30
Airtightness	10 ($m^3/(hm^2)$ at 50 Pa)	4 ($m^3/(hm^2)$ at 50 Pa)

[1] Glazing performance will need to be reviewed alongside acoustic performance as the design is developed.

Implementing these (or similar) building fabric standards will help to deliver substantial reductions in CO_2 emissions compared with the current building performance and regulations and meet the TFEE targets. The proposed specification should be viewed as guidance.

5.1.3 Energy Efficient Systems

The overarching principle for the selection of the building fabric standards and energy efficient systems is to achieve compliance with Part L1A 2013 requirements only through energy demand reduction measures.

5.1.3.1 Heating and Hot Water

The space heating requirement of the proposed development will be significantly reduced by the proposed fabric, air tightness and ventilation measures.

It is proposed to install a communal heat distribution network to provide space heating and hot water. Specifically, it is proposed to design the heating system to achieve the following:

- Variable flow rate heating system with high delta T and low return temperatures
- High efficiency motors and variable speed pumps for heating
- Appropriate controls for heating
- Temperature and time zoning
- Appropriate insulation of heating pipes
- Low flow and return temperatures

5.1.3.2 Ventilation

Air tightness standards will conform to, and exceed, Approved Document Part L requirements. An improvement of design air permeability rate together with the need to achieve the internal noise standards will require provision of mechanical ventilation. At this stage, it is proposed to provide an energy efficient mechanical ventilation system to meet the noise and fresh air supply requirements.

It is proposed to select a mechanical ventilation system with a low Specific Fan Power (SFP). Additionally, all dwellings will have openable windows and therefore the ability to naturally ventilate should the occupant desire.

5.1.3.3 Cooling

It is not proposed to provide cooling for the residential dwellings for the purposes of Part L. Acceptable internal conditions will be achieved by the incorporation of the proposed passive design measures, ventilation system and openable windows.

5.1.3.4 Lighting

The proposed windows aim to maximise daylight to minimise the need for artificial lighting. The electricity consumption associated with lighting will be further reduced by the provision of 100% energy efficient lighting within the dwellings.

5.1.3.5 Energy Metering and Monitoring

The provision of smart metering will be considered during detailed design stage and implemented if appropriate.

5.2 Non-residential

5.2.1 Passive Design

The non-residential units will be built to a shell only standard, defined as new build works that cover fabric, sub and superstructure of the building only, including external walls, windows, doors (external) and structural floors.

The design of the non-residential units propose to incorporate a number of passive design measures to reduce CO_2 emissions and improve the indoor climate.

The passive solar design will incorporate measures which control solar gain and improve direct and indirect natural lighting.

Internal glare control such as occupant controlled devices and internal blinds should be considered and incorporated by the future tenants as deemed appropriate.

Natural ventilation has been considered for modelling purposes, but due to the high energy efficiency requirements and CO_2 reduction targets as well as noise sources arising from the railway, implementation of a natural ventilation strategy is considered to be inappropriate.

In this case, taking into consideration noise issues, energy efficiency requirements and proposed building fabric standards, it is considered to be more appropriate to implement a mechanical ventilation strategy to ensure compliance with regulations and standards for modelling purposes.

Openable windows are proposed albeit they will not be essential to provide a fresh air supply. Nonetheless, they will provide a further allowance to residents and occupiers to control their indoor environment. The openable windows can also be used for purge ventilation.

The ventilation strategy will be reviewed by the future tenants to ensure compliance with all the relevant regulations and standards.

5.2.2 Building Fabric

Part L of the 2013 Building Regulations for non-residential buildings highlights the need for an energy efficient design. The minimum building fabric requirements for Part L2A 2013 and the proposed specification for individual building elements for the non-residential floor space are presented in Table 5.2.

Table 5.2 Proposed fabric energy efficiency targets for individual building elements

Element	U-values (W/m²K)	
	Part L1A 2013 minimum fabric requirements	**Proposed specification for the development**
External walls	0.30	0.18
Roof	0.20	0.16
Ground floor	0.25	0.20
Windows [1]	2.00	1.30
Airtightness [2]	10 ($m^3/(hm^2)$ at 50 Pa)	4 ($m^3/(hm^2)$ at 50 Pa)

[1] Glazing performance will need to be reviewed alongside acoustic performance as the design is developed.

[2] Default value will be used for the purposes of the shell only assessment, however for the modelling purposes a target value of 4 has been assumed.

Implementing these (or similar) building fabric standards will help to deliver substantial reductions in CO_2 emissions compared with the current building performance and regulations. The proposed specification should be viewed as guidance.

5.2.3 Energy Efficient Systems

Energy demand can be significantly reduced by using energy efficient M&E systems. The recommended indicative energy efficiency measures for the proposed non-residential units are provided below and have been used to carry out the energy and carbon modelling.

As the non-residential units will be provided as shell only, it will be the responsibility of the future tenant to review the proposed energy efficiency measures and incorporate them into the final design as required to meet the regulatory standards. The future tenants may vary the proposed energy efficiency measures/specification for specific requirements and needs.

The overarching principle for final selection of the building fabric standards and energy efficient systems is to achieve compliance with Part L2A 2013 requirements, where feasible.

5.2.3.1 Heating and Hot Water

The space heating requirement of the proposed development will be significantly reduced by the proposed fabric, air tightness and ventilation measures.

It is proposed to install a communal heat distribution network to provide space heating and hot water. Specifically, it is proposed to design the heating system to achieve the following:

- Variable flow rate heating system with high delta T and low return temperatures
- High efficiency motors and variable speed pumps for heating
- Appropriate controls for heating
- Appropriate insulation of heating pipes
- Low flow and return temperatures

5.2.3.2 Lighting

A major energy demand within modern non-residential spaces is generally lighting. Specified lighting in these areas should be low wattage and designed to CIBSE Illuminance levels. Appropriate lighting controls are recommended, such as PIRs and daylight dimmers, allowing light output to be automatically adjusted to suit prevailing conditions. Zoning of lighting circuits also allows greater benefit to be made of natural daylight in the areas where it is available, without compromising light levels further away from windows.

Additionally, high frequency ballasts and control gear will need to be utilised where appropriate to further reduce energy demand.

Display lighting may be required which generate a significant energy demand. Therefore, if applicable, it is proposed that all display lighting will use energy efficient luminaires.

The above will need to be considered at the fit-out stage by the future tenant.

5.2.3.3 Ventilation

Air tightness standards will conform to Approved Document Part L requirements. To achieve the internal noise standards and controlled internal conditions will require provision of mechanical ventilation. At this stage, it is proposed to provide an energy efficient mechanical ventilation system with heat recovery (MVHR) to meet the noise and fresh air supply requirements.

It is recommended to select MVHR with low Specific Fan Powers (SFP). SFP of 1.2 W/l/s is assumed for modelling purposes. This can be achieved by using systems with high efficiency fan motors and 45/90° radius bends and turning vanes in ductwork. The ventilation system should have a high heat recovery efficiency. The MVHR system should be specified to have purge ventilation or boost. An automatic control of MVHR systems, which may take the form of sensors to modulate their performance. All to be considered by the future tenant.

It is recommended to specify MVHR systems with summer by-pass which can overcome the issue of returning hot air to the dwelling by ensuring that it is not passed over the heat exchanger. There are systems available with automatic by-pass which can monitor both internal and external air temperatures. By-pass is initiated when internal temperature is above a set comfort level or is higher than external temperatures.

A more detailed ventilation strategy will be developed by the future tenant with the aim to specify the most appropriate system and achieve a pleasant indoor climate.

5.2.3.4 Cooling

At this stage, it is assumed that cooling may need to be provided to the non-residential unit. Cooling can be effectively provided by an energy efficient cooling system such as Variable Refrigerant Flow (VRF) system. It is recommended to select VRF system with high Coefficient of Performance (COP). COP of 4.5 W/l/s is assumed for modelling purposes.

5.2.3.5 Energy Metering and Monitoring

It is assumed that sub metering in non-residential units of major energy consuming systems together with an accessible energy monitoring and management system or separate accessible energy sub-meters with pulsed or other open protocol will be provided by the future tenants.

5.3 CO_2 Savings after Energy Demand Reduction (Be Lean)

5.3.1 Residential CO_2 Savings after Energy Demand Reduction

Based on the proposed energy efficiency measures, the Dwelling Emission Rate (DER) for each representative dwelling provides an indication of the anticipated regulated CO_2 emissions. The DERs do not include the unregulated energy use for appliances and cooking, these CO_2 emissions have been calculated separately using the BREDEM methodology.

The regulated energy and carbon baselines have been calculated by extrapolating the DER results of the typical dwellings across the entire residential development. The energy demand and CO_2 emissions of the representative dwellings have been inputted into the energy and carbon assessment model which calculated the total CO_2 emissions for the development.

The assessment shows that by implementing the energy efficient design, incorporating enhanced building fabric standards and using efficient energy supply systems, it is possible to achieve compliance with the Part L1A and achieve the TER target with energy efficiency measures alone. The regulated, unregulated and total emissions after energy demand reduction are summarised in Table 5.3.

Table 5.3 Anticipated residential CO_2 emissions after energy demand reduction

	CO_2 emissions (tonnes/year)		
	Regulated	**Unregulated**	**Total**
Residential Baseline	70.62	83.04	153.66
After energy demand reduction	70.60	83.04	153.63

5.3.2 Non-residential CO_2 Savings after Energy Demand Reduction

Based on the proposed energy efficiency measures, the Building Emission Rate (BER) for the non-residential floor space has been calculated using IES VE software which provides indications of the anticipated CO_2 emissions of an ‘actual’ building under the standard National Calculation Methodology (NCM).

The energy assessment shows that by implementing the energy efficient design, by incorporating enhanced building fabric standards and by using energy efficient systems, the regulated CO_2 emissions of the non-residential floor space can be reduced by circa 3.05 tCO_2 per annum, which equates to circa 13.7% reduction in regulated emissions over the baseline. The regulated, unregulated and total emissions after energy demand reduction are summarised in Table 5.4.

Table 5.4 Anticipated CO_2 emissions after non-residential demand reduction

	CO_2 emissions (tonnes/year)		
	Regulated	Unregulated	Total
Non-residential Baseline	22.19	26.32	48.50
After energy demand reduction	19.14	26.32	45.46

5.3.3 Total CO_2 Savings after Energy Demand Reduction

The CO_2 assessment shows that by implementing the energy efficient design, incorporating enhanced building fabric standards and using efficient energy systems, the regulated CO_2 emissions can be reduced by circa 3.07 tCO_2 per annum for the entire development, which equates to circa 3.3% reduction in regulated CO_2 emissions over the baseline. The summary of regulated, unregulated and total CO_2 emissions and anticipated savings are presented in Table 5.5.

Table 5.5 Summary of anticipated CO_2 emissions after energy demand reduction

	CO_2 emissions (tonnes/year)		
	Regulated	Unregulated	Total
Total Baseline	92.81	109.35	202.16
After energy demand reduction	89.74	109.35	199.09

6 Efficiency Energy Supply (Be Clean)

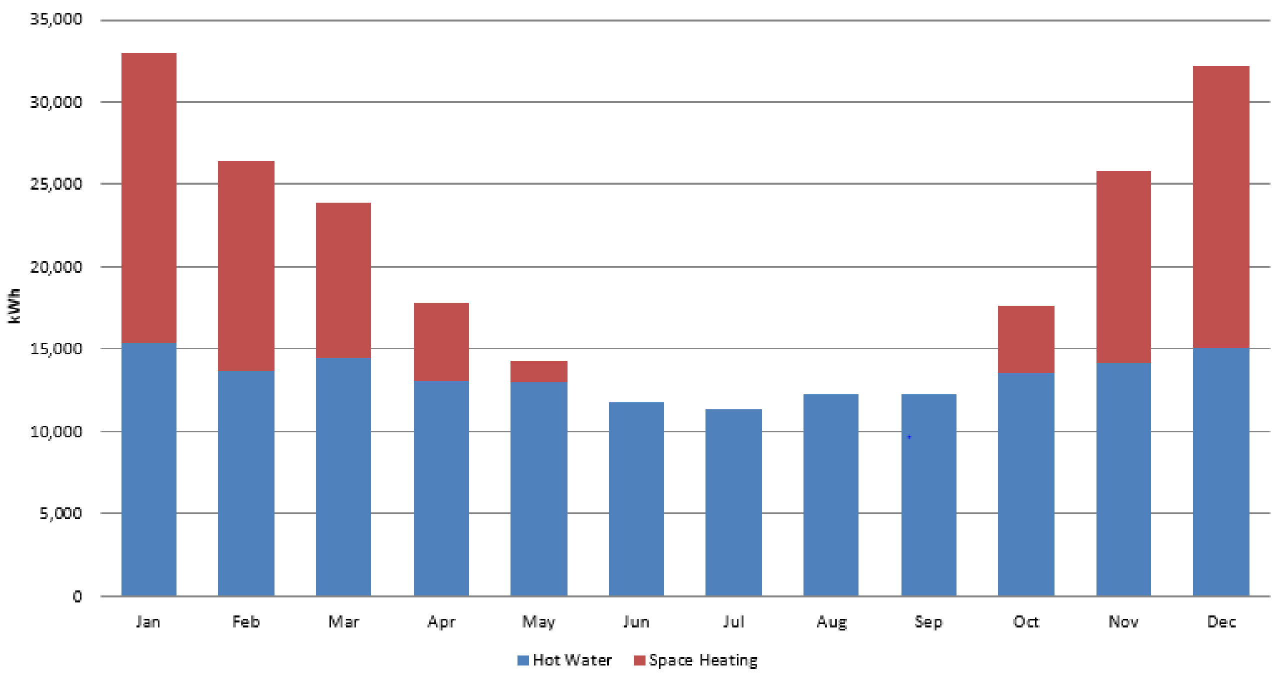
6.1 Residential Energy Demand

The residential energy demand assessment has been carried out to estimate and evaluate the space heating and hot water demands using the SAP methodology. The estimated hot water and space heating demands are as follows:

- Hot water – 160,018 kWh/year
- Space heating – 78,685 kWh/year

The residential estimated hot water and space heating demand profiles are provided in Figure 6.1.

Figure 6.1: Residential estimated hot water and space heating demand profiles



The estimated residential hot water demand is expected to present a consistent load throughout the year, although there will be peaks and troughs in daily use. These peaks and troughs can be managed through use of a thermal store to transform the hot water load into a consistent base load which can potentially be delivered by a CHP technology connected to a district heating network.

During the summer months space heating may not be needed or its requirement will be relatively low. The space heating demand during colder months of the year, which will be minimised through energy efficiency measures, can also be delivered by the CHP technology. The remaining space heating demand can effectively be supplied by gas boilers which work well, combined with CHP technology.

Mechanical cooling for the residential part of the development is not expected to be required. Therefore, no active cooling supply is proposed for the residential units.

6.2 Non-residential Energy Demand

It is more difficult to assess non-residential heat demand because the non-residential units are designed as shell only and the tenants of the units are unknown. The non-residential energy demand assessment has been carried out to estimate and evaluate the space heating, hot water and comfort cooling demands using the NCM methodology. The estimated hot water, space heating and comfort cooling demands are as follows:

- Hot water – 4,886 kWh/year
- Space heating – 9,738 kWh/year
- Comfort cooling – 14,921 kWh/year

The estimated hot water demand will not be significant. It is expected to present a consistent load throughout the year, although there will be peaks and troughs in daily use. The non-residential hot water demand alone cannot justify use of CHP technology but if combined with the residential hot water demand it will make use of the CHP technology justifiable.

The space heating load does not present a consistent demand and is seasonal in nature. It is also minimised through the application of the proposed energy efficiency measures. During the summer months, the space heating may not be needed or its requirement will be relatively low which means that only some portion of this energy demand can effectively be supplied by CHP. The remaining space heating demand can effectively be supplied by the district heating network gas boilers.

The estimated non-residential cooling load is expected to be all year round, but predominantly during the summer months. This relatively small load can be supplied effectively by either Variable Refrigerant Flow (VRF) systems or conventional air or water cooled chillers. It is considered that use of absorption chillers is unsuitable in this instance due to the relatively small anticipated cooling load and low efficiencies.

The VRF systems are generally more efficient than conventional cooling systems therefore, it is recommend to use them over the conventional cooling systems. It is considered that the use of absorption chillers is unsuitable in this instance due to the relatively small anticipated cooling load and low efficiencies.

6.3 Energy Supply Options Assessment

In accordance with Policy 5.6 of the London Plan, the feasibility of decentralised heating networks as a Be Clean measure has been evaluated. This is the next step in the Energy Hierarchy after Be Lean. The London Plan outlines the following order of preference:

1. Connection to existing heating or cooling networks;
2. Site wide CHP network;
3. Communal heating and cooling.

The inclusion of decentralised heating has been investigated in terms of appropriateness to the proposed development as it can help to provide the greatest reductions in CO_2 emissions.

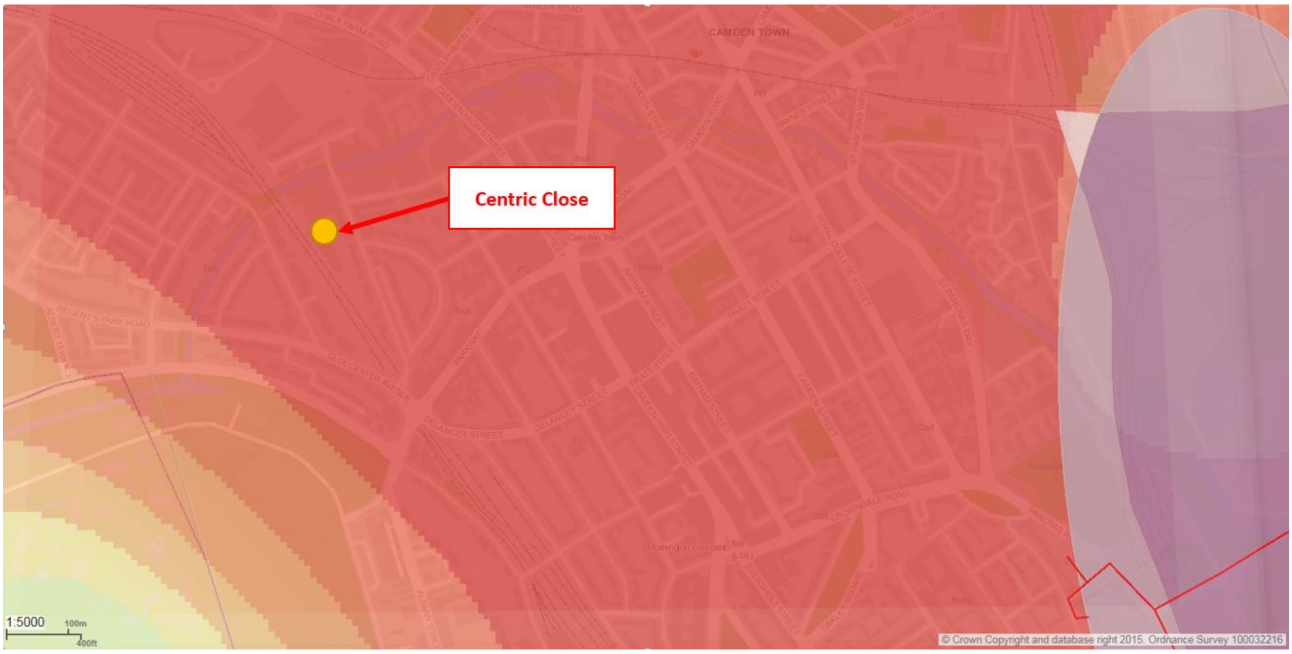
6.3.1 Connection to Existing District Heating Networks

In response to the London Plan Policy 5.6 hierarchy, an investigation using the London Heat Map was carried out to identify existing and planned district heating networks in the vicinity of the site. The London Heat Map provided in Figure 6.2 indicates that the site is not located within a district heating opportunity area and there are no existing or potential district heating networks in close proximity to the site.

The development falls on the south perimeter of the Kentish Town decentralised energy cluster area which holds potential for the delivery of a decentralised energy network.

This means that district heating or community heating schemes may potentially be developed around the site and there may be a possibility to connect the development to a wider district heating or community heating scheme in the future. Time scales and/or details for any potential heat networks are currently unknown.

Figure 6.2: District heating opportunity areas in the vicinity of the site



Given the lack of nearby district heating or community heating infrastructure to connect to at present or in the near future, on-site energy supply option will need to be implemented.

6.3.2 Site-wide Heating Network

Although the development is relatively small, it has a reasonably high density which can make a site-wide heating network justifiable. The provision of an on-site district heating system will provide an opportunity for the proposed development to be 'future proofed' to make the best use of efficient energy generation with current and future technologies. In particular, such a system will enable the necessary infrastructure to be brought forward to link with other potential decentralised energy generation schemes which may be developed in the area after completion of the proposed development.

The Combined Heat and Power (CHP) technology has been considered for the on-site district heating system. When the technology is applied correctly, it can be much more energy efficient than obtaining energy from conventional gas boilers. It can also help to significantly reduce CO_2 emissions associated with heat supply which can help the development to achieve the CO_2 reduction targets.

The CHP technology requires a relatively consistent heat demand throughout the year and the estimated total hot water and space heating demand of the development is expected to be high enough to make the use of the technology technically justifiable.

A viability assessment has also been carried out which indicates that it is more economical to operate and maintain the on-site district heating system with CHP technology than the same system without the CHP technology.

An initial Life Cycle Cost (LCC) assessment of the on-site heating system with CHP has been carried out and compared with the option which represents the on-site heating system without the use of CHP. The key inputs and outputs of this LCC assessment are provided in Appendix C.

The LCC assessment shows that the LCCs of the on-site heating system with CHP is better than the LCCs of the on-site system without CHP. Although the LCCs for both options are comparable, the assessment shows that it is more beneficial to utilise an on-site heating system with CHP because the system has lower LCCs and can achieve higher CO_2 reduction on-site over the on-site system without CHP.

Taking viability assessment results into account and the CO_2 reduction potential of the assessed options, it is proposed to develop a site-wide heating network with CHP to supply hot water and space heating to the entire development.

Due to the low amount of cooling that may be required by the non-residential units only, it is not viable to provide this from 'waste' heat with a Combined Cooling Heating and Power (CCHP) system, therefore this has been discounted.

6.3.2.1 Heating Network Design

The proposed design of the development's site-wide heating system will incorporate a gas-fired CHP engine, thermal store(s) for hot water storage, back-up/top-up gas-fired boilers, controls and associated ancillary equipment. The space heating and hot water will be supplied to the dwellings via Hydraulic Interface Units (HIUs).

The design of the proposed site-wide heating system will be developed during the detailed design stage. However, the overarching design principle is to design the system in accordance with standards and design recommendations provided within emerging Heat Networks Code of Practice, the London Heat Network Manual and CIBSE AM12 Combined Heat and Power for Buildings.

The design of the site-wide heating system needs to ensure that heat distribution pipework runs are minimised, particularly lateral pipework in the corridors to reduce heating system losses and minimise the risk of overheating. Heating infrastructure including distribution pipework and HIUs will also be properly insulated to minimise heat losses.

On-Site Combined Heat and Power (CHP)

By utilising both the electricity and heat generation of an engine, CHP enables substantial reductions in primary energy demand and CO_2 emissions over conventional methods.

For this development, it is proposed to install a natural gas CHP due to the availability of gas supply and reliability of natural gas engines.

Based on the assessment of the space heating and hot water demand profiles, it is proposed to size the CHP system to supply up to 75% of the total heat demand of the development. It is assumed that the CHP system will supply all annual domestic water demand of the development. Some of the space heating demand will also be supplied by the CHP. The remaining space heating load will be met by energy efficient gas boilers, installed in parallel to the CHP unit.

Based on the available information, a preliminary CHP sizing has been carried out which indicates that the CHP engine would be circa 15-20 kWe /30-40 kWth. There are a number of key technical parameters such as engine efficiencies, NOx emissions, noise levels, etc. which influence selection of the engine. The size of the thermal store must be such that the operation of the CHP is maximised and a full assessment must be undertaken at detail design stage when more accurate information about the heat demand profiles become available. It is estimated that the thermal store size should be circa 2.5-3 m^3.

The energy, air quality and cost assessments have been carried out based upon the technical parameters of Energimizer EM 16NG CHP engine. The technical specification of the engine is provided in Appendix D.

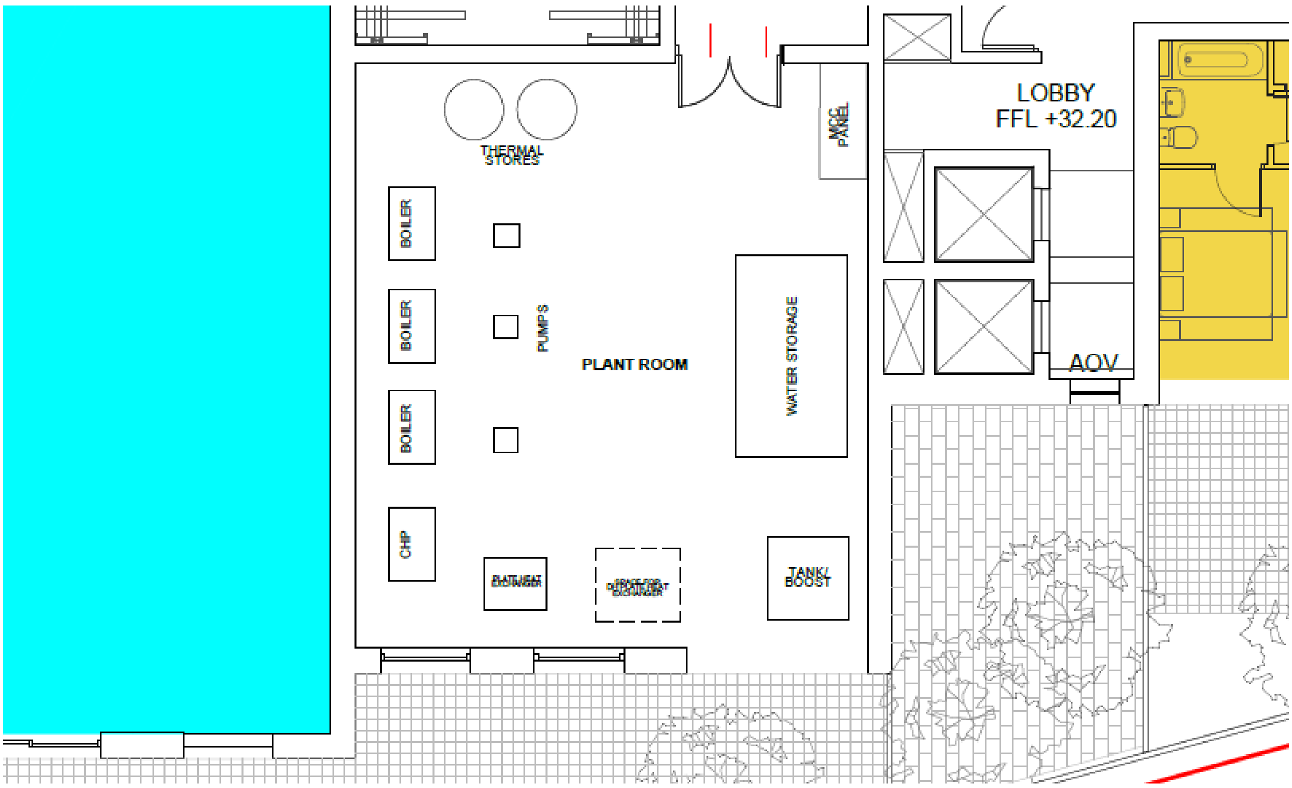
Final sizing and selection of the CHP system should be carried out during detailed design stage. The underlining principle for sizing and selecting the CHP system will be to maximise CO_2 reduction and reduce LCCs as well as achieve all other requirements such as low NOx emissions and required noise levels.

The impact of the proposed heating system on local air quality has been assessed and the results are provided in the Air Quality Assessment (AQA) report produced by MLM Consulting Engineers Limited. The AQA report indicates that the NOx emissions from the CHP and boiler are not predicted to have any significant adverse impact on the receptors within the development, as well the existing receptors nearby. It is not necessary to adjust the current proposed stack height (1.0m above roof on Block A), or increase the flue gas exit velocity.

Energy Centre

The CHP and boiler plant together with all the associated ancillary equipment will be located on the ground floor of the tallest block in the Energy Centre, to allow for the exit of flue gases at the highest point. The energy centre has a total floor area of circa 92 m^2 and this will be sufficient for the development together with the cold water storage tank. A proposed Energy Centre layout is provided in Figure 6.3.

Figure 6.3: Location of Energy Centre



Heating System Operation and Management

The development will be designed to meet onsite heat demands, but will make provision for possible future connection. The design of the heating system is to be completed during detailed design stage but the intention is that the CHP engine will act as a primary heat source followed by the thermal store and top-up gas boilers. Heat will be provided from the CHP engine to meet demand from the building and / or to charge the thermal storage vessel. If the heat demand of the building cannot be met by the CHP, the thermal store will discharge heat into the heating system. If the thermal store contains insufficient heat to meet the required heat demand which exceeds that provided by the CHP, the gas-fired boilers will operate.

The inclusion of a thermal store allows the CHP to run when there is low demand to build up a reserve of heat energy in the stored hot water. This energy can be released to provide heat at periods of peak demand. Releasing stored heat energy in this way means that the use of the top-up gas boilers is reduced and the proportion of heat supplied from the CHP increased. There are other benefits from the thermal store in that the CHP system will run at optimum output for the majority of the time. An optimum run time also reduces the size and life cycle cost of CHP required to meet a given energy load and increases CO_2 savings.

The CHP system should facilitate a minimum circa 5,000 operating hours per year and should improve the financial viability of the heating system operation whilst maintaining the demands of the system to meet variations in hot water and space heating.

The gas boiler system will be sized to provide full hot water demand backup in the event of failure or maintenance of the CHP units. It is estimated that the total capacity of the boiler plant should be circa 500 kW in order to supply peak heating and hot water demand for the development. The boiler system sizing needs to be reassessed during detailed design stage when more specific data is available regarding heat loss calculations.

When there is a sufficient electricity demand in the landlord areas, the electrical output of the CHP system will be fully utilised on site with no export to the grid. If the electricity demand is lower than the electricity supplied by the CHP unit, the surplus will be exported to the grid.

It is not possible to provide specific details regarding the electricity export arrangements due to the lack of specific technical information at this stage. In addition, the utility companies do not generally engage with potential electricity exporters at such an early stage in the project about site specific information related to electricity export arrangements. However, the initial information obtained from low carbon electricity buyers suggest that, at present, when low electricity amounts are exported, some utility suppliers will pay for exported electricity. To receive any payments for the exported electricity, it will also be required to negotiate and agree an electricity export contract with a DNO/electricity buyer.

The electricity export contractual arrangements should be discussed and agreed during later stages of the project. Detailed electricity demand of the landlord areas will need to be carried out and confirmed during later stages of the project when more details about the M&E design of the development is available.

Some of the electricity produced by the CHP may need to be exported to the grid. Therefore, an import and export electricity meter may need to be installed on site and the G59 requirements met to enable the electricity to be exported.

It is not currently possible to confirm an operator of the on-site heating network. The potential operator will require as a minimum information about the energy system design and equipment proposals before engaging with any meaningful discussions about the management and operation of the on-site heating network. This information is currently unavailable as it is too early in the process.

Future-Proofing the District Heat Network Connection

The development will be designed to meet the onsite heat demands only, but will make space provision in the plantroom for possible future connection to near-site energy generation facilities and networks should they become available and feasible in the future. The pipework to the boundary of the site will not be provided as the connection may never be required and this will only add unnecessary costs to the design. However, should the connection become viable in the future, the pipework can easily be installed at a later stage.

6.4 Summary of CO_2 Reductions from CHP system

6.4.1 Residential CO_2 Savings from CHP System

The energy assessment shows that by use of the proposed site-wide heating network with CHP, it is possible to achieve a reduction of CO_2 emissions of approximately 22.94 tCO_2 per annum for the residential part of the development. This is equivalent to a reduction in the regulated CO_2 emissions from the energy efficient building of circa 32.5%. The regulated, unregulated and total regulated emissions savings through use of CHP technology is summarised in Table 6.1.

Table 6.1 Residential CO_2 emissions after use of CHP technology

	CO_2 emissions (tonnes/year)		
	Regulated	**Unregulated**	**Total**
Residential Baseline	70.62	83.04	153.66
After energy demand reduction	70.60	83.04	153.63
After use of CHP technology	47.64	83.04	130.67

6.4.2 Non-residential CO_2 Savings from CHP System

The energy model assessment shows that by use of the proposed on-site heating network with CHP, it is possible to achieve a reduction of CO_2 emissions of approximately 1.95 tCO_2 per annum for the non-residential parts of the development. This is equivalent to a reduction in the regulated CO_2 emissions from the energy efficient building of circa 10.2%. The regulated, unregulated and total regulated emissions savings through use of CHP technology is summarised in Table 6.2.

Table 6.2 Non-residential CO_2 emissions after use of CHP technology

	CO_2 emissions (tonnes/year)		
	Regulated	**Unregulated**	**Total**
Non-residential Baseline	22.19	26.32	48.50
After energy demand reduction	19.14	26.32	45.46
After use of CHP technology	17.19	26.32	43.51

6.4.3 Total CO_2 Savings from CHP System

The energy assessment shows that by use of the proposed site-wide heating network with CHP, it is possible to achieve a reduction of CO_2 emissions of approximately 24.91 tCO_2 per annum for the entire development. This is equivalent to a reduction in the regulated CO_2 emissions from the energy efficient building of circa 27.8%. The regulated, unregulated and total regulated emissions savings through use of CHP technology is summarised in Table 6.3.

Table 6.3 Total CO_2 emissions after use of CHP technology

	CO_2 emissions (tonnes/year)		
	Regulated	**Unregulated**	**Total**
Total Baseline	92.81	109.35	202.16
After energy demand reduction	89.74	109.35	199.09
After use of CHP technology	64.83	109.35	174.18

7 Renewable Energy (Be Green)

The final part of the London Plan Energy Hierarchy is Be Green which seeks renewable energy technologies to be specified to provide a reduction in anticipated carbon dioxide emissions, where feasible.

The CHP engine and heat network strategy restricts the renewable energy technologies which will be feasible and appropriate for the development. Any renewable energy technologies that are to be included must be complementary and not conflict with the CHP engine. The following low and zero carbon technologies have been considered and compared for this particular development:

- Photovoltaic Panels (PV)
- Air Source Heat Pump (ASHP)
- Ground Source Heat Pump (GSHP)
- Wind Turbines
- Biomass Boiler
- Solar Thermal

The assessment of these technologies shows that PV systems are considered to be the most suitable renewable energy technology options for the development. All other renewable energy technology options are considered to be less suitable. The VRF system and PV options are discussed further in the following sections. A summary of the assessment can be found in Appendix A.

7.1 Photovoltaics (PV)

7.1.1 Design

The renewable energy assessment shows that PV systems can be provided to generate renewable power. This technology can work well with all the other proposed technologies (e.g. CHP and gas boilers) and can supply additional CO_2 reductions for parts of the residential and non-residential areas of the development.

PV panels use solar radiation and convert it into usable electricity through the application of semiconductor technology. Solar panel outputs vary depending upon orientation, inclination, solar radiation levels, cloud cover and temperature.

PV panels can be ground mounted, roof mounted or building Integrated (incorporated into the facade of a building). Due to the space limitations and costs, ground mounted and building integrated systems are not being considered for the site, whereas roof mounted systems are considered viable.

PV systems should ideally face south with an incline of 30^o, although orientations within 45^o of south and other angles can still generate outputs if panels are not over shaded. Optimum design of the PV installation is required to ensure maximum electrical output per kWp installed. There are a number of design considerations to be made to ensure the best use of the system. The key design considerations for designing and installing PV systems are:

- Design of PV installation to optimise inclination and orientation;
- Ensure that PV panels are not overshadowed;
- Ensure correct installation of PV arrays for good ventilation

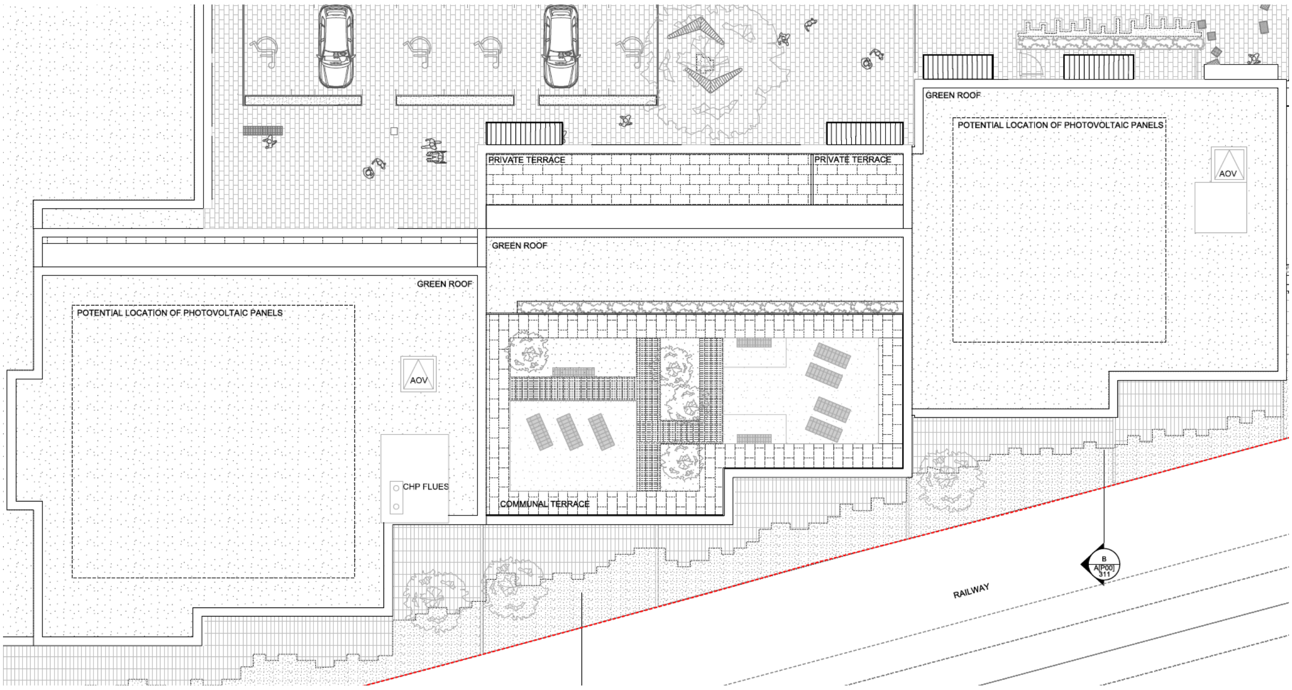
- Ensure that the electrical wiring from PV arrays to inverters is kept to a minimum to reduce electrical losses;
- Provide sufficient space around PV installations for safe access and maintenance of the modules and other equipment installed on the roof.

The electricity generating potential of PV panels is not dependent on development demand but on suitable available roof space for installation.

The energy assessment indicates that circa 13.9 kW of PV is required for the development to meet the London Plan 35% CO_2 reduction target on-site. Depending on the energy efficiency measures and design and selection of the CHP system, the PV capacity requirement may change during the detailed design stage. The initial assessment suggests that the required PV amount can be accommodated on the identified pitched roofs.

It is proposed to locate the PV panels on the highest roof of the building. The lower roof identified below could be used if the highest roof doesn't provide enough space to accommodate the PV requirement. For aesthetic purposes Fairview will try and avoid the lower roof area. The proposed and available roof areas for PV are illustrated in Figure 7.1.

Figure 7.1 Roof plan for the development indicating proposed areas for solar panels



The PV layout will be fully developed during the detailed design stage.

It is assumed that 1 kWp of PV panels can generate circa 800 kWh per annum which will equate to circa 11,120 kWh/year of renewable electricity generation.

The total system capacity and the estimated total electricity production for the residential and non-residential floor spaces are provided in Table 7.1.

Table 7.1 Proposed PV system capacity and anticipated CO_2 emissions reduction

Use	Estimated total PV system capacity (kW)	Estimated electricity production (kWh/year)
Residential	5.3	4,240
Non-residential	8.6	6,880
Total	**13.9**	**11,120**

The non-residential PV capacity will depend on the use of the non-residential units and how the future tenants choose to meet the requirements.

It is proposed to provide a dedicated stand-alone PV system for each non-residential unit. This arrangement will benefit future non-residential tenants as the generated PV electricity can be used within the non-residential units, reducing the reliance on grid electricity. The required PV capacity and roof area will need to be re-assessed and confirmed during the detailed design stage.

7.2 Summary CO_2 Savings from Renewable Systems

7.2.1 Residential CO_2 Savings from Renewable Systems

The energy assessment shows that PV may result in circa 1.86 tCO_2 reduction of regulated CO_2 emissions per annum which equates to circa 3.9% reduction for the residential part of the development. The regulated, unregulated and total emissions after use of PV technology is summarised in Table 7.2.

Table 7.2 Residential CO_2 emissions after use of PV technologies

	CO_2 emissions (tonnes/year)		
	Regulated	**Unregulated**	**Total**
Residential Baseline	70.62	83.04	153.66
After energy demand reduction	70.60	83.04	153.63
After use of CHP technology	47.64	83.04	130.67
After use of PV technology	45.78	83.04	128.82

7.2.2 Non-residential CO_2 Savings from Renewable Systems

The energy model assessment shows that PV systems may result in circa 2.8 tCO_2 reduction of regulated CO_2 emissions per annum which equates to circa 16.3% reduction for the non-residential units.

The regulated, unregulated and total emissions after use of PV technology is summarised in Table 7.3.

Table 7.3 Non-residential CO_2 emissions after use of PV technologies

	CO_2 emissions (tonnes/year)		
	Regulated	Unregulated	Total
Non-residential Baseline	22.19	26.32	48.50
After energy demand reduction	19.14	26.32	45.46
After use of CHP technology	17.19	26.32	43.51
After use of PV technology	14.38	26.32	40.70

7.2.3 Total CO_2 Savings from Renewable Systems

The energy model assessment shows that by using the proposed renewable energy technologies for residential and non-residential parts of the development, it is possible to achieve a reduction in CO_2 emissions of approximately 4.66 tCO_2 per annum for the entire development. This is equivalent to a reduction in the regulated CO_2 emissions of circa 7.2%. The regulated, unregulated and total regulated emissions savings through use of the renewable energy technologies is summarised in Table 7.4.

Table 7.4 Total CO_2 emissions after use of renewable technologies

	CO_2 emissions (tonnes/year)		
	Regulated	Unregulated	Total
Total CO_2 Emissions Baseline	92.81	109.35	202.16
After energy demand reduction	89.74	109.35	199.09
After use of CHP technology	64.83	109.35	174.18
After use of PV technology	60.17	109.35	169.52

8 Summary and Conclusions

The Energy Strategy for the development has been formulated following the London Plan Energy Hierarchy: Be Lean, Be Clean and Be Green. The overriding objective in the formulation of the strategy is to maximise the reductions in total CO_2 emissions through the application of this hierarchy with a cost-effective and technically appropriate approach and to minimise the emission of other pollutants. The energy strategy measures are summarised and presented in Table 8.1.

Table 8.1 The Energy Strategy: Be Lean, Be Clean and Be Green principles

Energy Hierarchy	Energy Strategy Measures
Be Lean	**Passive design** • Optimised design to enable controlled solar gain and improved direct and indirect natural lighting. • Incorporation of balconies and overhangs into the design to provide some shading. **Building Fabric** • Use of optimal building fabric standards. • Design with low air permeability rates **Energy Efficiency** • Energy efficient lighting and appropriate controls • Variable speed heating system with high delta T and low return temperatures • High efficiency motors and variable speed pumps for heating and ventilation systems • High efficiency heating plant and auxiliary equipment • Appropriate controls for heating system • Appropriate temperature and time zoning • Appropriate insulation of heating distribution system • Appropriate energy metering and monitoring
Be Clean	**Energy efficient energy supply** • On-site Combined heat and Power (CHP) system connected to a site-wide heating network to supply hot water and space heating to the entire development.
Be Green	**Renewable energy** • PV to supply renewable electricity to both residential and non-residential parts of the building.

Residential

The summary of the overall reduction in residential CO_2 emissions after each stage of the energy hierarchy is presented in Table 8.2.

Table 8.2 Summary of residential CO_2 emissions after each stage of the Energy Hierarchy

	CO_2 emissions (tonnes/year)		
	Regulated	**Unregulated**	**Total**
Residential Baseline	70.62	83.04	153.66
After energy demand reduction	70.60	83.04	153.63
After use of CHP technology	47.64	83.04	130.67
After use of PV technology	45.78	83.04	128.82

The regulated CO_2 savings for the residential development expressed in terms of actual and percentage reduction after each stage of the energy hierarchy are presented in Table 8.3.

The energy strategy shows that the overall CO_2 emissions from both regulated and unregulated energy can be reduced by circa 24.84 tCO_2 per annum which is equivalent to circa 16.2% reduction.

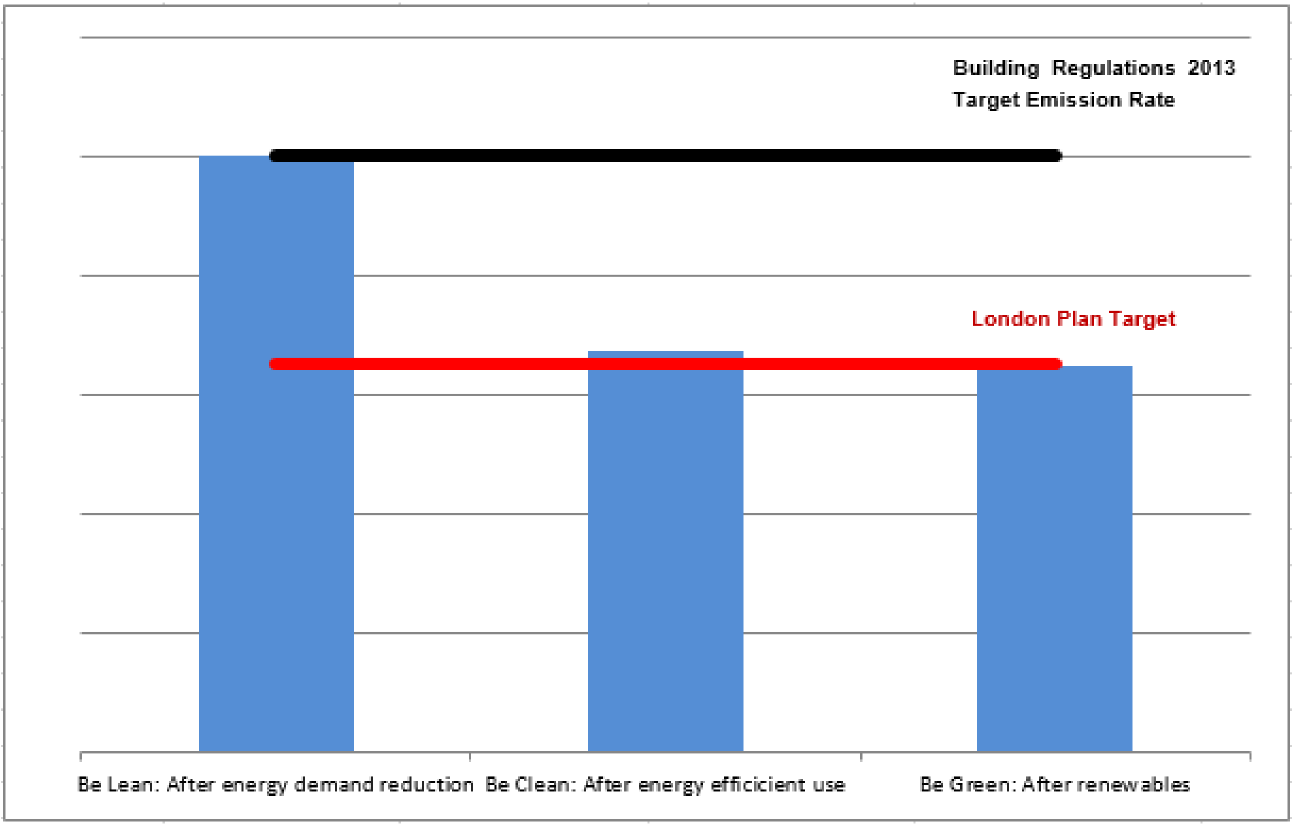
Table 8.3 Summary of residential CO_2 savings from each stage of the Energy Hierarchy

	Regulated Energy CO_2 savings	
	Tonnes per annum	**%**
Savings from energy demand reduction	0.02	0%
Savings from CHP	22.96	32.5%
Savings from renewables	1.86	3.9%
Total cumulative savings	**24.84**	**35.2%**
Annual Savings from off-set payment	**45.8**	
Cumulative savings for off-set payment (tonnes for 30 years)	**1,373.49**	

Table 9.3 shows that the proposed strategy can achieve regulated CO_2 savings of circa 24.84 tCO2 which is equivalent to circa 35.2% reduction when compared to the baseline. To achieve the zero carbon homes standard, an off-set payment will be made to for the outstanding regulated CO_2 emissions based on the carbon off-set price of £60 per tonne over a 30 year period.

The overall reduction in regulated carbon emissions associated with the proposed design is graphically illustrated in Figure 8.1.

Figure 8.1 Overall residential reduction in regulated CO_2 emissions compared to Part L baseline emissions



Non-residential

The summary of the overall reduction in residential CO_2 emissions after each stage of the energy hierarchy is presented in Table 8.4.

Table 8.4 Summary of non-residential CO_2 emissions after each stage of the Energy Hierarchy

	CO_2 emissions (tonnes/year)		
	Regulated	Unregulated	Total
Non-residential Baseline	22.19	26.32	48.50
After energy demand reduction	19.14	26.32	45.46
After use of CHP technology	17.19	26.32	43.51
After use of PV technology	14.38	26.32	40.70

The regulated CO_2 savings for the non-residential development expressed in terms of actual and percentage reduction after each stage of the energy hierarchy are presented in Table 8.4.

The energy strategy shows that the overall CO_2 emissions from both regulated and unregulated energy can be reduced by circa 7.8 tCO_2 per annum which is equivalent to circa 16.1% reduction.

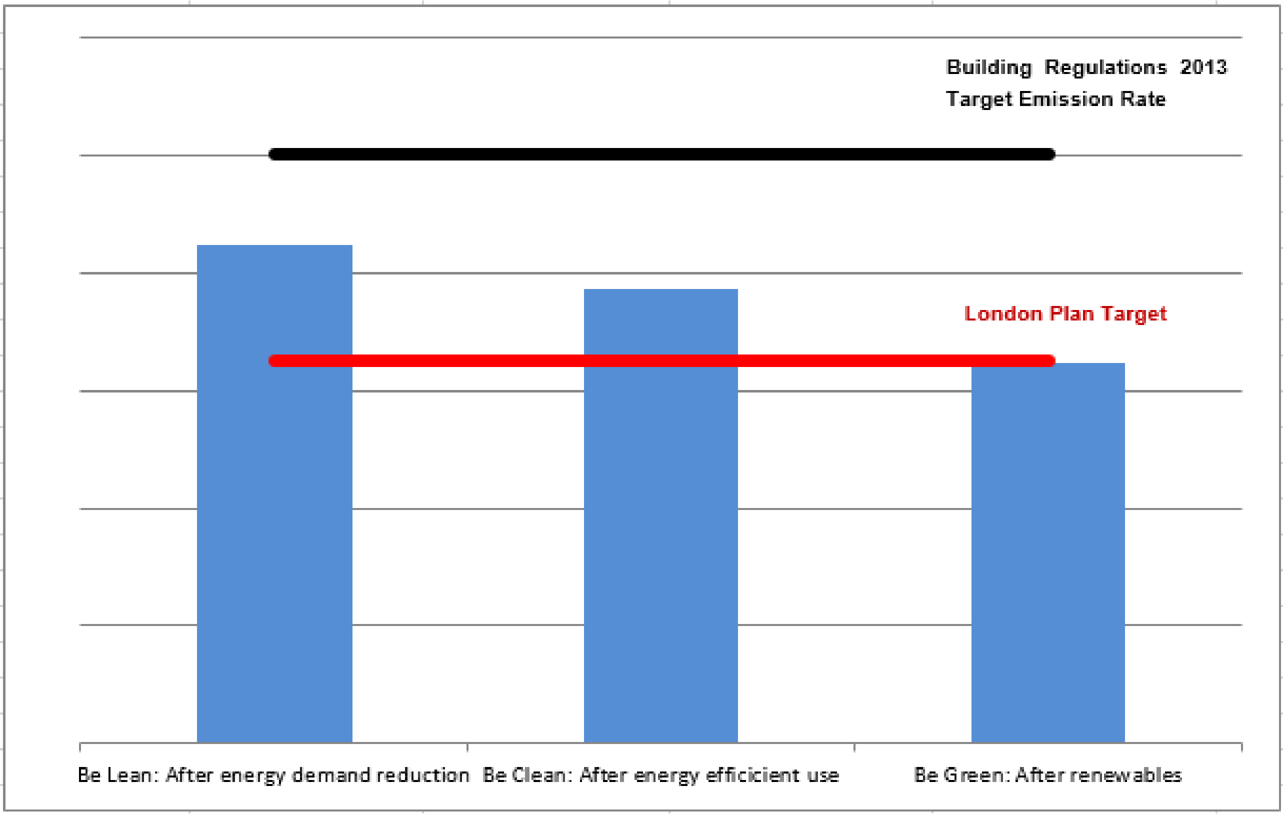
Table 8.5 Summary of non-residential CO_2 savings from each stage of the Energy Hierarchy

	Regulated Energy CO_2 savings	
	Tonnes per annum	**%**
Savings from energy demand reduction	3.05	13.7%
Savings from CHP	1.95	10.2%
Savings from renewables	2.80	16.3%
Total cumulative savings	7.80	**35.2%**

Table 9.5 shows that the proposed strategy can achieve regulated CO_2 savings of circa 7.8 tCO_2 which is equivalent to circa 35.2% reduction when compared to the baseline.

The overall reduction in regulated carbon emissions associated with the proposed design is graphically illustrated in Figure 8.2.

Figure 8.2 Overall non-residential reduction in regulated CO_2 emissions compared to Part L baseline emissions



Entire Development

The summary of the overall reduction in residential CO_2 emissions after each stage of the energy hierarchy is presented in Table 8.6.

Table 8.6 Summary of total CO_2 emissions after each stage of the Energy Hierarchy

	CO_2 emissions (tonnes/year)		
	Regulated	**Unregulated**	**Total**
Total CO_2 Emissions Baseline	92.81	109.35	202.16
After energy demand reduction	89.74	109.35	199.09
After use of CHP technology	64.83	109.35	174.18
After use of PV technology	60.17	109.35	169.52

The regulated CO_2 savings for the entire development expressed in terms of actual and percentage reduction after each stage of the energy hierarchy are presented in Table 8.7.

The energy strategy shows that the overall CO_2 emissions from both regulated and unregulated energy can be reduced by circa 32.64 tCO_2 per annum which is equivalent to circa 16.1% reduction.

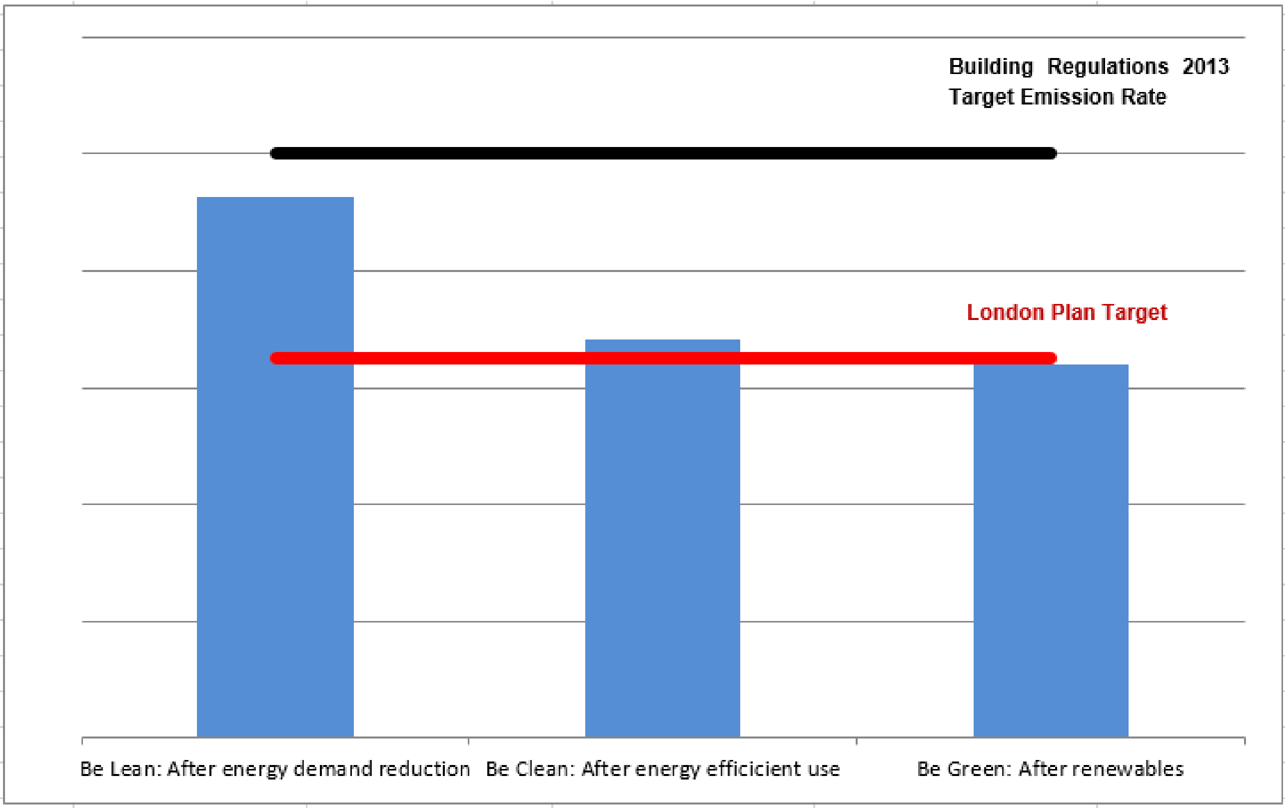
Table 9.7 Summary of total CO_2 savings from each stage of the Energy Hierarchy

	Regulated Energy CO_2 savings	
	Tonnes per annum	**%**
Savings from energy demand reduction	3.07	3.3%
Savings from CHP	24.91	27.8%
Savings from renewables	4.66	7.2%
Total cumulative savings	**32.64**	**35.2%**

Table 8.7 shows that the proposed strategy can achieve regulated CO_2 savings of circa 32.64tCO_2 which is equivalent to circa 35.2% reduction when compared to the baseline.

The overall reduction in regulated carbon emissions associated with the proposed design is graphically illustrated in Figure 8.3.

Figure 8.3 Overall total reduction in regulated CO_2 emissions compared to Part L baseline emissions



Summary

In summary, the proposed energy strategy for the development:

1. Informs the built form and orientation of the buildings to respond to daylight and indoor comfort levels;
2. Includes optimal building fabric standards, energy efficient design of building services and energy efficient appliances;
3. Complies with Part L 2013 Building Regulations and meets TFEE requirements;
4. Includes on-site CHP system connected to site-wide heating network to supply hot water and space heating to the residential development;
5. Includes renewable energy technologies;
6. Meets the 35% regulated energy CO_2 emissions reduction requirement on-site;
7. Achieves the zero carbon homes standard for the residential development by making an off-set payment the outstanding regulated CO_2 emissions based on the carbon off-set price of £60 per tonne over a 30 year period.
8. Achieve BREEAM Excellent mandatory Ene 01 energy requirement.

Appendix A – Alternative Renewable Technologies

This appendix presents an assessment of the renewable technology options relative to the site which are considered to be less suitable or unsuitable for this development.

Air Source Heat Pumps

The Air Source Heat pumps (ASHP) can be used as both a source of heating and cooling. ASHP use the same principle operation as GSHPs but the use air instead of water, as a heat source. The downside is that the air temperature and therefore efficiency of the heat pump is reduced in cold weather when the heat is most needed. This means that one either needs to oversize ASHPs to take into account degradation in performance or, alternatively, provide an auxiliary electric heating system. Provision of an auxiliary heater reduces capital cost but adds to running costs and reduces carbon savings.

Outdoor air systems are widely implemented in the form of split systems, with indoor and outdoor units linked by refrigerant pipes running through the wall. Packaged air systems where outdoor air is ducted to an indoor package are also available.

Theoretically, ASHPs could provide heat for a community heating scheme supplying the remaining circa 30% thermal demand by preheating the district heating water.

However, because the ASHPs should be placed on the roofs of the building, it will significantly reduce area available for PV as well as have significant negative aesthetic impact on the development.

Installation of the ASHPs on the roofs would require higher installation costs associated with support and access to the plant and greater need to consider noise impacts.

In addition, they are not very compatible with higher temperature technologies and systems such as CHP systems. Integration of ASHPs in one system with CHP units has significant technical challenges and risks. Therefore, the ASHP system should ideally be installed separately from the CHP system. In either option, the overall heating supply system could become unnecessarily complicated, which would likely increase the costs of the system. Because of the aforementioned issues, this arrangement is unlikely be practical and cost effective and therefore, it is not suitable for this development.

Ground Source Heat Pumps

The ground can be used as both a source of heating and a source of cooling. Ground source heating involves heat pumps, drawing heat from underground, whereas ground source cooling can either use heat pumps or make use of low temperature groundwater directly. Ground Source Heat Pumps (GSHP) are a relatively mature technology and utilise the energy in the ground through a refrigeration cycle. Where GSHP are used for both heating and cooling, depending on the season, this can be a very efficient solution. GSHP can be open loop or closed loop.

Open Loop GSHP system uses groundwater which is taken from an aquifer to supply heating or cooling. The water is then returned to the ground (sometimes via a borehole or sometimes via storm water drainage). Open loop systems require abstraction and discharge licences from the Environment Agency (EA).

Closed loop GSHP system comprises a sealed system of buried pipes, normally containing brine or water/antifreeze solution. The solution is circulated continuously around a closed system. This system requires extensive ground works to bury the coils that extract the low grade heat from the earth. They therefore require a large area for horizontal burial (40-100m long trench) or a vertical pile (50-100m) which is considerably more expensive but can be used where space is limited.

The ground conditions are currently unknown and may not be suitable to use an open-loop system. To assess ground conditions, it will be required to test bore holes. Generally, use of open-loop systems is associated with the technical, financial risk and other risks. Closed loop systems will unlikely be able to supply heat for the development. In addition, both GSHPs and CHP provide the base heating loads for a development. For this reason, they compete with each other and should not be installed in tandem.

Closed loop GSHP can theoretically be used to supply heating and cooling for the non-residential unit. However, it is not practical and cost effective to provide such system for a small cooling and heating load. Taking this into account, it is recommended to consider other options for the cooling and heating supply of the non-residential unit such air source heat pumps (ASHP).

Because of the aforementioned issues, GSHPs are unlikely be practical and cost effective and therefore, they are not recommended for this development.

Wind Power

Wind energy installations can range from small domestic turbines (1kW) to large commercial turbines (140m tall, 2MW). There are also different designs and styles (horizontal or vertical axis; 1 blade to multiple blades) to suit the location. They generate renewable electricity that can be provided for use on-site, or sold directly to the local electricity network.

Installation of large/medium scale wind turbine(s) could meet the renewable energy and carbon reduction targets however there is no appropriate space for the installation of large/medium scale wind turbines within the site.

Vertical axis turbines have a lower performance than horizontal axis turbines but work better in urban environments. However, effective energy generation through small scale roof mounted wind turbines is not feasible due to the following:

- The average wind speed at the site is estimated to be circa 5.6 m/s at 25 m above ground which is based on NOABLE Wind Map (the wind speed was taken from the Rensmart Wind Map). The wind speed is marginal for effective operation of a wind turbine;
- Issues such as noise, telecoms interference and visual impact are likely to restrict installation of wind turbines;
- Installation of wind turbines on the roofs will have a significant visual impact;
- There will be risks associated with operation and maintenance of the turbines.

Taking into account the above, wind power is not recommended for this development.

Biomass Boilers

Biomass boilers are now regarded as a conventional form of technology with a wide range of sizes and types to meet renewable targets. Biomass boilers use biomass as a fuel source, which is an alternative solid fuel to the conventional fossil fuels and has carbon emissions close to zero. Various types of biomass fuel are in use, the most common being wood chips and pellets.

Although pellets are more expensive than chips, they have greater energy content per unit of weight and require a lower storage volume. Pellet boilers also require less maintenance and produce considerably less ash residue.

There are some local/regional as well as national biomass suppliers who can supply biomass for the site. Biomass would need to be delivered to site in large trucks and the arrangements for supply and storage of the biomass fuel would need careful consideration. It would also require a suitable biomass storage space, which given the space constraints on this site is likely to be restrictive.

The potential reduction in carbon emissions from the installation of biomass boilers can be considerable and this would likely meet the GLA's target for carbon emissions reduction from renewable energy sources. However, although biomass systems have a number of advantages, in the context of this development, the following issues prevent the installation of biomass boilers:

- Likely significant negative impact on local air quality;
- No space availability for fuel delivery and storage;
- Significantly higher capital costs in comparison with gas boiler system;
- Requirements of additional resources for management of the operation;
- The location of the development may not be suitable for large-scale fuel delivery; and,
- Security of biomass supply.

However, like CHP engines, biomass boilers are best designed to provide the base heating. In line with the London Plan Energy Hierarchy, the size of the CHP engine as a Be Clean measure has been maximised. Therefore, a biomass boiler would be in conflict with the CHP engine that has already been specified and has therefore been discounted.

Solar Thermal

Solar Thermal heating systems can contribute to the hot water demand of a dwelling or building. Water or glycol (heat transfer fluid) is circulated to roof level where it is heated using solar energy before being returned to a thermal store in the plant room where heat is exchanged with water from the conventional system. The solar water systems are usually sized to provide circa 60% of the total hot water demand.

The use of solar thermal systems is inappropriate for this development on the basis that the technology is not compatible with the use of CHP as both technologies compete for the same base hot water load.

In addition, the system will produce relatively small CO_2 savings but will have significant negative impact of the cost of the heating system and its practicability. Therefore, solar thermal systems are not recommended for this development.

Appendix B – GLA Domestic Overheating Checklist

Section 1 Site features affecting vulnerability to overheating		Yes or No
Site Location	Urban – with central London or in a high density conurbation	Yes
	Peri-urban – on the suburban fringes of London	No
Air Quality and / or Noise sensitivity – are any of the following in the vicinity of buildings	Busy roads / A roads	No
	Railways / Overground / DLR	Yes
	Airport / Flight Path	No
	Industrial uses / Waste facility	No (industrial use on site replaced)
Proposed building use	Will any building be occupied by vulnerable people (e.g. elderly, disabled, young children)?	Unknown
	Are residents likely to be at home during the day (e.g. students)?	Unknown
Dwelling aspect	Are there any single aspect units?	Yes
Glazing ratio	Is the glazing ratio (glazing: internal floor area)greater than 25%	Yes
	If Yes is this to allow acceptable levels of daylight?	Yes
Security – Are there any security issues that could limit opening of windows for ventilation?	Single storey ground floor units	Yes
	Vulnerable areas identified by police Architectural Liaison Officer	Yes
	Other	The presence of the railway and restrictions imposed by Network Rail regarding allowable opening.

Section 2 - Design features implemented to mitigate overheating risk		Response
Landscaping	Will deciduous trees be provided for summer shading (to windows and pedestrian routes)?	Yes
	Will green roofs be provided	Yes

Section 2 - Design features implemented to mitigate overheating risk		Response
	Will other green or blue infrastructure be provided around buildings for evaporative cooling	No
Materials	Have high albedo (light colour) materials been specified?	Brickwork will likely be buff in colour.
Dwelling aspect	% of total units that are single aspect	30%
	% single aspect with N / NE / NW orientation	0%
	% single aspect with E orientation	21%
	% single aspect with S / SE / SW orientation	
	% single aspect with W orientation	9%
Glazing ratio – what is the glazing ratio (glazing; internal floor area on each façade?	N / NE / NW	
	E	35%
	S/SE/SW	
	W	36%
Daylighting	What is the average daylight factor range?	GIA to advise
Window opening	Are windows openable?	Yes
Window opening	What is the average percentage of openable area for the windows?	Fully openable to Courtyard façade, restricted opening to railway façade. Assumed 100mm.
Window opening	Fully openable	See above
What is the extent of the opening?	Limited (e.g. for security, safety, wind loading reasons)	See above
Security	Where there are security issues (e.g. ground floor flats) has an alternative night time natural ventilation method been provided (e.g. ventilation grates)?	Windows will be capable of being opened slightly to allow ventilation whilst in a locked position. Restrictors are also provided allowing windows to be opened slightly further but fully open.

Section 2 - Design features implemented to mitigate overheating risk		Response
Shading	Is there any external shading?	225mm deep brick reveals as standard, inset balconies, and windows beneath projecting balconies.
	Is there any internal shading	No. Occupants may install internal blinds/curtains according to their preference.
Glazing specification	Is there any solar control glazing?	It is proposed to consider solar control glazing.
Ventilation - What is the ventilation strategy?	Natural – background	No
	Natural – purge	Purge by openable windows and balcony doors
	Mechanical – background (e.g. MVHR)	Yes. Contentious extract mechanical ventilation.
	Mechanical – purge	The use of kitchen booster ventilation system
	What is the average design air change rate	1.5-2 air changes per hour
Heating system	Is communal heating present?	Yes with CHP.
	What is the flow/return temperature?	Proposed design flow and return temperatures are 70/40 ^oC.
	Have horizontal pipe runs been minimised?	Yes. The horizontal pipe runs have been minimised by optimal design of the corridors.
	Do the specifications include insulation levels in line with the London Heat Network Manual	It is proposed to provide insulation levels in line with the London Heat Network Manual.

Appendix C – CHP System LCC Assessment Summary

LCC Assessment Key Inputs

	Option 1 - Gas Boiler and CHP System	Option 2 - Gas Boiler System	Units
Heating System Technical Inputs			
Estimated Hot Water demand	164,904	164,904	kWh/year
Estimated Space Heating Demand	88,423	88,423	kWh/year
Estimated Landlord Electricity Demand	59,000	59,000	kWh/year
Estimated CHP Electricity Export	22,311	N/A	kWh/year
Heating System Efficiency	90%	90%	%
Gas Boiler Efficiency	94%	94%	%
Contribution from CHP	75%	N/A	%
Estimated Export from CHP	38%	N/A	%
Boiler and CHP Lifecycle	15	15	years
Life Cycle Assessment Period	30	30	years
Heating System Cost Inputs			
Gas Tariff	3.0	3.0	p/kWh
Electricity Export Tariff	4.317	N/A	p/kWh
Electricity Import Tariff	12.0	12.0	p/kWh
Gas Boiler System Capital Costs	27,000	27,000	£
CHP Engine System Costs	54,500	N/A	£
Energy Centre (EC) Cost	240,000	185,500	£
Maintenance of Gas Boiler and CHP Systems	4,167	1,800	£
Heating System Management and Maintenance (excluding HIUs)	25,667	23,300	£
Standing Charges for EC Management and Maintenance Service - Per Property Per Month	29.7	27.0	£

LCC Assessment Key Outputs

Heating System Life Cycle Costs (LCCs)			
Capital	329,469	254,652	£
Capital - Per Property Per Year	145	112	£
Fuel Costs and Income from Electricity Generation	121,219	364,432	£
Average Fuel and Income from Electricity Generation - Per Property Per Year	53	160	£
Standing Charge for EC operation and maintenance	1,099,109	997,749	£
Average Standing Charge for EC operation and maintenance - Per Property Per Year	482	438	£
Life Cycle Heat Costs	1,549,797	1,616,833	£
Average Heat Costs Per Property Per Year (Over 30 Year Period)	680	709	£

Appendix D – Energimizer EM 16NG Specification

ENERGIMIZER

NATURAL GAS FIRED CHP EM 16NG

NATURAL GAS FIRED EM 16NG

SPECIFICATION DATASHEET

Energy efficiency:	A++
Operational mode:	Mains parallel operation
Fuel:	Natural gas or LPG
Electrical output (P_{el}):	16 kW [2] min 8 kW
Thermal output (P_{th}):	35.6 kW [2] min 24.7 kW
Fuel consumption:	51.8 kW[1] (nett) 57.5 kW (gross)
CHP coefficient:	0.43
Efficiency:	EN 50465
Total efficiency:	104.5% (nett) 94.1% (gross)
Electric efficiency:	31% (nett) 28.1% (gross)
Thermal efficiency:	73.5% (nett) 66.0% (gross)
Gas-connection pressure:	20-50 mbar
Gas-flow pressure:	≤16 mbar
Flow rate with natural gas:	5.0 Nm^3/h
Flow temperature:	max. 90 ° C
Return temperature:	max. 70 ° C
Max. system pressure:	6 bar (heating side)
Combustion & cooling air requirement:	min. 58 m^3/h (65 kg/h)
Ambient temperature:	5°C to max. 35°C
Exhaust gas emissions:	at 5 Vol% remaining oxygen
CO (carbon monoxide):	< 63.5 mg/m^3 (50% TA-air)
NOx (nitrogen oxide):	< 12.1 mg/m^3 (50% TA-air)
Exhaust gas temperature:	~ 50 ° C2)
Exhaust gas volume flow:	~ 63 m^3/h
Exhaust gas mass flow dry:	~ 70 kg/h
Exhaust gas back pressure after CS[4]:	max. 5 mbar
Sound pressure level CHP:	~ 46 dB(A) (1 m distance)

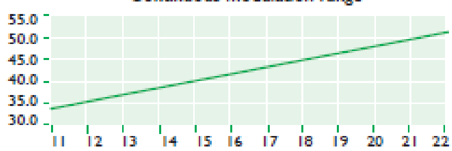
CHP: Dimensions, weights and connections

L x W x H CHP:	1.27 x 0.82 x 0.98 m
Weight CHP: incl. oil and water	740 kg
ϕ x H CS[4]:	0.30 x 1.52 m (w/o flanges)
Weight CS[4]:	30 kg
Colour CHP:	Pantone 5517C
Heating connections (VL):	R 3/4" Flow (warm)
	R 3/4" Return (cold)
Exhaust gas connection CS[4]:	DN100
Gas connection:	R 3/4" NG

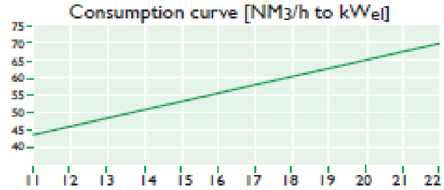
Motor

Motor	K18
Type:	Straight line (Otto)
Operation:	4-stroke
Cylinder:	3
Displacement:	1.8 litres
Nominal engine speed:	1500 1/min

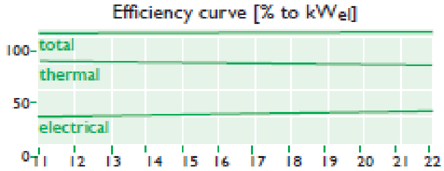
Output curve [kW_{th} to kW_{el}]
Continuous modulation range



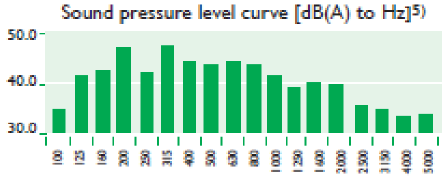
Consumption curve [$NM3/h$ to kW_{el}]



Efficiency curve [% to kW_{el}]



Sound pressure level curve [dB(A) to Hz][5]



[1] According to DIN ISO 3046-1, tolerance 5%
[2] Return temperature 60° C
[3] According to EU RL 2004/8/EG with 100% internal use
[4] Combination silencer
[5] Test stand measuring without liability
[6] According to EnEVAndV 2009

Environmentally friendly, independent, reliable energy

Appendix E – Sample SAP and BRUKL Reports

DER Worksheet
Design - Draft

NHER

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

Assessor name	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	23/11/2016
Address	A-L00-28 A Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		73.69	(1a)	x	2.50	(2a)	=	184.23	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	73.69	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			184.23	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(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) =	0.17	(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	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.20	(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	N/A	(23c)

c) whole house extract ventilation or positive input ventilation from outside

0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)

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

0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			23.06	x	1.24	=	28.50			(27)
Ground floor			73.69	x	0.20	=	14.74			(28a)
External wall			20.99	x	0.18	=	3.78			(29a)
Party wall			56.27	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			117.74							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	47.01	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		8.56	(36)
Total fabric heat loss	(33) + (36) =	55.58	(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)	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40	(38)
Heat transfer coefficient, W/K (37)m + (38)m	85.97	85.97	85.97	85.97	85.97	85.97	85.97	85.97	85.97	85.97	85.97	85.97	
Average = ∑(39)1...12/12 =												85.97	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	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	2.33	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	89.59	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	98.55	94.97	91.38	87.80	84.22	80.63	80.63	84.22	87.80	91.38	94.97	98.55	
∑(44)1...12 =												1075.10	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	146.15	127.82	131.90	114.99	110.34	95.21	88.23	101.25	102.45	119.40	130.34	141.54	
∑(45)1...12 =												1409.62	(45)
Distribution loss 0.15 x (45)m	21.92	19.17	19.79	17.25	16.55	14.28	13.23	15.19	15.37	17.91	19.55	21.23	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

201.42	177.75	187.18	168.49	165.62	148.71	143.51	156.52	155.95	174.68	183.83	196.81	(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

201.42	177.75	187.18	168.49	165.62	148.71	143.51	156.52	155.95	174.68	183.83	196.81

∑(64)1...12 = 2060.46 (64)

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

92.82	82.44	88.08	81.03	80.91	74.45	73.56	77.89	76.86	83.92	86.13	91.28	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	116.61	116.61	116.61	116.61	116.61	116.61	116.61	116.61	116.61	116.61	116.61	116.61	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.34	16.29	13.25	10.03	7.50	6.33	6.84	8.89	11.93	15.15	17.68	18.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	205.75	207.89	202.51	191.05	176.59	163.00	153.93	151.79	157.17	168.63	183.08	196.67	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	(71)
Water heating gains (Table 5)	124.75	122.68	118.38	112.54	108.75	103.41	98.87	104.69	106.75	112.80	119.63	122.69	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	406.83	404.85	392.13	371.61	350.83	330.73	317.62	323.35	333.84	354.56	378.38	396.20	(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	23.06	x	36.79	x 0.9 x	0.40	x	0.80	=	188.16	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	188.16	320.50	438.52	543.35	608.60	604.19	582.51	533.83	474.83	354.22	225.37	161.02	(83)
Total gains - internal and solar (73)m + (83)m	594.99	725.34	830.65	914.96	959.42	934.92	900.13	857.18	808.67	708.78	603.75	557.22	(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	0.98	0.95	0.88	0.75	0.57	0.42	0.46	0.68	0.91	0.98	0.99	(86)

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

19.93	20.14	20.42	20.70	20.90	20.98	21.00	20.99	20.95	20.69	20.24	19.87	(87)

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

19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.97	0.94	0.85	0.69	0.48	0.32	0.35	0.60	0.88	0.98	0.99	(89)

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

18.54	18.85	19.24	19.62	19.86	19.93	19.95	19.94	19.91	19.61	18.99	18.46	(90)

Living area fraction — Living area ÷ (4) = 0.39 (91)

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

19.07	19.35	19.70	20.04	20.26	20.34	20.35	20.35	20.31	20.03	19.47	19.00	(92)

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

19.07	19.35	19.70	20.04	20.26	20.34	20.35	20.35	20.31	20.03	19.47	19.00	(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	0.93	0.85	0.71	0.52	0.36	0.39	0.63	0.88	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	587.60	703.64	774.67	778.47	677.95	483.23	321.16	337.44	508.79	625.80	587.52	552.01	(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]	1270.16	1242.46	1134.56	957.62	735.62	493.16	322.42	339.50	533.98	810.37	1063.42	1272.48	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	507.82	362.08	267.76	128.99	42.91	0.00	0.00	0.00	0.00	137.32	342.65	536.03	

∑(98)1...5, 10...12 = 2325.56 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 31.56 (99)

9b. Energy requirements - community heating scheme

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

Space heating

Annual space heating requirement	2325.56			(98)
Space heat from boilers		(98) x (304a) x (305) x (306) =	2441.84	(307a)

Water heating

Annual water heating requirement	2060.46			(64)
Water heat from boilers		(64) x (303a) x (305a) x (306) =	2163.49	(310a)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] =	46.05	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)				
mechanical ventilation fans - balanced, extract or positive input from outside	49.67			(330a)

Total electricity for the above, kWh/year					49.67	(331)
Electricity for lighting (Appendix L)					323.94	(332)
Total delivered energy for all uses				(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4978.94	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	2441.84	x	4.24	x 0.01 =	103.53	(340a)
Water heating from boilers	2163.49	x	4.24	x 0.01 =	91.73	(342a)
Pumps and fans	49.67	x	13.19	x 0.01 =	6.55	(349)
Electricity for lighting	323.94	x	13.19	x 0.01 =	42.73	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	364.55	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.29	(357)
SAP value	82.00	
SAP rating (section 13)	82	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	94.00					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	4899.28	x	0.216	=	1058.25	(367)
Electrical energy for community heat distribution	46.05	x	0.52	=	23.90	(372)
Total CO2 associated with community systems					1082.15	(373)
Total CO2 associated with space and water heating					1082.15	(376)
Pumps and fans	49.67	x	0.52	=	25.78	(378)
Electricity for lighting	323.94	x	0.52	=	168.13	(379)
Total CO_2, kg/year				(376)..(382) =	1276.05	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	17.32	(384)
EI value					85.59	
EI rating (section 14)					86	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	94.00					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	4899.28	x	1.22	=	5977.12	(367)
Electrical energy for community heat distribution	46.05	x	3.07	=	141.38	(372)
Total primary energy associated with community systems					6118.51	(373)
Total primary energy associated with space and water heating					6118.51	(376)
Pumps and fans	49.67	x	3.07	=	152.49	(378)
Electricity for lighting	323.94	x	3.07	=	994.50	(379)
Primary energy kWh/year					7265.50	(383)

Dwelling primary energy rate kWh/m2/year	98.60	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	23/11/2016
Address	A-L03-19 A Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		87.58	(1a)	x	2.50	(2a)	=	218.95	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	87.58	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			218.95	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(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) =	0.17	(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	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.20	(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	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			29.45	x	1.24	=	36.39			(27)
External wall			21.97	x	0.18	=	3.95			(29a)
Party wall			57.05	x	0.00	=	0.00			(32)
Roof			87.58	x	0.16	=	14.01			(30)
Total area of external elements ∑A, m²			139.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	54.36	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		7.51	(36)
Total fabric heat loss	(33) + (36) =	61.87	(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)	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	(38)
Heat transfer coefficient, W/K (37)m + (38)m	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	
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)

Average = ∑(39)1...12/12 = 98.00 (39)

Average = ∑(40)1...12/12 = 1.12 (40)

4. Water heating energy requirement

Assumed occupancy, N	2.59	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	95.74	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	105.31	101.48	97.65	93.82	89.99	86.17	86.17	89.99	93.82	97.65	101.48	105.31	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	156.18	136.59	140.95	122.89	117.91	101.75	94.28	108.19	109.49	127.59	139.28	151.25	
Distribution loss 0.15 x (45)m	23.43	20.49	21.14	18.43	17.69	15.26	14.14	16.23	16.42	19.14	20.89	22.69	(46)

∑(44)1...12 = 1148.87 (44)

∑(45)1...12 = 1506.35 (45)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

211.45	186.52	196.23	176.38	173.19	155.24	149.56	163.47	162.98	182.87	192.77	206.53	(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

211.45	186.52	196.23	176.38	173.19	155.24	149.56	163.47	162.98	182.87	192.77	206.53

∑(64)1...12 = 2157.19 (64)

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

96.15	85.36	91.09	83.65	83.43	76.63	75.57	80.20	79.20	86.65	89.11	94.51	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	129.56	129.56	129.56	129.56	129.56	129.56	129.56	129.56	129.56	129.56	129.56	129.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.91	18.57	15.10	11.43	8.55	7.22	7.80	10.14	13.60	17.27	20.16	21.49	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	234.55	236.99	230.85	217.80	201.31	185.82	175.47	173.04	179.17	192.23	208.71	224.21	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.96	35.96	35.96	35.96	35.96	35.96	35.96	35.96	35.96	35.96	35.96	35.96	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	(71)
Water heating gains (Table 5)	129.23	127.02	122.43	116.19	112.13	106.43	101.57	107.79	110.00	116.46	123.76	127.03	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	446.57	444.45	430.26	407.29	383.86	361.33	346.71	352.83	364.64	387.83	414.50	434.60	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	29.45	x	36.79	x 0.9 x	0.40	x	0.80	=	240.29	(79)

Solar gains in watts ∑(74)m...(82)m

240.29	409.31	560.04	693.91	777.24	771.62	743.92	681.76	606.40	452.37	287.82	205.64	(83)

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

686.86	853.76	990.29	1101.20	1161.10	1132.95	1090.64	1034.59	971.04	840.21	702.32	640.24	(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)	0.99	0.98	0.95	0.87	0.72	0.54	0.39	0.43	0.66	0.91	0.98	1.00	(86)

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

19.97	20.20	20.48	20.75	20.92	20.99	21.00	21.00	20.96	20.72	20.28	19.91	(87)

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

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

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.97	0.93	0.83	0.66	0.46	0.30	0.34	0.58	0.87	0.98	0.99	(89)

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

18.63	18.96	19.35	19.72	19.92	19.98	19.98	19.98	19.96	19.69	19.08	18.55	(90)

Living area fraction — Living area ÷ (4) = 0.34 (91)

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

19.09	19.39	19.74	20.07	20.26	20.32	20.33	20.33	20.30	20.04	19.49	19.01	(92)

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

19.09	19.39	19.74	20.07	20.26	20.32	20.33	20.33	20.30	20.04	19.49	19.01	(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	0.93	0.83	0.68	0.49	0.33	0.37	0.60	0.87	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	678.99	827.66	918.02	919.02	788.21	553.04	364.84	383.72	586.13	734.93	683.88	634.87	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1449.54	1419.78	1297.51	1094.66	838.95	560.78	365.73	385.24	607.84	925.51	1213.90	1451.82	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	573.29	397.91	282.34	126.46	37.75	0.00	0.00	0.00	0.00	141.79	381.62	607.81	

∑(98)1...5, 10...12 = 2548.97 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 29.10 (99)

9b. Energy requirements - community heating scheme

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

Space heating

Annual space heating requirement	2548.97		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	2676.42	(307a)

Water heating

Annual water heating requirement	2157.19		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	2265.05	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	49.41	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	55.56		(330a)

Total electricity for the above, kWh/year					55.56	(331)
Electricity for lighting (Appendix L)					369.29	(332)
Total delivered energy for all uses				(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	5366.32	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	2676.42	x	4.24	x 0.01 =	113.48	(340a)
Water heating from boilers	2265.05	x	4.24	x 0.01 =	96.04	(342a)
Pumps and fans	55.56	x	13.19	x 0.01 =	7.33	(349)
Electricity for lighting	369.29	x	13.19	x 0.01 =	48.71	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	385.56	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.22	(357)
SAP value	82.96	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	94.00					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	5256.88	x	0.216	=	1135.49	(367)
Electrical energy for community heat distribution	49.41	x	0.52	=	25.65	(372)
Total CO2 associated with community systems					1161.13	(373)
Total CO2 associated with space and water heating					1161.13	(376)
Pumps and fans	55.56	x	0.52	=	28.84	(378)
Electricity for lighting	369.29	x	0.52	=	191.66	(379)
Total CO_2, kg/year				(376)..(382) =	1381.63	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	15.78	(384)
EI value					86.04	
EI rating (section 14)					86	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	94.00					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	5256.88	x	1.22	=	6413.39	(367)
Electrical energy for community heat distribution	49.41	x	3.07	=	151.70	(372)
Total primary energy associated with community systems					6565.10	(373)
Total primary energy associated with space and water heating					6565.10	(376)
Pumps and fans	55.56	x	3.07	=	170.57	(378)
Electricity for lighting	369.29	x	3.07	=	1133.72	(379)
Primary energy kWh/year					7869.39	(383)

Dwelling primary energy rate kWh/m2/year	89.85	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	23/11/2016
Address	A-L03-48 A Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m^2)			Average storey height (m)			Volume (m^3)	
Lowest occupied		87.21	(1a)	x	2.50	(2a)	=	218.03	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	87.21	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			218.03	(5)

2. Ventilation rate

			m^3 per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(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) =	0.17	(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	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.20	(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	N/A	(23c)

c) whole house extract ventilation or positive input ventilation from outside

0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)

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

0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			23.17	x	1.24	=	28.63			(27)
External wall			23.10	x	0.18	=	4.16			(29a)
Party wall			63.52	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			46.27							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.79	(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		6.50	(36)
Total fabric heat loss	(33) + (36) =	39.29	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	(38)
Heat transfer coefficient, W/K (37)m + (38)m	75.26	75.26	75.26	75.26	75.26	75.26	75.26	75.26	75.26	75.26	75.26	75.26	
Average = ∑(39)1...12/12 =												75.26	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	
Average = ∑(40)1...12/12 =												0.86	(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	2.59	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	95.61	(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)	105.17	101.34	97.52	93.70	89.87	86.05	86.05	89.87	93.70	97.52	101.34	105.17	
∑(44)1...12 =												1147.29	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	155.96	136.40	140.76	122.72	117.75	101.61	94.15	108.04	109.33	127.42	139.09	151.04	
∑(45)1...12 =												1504.28	(45)
Distribution loss 0.15 x (45)m	23.39	20.46	21.11	18.41	17.66	15.24	14.12	16.21	16.40	19.11	20.86	22.66	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

211.24	186.33	196.03	176.21	173.03	155.10	149.43	163.32	162.83	182.70	192.58	206.32	(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

211.24	186.33	196.03	176.21	173.03	155.10	149.43	163.32	162.83	182.70	192.58	206.32

∑(64)1...12 = 2155.12 (64)

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

96.08	85.30	91.02	83.60	83.37	76.58	75.53	80.15	79.15	86.59	89.04	94.44	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	129.28	129.28	129.28	129.28	129.28	129.28	129.28	129.28	129.28	129.28	129.28	129.28	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.85	18.52	15.06	11.40	8.52	7.19	7.77	10.11	13.56	17.22	20.10	21.43	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	233.85	236.28	230.16	217.14	200.71	185.27	174.95	172.52	178.64	191.65	208.09	223.53	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	(71)
Water heating gains (Table 5)	129.14	126.93	122.34	116.11	112.06	106.36	101.52	107.72	109.93	116.38	123.67	126.94	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	445.62	443.51	429.35	406.44	383.08	360.60	346.02	352.13	363.91	387.04	413.64	433.68	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	2.09	x	10.63	x 0.9 x	0.40	x	0.80	=	4.93	(74)
NorthEast	0.77	x	21.08	x	11.28	x 0.9 x	0.40	x	0.80	=	52.74	(75)

Solar gains in watts ∑(74)m...(82)m

57.67	116.78	209.44	343.38	461.64	492.31	460.48	366.97	254.94	142.42	72.45	47.18	(83)

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

503.29	560.29	638.79	749.82	844.72	852.92	806.50	719.10	618.86	529.46	486.09	480.86	(84)

7. Mean internal temperature (heating season)

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

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

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

1.00	1.00	0.99	0.93	0.77	0.56	0.41	0.48	0.78	0.97	1.00	1.00	(86)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.14	20.26	20.48	20.76	20.95	20.99	21.00	21.00	20.96	20.70	20.36	20.11	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.99	0.98	0.91	0.72	0.49	0.34	0.40	0.71	0.96	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	19.04	19.21	19.53	19.92	20.15	20.20	20.20	20.20	20.17	19.84	19.36	18.99	(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	19.38	19.53	19.82	20.18	20.40	20.44	20.45	20.45	20.41	20.11	19.67	19.34	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	19.38	19.53	19.82	20.18	20.40	20.44	20.45	20.45	20.41	20.11	19.67	19.34	(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	0.91	0.73	0.51	0.36	0.42	0.73	0.96	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	501.71	556.53	625.13	683.57	620.17	436.57	289.26	303.79	451.09	506.73	482.65	479.72	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1135.29	1101.48	1002.57	849.11	654.45	439.74	289.53	304.53	475.00	715.47	946.24	1139.47	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	471.38	366.20	280.81	119.19	25.51	0.00	0.00	0.00	0.00	155.31	333.78	490.85	

	∑(98)1...5, 10...12 =	2243.04	(98)
Space heating requirement kWh/m²/year	(98) ÷ (4)	25.72	(99)

9b. Energy requirements - community heating scheme

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

Space heating

Annual space heating requirement	2243.04			(98)
Space heat from boilers		(98) x (304a) x (305) x (306) =	2355.19	(307a)

Water heating

Annual water heating requirement	2155.12			(64)
Water heat from boilers		(64) x (303a) x (305a) x (306) =	2262.87	(310a)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] =	46.18	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)				
mechanical ventilation fans - balanced, extract or positive input from outside	55.33			(330a)

Total electricity for the above, kWh/year	55.33	(331)
Electricity for lighting (Appendix L)	368.18	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	5041.57	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	2355.19	x	4.24	x 0.01 =	99.86	(340a)
Water heating from boilers	2262.87	x	4.24	x 0.01 =	95.95	(342a)
Pumps and fans	55.33	x	13.19	x 0.01 =	7.30	(349)
Electricity for lighting	368.18	x	13.19	x 0.01 =	48.56	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	371.67	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.18	(357)
SAP value	83.53	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	94.00					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	4912.83	x	0.216	=	1061.17	(367)
Electrical energy for community heat distribution	46.18	x	0.52	=	23.97	(372)
Total CO2 associated with community systems					1085.14	(373)
Total CO2 associated with space and water heating					1085.14	(376)
Pumps and fans	55.33	x	0.52	=	28.71	(378)
Electricity for lighting	368.18	x	0.52	=	191.09	(379)
Total CO_2, kg/year				(376)..(382) =	1304.94	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	14.96	(384)
EI value					86.77	
EI rating (section 14)					87	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	94.00					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	4912.83	x	1.22	=	5993.65	(367)
Electrical energy for community heat distribution	46.18	x	3.07	=	141.77	(372)
Total primary energy associated with community systems					6135.43	(373)
Total primary energy associated with space and water heating					6135.43	(376)
Pumps and fans	55.33	x	3.07	=	169.85	(378)
Electricity for lighting	368.18	x	3.07	=	1130.31	(379)
Primary energy kWh/year					7435.59	(383)

Dwelling primary energy rate kWh/m2/year	85.26	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	23/11/2016
Address	A-L04-60 A Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		49.39	(1a)	x	2.50	(2a)	=	123.48	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	49.39	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			123.48	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.16	(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	0.20	0.19	0.19	0.17	0.17	0.15	0.15	0.14	0.16	0.17	0.17	0.18	(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	N/A	(23c)

c) whole house extract ventilation or positive input ventilation from outside

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			12.36	x	1.24	=	15.27			(27)
External wall			6.99	x	0.18	=	1.26			(29a)
Party wall			53.62	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			19.35							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	16.53	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.11	(36)
Total fabric heat loss	(33) + (36) =	20.64	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.37	(38)
Heat transfer coefficient, W/K (37)m + (38)m	41.01	41.01	41.01	41.01	41.01	41.01	41.01	41.01	41.01	41.01	41.01	41.01	
Average = ∑(39)1...12/12 =												41.01	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	
Average = ∑(40)1...12/12 =												0.83	(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	1.67	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	73.91	(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)	81.31	78.35	75.39	72.44	69.48	66.52	66.52	69.48	72.44	75.39	78.35	81.31	
∑(44)1...12 =												886.96	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	120.57	105.45	108.82	94.87	91.03	78.55	72.79	83.53	84.53	98.51	107.53	116.77	
∑(45)1...12 =												1162.95	(45)
Distribution loss 0.15 x (45)m	18.09	15.82	16.32	14.23	13.65	11.78	10.92	12.53	12.68	14.78	16.13	17.52	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

175.85	155.38	164.10	148.36	146.31	132.05	128.07	138.81	138.02	153.78	161.02	172.05	(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

175.85	155.38	164.10	148.36	146.31	132.05	128.07	138.81	138.02	153.78	161.02	172.05

∑(64)1...12 = 1813.79 (64)

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

84.31	75.01	80.40	74.34	74.49	68.91	68.42	71.99	70.90	76.98	78.55	83.05	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	83.61	83.61	83.61	83.61	83.61	83.61	83.61	83.61	83.61	83.61	83.61	83.61	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	12.98	11.53	9.38	7.10	5.31	4.48	4.84	6.29	8.45	10.73	12.52	13.35	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	145.65	147.16	143.35	135.24	125.01	115.39	108.96	107.45	111.26	119.37	129.60	139.22	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.36	31.36	31.36	31.36	31.36	31.36	31.36	31.36	31.36	31.36	31.36	31.36	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	(71)
Water heating gains (Table 5)	113.32	111.62	108.07	103.25	100.12	95.71	91.97	96.77	98.47	103.46	109.09	111.62	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	320.04	318.39	308.88	293.68	278.52	263.67	253.86	258.59	266.26	281.64	299.30	312.27	(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	12.36	x	36.79	x 0.9 x	0.40	x	0.80	=	100.85	(79)

Solar gains in watts ∑(74)m...(82)m

100.85	171.79	235.04	291.23	326.20	323.84	312.22	286.13	254.50	189.86	120.80	86.31	(83)

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

420.89	490.18	543.93	584.91	604.72	587.51	566.08	544.72	520.77	471.50	420.09	398.58	(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)	0.98	0.96	0.90	0.79	0.62	0.45	0.32	0.35	0.54	0.82	0.96	0.99	(86)

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

20.45	20.62	20.79	20.93	20.99	21.00	21.00	21.00	21.00	20.92	20.66	20.40	(87)

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

20.23	20.23	20.23	20.23	20.23	20.23	20.23	20.23	20.23	20.23	20.23	20.23	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.95	0.88	0.75	0.57	0.39	0.26	0.29	0.48	0.78	0.95	0.98	(89)

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

19.51	19.74	19.98	20.15	20.21	20.23	20.23	20.23	20.22	20.15	19.81	19.44	(90)

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

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

20.00	20.19	20.40	20.55	20.61	20.62	20.63	20.63	20.62	20.55	20.25	19.94	(92)

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

20.00	20.19	20.40	20.55	20.61	20.62	20.63	20.63	20.62	20.55	20.25	19.94	(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	0.89	0.77	0.60	0.42	0.29	0.32	0.51	0.80	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	411.61	465.14	482.70	448.34	360.14	246.61	165.07	173.24	265.84	376.06	398.96	392.01	(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]													
	643.86	627.26	570.06	477.89	365.54	247.09	165.11	173.31	267.48	407.91	539.43	645.52	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	172.79	108.95	64.99	21.27	4.02	0.00	0.00	0.00	0.00	23.70	101.14	188.62	

	∑(98)1...5, 10...12 =	685.46	(98)
Space heating requirement kWh/m²/year	(98) ÷ (4)	13.88	(99)

9b. Energy requirements - community heating scheme

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

Space heating

Annual space heating requirement	685.46			(98)
Space heat from boilers		(98) x (304a) x (305) x (306) =	719.74	(307a)

Water heating

Annual water heating requirement	1813.79			(64)
Water heat from boilers		(64) x (303a) x (305a) x (306) =	1904.48	(310a)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] =	26.24	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)				
mechanical ventilation fans - balanced, extract or positive input from outside	33.29			(330a)
Total electricity for the above, kWh/year			33.29	(331)

Electricity for lighting (Appendix L)				229.32	(332)
Total delivered energy for all uses			(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2886.82	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	719.74	x	4.24	x 0.01 =	30.52	(340a)
Water heating from boilers	1904.48	x	4.24	x 0.01 =	80.75	(342a)
Pumps and fans	33.29	x	13.19	x 0.01 =	4.39	(349)
Electricity for lighting	229.32	x	13.19	x 0.01 =	30.25	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	265.90	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.18	(357)
SAP value	83.49	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	94.00					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2791.72	x	0.216	=	603.01	(367)
Electrical energy for community heat distribution	26.24	x	0.52	=	13.62	(372)
Total CO2 associated with community systems					616.63	(373)
Total CO2 associated with space and water heating					616.63	(376)
Pumps and fans	33.29	x	0.52	=	17.28	(378)
Electricity for lighting	229.32	x	0.52	=	119.01	(379)
Total CO_2, kg/year				(376)..(382) =	752.92	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	15.24	(384)
EI value					89.31	
EI rating (section 14)					89	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	94.00					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2791.72	x	1.22	=	3405.90	(367)
Electrical energy for community heat distribution	26.24	x	3.07	=	80.56	(372)
Total primary energy associated with community systems					3486.46	(373)
Total primary energy associated with space and water heating					3486.46	(376)
Pumps and fans	33.29	x	3.07	=	102.20	(378)
Electricity for lighting	229.32	x	3.07	=	704.00	(379)
Primary energy kWh/year					4292.66	(383)
Dwelling primary energy rate kWh/m2/year					86.91	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	23/11/2016
Address	A-L06-73 A Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		72.32	(1a)	x	2.50	(2a)	=	180.80	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	72.32	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			180.80	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(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) =	0.17	(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	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.20	(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	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			21.34	x	1.24	=	26.37			(27)
External wall			11.81	x	0.18	=	2.13			(29a)
Party wall			51.97	x	0.00	=	0.00			(32)
Roof			72.32	x	0.16	=	11.57			(30)
Total area of external elements ∑A, m²			105.47							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	40.07	(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		4.81	(36)
Total fabric heat loss	(33) + (36) =	44.88	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	29.83	29.83	29.83	29.83	29.83	29.83	29.83	29.83	29.83	29.83	29.83	29.83	(38)
Heat transfer coefficient, W/K (37)m + (38)m	74.71	74.71	74.71	74.71	74.71	74.71	74.71	74.71	74.71	74.71	74.71	74.71	
Average = ∑(39)1...12/12 =												74.71	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	
Average = ∑(40)1...12/12 =												1.03	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.30	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.85	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	97.74	94.18	90.63	87.07	83.52	79.97	79.97	83.52	87.07	90.63	94.18	97.74	
∑(44)1...12 =												1066.22	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	144.94	126.77	130.81	114.04	109.43	94.43	87.50	100.41	101.61	118.41	129.26	140.37	
∑(45)1...12 =												1397.98	(45)
Distribution loss 0.15 x (45)m	21.74	19.01	19.62	17.11	16.41	14.16	13.13	15.06	15.24	17.76	19.39	21.06	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

200.22	176.69	186.09	167.54	164.70	147.92	142.78	155.69	155.10	173.69	182.75	195.64	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

200.22	176.69	186.09	167.54	164.70	147.92	142.78	155.69	155.10	173.69	182.75	195.64	

∑(64)1...12 = 2048.82 (64)

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

92.41	82.09	87.72	80.71	80.61	74.19	73.32	77.61	76.58	83.59	85.77	90.89	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	115.06	115.06	115.06	115.06	115.06	115.06	115.06	115.06	115.06	115.06	115.06	115.06	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.07	16.05	13.05	9.88	7.39	6.23	6.74	8.76	11.75	14.92	17.42	18.57	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	202.65	204.75	199.45	188.17	173.93	160.55	151.61	149.50	154.80	166.08	180.32	193.71	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.51	34.51	34.51	34.51	34.51	34.51	34.51	34.51	34.51	34.51	34.51	34.51	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	(71)
Water heating gains (Table 5)	124.21	122.16	117.90	112.10	108.34	103.04	98.54	104.31	106.36	112.36	119.13	122.17	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	402.45	400.48	387.92	367.67	347.18	327.34	314.40	320.09	330.43	350.88	374.39	391.96	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	21.34	x	36.79	x 0.9 x	0.40	x	0.80	=	174.12	(79)

Solar gains in watts ∑(74)m...(82)m

174.12	296.59	405.81	502.82	563.20	559.13	539.06	494.01	439.41	327.80	208.56	149.01	(83)

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

576.57	697.07	793.73	870.49	910.38	886.47	853.46	814.10	769.84	678.68	582.95	540.97	(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	0.86	0.71	0.53	0.38	0.42	0.64	0.90	0.98	0.99	(86)

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

20.10	20.31	20.56	20.80	20.94	20.99	21.00	21.00	20.97	20.78	20.38	20.05	(87)

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

20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.97	0.93	0.83	0.66	0.46	0.30	0.33	0.57	0.86	0.97	0.99	(89)

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

18.88	19.17	19.52	19.83	20.00	20.05	20.06	20.05	20.04	19.82	19.28	18.80	(90)

Living area fraction — Living area ÷ (4) = 0.28 (91)

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

19.22	19.49	19.81	20.10	20.27	20.31	20.32	20.32	20.30	20.09	19.59	19.15	(92)

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

19.22	19.49	19.81	20.10	20.27	20.31	20.32	20.32	20.30	20.09	19.59	19.15	(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	0.92	0.83	0.67	0.48	0.33	0.36	0.59	0.86	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	568.96	674.14	733.11	721.36	609.30	422.79	277.51	292.12	451.35	586.05	565.51	535.68	(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]	1114.76	1090.08	994.43	837.06	639.95	426.85	277.91	292.81	463.18	708.87	932.96	1116.77	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	406.07	279.51	194.42	83.30	22.81	0.00	0.00	0.00	0.00	91.38	264.56	432.33	

∑(98)1...5, 10...12 = 1774.40 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 24.54 (99)

9b. Energy requirements - community heating scheme

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

Space heating

Annual space heating requirement	1774.40			(98)
Space heat from boilers		(98) x (304a) x (305) x (306) =	1863.12	(307a)

Water heating

Annual water heating requirement	2048.82			(64)
Water heat from boilers		(64) x (303a) x (305a) x (306) =	2151.26	(310a)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] =	40.14	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)				
mechanical ventilation fans - balanced, extract or positive input from outside	45.88			(330a)

Total electricity for the above, kWh/year		45.88	(331)
Electricity for lighting (Appendix L)		319.06	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4379.32	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1863.12	x	4.24	x 0.01 =	79.00	(340a)
Water heating from boilers	2151.26	x	4.24	x 0.01 =	91.21	(342a)
Pumps and fans	45.88	x	13.19	x 0.01 =	6.05	(349)
Electricity for lighting	319.06	x	13.19	x 0.01 =	42.08	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		338.35	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.21	(357)
SAP value	83.10	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	94.00					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	4270.62	x	0.216	=	922.45	(367)
Electrical energy for community heat distribution	40.14	x	0.52	=	20.83	(372)
Total CO2 associated with community systems					943.29	(373)
Total CO2 associated with space and water heating					943.29	(376)
Pumps and fans	45.88	x	0.52	=	23.81	(378)
Electricity for lighting	319.06	x	0.52	=	165.59	(379)
Total CO_2, kg/year				(376)..(382) =	1132.69	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	15.66	(384)
EI value					87.06	
EI rating (section 14)					87	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	94.00					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	4270.62	x	1.22	=	5210.16	(367)
Electrical energy for community heat distribution	40.14	x	3.07	=	123.24	(372)
Total primary energy associated with community systems					5333.40	(373)
Total primary energy associated with space and water heating					5333.40	(376)
Pumps and fans	45.88	x	3.07	=	140.85	(378)
Electricity for lighting	319.06	x	3.07	=	979.51	(379)
Primary energy kWh/year					6453.76	(383)

Dwelling primary energy rate kWh/m2/year	89.24	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	23/11/2016
Address	A-L04-65 A Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		77.30	(1a)	x	2.50	(2a)	=	193.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	77.30	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			193.25	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.16	(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	0.20	0.19	0.19	0.17	0.17	0.15	0.15	0.14	0.16	0.17	0.17	0.18	(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	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			14.12	x	1.24	=	17.45			(27)
External wall			13.75	x	0.18	=	2.48			(29a)
Party wall			60.09	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			27.87							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	19.92	(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		4.23	(36)
Total fabric heat loss	(33) + (36) =	24.15	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	(38)
Heat transfer coefficient, W/K (37)m + (38)m	56.04	56.04	56.04	56.04	56.04	56.04	56.04	56.04	56.04	56.04	56.04	56.04	
Average = ∑(39)1...12/12 =												56.04	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	
Average = ∑(40)1...12/12 =												0.72	(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	2.41	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	91.43	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	100.57	96.91	93.26	89.60	85.94	82.29	82.29	85.94	89.60	93.26	96.91	100.57	
∑(44)1...12 =												1097.15	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	149.14	130.44	134.61	117.35	112.60	97.17	90.04	103.32	104.56	121.85	133.01	144.44	
∑(45)1...12 =												1438.53	(45)
Distribution loss 0.15 x (45)m	22.37	19.57	20.19	17.60	16.89	14.58	13.51	15.50	15.68	18.28	19.95	21.67	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

204.42	180.37	189.88	170.85	167.88	150.66	145.32	158.60	158.05	177.13	186.50	199.72	(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

204.42	180.37	189.88	170.85	167.88	150.66	145.32	158.60	158.05	177.13	186.50	199.72

∑(64)1...12 = 2089.37 (64)

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

93.81	83.31	88.98	81.81	81.66	75.10	74.16	78.58	77.56	84.74	87.02	92.25	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	120.48	120.48	120.48	120.48	120.48	120.48	120.48	120.48	120.48	120.48	120.48	120.48	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.11	16.98	13.81	10.45	7.81	6.60	7.13	9.26	12.43	15.79	18.43	19.64	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	213.71	215.92	210.33	198.44	183.42	169.31	159.88	157.66	163.25	175.14	190.16	204.28	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.05	35.05	35.05	35.05	35.05	35.05	35.05	35.05	35.05	35.05	35.05	35.05	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	(71)
Water heating gains (Table 5)	126.09	123.98	119.59	113.63	109.76	104.31	99.68	105.61	107.72	113.89	120.86	123.99	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	418.05	416.02	402.88	381.67	360.14	339.36	325.83	331.68	342.55	363.97	388.59	407.05	(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	
NorthEast	0.77	x	14.12	x	11.28	x 0.9 x	0.40	x	0.80	=	35.33	(75)

Solar gains in watts ∑(74)m...(82)m

35.33	71.91	129.57	212.79	286.03	304.94	285.26	227.41	157.88	87.89	44.45	28.85	(83)

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

453.38	487.94	532.45	594.45	646.17	644.29	611.09	559.09	500.43	451.86	433.05	435.90	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	1.00	0.98	0.93	0.77	0.55	0.40	0.46	0.74	0.96	0.99	1.00	(86)

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

20.36	20.45	20.62	20.84	20.97	21.00	21.00	21.00	20.98	20.80	20.54	20.33	(87)

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

20.32	20.32	20.32	20.32	20.32	20.32	20.32	20.32	20.32	20.32	20.32	20.32	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.98	0.91	0.72	0.50	0.34	0.39	0.68	0.95	0.99	1.00	(89)

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

19.46	19.59	19.83	20.13	20.29	20.32	20.32	20.32	20.30	20.09	19.72	19.42	(90)

Living area fraction — Living area ÷ (4) = 0.34 (91)

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

19.76	19.88	20.10	20.37	20.52	20.55	20.55	20.55	20.53	20.33	19.99	19.72	(92)

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

19.76	19.88	20.10	20.37	20.52	20.55	20.55	20.55	20.53	20.33	19.99	19.72	(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	0.91	0.74	0.52	0.36	0.42	0.70	0.95	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	451.57	484.18	520.49	542.18	476.17	331.94	221.13	232.19	350.86	427.51	429.04	434.58	(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]	866.52	839.33	761.92	642.55	494.08	333.17	221.20	232.40	360.40	545.36	722.62	869.93	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	308.73	238.66	179.62	72.26	13.33	0.00	0.00	0.00	0.00	87.67	211.38	323.90	

	∑(98)1...5, 10...12 =	1435.55	(98)
Space heating requirement kWh/m²/year	(98) ÷ (4)	18.57	(99)

9b. Energy requirements - community heating scheme

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

Space heating

Annual space heating requirement	1435.55			(98)
Space heat from boilers		(98) x (304a) x (305) x (306) =	1507.33	(307a)

Water heating

Annual water heating requirement	2089.37			(64)
Water heat from boilers		(64) x (303a) x (305a) x (306) =	2193.84	(310a)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] =	37.01	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)				
mechanical ventilation fans - balanced, extract or positive input from outside	52.10			(330a)
Total electricity for the above, kWh/year			52.10	(331)

Electricity for lighting (Appendix L)				337.53	(332)
Total delivered energy for all uses			(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4090.81	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1507.33	x	4.24	x 0.01 =	63.91	(340a)
Water heating from boilers	2193.84	x	4.24	x 0.01 =	93.02	(342a)
Pumps and fans	52.10	x	13.19	x 0.01 =	6.87	(349)
Electricity for lighting	337.53	x	13.19	x 0.01 =	44.52	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	328.32	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.13	(357)
SAP value	84.27	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	94.00					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	3937.41	x	0.216	=	850.48	(367)
Electrical energy for community heat distribution	37.01	x	0.52	=	19.21	(372)
Total CO2 associated with community systems					869.69	(373)
Total CO2 associated with space and water heating					869.69	(376)
Pumps and fans	52.10	x	0.52	=	27.04	(378)
Electricity for lighting	337.53	x	0.52	=	175.18	(379)
Total CO_2, kg/year				(376)..(382) =	1071.91	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	13.87	(384)
EI value					88.26	
EI rating (section 14)					88	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	94.00					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	3937.41	x	1.22	=	4803.65	(367)
Electrical energy for community heat distribution	37.01	x	3.07	=	113.63	(372)
Total primary energy associated with community systems					4917.27	(373)
Total primary energy associated with space and water heating					4917.27	(376)
Pumps and fans	52.10	x	3.07	=	159.96	(378)
Electricity for lighting	337.53	x	3.07	=	1036.22	(379)
Primary energy kWh/year					6113.45	(383)
Dwelling primary energy rate kWh/m2/year					79.09	(384)

DER Worksheet
Design - Draft

NHER

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

Assessor name	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	23/11/2016
Address	B-L00-05 B Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		63.47	(1a)	x	2.50	(2a)	=	158.68	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	63.47	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	158.68	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.16	(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	0.20	0.19	0.19	0.17	0.17	0.15	0.15	0.14	0.16	0.17	0.17	0.18	(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	N/A	(23c)

c) whole house extract ventilation or positive input ventilation from outside

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			12.76	x	1.24	=	15.77			(27)
Door			2.32	x	1.80	=	4.18			(26)
Ground floor			63.47	x	0.20	=	12.69			(28a)
External wall			7.89	x	0.18	=	1.42			(29a)
Party wall			57.47	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			86.44							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	34.06	(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		5.06	(36)
Total fabric heat loss	(33) + (36) =	39.11	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	26.18	26.18	26.18	26.18	26.18	26.18	26.18	26.18	26.18	26.18	26.18	26.18	(38)
Heat transfer coefficient, W/K (37)m + (38)m	65.30	65.30	65.30	65.30	65.30	65.30	65.30	65.30	65.30	65.30	65.30	65.30	
Average = ∑(39)1...12/12 =												65.30	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	
Average = ∑(40)1...12/12 =												1.03	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.08	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	83.55	(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)	91.90	88.56	85.22	81.88	78.54	75.19	75.19	78.54	81.88	85.22	88.56	91.90	
∑(44)1...12 =												1002.59	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	136.29	119.20	123.00	107.24	102.90	88.79	82.28	94.42	95.54	111.35	121.55	131.99	
∑(45)1...12 =												1314.55	(45)
Distribution loss 0.15 x (45)m	20.44	17.88	18.45	16.09	15.43	13.32	12.34	14.16	14.33	16.70	18.23	19.80	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss for each month from Table 3

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

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

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

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

191.57	169.13	178.28	160.73	158.17	142.29	137.56	149.69	149.04	166.63	175.04	187.27	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

191.57	169.13	178.28	160.73	158.17	142.29	137.56	149.69	149.04	166.63	175.04	187.27

∑(64)1...12 = 1965.39 (64)

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

89.54	79.58	85.12	78.45	78.43	72.32	71.58	75.62	74.56	81.24	83.21	88.11	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	103.89	103.89	103.89	103.89	103.89	103.89	103.89	103.89	103.89	103.89	103.89	103.89	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	16.19	14.38	11.69	8.85	6.62	5.59	6.04	7.85	10.53	13.37	15.61	16.64	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	181.61	183.49	178.74	168.63	155.87	143.88	135.86	133.98	138.73	148.84	161.60	173.59	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	(71)
Water heating gains (Table 5)	120.35	118.42	114.41	108.96	105.42	100.44	96.21	101.63	103.56	109.20	115.57	118.43	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	372.31	370.46	359.01	340.61	322.08	304.07	292.28	297.63	306.99	325.58	346.94	362.83	(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	
NorthEast	0.77	x	12.76	x	11.28	x 0.9 x	0.40	x	0.80	=	31.93	(75)

Solar gains in watts ∑(74)m...(82)m

31.93	64.99	117.09	192.29	258.48	275.56	257.79	205.51	142.67	79.42	40.17	26.07	(83)

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

404.24	435.44	476.10	532.91	580.56	579.64	550.06	503.14	449.66	405.00	387.12	388.90	(84)

7. Mean internal temperature (heating season)

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

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

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

1.00	1.00	0.99	0.96	0.86	0.68	0.52	0.58	0.85	0.98	0.99	1.00	(86)

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

19.96	20.07	20.28	20.58	20.84	20.97	20.99	20.99	20.89	20.57	20.21	19.93	(87)

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

20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.98	0.94	0.82	0.60	0.41	0.47	0.78	0.96	0.99	1.00	(89)

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

18.67	18.82	19.14	19.56	19.90	20.04	20.06	20.05	19.97	19.56	19.04	18.62	(90)

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

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

19.36	19.49	19.75	20.11	20.41	20.54	20.56	20.56	20.47	20.10	19.67	19.32	(92)

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

19.36	19.49	19.75	20.11	20.41	20.54	20.56	20.56	20.47	20.10	19.67	19.32	(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	0.95	0.84	0.64	0.47	0.53	0.81	0.96	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	402.44	432.24	467.92	503.91	486.03	372.52	256.46	267.17	364.79	390.63	383.81	387.50	(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]													
	983.65	952.79	865.23	731.82	568.56	387.68	258.64	271.44	415.85	620.40	820.56	987.59	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	432.42	349.81	295.60	164.09	61.40	0.00	0.00	0.00	0.00	170.95	314.46	446.47	

∑(98)1...5, 10...12 = 2235.19 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 35.22 (99)

9b. Energy requirements - community heating scheme

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

Space heating

Annual space heating requirement	2235.19			(98)
Space heat from boilers		(98) x (304a) x (305) x (306) =	2346.95	(307a)

Water heating

Annual water heating requirement	1965.39			(64)
Water heat from boilers		(64) x (303a) x (305a) x (306) =	2063.66	(310a)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] =	44.11	(313)

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

mechanical ventilation fans - balanced, extract or positive input from outside			42.78			(330a)
Total electricity for the above, kWh/year					42.78	(331)
Electricity for lighting (Appendix L)					285.93	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =				4739.32	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	2346.95	x	4.24	x 0.01 =	99.51	(340a)
Water heating from boilers	2063.66	x	4.24	x 0.01 =	87.50	(342a)
Pumps and fans	42.78	x	13.19	x 0.01 =	5.64	(349)
Electricity for lighting	285.93	x	13.19	x 0.01 =	37.71	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		350.37	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.36	(357)
SAP value	81.07	
SAP rating (section 13)	81	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	4692.14	x	0.216	=	1013.50	(367)
Electrical energy for community heat distribution		44.11	x	0.52	=	22.89	(372)
Total CO2 associated with community systems						1036.39	(373)
Total CO2 associated with space and water heating						1036.39	(376)
Pumps and fans		42.78	x	0.52	=	22.20	(378)
Electricity for lighting		285.93	x	0.52	=	148.40	(379)
Total CO_2, kg/year					(376)..(382) =	1206.99	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	19.02	(384)
EI value						85.09	
EI rating (section 14)						85	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		94.00					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	4692.14	x	1.22	=	5724.42	(367)
Electrical energy for community heat distribution		44.11	x	3.07	=	135.41	(372)
Total primary energy associated with community systems						5859.82	(373)
Total primary energy associated with space and water heating						5859.82	(376)
Pumps and fans		42.78	x	3.07	=	131.34	(378)
Electricity for lighting		285.93	x	3.07	=	877.79	(379)

Primary energy kWh/year	6868.95	(383)
Dwelling primary energy rate kWh/m2/year	108.22	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	23/11/2016
Address	B-L00-02 B Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		95.27	(1a)	x	2.50	(2a)	=	238.18	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	95.27	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	238.18	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(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) =	0.17	(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	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.20	(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	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			27.95	x	1.24	=	34.54			(27)
Ground floor			95.27	x	0.20	=	19.05			(28a)
External wall			25.22	x	0.18	=	4.54			(29a)
Party wall			63.29	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			148.44							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	58.13	(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		10.27	(36)
Total fabric heat loss	(33) + (36) =	68.41	(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)	39.30	39.30	39.30	39.30	39.30	39.30	39.30	39.30	39.30	39.30	39.30	39.30	(38)
Heat transfer coefficient, W/K (37)m + (38)m	107.70	107.70	107.70	107.70	107.70	107.70	107.70	107.70	107.70	107.70	107.70	107.70	
Average = ∑(39)1...12/12 =												107.70	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	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	2.69	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	98.12	(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)	107.93	104.00	100.08	96.15	92.23	88.30	88.30	92.23	96.15	100.08	104.00	107.93	
∑(44)1...12 =												1177.40	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	160.05	139.98	144.45	125.94	120.84	104.27	96.63	110.88	112.20	130.76	142.74	155.00	
∑(45)1...12 =												1543.75	(45)
Distribution loss 0.15 x (45)m	24.01	21.00	21.67	18.89	18.13	15.64	14.49	16.63	16.83	19.61	21.41	23.25	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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													
	215.33	189.91	199.73	179.43	176.12	157.77	151.90	166.16	165.70	186.04	196.23	210.28	(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													
	215.33	189.91	199.73	179.43	176.12	157.77	151.90	166.16	165.70	186.04	196.23	210.28	
											∑(64)1...12 =	2194.59	(64)
Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]													
	97.44	86.49	92.25	84.67	84.40	77.47	76.35	81.09	80.10	87.70	90.26	95.76	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)													
	134.56	134.56	134.56	134.56	134.56	134.56	134.56	134.56	134.56	134.56	134.56	134.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.15	19.67	16.00	12.11	9.05	7.64	8.26	10.74	14.41	18.30	21.35	22.76	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	248.45	251.02	244.53	230.70	213.24	196.83	185.87	183.29	189.79	203.62	221.08	237.48	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.46	36.46	36.46	36.46	36.46	36.46	36.46	36.46	36.46	36.46	36.46	36.46	(69)
Pump and fan gains (Table 5a)													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)													
	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	(71)
Water heating gains (Table 5)													
	130.97	128.70	123.99	117.60	113.44	107.59	102.62	108.99	111.25	117.88	125.35	128.71	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
	464.93	462.77	447.89	423.77	399.10	375.43	360.12	366.38	378.82	403.16	431.15	452.33	(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	27.95	x	36.79	x 0.9 x	0.40	x	0.80	=	228.06	(79)

Solar gains in watts ∑(74)m...(82)m													
	228.06	388.46	531.51	658.57	737.65	732.32	706.03	647.03	575.51	429.33	273.16	195.17	(83)
Total gains - internal and solar (73)m + (83)m													
	692.99	851.23	979.40	1082.34	1136.75	1107.75	1066.15	1013.42	954.33	832.49	704.31	647.50	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)													
	1.00	0.99	0.96	0.90	0.78	0.60	0.44	0.48	0.72	0.93	0.99	1.00	(86)

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

19.90	20.12	20.39	20.68	20.89	20.98	21.00	20.99	20.94	20.66	20.21	19.85	(87)

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

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

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.98	0.95	0.87	0.72	0.51	0.34	0.38	0.63	0.91	0.98	1.00	(89)

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

18.53	18.83	19.22	19.62	19.87	19.96	19.97	19.97	19.93	19.60	18.97	18.45	(90)

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

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

19.09	19.36	19.70	20.05	20.29	20.38	20.39	20.39	20.35	20.04	19.48	19.02	(92)

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

19.09	19.36	19.70	20.05	20.29	20.38	20.39	20.39	20.35	20.04	19.48	19.02	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.95	0.88	0.74	0.55	0.38	0.42	0.67	0.91	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	687.32	832.99	928.54	948.36	840.67	607.37	406.68	426.80	634.95	755.09	691.18	643.60	(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]	1593.14	1557.39	1421.86	1201.18	924.90	622.24	408.58	429.95	672.92	1016.46	1333.21	1596.45	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	673.93	486.79	367.03	182.03	62.67	0.00	0.00	0.00	0.00	194.46	462.26	708.92	

∑(98)1...5, 10...12 = 3138.08 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 32.94 (99)

9b. Energy requirements - community heating scheme

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

Space heating

Annual space heating requirement	3138.08			(98)
Space heat from boilers		(98) x (304a) x (305) x (306) =	3294.99	(307a)

Water heating

Annual water heating requirement	2194.59			(64)
Water heat from boilers		(64) x (303a) x (305a) x (306) =	2304.32	(310a)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] =	55.99	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)				
mechanical ventilation fans - balanced, extract or positive input from outside	60.44			(330a)

Total electricity for the above, kWh/year		60.44	(331)
Electricity for lighting (Appendix L)		391.16	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	6050.91	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	3294.99	x	4.24	x 0.01 =	139.71	(340a)
Water heating from boilers	2304.32	x	4.24	x 0.01 =	97.70	(342a)
Pumps and fans	60.44	x	13.19	x 0.01 =	7.97	(349)
Electricity for lighting	391.16	x	13.19	x 0.01 =	51.59	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		416.98	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.25	(357)
SAP value	82.58	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	5956.71	x	0.216	=	1286.65	(367)
Electrical energy for community heat distribution		55.99	x	0.52	=	29.06	(372)
Total CO2 associated with community systems						1315.71	(373)
Total CO2 associated with space and water heating						1315.71	(376)
Pumps and fans		60.44	x	0.52	=	31.37	(378)
Electricity for lighting		391.16	x	0.52	=	203.01	(379)
Total CO_2, kg/year					(376)..(382) =	1550.09	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	16.27	(384)
EI value						85.19	
EI rating (section 14)						85	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		94.00					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	5956.71	x	1.22	=	7267.19	(367)
Electrical energy for community heat distribution		55.99	x	3.07	=	171.90	(372)
Total primary energy associated with community systems						7439.09	(373)
Total primary energy associated with space and water heating						7439.09	(376)
Pumps and fans		60.44	x	3.07	=	185.55	(378)
Electricity for lighting		391.16	x	3.07	=	1200.87	(379)
Primary energy kWh/year						8825.50	(383)

Dwelling primary energy rate kWh/m2/year	92.64	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	23/11/2016
Address	B-L04-26 B Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		49.68	(1a)	x	2.50	(2a)	=	124.20	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	49.68	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			124.20	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(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) =	0.17	(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	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.20	(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	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			15.15	x	1.24	=	18.72			(27)
External wall			11.17	x	0.18	=	2.01			(29a)
Party wall			44.15	x	0.00	=	0.00			(32)
Roof			49.68	x	0.16	=	7.95			(30)
Total area of external elements ∑A, m²			76.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	28.68	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.30	(36)
Total fabric heat loss	(33) + (36) =	32.98	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	20.49	20.49	20.49	20.49	20.49	20.49	20.49	20.49	20.49	20.49	20.49	20.49	(38)
Heat transfer coefficient, W/K (37)m + (38)m	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	
Average = ∑(39)1...12/12 =												53.48	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	
Average = ∑(40)1...12/12 =												1.08	(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	74.12	(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)	81.53	78.56	75.60	72.63	69.67	66.70	66.70	69.67	72.63	75.60	78.56	81.53	
∑(44)1...12 =												889.39	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	120.90	105.74	109.12	95.13	91.28	78.77	72.99	83.76	84.76	98.78	107.82	117.09	
∑(45)1...12 =												1166.14	(45)
Distribution loss 0.15 x (45)m	18.14	15.86	16.37	14.27	13.69	11.82	10.95	12.56	12.71	14.82	16.17	17.56	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

176.18	155.67	164.39	148.62	146.56	132.26	128.27	139.03	138.25	154.05	161.32	172.37	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

176.18	155.67	164.39	148.62	146.56	132.26	128.27	139.03	138.25	154.05	161.32	172.37	

∑(64)1...12 = 1816.98 (64)

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

84.42	75.10	80.50	74.43	74.57	68.99	68.49	72.07	70.98	77.06	78.65	83.15	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.05	11.59	9.43	7.14	5.34	4.50	4.87	6.33	8.49	10.78	12.58	13.41	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	146.40	147.92	144.09	135.94	125.66	115.99	109.53	108.01	111.84	119.99	130.27	139.94	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	(71)
Water heating gains (Table 5)	113.47	111.76	108.20	103.37	100.23	95.81	92.06	96.87	98.58	103.58	109.23	111.77	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	321.14	319.48	309.93	294.66	279.43	264.51	254.66	259.41	267.12	282.56	300.30	313.33	(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	
North	0.77	x	2.09	x	10.63	x 0.9 x	0.40	x	0.80	=	4.93	(74)
NorthEast	0.77	x	13.06	x	11.28	x 0.9 x	0.40	x	0.80	=	32.68	(75)

Solar gains in watts ∑(74)m...(82)m

37.61	75.93	135.84	222.52	299.18	319.12	298.46	237.80	165.27	92.50	47.20	30.79	(83)

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

358.74	395.42	445.78	517.18	578.62	583.63	553.12	497.21	432.39	375.06	347.49	344.13	(84)

7. Mean internal temperature (heating season)

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

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

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

1.00	0.99	0.98	0.92	0.77	0.57	0.42	0.49	0.77	0.96	0.99	1.00	(86)

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

19.97	20.10	20.35	20.67	20.90	20.98	21.00	20.99	20.93	20.62	20.24	19.94	(87)

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

20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.02	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.99	0.97	0.89	0.71	0.49	0.33	0.39	0.69	0.94	0.99	0.99	(89)

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

18.66	18.85	19.20	19.65	19.93	20.01	20.02	20.02	19.97	19.59	19.04	18.61	(90)

Living area fraction — Living area ÷ (4) = 0.47 (91)

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

19.28	19.44	19.75	20.13	20.39	20.47	20.48	20.48	20.42	20.08	19.61	19.24	(92)

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

19.28	19.44	19.75	20.13	20.39	20.47	20.48	20.48	20.42	20.08	19.61	19.24	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.97	0.90	0.74	0.53	0.37	0.44	0.72	0.94	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	355.92	389.95	430.78	463.92	426.52	308.41	206.88	216.62	312.70	351.82	342.22	341.93	(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]	801.18	777.60	708.31	600.66	464.76	313.94	207.60	218.19	338.10	506.92	668.85	804.05	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	331.27	260.50	206.48	98.46	28.45	0.00	0.00	0.00	0.00	115.39	235.18	343.82	

∑(98)1...5, 10...12 = 1619.54 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 32.60 (99)

9b. Energy requirements - community heating scheme

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

Space heating

Annual space heating requirement	1619.54			(98)
Space heat from boilers		(98) x (304a) x (305) x (306) =	1700.52	(307a)

Water heating

Annual water heating requirement	1816.98			(64)
Water heat from boilers		(64) x (303a) x (305a) x (306) =	1907.83	(310a)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] =	36.08	(313)

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

mechanical ventilation fans - balanced, extract or positive input from outside	33.49		(330a)
Total electricity for the above, kWh/year		33.49	(331)
Electricity for lighting (Appendix L)		230.50	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3872.33	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1700.52	x	4.24	x 0.01 =	72.10	(340a)
Water heating from boilers	1907.83	x	4.24	x 0.01 =	80.89	(342a)
Pumps and fans	33.49	x	13.19	x 0.01 =	4.42	(349)
Electricity for lighting	230.50	x	13.19	x 0.01 =	30.40	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	307.81	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.37	(357)
SAP value	80.95	
SAP rating (section 13)	81	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	94.00					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	3838.66	x	0.216	=	829.15	(367)
Electrical energy for community heat distribution	36.08	x	0.52	=	18.73	(372)
Total CO2 associated with community systems					847.88	(373)
Total CO2 associated with space and water heating					847.88	(376)
Pumps and fans	33.49	x	0.52	=	17.38	(378)
Electricity for lighting	230.50	x	0.52	=	119.63	(379)
Total CO_2, kg/year				(376)..(382) =	984.89	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	19.82	(384)
EI value					86.06	
EI rating (section 14)					86	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	94.00					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	3838.66	x	1.22	=	4683.17	(367)
Electrical energy for community heat distribution	36.08	x	3.07	=	110.78	(372)
Total primary energy associated with community systems					4793.95	(373)
Total primary energy associated with space and water heating					4793.95	(376)
Pumps and fans	33.49	x	3.07	=	102.80	(378)
Electricity for lighting	230.50	x	3.07	=	707.64	(379)

Primary energy kWh/year	5604.39	(383)
Dwelling primary energy rate kWh/m2/year	112.81	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	23/11/2016
Address	A-L00-28 A Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m^2)			Average storey height (m)			Volume (m^3)	
Lowest occupied		73.69	(1a)	x	2.50	(2a)	=	184.23	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	73.69	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			184.23	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(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) =	0.17	(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	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.20	(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	N/A	(23c)

c) whole house extract ventilation or positive input ventilation from outside

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			23.06	x	1.24	=	28.50			(27)
Ground floor			73.69	x	0.20	=	14.74			(28a)
External wall			20.99	x	0.18	=	3.78			(29a)
Party wall			56.27	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			117.74							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	47.01	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		8.56	(36)
Total fabric heat loss	(33) + (36) =	55.58	(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)	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40	(38)
Heat transfer coefficient, W/K (37)m + (38)m	85.97	85.97	85.97	85.97	85.97	85.97	85.97	85.97	85.97	85.97	85.97	85.97	
Average = ∑(39)1...12/12 =												85.97	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	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	2.33	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	89.59	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	98.55	94.97	91.38	87.80	84.22	80.63	80.63	84.22	87.80	91.38	94.97	98.55	
∑(44)1...12 =												1075.10	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	146.15	127.82	131.90	114.99	110.34	95.21	88.23	101.25	102.45	119.40	130.34	141.54	
∑(45)1...12 =												1409.62	(45)
Distribution loss 0.15 x (45)m	21.92	19.17	19.79	17.25	16.55	14.28	13.23	15.19	15.37	17.91	19.55	21.23	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

201.42	177.75	187.18	168.49	165.62	148.71	143.51	156.52	155.95	174.68	183.83	196.81	(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

201.42	177.75	187.18	168.49	165.62	148.71	143.51	156.52	155.95	174.68	183.83	196.81

∑(64)1...12 = 2060.46 (64)

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

92.82	82.44	88.08	81.03	80.91	74.45	73.56	77.89	76.86	83.92	86.13	91.28	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	116.61	116.61	116.61	116.61	116.61	116.61	116.61	116.61	116.61	116.61	116.61	116.61	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.34	16.29	13.25	10.03	7.50	6.33	6.84	8.89	11.93	15.15	17.68	18.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	205.75	207.89	202.51	191.05	176.59	163.00	153.93	151.79	157.17	168.63	183.08	196.67	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	(71)
Water heating gains (Table 5)	124.75	122.68	118.38	112.54	108.75	103.41	98.87	104.69	106.75	112.80	119.63	122.69	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	406.83	404.85	392.13	371.61	350.83	330.73	317.62	323.35	333.84	354.56	378.38	396.20	(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	23.06	x	36.79	x 0.9 x	0.40	x	0.80	=	188.16	(79)

Solar gains in watts ∑(74)m...(82)m

188.16	320.50	438.52	543.35	608.60	604.19	582.51	533.83	474.83	354.22	225.37	161.02	(83)

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

594.99	725.34	830.65	914.96	959.42	934.92	900.13	857.18	808.67	708.78	603.75	557.22	(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	0.98	0.95	0.88	0.75	0.57	0.42	0.46	0.68	0.91	0.98	0.99	(86)

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

19.93	20.14	20.42	20.70	20.90	20.98	21.00	20.99	20.95	20.69	20.24	19.87	(87)

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

19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.97	0.94	0.85	0.69	0.48	0.32	0.35	0.60	0.88	0.98	0.99	(89)

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

18.54	18.85	19.24	19.62	19.86	19.93	19.95	19.94	19.91	19.61	18.99	18.46	(90)

Living area fraction — Living area ÷ (4) = 0.39 (91)

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

19.07	19.35	19.70	20.04	20.26	20.34	20.35	20.35	20.31	20.03	19.47	19.00	(92)

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

19.07	19.35	19.70	20.04	20.26	20.34	20.35	20.35	20.31	20.03	19.47	19.00	(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	0.93	0.85	0.71	0.52	0.36	0.39	0.63	0.88	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	587.60	703.64	774.67	778.47	677.95	483.23	321.16	337.44	508.79	625.80	587.52	552.01	(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]	1270.16	1242.46	1134.56	957.62	735.62	493.16	322.42	339.50	533.98	810.37	1063.42	1272.48	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	507.82	362.08	267.76	128.99	42.91	0.00	0.00	0.00	0.00	137.32	342.65	536.03	

∑(98)1...5, 10...12 = 2325.56 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 31.56 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.25	(303a)
Fraction of community heat from CHP		0.75	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.75	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.25	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	2325.56			(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	1831.38	(307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	610.46	(307b)

Water heating

Annual water heating requirement	2060.46			(64)
Water heat from CHP		(64) x (303a) x (305a) x (306) =	1622.62	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	540.87	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	46.05	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	49.67		(330a)
Total electricity for the above, kWh/year		49.67	(331)
Electricity for lighting (Appendix L)		323.94	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4978.94	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	1831.38	x	2.97	x 0.01 =	54.39	(340a)
Space heating from boilers	610.46	x	4.24	x 0.01 =	25.88	(340b)
Water heating from CHP	1622.62	x	2.97	x 0.01 =	48.19	(342a)
Water heating from boilers	540.87	x	4.24	x 0.01 =	22.93	(342b)
Pumps and fans	49.67	x	13.19	x 0.01 =	6.55	(349)
Electricity for lighting	323.94	x	13.19	x 0.01 =	42.73	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		320.68	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.13	(357)
SAP value	84.17	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	2774.3769	x	0.2160	=	599.2654	(363)
less credit emissions for electricity		-779.3100	x	0.5190	=	-404.4619	(364)
Water heated by CHP		2458.1194	x	0.2160	=	530.9538	(365)
less credit emissions for electricity		-690.4747	x	0.5190	=	-358.3564	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1224.82	x	0.216	=	264.56	(368)
Electrical energy for community heat distribution		46.05	x	0.52	=	23.90	(372)
Total CO2 associated with community systems						655.86	(373)
Total CO2 associated with space and water heating						655.86	(376)
Pumps and fans		49.67	x	0.52	=	25.78	(378)
Electricity for lighting		323.94	x	0.52	=	168.13	(379)
Total CO_2, kg/year					(376)..(382) =	849.77	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	11.53	(384)
EI value						90.41	
EI rating (section 14)						90	(385)

EI band	B

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	2774.38	x	1.22	=	3384.74	(363)
less credit energy for electricity		-779.31	x	3.07	=	-2392.48	(364)
Water heated by CHP		2458.12	x	1.22	=	2998.91	(365)
less credit energy for electricity		-690.47	x	3.07	=	-2119.76	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1224.82	x	1.22	=	1494.28	(368)
Electrical energy for community heat distribution		46.05	x	3.07	=	141.38	(372)
Total primary energy associated with community systems						3507.07	(373)
Total primary energy associated with space and water heating						3507.07	(376)
Pumps and fans		49.67	x	3.07	=	152.49	(378)
Electricity for lighting		323.94	x	3.07	=	994.50	(379)
Primary energy kWh/year						4654.06	(383)
Dwelling primary energy rate kWh/m2/year						63.16	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	23/11/2016
Address	A-L03-19 A Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		87.58	(1a)	x	2.50	(2a)	=	218.95	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	87.58	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			218.95	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(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) =	0.17	(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	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.20	(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	N/A	(23c)

c) whole house extract ventilation or positive input ventilation from outside

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			29.45	x	1.24	=	36.39			(27)
External wall			21.97	x	0.18	=	3.95			(29a)
Party wall			57.05	x	0.00	=	0.00			(32)
Roof			87.58	x	0.16	=	14.01			(30)
Total area of external elements ∑A, m²			139.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	54.36	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		7.51	(36)
Total fabric heat loss	(33) + (36) =	61.87	(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)	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	(38)
Heat transfer coefficient, W/K (37)m + (38)m	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	
Average = ∑(39)1...12/12 =												98.00	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	
Average = ∑(40)1...12/12 =												1.12	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.59	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	95.74	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	105.31	101.48	97.65	93.82	89.99	86.17	86.17	89.99	93.82	97.65	101.48	105.31	
∑(44)1...12 =												1148.87	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	156.18	136.59	140.95	122.89	117.91	101.75	94.28	108.19	109.49	127.59	139.28	151.25	
∑(45)1...12 =												1506.35	(45)
Distribution loss 0.15 x (45)m	23.43	20.49	21.14	18.43	17.69	15.26	14.14	16.23	16.42	19.14	20.89	22.69	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

211.45	186.52	196.23	176.38	173.19	155.24	149.56	163.47	162.98	182.87	192.77	206.53	(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

211.45	186.52	196.23	176.38	173.19	155.24	149.56	163.47	162.98	182.87	192.77	206.53

∑(64)1...12 = 2157.19 (64)

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

96.15	85.36	91.09	83.65	83.43	76.63	75.57	80.20	79.20	86.65	89.11	94.51	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	129.56	129.56	129.56	129.56	129.56	129.56	129.56	129.56	129.56	129.56	129.56	129.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.91	18.57	15.10	11.43	8.55	7.22	7.80	10.14	13.60	17.27	20.16	21.49	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	234.55	236.99	230.85	217.80	201.31	185.82	175.47	173.04	179.17	192.23	208.71	224.21	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.96	35.96	35.96	35.96	35.96	35.96	35.96	35.96	35.96	35.96	35.96	35.96	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	(71)
Water heating gains (Table 5)	129.23	127.02	122.43	116.19	112.13	106.43	101.57	107.79	110.00	116.46	123.76	127.03	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	446.57	444.45	430.26	407.29	383.86	361.33	346.71	352.83	364.64	387.83	414.50	434.60	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	29.45	x	36.79	x 0.9 x	0.40	x	0.80	=	240.29	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	240.29	409.31	560.04	693.91	777.24	771.62	743.92	681.76	606.40	452.37	287.82	205.64	(83)
Total gains - internal and solar (73)m + (83)m	686.86	853.76	990.29	1101.20	1161.10	1132.95	1090.64	1034.59	971.04	840.21	702.32	640.24	(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)	0.99	0.98	0.95	0.87	0.72	0.54	0.39	0.43	0.66	0.91	0.98	1.00	(86)

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

19.97	20.20	20.48	20.75	20.92	20.99	21.00	21.00	20.96	20.72	20.28	19.91	(87)

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

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

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.97	0.93	0.83	0.66	0.46	0.30	0.34	0.58	0.87	0.98	0.99	(89)

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

18.63	18.96	19.35	19.72	19.92	19.98	19.98	19.98	19.96	19.69	19.08	18.55	(90)

Living area fraction — Living area ÷ (4) = 0.34 (91)

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

19.09	19.39	19.74	20.07	20.26	20.32	20.33	20.33	20.30	20.04	19.49	19.01	(92)

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

19.09	19.39	19.74	20.07	20.26	20.32	20.33	20.33	20.30	20.04	19.49	19.01	(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	0.93	0.83	0.68	0.49	0.33	0.37	0.60	0.87	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	678.99	827.66	918.02	919.02	788.21	553.04	364.84	383.72	586.13	734.93	683.88	634.87	(95)
Monthly average external temperature from Table U1													
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]													
	1449.54	1419.78	1297.51	1094.66	838.95	560.78	365.73	385.24	607.84	925.51	1213.90	1451.82	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	573.29	397.91	282.34	126.46	37.75	0.00	0.00	0.00	0.00	141.79	381.62	607.81	

∑(98)1...5, 10...12 = 2548.97 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 29.10 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.25	(303a)
Fraction of community heat from CHP		0.75	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.75	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.25	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	2548.97		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	2007.31	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	669.10	(307b)

Water heating

Annual water heating requirement	2157.19		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	1698.79	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	566.26	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	49.41	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	55.56		(330a)
Total electricity for the above, kWh/year		55.56	(331)
Electricity for lighting (Appendix L)		369.29	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	5366.32	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	2007.31	x	2.97	x 0.01 =	59.62	(340a)
Space heating from boilers	669.10	x	4.24	x 0.01 =	28.37	(340b)
Water heating from CHP	1698.79	x	2.97	x 0.01 =	50.45	(342a)
Water heating from boilers	566.26	x	4.24	x 0.01 =	24.01	(342b)
Pumps and fans	55.56	x	13.19	x 0.01 =	7.33	(349)
Electricity for lighting	369.29	x	13.19	x 0.01 =	48.71	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		338.49	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.07	(357)
SAP value	85.04	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	3040.9017	x	0.2160	=	656.8348	(363)
less credit emissions for electricity		-854.1757	x	0.5190	=	-443.3172	(364)
Water heated by CHP		2573.5136	x	0.2160	=	555.8789	(365)
less credit emissions for electricity		-722.8884	x	0.5190	=	-375.1791	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1314.22	x	0.216	=	283.87	(368)
Electrical energy for community heat distribution		49.41	x	0.52	=	25.65	(372)
Total CO2 associated with community systems						703.74	(373)
Total CO2 associated with space and water heating						703.74	(376)
Pumps and fans		55.56	x	0.52	=	28.84	(378)
Electricity for lighting		369.29	x	0.52	=	191.66	(379)
Total CO_2, kg/year					(376)..(382) =	924.23	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.55	(384)
EI value						90.66	
EI rating (section 14)						91	(385)

EI band | B

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	3040.90	x	1.22	=	3709.90	(363)
less credit energy for electricity		-854.18	x	3.07	=	-2622.32	(364)
Water heated by CHP		2573.51	x	1.22	=	3139.69	(365)
less credit energy for electricity		-722.89	x	3.07	=	-2219.27	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1314.22	x	1.22	=	1603.35	(368)
Electrical energy for community heat distribution		49.41	x	3.07	=	151.70	(372)
Total primary energy associated with community systems						3763.05	(373)
Total primary energy associated with space and water heating						3763.05	(376)
Pumps and fans		55.56	x	3.07	=	170.57	(378)
Electricity for lighting		369.29	x	3.07	=	1133.72	(379)
Primary energy kWh/year						5067.34	(383)
Dwelling primary energy rate kWh/m2/year						57.86	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	23/11/2016
Address	A-L03-48 A Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		87.21	(1a)	x	2.50	(2a)	=	218.03	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	87.21	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			218.03	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(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) =	0.17	(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	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.20	(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	N/A	(23c)

c) whole house extract ventilation or positive input ventilation from outside

0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)

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

0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			23.17	x	1.24	=	28.63			(27)
External wall			23.10	x	0.18	=	4.16			(29a)
Party wall			63.52	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			46.27							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.79	(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		6.50	(36)
Total fabric heat loss	(33) + (36) =	39.29	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	(38)
Heat transfer coefficient, W/K (37)m + (38)m	75.26	75.26	75.26	75.26	75.26	75.26	75.26	75.26	75.26	75.26	75.26	75.26	
Average = ∑(39)1...12/12 =												75.26	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	
Average = ∑(40)1...12/12 =												0.86	(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	2.59	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	95.61	(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)	105.17	101.34	97.52	93.70	89.87	86.05	86.05	89.87	93.70	97.52	101.34	105.17	
∑(44)1...12 =												1147.29	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	155.96	136.40	140.76	122.72	117.75	101.61	94.15	108.04	109.33	127.42	139.09	151.04	
∑(45)1...12 =												1504.28	(45)
Distribution loss 0.15 x (45)m	23.39	20.46	21.11	18.41	17.66	15.24	14.12	16.21	16.40	19.11	20.86	22.66	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

211.24	186.33	196.03	176.21	173.03	155.10	149.43	163.32	162.83	182.70	192.58	206.32	(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

211.24	186.33	196.03	176.21	173.03	155.10	149.43	163.32	162.83	182.70	192.58	206.32

∑(64)1...12 = 2155.12 (64)

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

96.08	85.30	91.02	83.60	83.37	76.58	75.53	80.15	79.15	86.59	89.04	94.44	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)													
	129.28	129.28	129.28	129.28	129.28	129.28	129.28	129.28	129.28	129.28	129.28	129.28	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.85	18.52	15.06	11.40	8.52	7.19	7.77	10.11	13.56	17.22	20.10	21.43	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	233.85	236.28	230.16	217.14	200.71	185.27	174.95	172.52	178.64	191.65	208.09	223.53	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	(69)
Pump and fan gains (Table 5a)													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)													
	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	(71)
Water heating gains (Table 5)													
	129.14	126.93	122.34	116.11	112.06	106.36	101.52	107.72	109.93	116.38	123.67	126.94	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
	445.62	443.51	429.35	406.44	383.08	360.60	346.02	352.13	363.91	387.04	413.64	433.68	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	2.09	x	10.63	x 0.9 x	0.40	x	0.80	=	4.93	(74)
NorthEast	0.77	x	21.08	x	11.28	x 0.9 x	0.40	x	0.80	=	52.74	(75)

Solar gains in watts ∑(74)m...(82)m

57.67	116.78	209.44	343.38	461.64	492.31	460.48	366.97	254.94	142.42	72.45	47.18	(83)

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

503.29	560.29	638.79	749.82	844.72	852.92	806.50	719.10	618.86	529.46	486.09	480.86	(84)

7. Mean internal temperature (heating season)

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

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

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

1.00	1.00	0.99	0.93	0.77	0.56	0.41	0.48	0.78	0.97	1.00	1.00	(86)

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

20.14	20.26	20.48	20.76	20.95	20.99	21.00	21.00	20.96	20.70	20.36	20.11	(87)

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

20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.98	0.91	0.72	0.49	0.34	0.40	0.71	0.96	0.99	1.00	(89)

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

19.04	19.21	19.53	19.92	20.15	20.20	20.20	20.20	20.17	19.84	19.36	18.99	(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

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

19.38	19.53	19.82	20.18	20.40	20.44	20.45	20.45	20.41	20.11	19.67	19.34	(92)

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

19.38	19.53	19.82	20.18	20.40	20.44	20.45	20.45	20.41	20.11	19.67	19.34	(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	0.91	0.73	0.51	0.36	0.42	0.73	0.96	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	501.71	556.53	625.13	683.57	620.17	436.57	289.26	303.79	451.09	506.73	482.65	479.72	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1135.29	1101.48	1002.57	849.11	654.45	439.74	289.53	304.53	475.00	715.47	946.24	1139.47	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	471.38	366.20	280.81	119.19	25.51	0.00	0.00	0.00	0.00	155.31	333.78	490.85	

∑(98)1...5, 10...12 = 2243.04 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 25.72 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.25	(303a)
Fraction of community heat from CHP		0.75	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.75	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.25	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	2243.04		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	1766.39	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	588.80	(307b)

Water heating

Annual water heating requirement	2155.12		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	1697.15	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	565.72	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	46.18	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	55.33		(330a)
Total electricity for the above, kWh/year		55.33	(331)
Electricity for lighting (Appendix L)		368.18	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	5041.57	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	1766.39	x	2.97	x 0.01 =	52.46	(340a)
Space heating from boilers	588.80	x	4.24	x 0.01 =	24.97	(340b)
Water heating from CHP	1697.15	x	2.97	x 0.01 =	50.41	(342a)
Water heating from boilers	565.72	x	4.24	x 0.01 =	23.99	(342b)
Pumps and fans	55.33	x	13.19	x 0.01 =	7.30	(349)
Electricity for lighting	368.18	x	13.19	x 0.01 =	48.56	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		327.68	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.04	(357)
SAP value	85.48	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	2675.9278	x	0.2160	=	578.0004	(363)
less credit emissions for electricity		-751.6561	x	0.5190	=	-390.1095	(364)
Water heated by CHP		2571.0383	x	0.2160	=	555.3443	(365)
less credit emissions for electricity		-722.1932	x	0.5190	=	-374.8182	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1228.21	x	0.216	=	265.29	(368)
Electrical energy for community heat distribution		46.18	x	0.52	=	23.97	(372)
Total CO2 associated with community systems						657.68	(373)
Total CO2 associated with space and water heating						657.68	(376)
Pumps and fans		55.33	x	0.52	=	28.71	(378)
Electricity for lighting		368.18	x	0.52	=	191.09	(379)
Total CO_2, kg/year					(376)..(382) =	877.48	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.06	(384)
EI value						91.11	
EI rating (section 14)						91	(385)

EI band	B

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	2675.93	x	1.22	=	3264.63	(363)
less credit energy for electricity		-751.66	x	3.07	=	-2307.58	(364)
Water heated by CHP		2571.04	x	1.22	=	3136.67	(365)
less credit energy for electricity		-722.19	x	3.07	=	-2217.13	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1228.21	x	1.22	=	1498.41	(368)
Electrical energy for community heat distribution		46.18	x	3.07	=	141.77	(372)
Total primary energy associated with community systems						3516.77	(373)
Total primary energy associated with space and water heating						3516.77	(376)
Pumps and fans		55.33	x	3.07	=	169.85	(378)
Electricity for lighting		368.18	x	3.07	=	1130.31	(379)
Primary energy kWh/year						4816.93	(383)
Dwelling primary energy rate kWh/m2/year						55.23	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	23/11/2016
Address	A-L04-60 A Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m^2)			Average storey height (m)			Volume (m^3)	
Lowest occupied		49.39	(1a)	x	2.50	(2a)	=	123.48	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	49.39	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	123.48	(5)

2. Ventilation rate

			m^3 per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.16	(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	0.20	0.19	0.19	0.17	0.17	0.15	0.15	0.14	0.16	0.17	0.17	0.18	(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	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			12.36	x	1.24	=	15.27			(27)
External wall			6.99	x	0.18	=	1.26			(29a)
Party wall			53.62	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			19.35							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	16.53	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.11	(36)
Total fabric heat loss	(33) + (36) =	20.64	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.37	(38)
Heat transfer coefficient, W/K (37)m + (38)m	41.01	41.01	41.01	41.01	41.01	41.01	41.01	41.01	41.01	41.01	41.01	41.01	

Average = ∑(39)1...12/12 = 41.01 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	

Average = ∑(40)1...12/12 = 0.83 (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	1.67	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	73.91	(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)	81.31	78.35	75.39	72.44	69.48	66.52	66.52	69.48	72.44	75.39	78.35	81.31	

∑(44)1...12 = 886.96 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	120.57	105.45	108.82	94.87	91.03	78.55	72.79	83.53	84.53	98.51	107.53	116.77	

∑(45)1...12 = 1162.95 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	18.09	15.82	16.32	14.23	13.65	11.78	10.92	12.53	12.68	14.78	16.13	17.52	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

175.85	155.38	164.10	148.36	146.31	132.05	128.07	138.81	138.02	153.78	161.02	172.05	(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

175.85	155.38	164.10	148.36	146.31	132.05	128.07	138.81	138.02	153.78	161.02	172.05	
										∑(64)1...12 =	1813.79	(64)

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

84.31	75.01	80.40	74.34	74.49	68.91	68.42	71.99	70.90	76.98	78.55	83.05	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)													
	83.61	83.61	83.61	83.61	83.61	83.61	83.61	83.61	83.61	83.61	83.61	83.61	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	12.98	11.53	9.38	7.10	5.31	4.48	4.84	6.29	8.45	10.73	12.52	13.35	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	145.65	147.16	143.35	135.24	125.01	115.39	108.96	107.45	111.26	119.37	129.60	139.22	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.36	31.36	31.36	31.36	31.36	31.36	31.36	31.36	31.36	31.36	31.36	31.36	(69)
Pump and fan gains (Table 5a)													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)													
	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	(71)
Water heating gains (Table 5)													
	113.32	111.62	108.07	103.25	100.12	95.71	91.97	96.77	98.47	103.46	109.09	111.62	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
	320.04	318.39	308.88	293.68	278.52	263.67	253.86	258.59	266.26	281.64	299.30	312.27	(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	12.36	x	36.79	x 0.9 x	0.40	x	0.80	=	100.85	(79)

Solar gains in watts ∑(74)m...(82)m

100.85	171.79	235.04	291.23	326.20	323.84	312.22	286.13	254.50	189.86	120.80	86.31	(83)

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

420.89	490.18	543.93	584.91	604.72	587.51	566.08	544.72	520.77	471.50	420.09	398.58	(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)													
	0.98	0.96	0.90	0.79	0.62	0.45	0.32	0.35	0.54	0.82	0.96	0.99	(86)

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

20.45	20.62	20.79	20.93	20.99	21.00	21.00	21.00	21.00	20.92	20.66	20.40	(87)

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

20.23	20.23	20.23	20.23	20.23	20.23	20.23	20.23	20.23	20.23	20.23	20.23	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.95	0.88	0.75	0.57	0.39	0.26	0.29	0.48	0.78	0.95	0.98	(89)

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

19.51	19.74	19.98	20.15	20.21	20.23	20.23	20.23	20.22	20.15	19.81	19.44	(90)

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

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

20.00	20.19	20.40	20.55	20.61	20.62	20.63	20.63	20.62	20.55	20.25	19.94	(92)

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

20.00	20.19	20.40	20.55	20.61	20.62	20.63	20.63	20.62	20.55	20.25	19.94	(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	0.89	0.77	0.60	0.42	0.29	0.32	0.51	0.80	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	411.61	465.14	482.70	448.34	360.14	246.61	165.07	173.24	265.84	376.06	398.96	392.01	(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]	643.86	627.26	570.06	477.89	365.54	247.09	165.11	173.31	267.48	407.91	539.43	645.52	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	172.79	108.95	64.99	21.27	4.02	0.00	0.00	0.00	0.00	23.70	101.14	188.62	

	∑(98)1...5, 10...12 =	685.46	(98)
Space heating requirement kWh/m²/year	(98) ÷ (4)	13.88	(99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.25	(303a)
Fraction of community heat from CHP		0.75	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.75	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.25	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	685.46			(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	539.80	(307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	179.93	(307b)

Water heating

Annual water heating requirement	1813.79			(64)
Water heat from CHP		(64) x (303a) x (305a) x (306) =	1428.36	(310a)
Water heat from boilers		(64) x (303b) x (305a) x (306) =	476.12	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] = 26.24	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)		
mechanical ventilation fans - balanced, extract or positive input from outside	33.29	(330a)
Total electricity for the above, kWh/year	33.29	(331)
Electricity for lighting (Appendix L)	229.32	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) = 2886.82	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	539.80	x	2.97	x 0.01 =	16.03	(340a)
Space heating from boilers	179.93	x	4.24	x 0.01 =	7.63	(340b)
Water heating from CHP	1428.36	x	2.97	x 0.01 =	42.42	(342a)
Water heating from boilers	476.12	x	4.24	x 0.01 =	20.19	(342b)
Pumps and fans	33.29	x	13.19	x 0.01 =	4.39	(349)
Electricity for lighting	229.32	x	13.19	x 0.01 =	30.25	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	240.91	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.07	(357)
SAP value	85.05	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	817.7541	x	0.2160	=	176.6349	(363)
less credit emissions for electricity		-229.7035	x	0.5190	=	-119.2161	(364)
Water heated by CHP		2163.8390	x	0.2160	=	467.3892	(365)
less credit emissions for electricity		-607.8127	x	0.5190	=	-315.4548	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	697.93	x	0.216	=	150.75	(368)
Electrical energy for community heat distribution		26.24	x	0.52	=	13.62	(372)
Total CO2 associated with community systems						373.73	(373)
Total CO2 associated with space and water heating						373.73	(376)
Pumps and fans		33.29	x	0.52	=	17.28	(378)
Electricity for lighting		229.32	x	0.52	=	119.01	(379)
Total CO_2, kg/year					(376)..(382) =	510.02	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.33	(384)
EI value						92.76	
EI rating (section 14)						93	(385)
EI band						A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	817.75	x	1.22	=	997.66	(363)
less credit energy for electricity		-229.70	x	3.07	=	-705.19	(364)
Water heated by CHP		2163.84	x	1.22	=	2639.88	(365)
less credit energy for electricity		-607.81	x	3.07	=	-1865.98	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	697.93	x	1.22	=	851.47	(368)
Electrical energy for community heat distribution		26.24	x	3.07	=	80.56	(372)
Total primary energy associated with community systems						1998.41	(373)
Total primary energy associated with space and water heating						1998.41	(376)
Pumps and fans		33.29	x	3.07	=	102.20	(378)
Electricity for lighting		229.32	x	3.07	=	704.00	(379)
Primary energy kWh/year						2804.61	(383)
Dwelling primary energy rate kWh/m2/year						56.78	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	23/11/2016
Address	A-L04-65 A Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m^2)			Average storey height (m)			Volume (m^3)	
Lowest occupied		77.30	(1a)	x	2.50	(2a)	=	193.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	77.30	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	193.25	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.16	(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	0.20	0.19	0.19	0.17	0.17	0.15	0.15	0.14	0.16	0.17	0.17	0.18	(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	N/A	(23c)

c) whole house extract ventilation or positive input ventilation from outside

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			14.12	x	1.24	=	17.45			(27)
External wall			13.75	x	0.18	=	2.48			(29a)
Party wall			60.09	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			27.87							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	19.92	(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		4.23	(36)
Total fabric heat loss	(33) + (36) =	24.15	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	(38)
Heat transfer coefficient, W/K (37)m + (38)m	56.04	56.04	56.04	56.04	56.04	56.04	56.04	56.04	56.04	56.04	56.04	56.04	
Average = ∑(39)1...12/12 =												56.04	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	
Average = ∑(40)1...12/12 =												0.72	(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	2.41	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	91.43	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	100.57	96.91	93.26	89.60	85.94	82.29	82.29	85.94	89.60	93.26	96.91	100.57	
∑(44)1...12 =												1097.15	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	149.14	130.44	134.61	117.35	112.60	97.17	90.04	103.32	104.56	121.85	133.01	144.44	
∑(45)1...12 =												1438.53	(45)
Distribution loss 0.15 x (45)m	22.37	19.57	20.19	17.60	16.89	14.58	13.51	15.50	15.68	18.28	19.95	21.67	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

204.42	180.37	189.88	170.85	167.88	150.66	145.32	158.60	158.05	177.13	186.50	199.72	(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

204.42	180.37	189.88	170.85	167.88	150.66	145.32	158.60	158.05	177.13	186.50	199.72

∑(64)1...12 = 2089.37 (64)

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

93.81	83.31	88.98	81.81	81.66	75.10	74.16	78.58	77.56	84.74	87.02	92.25	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	120.48	120.48	120.48	120.48	120.48	120.48	120.48	120.48	120.48	120.48	120.48	120.48	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.11	16.98	13.81	10.45	7.81	6.60	7.13	9.26	12.43	15.79	18.43	19.64	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	213.71	215.92	210.33	198.44	183.42	169.31	159.88	157.66	163.25	175.14	190.16	204.28	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.05	35.05	35.05	35.05	35.05	35.05	35.05	35.05	35.05	35.05	35.05	35.05	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	(71)
Water heating gains (Table 5)	126.09	123.98	119.59	113.63	109.76	104.31	99.68	105.61	107.72	113.89	120.86	123.99	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	418.05	416.02	402.88	381.67	360.14	339.36	325.83	331.68	342.55	363.97	388.59	407.05	(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	
NorthEast	0.77	x	14.12	x	11.28	x 0.9 x	0.40	x	0.80	=	35.33	(75)

Solar gains in watts ∑(74)m...(82)m

35.33	71.91	129.57	212.79	286.03	304.94	285.26	227.41	157.88	87.89	44.45	28.85	(83)

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

453.38	487.94	532.45	594.45	646.17	644.29	611.09	559.09	500.43	451.86	433.05	435.90	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	1.00	0.98	0.93	0.77	0.55	0.40	0.46	0.74	0.96	0.99	1.00	(86)

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

20.36	20.45	20.62	20.84	20.97	21.00	21.00	21.00	20.98	20.80	20.54	20.33	(87)

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

20.32	20.32	20.32	20.32	20.32	20.32	20.32	20.32	20.32	20.32	20.32	20.32	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.98	0.91	0.72	0.50	0.34	0.39	0.68	0.95	0.99	1.00	(89)

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

19.46	19.59	19.83	20.13	20.29	20.32	20.32	20.32	20.30	20.09	19.72	19.42	(90)

Living area fraction — Living area ÷ (4) = 0.34 (91)

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

19.76	19.88	20.10	20.37	20.52	20.55	20.55	20.55	20.53	20.33	19.99	19.72	(92)

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

19.76	19.88	20.10	20.37	20.52	20.55	20.55	20.55	20.53	20.33	19.99	19.72	(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	0.91	0.74	0.52	0.36	0.42	0.70	0.95	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	451.57	484.18	520.49	542.18	476.17	331.94	221.13	232.19	350.86	427.51	429.04	434.58	(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]													
	866.52	839.33	761.92	642.55	494.08	333.17	221.20	232.40	360.40	545.36	722.62	869.93	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	308.73	238.66	179.62	72.26	13.33	0.00	0.00	0.00	0.00	87.67	211.38	323.90	

∑(98)1...5, 10...12 = 1435.55 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 18.57 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.25	(303a)
Fraction of community heat from CHP		0.75	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.75	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.25	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1435.55			(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	1130.50	(307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	376.83	(307b)

Water heating

Annual water heating requirement	2089.37			(64)
Water heat from CHP		(64) x (303a) x (305a) x (306) =	1645.38	(310a)
Water heat from boilers		(64) x (303b) x (305a) x (306) =	548.46	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =		37.01	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)				
mechanical ventilation fans - balanced, extract or positive input from outside		52.10		(330a)
Total electricity for the above, kWh/year			52.10	(331)
Electricity for lighting (Appendix L)			337.53	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =		4090.81	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	1130.50	x	2.97	x 0.01 =	33.58	(340a)
Space heating from boilers	376.83	x	4.24	x 0.01 =	15.98	(340b)
Water heating from CHP	1645.38	x	2.97	x 0.01 =	48.87	(342a)
Water heating from boilers	548.46	x	4.24	x 0.01 =	23.25	(342b)
Pumps and fans	52.10	x	13.19	x 0.01 =	6.87	(349)
Electricity for lighting	337.53	x	13.19	x 0.01 =	44.52	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		293.07	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.01	(357)
SAP value	85.96	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	1712.6044	x	0.2160	=	369.9226	(363)
less credit emissions for electricity		-481.0629	x	0.5190	=	-249.6717	(364)
Water heated by CHP		2492.6050	x	0.2160	=	538.4027	(365)
less credit emissions for electricity		-700.1616	x	0.5190	=	-363.3839	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	984.35	x	0.216	=	212.62	(368)
Electrical energy for community heat distribution		37.01	x	0.52	=	19.21	(372)
Total CO2 associated with community systems						527.10	(373)
Total CO2 associated with space and water heating						527.10	(376)
Pumps and fans		52.10	x	0.52	=	27.04	(378)
Electricity for lighting		337.53	x	0.52	=	175.18	(379)
Total CO_2, kg/year					(376)..(382) =	729.32	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	9.43	(384)
EI value						92.01	
EI rating (section 14)						92	(385)
EI band						A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	1712.60	x	1.22	=	2089.38	(363)
less credit energy for electricity		-481.06	x	3.07	=	-1476.86	(364)
Water heated by CHP		2492.60	x	1.22	=	3040.98	(365)
less credit energy for electricity		-700.16	x	3.07	=	-2149.50	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	984.35	x	1.22	=	1200.91	(368)
Electrical energy for community heat distribution		37.01	x	3.07	=	113.63	(372)
Total primary energy associated with community systems						2818.53	(373)
Total primary energy associated with space and water heating						2818.53	(376)
Pumps and fans		52.10	x	3.07	=	159.96	(378)
Electricity for lighting		337.53	x	3.07	=	1036.22	(379)
Primary energy kWh/year						4014.71	(383)
Dwelling primary energy rate kWh/m2/year						51.94	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	23/11/2016
Address	A-L06-73 A Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		72.32	(1a)	x	2.50	(2a)	=	180.80	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	72.32	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			180.80	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(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) =	0.17	(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	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.20	(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	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			21.34	x	1.24	=	26.37			(27)
External wall			11.81	x	0.18	=	2.13			(29a)
Party wall			51.97	x	0.00	=	0.00			(32)
Roof			72.32	x	0.16	=	11.57			(30)
Total area of external elements ∑A, m²			105.47							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	40.07	(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		4.81	(36)
Total fabric heat loss	(33) + (36) =	44.88	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	29.83	29.83	29.83	29.83	29.83	29.83	29.83	29.83	29.83	29.83	29.83	29.83	(38)
Heat transfer coefficient, W/K (37)m + (38)m	74.71	74.71	74.71	74.71	74.71	74.71	74.71	74.71	74.71	74.71	74.71	74.71	
Average = ∑(39)1...12/12 =												74.71	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	
Average = ∑(40)1...12/12 =												1.03	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.30	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.85	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	97.74	94.18	90.63	87.07	83.52	79.97	79.97	83.52	87.07	90.63	94.18	97.74	
∑(44)1...12 =												1066.22	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	144.94	126.77	130.81	114.04	109.43	94.43	87.50	100.41	101.61	118.41	129.26	140.37	
∑(45)1...12 =												1397.98	(45)
Distribution loss 0.15 x (45)m	21.74	19.01	19.62	17.11	16.41	14.16	13.13	15.06	15.24	17.76	19.39	21.06	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

200.22	176.69	186.09	167.54	164.70	147.92	142.78	155.69	155.10	173.69	182.75	195.64	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

200.22	176.69	186.09	167.54	164.70	147.92	142.78	155.69	155.10	173.69	182.75	195.64	
										∑(64)1...12 =	2048.82	(64)

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

92.41	82.09	87.72	80.71	80.61	74.19	73.32	77.61	76.58	83.59	85.77	90.89	(65)

5. Internal gains

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

Metabolic gains (Table 5)

115.06	115.06	115.06	115.06	115.06	115.06	115.06	115.06	115.06	115.06	115.06	115.06	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

18.07	16.05	13.05	9.88	7.39	6.23	6.74	8.76	11.75	14.92	17.42	18.57	(67)

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

202.65	204.75	199.45	188.17	173.93	160.55	151.61	149.50	154.80	166.08	180.32	193.71	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

34.51	34.51	34.51	34.51	34.51	34.51	34.51	34.51	34.51	34.51	34.51	34.51	(69)

Pump and fan gains (Table 5a)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)

Losses e.g. evaporation (Table 5)

-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	(71)

Water heating gains (Table 5)

124.21	122.16	117.90	112.10	108.34	103.04	98.54	104.31	106.36	112.36	119.13	122.17	(72)

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

402.45	400.48	387.92	367.67	347.18	327.34	314.40	320.09	330.43	350.88	374.39	391.96	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	21.34	x	36.79	x 0.9 x	0.40	x	0.80	=	174.12	(79)

Solar gains in watts ∑(74)m...(82)m

174.12	296.59	405.81	502.82	563.20	559.13	539.06	494.01	439.41	327.80	208.56	149.01	(83)

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

576.57	697.07	793.73	870.49	910.38	886.47	853.46	814.10	769.84	678.68	582.95	540.97	(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	0.86	0.71	0.53	0.38	0.42	0.64	0.90	0.98	0.99	(86)

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

20.10	20.31	20.56	20.80	20.94	20.99	21.00	21.00	20.97	20.78	20.38	20.05	(87)

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

20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.97	0.93	0.83	0.66	0.46	0.30	0.33	0.57	0.86	0.97	0.99	(89)

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

18.88	19.17	19.52	19.83	20.00	20.05	20.06	20.05	20.04	19.82	19.28	18.80	(90)

Living area fraction — Living area ÷ (4) = 0.28 (91)

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

19.22	19.49	19.81	20.10	20.27	20.31	20.32	20.32	20.30	20.09	19.59	19.15	(92)

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

19.22	19.49	19.81	20.10	20.27	20.31	20.32	20.32	20.30	20.09	19.59	19.15	(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	0.92	0.83	0.67	0.48	0.33	0.36	0.59	0.86	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	568.96	674.14	733.11	721.36	609.30	422.79	277.51	292.12	451.35	586.05	565.51	535.68	(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]	1114.76	1090.08	994.43	837.06	639.95	426.85	277.91	292.81	463.18	708.87	932.96	1116.77	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	406.07	279.51	194.42	83.30	22.81	0.00	0.00	0.00	0.00	91.38	264.56	432.33	

∑(98)1...5, 10...12 = 1774.40 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 24.54 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.25	(303a)
Fraction of community heat from CHP		0.75	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.75	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.25	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1774.40			(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	1397.34	(307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	465.78	(307b)

Water heating

Annual water heating requirement	2048.82			(64)
Water heat from CHP		(64) x (303a) x (305a) x (306) =	1613.44	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	537.81	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	40.14	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	45.88		(330a)
Total electricity for the above, kWh/year		45.88	(331)
Electricity for lighting (Appendix L)		319.06	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4379.32	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	1397.34	x	2.97	x 0.01 =	41.50	(340a)
Space heating from boilers	465.78	x	4.24	x 0.01 =	19.75	(340b)
Water heating from CHP	1613.44	x	2.97	x 0.01 =	47.92	(342a)
Water heating from boilers	537.81	x	4.24	x 0.01 =	22.80	(342b)
Pumps and fans	45.88	x	13.19	x 0.01 =	6.05	(349)
Electricity for lighting	319.06	x	13.19	x 0.01 =	42.08	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	300.11	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.07	(357)
SAP value	85.01	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	2116.8523	x	0.2160	=	457.2401	(363)
less credit emissions for electricity		-594.6143	x	0.5190	=	-308.6048	(364)
Water heated by CHP		2444.2232	x	0.2160	=	527.9522	(365)
less credit emissions for electricity		-686.5713	x	0.5190	=	-356.3305	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1067.65	x	0.216	=	230.61	(368)
Electrical energy for community heat distribution		40.14	x	0.52	=	20.83	(372)
Total CO2 associated with community systems						571.70	(373)
Total CO2 associated with space and water heating						571.70	(376)
Pumps and fans		45.88	x	0.52	=	23.81	(378)
Electricity for lighting		319.06	x	0.52	=	165.59	(379)
Total CO_2, kg/year					(376)..(382) =	761.11	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.52	(384)
EI value						91.31	
EI rating (section 14)						91	(385)

EI band	B

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	2116.85	x	1.22	=	2582.56	(363)
less credit energy for electricity		-594.61	x	3.07	=	-1825.47	(364)
Water heated by CHP		2444.22	x	1.22	=	2981.95	(365)
less credit energy for electricity		-686.57	x	3.07	=	-2107.77	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1067.65	x	1.22	=	1302.54	(368)
Electrical energy for community heat distribution		40.14	x	3.07	=	123.24	(372)
Total primary energy associated with community systems						3057.05	(373)
Total primary energy associated with space and water heating						3057.05	(376)
Pumps and fans		45.88	x	3.07	=	140.85	(378)
Electricity for lighting		319.06	x	3.07	=	979.51	(379)
Primary energy kWh/year						4177.41	(383)
Dwelling primary energy rate kWh/m2/year						57.76	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	23/11/2016
Address	B-L00-02 B Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		95.27	(1a)	x	2.50	(2a)	=	238.18	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	95.27	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	238.18	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(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) =	0.17	(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	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.20	(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	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			27.95	x	1.24	=	34.54			(27)
Ground floor			95.27	x	0.20	=	19.05			(28a)
External wall			25.22	x	0.18	=	4.54			(29a)
Party wall			63.29	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			148.44							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	58.13	(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		10.27	(36)
Total fabric heat loss	(33) + (36) =	68.41	(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)	39.30	39.30	39.30	39.30	39.30	39.30	39.30	39.30	39.30	39.30	39.30	39.30	(38)
Heat transfer coefficient, W/K (37)m + (38)m	107.70	107.70	107.70	107.70	107.70	107.70	107.70	107.70	107.70	107.70	107.70	107.70	
Average = ∑(39)1...12/12 =												107.70	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	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	2.69	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	98.12	(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)	107.93	104.00	100.08	96.15	92.23	88.30	88.30	92.23	96.15	100.08	104.00	107.93	
∑(44)1...12 =												1177.40	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	160.05	139.98	144.45	125.94	120.84	104.27	96.63	110.88	112.20	130.76	142.74	155.00	
∑(45)1...12 =												1543.75	(45)
Distribution loss 0.15 x (45)m	24.01	21.00	21.67	18.89	18.13	15.64	14.49	16.63	16.83	19.61	21.41	23.25	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

215.33	189.91	199.73	179.43	176.12	157.77	151.90	166.16	165.70	186.04	196.23	210.28	(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

215.33	189.91	199.73	179.43	176.12	157.77	151.90	166.16	165.70	186.04	196.23	210.28	

∑(64)1...12 = 2194.59 (64)

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

97.44	86.49	92.25	84.67	84.40	77.47	76.35	81.09	80.10	87.70	90.26	95.76	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	134.56	134.56	134.56	134.56	134.56	134.56	134.56	134.56	134.56	134.56	134.56	134.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.15	19.67	16.00	12.11	9.05	7.64	8.26	10.74	14.41	18.30	21.35	22.76	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	248.45	251.02	244.53	230.70	213.24	196.83	185.87	183.29	189.79	203.62	221.08	237.48	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.46	36.46	36.46	36.46	36.46	36.46	36.46	36.46	36.46	36.46	36.46	36.46	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	(71)
Water heating gains (Table 5)	130.97	128.70	123.99	117.60	113.44	107.59	102.62	108.99	111.25	117.88	125.35	128.71	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	464.93	462.77	447.89	423.77	399.10	375.43	360.12	366.38	378.82	403.16	431.15	452.33	(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	27.95	x	36.79	x 0.9 x	0.40	x	0.80	=	228.06	(79)

Solar gains in watts ∑(74)m...(82)m

228.06	388.46	531.51	658.57	737.65	732.32	706.03	647.03	575.51	429.33	273.16	195.17	(83)

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

692.99	851.23	979.40	1082.34	1136.75	1107.75	1066.15	1013.42	954.33	832.49	704.31	647.50	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	0.99	0.96	0.90	0.78	0.60	0.44	0.48	0.72	0.93	0.99	1.00	(86)

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

19.90	20.12	20.39	20.68	20.89	20.98	21.00	20.99	20.94	20.66	20.21	19.85	(87)

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

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

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.98	0.95	0.87	0.72	0.51	0.34	0.38	0.63	0.91	0.98	1.00	(89)

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

18.53	18.83	19.22	19.62	19.87	19.96	19.97	19.97	19.93	19.60	18.97	18.45	(90)

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

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

19.09	19.36	19.70	20.05	20.29	20.38	20.39	20.39	20.35	20.04	19.48	19.02	(92)

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

19.09	19.36	19.70	20.05	20.29	20.38	20.39	20.39	20.35	20.04	19.48	19.02	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.95	0.88	0.74	0.55	0.38	0.42	0.67	0.91	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	687.32	832.99	928.54	948.36	840.67	607.37	406.68	426.80	634.95	755.09	691.18	643.60	(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]	1593.14	1557.39	1421.86	1201.18	924.90	622.24	408.58	429.95	672.92	1016.46	1333.21	1596.45	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	673.93	486.79	367.03	182.03	62.67	0.00	0.00	0.00	0.00	194.46	462.26	708.92	

∑(98)1...5, 10...12 = 3138.08 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 32.94 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.25	(303a)
Fraction of community heat from CHP		0.75	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.75	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.25	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	3138.08			(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	2471.24	(307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	823.75	(307b)

Water heating

Annual water heating requirement	2194.59			(64)
Water heat from CHP		(64) x (303a) x (305a) x (306) =	1728.24	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	576.08	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	55.99	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	60.44		(330a)
Total electricity for the above, kWh/year		60.44	(331)
Electricity for lighting (Appendix L)		391.16	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)…(337b) =	6050.91	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	2471.24	x	2.97	x 0.01 =	73.40	(340a)
Space heating from boilers	823.75	x	4.24	x 0.01 =	34.93	(340b)
Water heating from CHP	1728.24	x	2.97	x 0.01 =	51.33	(342a)
Water heating from boilers	576.08	x	4.24	x 0.01 =	24.43	(342b)
Pumps and fans	60.44	x	13.19	x 0.01 =	7.97	(349)
Electricity for lighting	391.16	x	13.19	x 0.01 =	51.59	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)…(342e) + (345)…(354) =	363.64	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.09	(357)
SAP value	84.81	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	3743.7107	x	0.2160	=	808.6415	(363)
less credit emissions for electricity		-1051.5916	x	0.5190	=	-545.7760	(364)
Water heated by CHP		2618.1322	x	0.2160	=	565.5165	(365)
less credit emissions for electricity		-735.4216	x	0.5190	=	-381.6838	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1489.18	x	0.216	=	321.66	(368)
Electrical energy for community heat distribution		55.99	x	0.52	=	29.06	(372)
Total CO2 associated with community systems						797.42	(373)
Total CO2 associated with space and water heating						797.42	(376)
Pumps and fans		60.44	x	0.52	=	31.37	(378)
Electricity for lighting		391.16	x	0.52	=	203.01	(379)
Total CO_2, kg/year					(376)..(382) =	1031.80	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.83	(384)
EI value						90.14	
EI rating (section 14)						90	(385)

EI band	B

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	3743.71	x	1.22	=	4567.33	(363)
less credit energy for electricity		-1051.59	x	3.07	=	-3228.39	(364)
Water heated by CHP		2618.13	x	1.22	=	3194.12	(365)
less credit energy for electricity		-735.42	x	3.07	=	-2257.74	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1489.18	x	1.22	=	1816.80	(368)
Electrical energy for community heat distribution		55.99	x	3.07	=	171.90	(372)
Total primary energy associated with community systems						4264.01	(373)
Total primary energy associated with space and water heating						4264.01	(376)
Pumps and fans		60.44	x	3.07	=	185.55	(378)
Electricity for lighting		391.16	x	3.07	=	1200.87	(379)
Primary energy kWh/year						5650.43	(383)
Dwelling primary energy rate kWh/m2/year						59.31	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	23/11/2016
Address	B-L00-05 B Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		63.47	(1a)	x	2.50	(2a)	=	158.68	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	63.47	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			158.68	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.16	(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	0.20	0.19	0.19	0.17	0.17	0.15	0.15	0.14	0.16	0.17	0.17	0.18	(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	N/A	(23c)

c) whole house extract ventilation or positive input ventilation from outside

0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)

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

0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			12.76	x	1.24	=	15.77			(27)
Door			2.32	x	1.80	=	4.18			(26)
Ground floor			63.47	x	0.20	=	12.69			(28a)
External wall			7.89	x	0.18	=	1.42			(29a)
Party wall			57.47	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			86.44							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	34.06	(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		5.06	(36)
Total fabric heat loss	(33) + (36) =	39.11	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	26.18	26.18	26.18	26.18	26.18	26.18	26.18	26.18	26.18	26.18	26.18	26.18	(38)
Heat transfer coefficient, W/K (37)m + (38)m	65.30	65.30	65.30	65.30	65.30	65.30	65.30	65.30	65.30	65.30	65.30	65.30	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	
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)

Heat transfer coefficient: Average = ∑(39)1...12/12 = 65.30 (39)

Heat loss parameter: Average = ∑(40)1...12/12 = 1.03 (40)

4. Water heating energy requirement

Assumed occupancy, N	2.08	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	83.55	(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)	91.90	88.56	85.22	81.88	78.54	75.19	75.19	78.54	81.88	85.22	88.56	91.90	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	136.29	119.20	123.00	107.24	102.90	88.79	82.28	94.42	95.54	111.35	121.55	131.99	
Distribution loss 0.15 x (45)m	20.44	17.88	18.45	16.09	15.43	13.32	12.34	14.16	14.33	16.70	18.23	19.80	(46)

Hot water usage: ∑(44)1...12 = 1002.59 (44)

Energy content: ∑(45)1...12 = 1314.55 (45)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)
Primary circuit loss for each month from Table 3	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Combi loss for each month from Table 3a, 3b or 3c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	191.57	169.13	178.28	160.73	158.17	142.29	137.56	149.69	149.04	166.63	175.04	187.27	(62)
Solar DHW input calculated using Appendix G or Appendix H	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from water heater for each month (kWh/month) (62)m + (63)m	191.57	169.13	178.28	160.73	158.17	142.29	137.56	149.69	149.04	166.63	175.04	187.27	

∑(64)1...12 = 1965.39 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	89.54	79.58	85.12	78.45	78.43	72.32	71.58	75.62	74.56	81.24	83.21	88.11	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	103.89	103.89	103.89	103.89	103.89	103.89	103.89	103.89	103.89	103.89	103.89	103.89	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	16.19	14.38	11.69	8.85	6.62	5.59	6.04	7.85	10.53	13.37	15.61	16.64	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	181.61	183.49	178.74	168.63	155.87	143.88	135.86	133.98	138.73	148.84	161.60	173.59	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	(71)
Water heating gains (Table 5)	120.35	118.42	114.41	108.96	105.42	100.44	96.21	101.63	103.56	109.20	115.57	118.43	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	372.31	370.46	359.01	340.61	322.08	304.07	292.28	297.63	306.99	325.58	346.94	362.83	(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	
NorthEast	0.77	x	12.76	x	11.28	x 0.9 x	0.40	x	0.80	=	31.93	(75)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	31.93	64.99	117.09	192.29	258.48	275.56	257.79	205.51	142.67	79.42	40.17	26.07	(83)
Total gains - internal and solar (73)m + (83)m	404.24	435.44	476.10	532.91	580.56	579.64	550.06	503.14	449.66	405.00	387.12	388.90	(84)

7. Mean internal temperature (heating season)

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

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

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

1.00	1.00	0.99	0.96	0.86	0.68	0.52	0.58	0.85	0.98	0.99	1.00	(86)

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

19.96	20.07	20.28	20.58	20.84	20.97	20.99	20.99	20.89	20.57	20.21	19.93	(87)

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

20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.98	0.94	0.82	0.60	0.41	0.47	0.78	0.96	0.99	1.00	(89)

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

18.67	18.82	19.14	19.56	19.90	20.04	20.06	20.05	19.97	19.56	19.04	18.62	(90)

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

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

19.36	19.49	19.75	20.11	20.41	20.54	20.56	20.56	20.47	20.10	19.67	19.32	(92)

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

19.36	19.49	19.75	20.11	20.41	20.54	20.56	20.56	20.47	20.10	19.67	19.32	(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	0.95	0.84	0.64	0.47	0.53	0.81	0.96	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	402.44	432.24	467.92	503.91	486.03	372.52	256.46	267.17	364.79	390.63	383.81	387.50	(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]													
	983.65	952.79	865.23	731.82	568.56	387.68	258.64	271.44	415.85	620.40	820.56	987.59	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	432.42	349.81	295.60	164.09	61.40	0.00	0.00	0.00	0.00	170.95	314.46	446.47	

∑(98)1...5, 10...12 = 2235.19 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 35.22 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.25	(303a)
Fraction of community heat from CHP		0.75	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.75	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.25	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	2235.19			(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	1760.22	(307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	586.74	(307b)

Water heating

Annual water heating requirement	1965.39	(64)

Water heat from CHP	(64) x (303a) x (305a) x (306) =	1547.75	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	515.92	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	44.11	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	42.78		(330a)
Total electricity for the above, kWh/year		42.78	(331)
Electricity for lighting (Appendix L)		285.93	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4739.32	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	1760.22	x	2.97	x 0.01 =	52.28	(340a)
Space heating from boilers	586.74	x	4.24	x 0.01 =	24.88	(340b)
Water heating from CHP	1547.75	x	2.97	x 0.01 =	45.97	(342a)
Water heating from boilers	515.92	x	4.24	x 0.01 =	21.87	(342b)
Pumps and fans	42.78	x	13.19	x 0.01 =	5.64	(349)
Electricity for lighting	285.93	x	13.19	x 0.01 =	37.71	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	308.36	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.19	(357)
SAP value	83.34	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	2666.5716	x	0.2160	=	575.9795	(363)
less credit emissions for electricity		-749.0280	x	0.5190	=	-388.7455	(364)
Water heated by CHP		2344.6983	x	0.2160	=	506.4548	(365)
less credit emissions for electricity		-658.6153	x	0.5190	=	-341.8213	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1173.04	x	0.216	=	253.38	(368)
Electrical energy for community heat distribution		44.11	x	0.52	=	22.89	(372)
Total CO2 associated with community systems						628.13	(373)
Total CO2 associated with space and water heating						628.13	(376)
Pumps and fans		42.78	x	0.52	=	22.20	(378)
Electricity for lighting		285.93	x	0.52	=	148.40	(379)
Total CO_2, kg/year					(376)..(382) =	798.73	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	12.58	(384)
EI value						90.13	

EI rating (section 14)	90	(385)
EI band	B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	2666.57	x	1.22	=	3253.22	(363)
less credit energy for electricity		-749.03	x	3.07	=	-2299.52	(364)
Water heated by CHP		2344.70	x	1.22	=	2860.53	(365)
less credit energy for electricity		-658.62	x	3.07	=	-2021.95	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1173.04	x	1.22	=	1431.10	(368)
Electrical energy for community heat distribution		44.11	x	3.07	=	135.41	(372)
Total primary energy associated with community systems						3358.79	(373)
Total primary energy associated with space and water heating						3358.79	(376)
Pumps and fans		42.78	x	3.07	=	131.34	(378)
Electricity for lighting		285.93	x	3.07	=	877.79	(379)
Primary energy kWh/year						4367.93	(383)
Dwelling primary energy rate kWh/m2/year						68.82	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	23/11/2016
Address	B-L04-26 B Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		49.68	(1a)	x	2.50	(2a)	=	124.20	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	49.68	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			124.20	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(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) =	0.17	(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	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.20	(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	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			15.15	x	1.24	=	18.72			(27)
External wall			11.17	x	0.18	=	2.01			(29a)
Party wall			44.15	x	0.00	=	0.00			(32)
Roof			49.68	x	0.16	=	7.95			(30)
Total area of external elements ∑A, m²			76.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	28.68	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.30	(36)
Total fabric heat loss	(33) + (36) =	32.98	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	20.49	20.49	20.49	20.49	20.49	20.49	20.49	20.49	20.49	20.49	20.49	20.49	(38)
Heat transfer coefficient, W/K (37)m + (38)m	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	
Average = ∑(39)1...12/12 =												53.48	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	
Average = ∑(40)1...12/12 =												1.08	(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	74.12	(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)	81.53	78.56	75.60	72.63	69.67	66.70	66.70	69.67	72.63	75.60	78.56	81.53	
∑(44)1...12 =												889.39	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	120.90	105.74	109.12	95.13	91.28	78.77	72.99	83.76	84.76	98.78	107.82	117.09	
∑(45)1...12 =												1166.14	(45)
Distribution loss 0.15 x (45)m	18.14	15.86	16.37	14.27	13.69	11.82	10.95	12.56	12.71	14.82	16.17	17.56	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

176.18	155.67	164.39	148.62	146.56	132.26	128.27	139.03	138.25	154.05	161.32	172.37	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

176.18	155.67	164.39	148.62	146.56	132.26	128.27	139.03	138.25	154.05	161.32	172.37

∑(64)1...12 = 1816.98 (64)

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

84.42	75.10	80.50	74.43	74.57	68.99	68.49	72.07	70.98	77.06	78.65	83.15	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.05	11.59	9.43	7.14	5.34	4.50	4.87	6.33	8.49	10.78	12.58	13.41	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	146.40	147.92	144.09	135.94	125.66	115.99	109.53	108.01	111.84	119.99	130.27	139.94	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	(71)
Water heating gains (Table 5)	113.47	111.76	108.20	103.37	100.23	95.81	92.06	96.87	98.58	103.58	109.23	111.77	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	321.14	319.48	309.93	294.66	279.43	264.51	254.66	259.41	267.12	282.56	300.30	313.33	(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	
North	0.77	x	2.09	x	10.63	x 0.9 x	0.40	x	0.80	=	4.93	(74)
NorthEast	0.77	x	13.06	x	11.28	x 0.9 x	0.40	x	0.80	=	32.68	(75)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	37.61	75.93	135.84	222.52	299.18	319.12	298.46	237.80	165.27	92.50	47.20	30.79	(83)
Total gains - internal and solar (73)m + (83)m	358.74	395.42	445.78	517.18	578.62	583.63	553.12	497.21	432.39	375.06	347.49	344.13	(84)

7. Mean internal temperature (heating season)

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

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

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

1.00	0.99	0.98	0.92	0.77	0.57	0.42	0.49	0.77	0.96	0.99	1.00	(86)

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

19.97	20.10	20.35	20.67	20.90	20.98	21.00	20.99	20.93	20.62	20.24	19.94	(87)

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

20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.02	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.99	0.97	0.89	0.71	0.49	0.33	0.39	0.69	0.94	0.99	0.99	(89)

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

18.66	18.85	19.20	19.65	19.93	20.01	20.02	20.02	19.97	19.59	19.04	18.61	(90)

Living area fraction	Living area ÷ (4) =	0.47	(91)

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

19.28	19.44	19.75	20.13	20.39	20.47	20.48	20.48	20.42	20.08	19.61	19.24	(92)

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

19.28	19.44	19.75	20.13	20.39	20.47	20.48	20.48	20.42	20.08	19.61	19.24	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.99	0.99	0.97	0.90	0.74	0.53	0.37	0.44	0.72	0.94	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	355.92	389.95	430.78	463.92	426.52	308.41	206.88	216.62	312.70	351.82	342.22	341.93	(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]													
	801.18	777.60	708.31	600.66	464.76	313.94	207.60	218.19	338.10	506.92	668.85	804.05	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	331.27	260.50	206.48	98.46	28.45	0.00	0.00	0.00	0.00	115.39	235.18	343.82	

	∑(98)1...5, 10...12 =	1619.54	(98)
Space heating requirement kWh/m²/year	(98) ÷ (4)	32.60	(99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.25	(303a)
Fraction of community heat from CHP		0.75	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.75	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.25	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1619.54			(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	1275.39	(307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	425.13	(307b)

Water heating

Annual water heating requirement	1816.98	(64)

Water heat from CHP				(64) x (303a) x (305a) x (306) =	1430.87	(310a)
Water heat from boilers				(64) x (303b) x (305a) x (306) =	476.96	(310b)
Electricity used for heat distribution				0.01 × [(307a)...(307e) + (310a)...(310e)] =	36.08	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)						
mechanical ventilation fans - balanced, extract or positive input from outside			33.49			(330a)
Total electricity for the above, kWh/year					33.49	(331)
Electricity for lighting (Appendix L)					230.50	(332)
Total delivered energy for all uses				(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3872.33	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	1275.39	x	2.97	x 0.01 =	37.88	(340a)
Space heating from boilers	425.13	x	4.24	x 0.01 =	18.03	(340b)
Water heating from CHP	1430.87	x	2.97	x 0.01 =	42.50	(342a)
Water heating from boilers	476.96	x	4.24	x 0.01 =	20.22	(342b)
Pumps and fans	33.49	x	13.19	x 0.01 =	4.42	(349)
Electricity for lighting	230.50	x	13.19	x 0.01 =	30.40	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	273.44	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.21	(357)
SAP value	83.08	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	1932.1019	x	0.2160	=	417.3340	(363)
less credit emissions for electricity		-542.7188	x	0.5190	=	-281.6710	(364)
Water heated by CHP		2167.6404	x	0.2160	=	468.2103	(365)
less credit emissions for electricity		-608.8805	x	0.5190	=	-316.0090	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	959.67	x	0.216	=	207.29	(368)
Electrical energy for community heat distribution		36.08	x	0.52	=	18.73	(372)
Total CO2 associated with community systems						513.88	(373)
Total CO2 associated with space and water heating						513.88	(376)
Pumps and fans		33.49	x	0.52	=	17.38	(378)
Electricity for lighting		230.50	x	0.52	=	119.63	(379)
Total CO_2, kg/year					(376)..(382) =	650.89	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	13.10	(384)
EI value						90.79	

EI rating (section 14)				91	(385)
EI band				B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)						
Power efficiency of CHP unit	28.09					(361)
Heat efficiency of CHP unit	66.01					(362)
Space heating from CHP (307a) × 100 ÷ (362) =	1932.10	x	1.22	=	2357.16	(363)
less credit energy for electricity	-542.72	x	3.07	=	-1666.15	(364)
Water heated by CHP	2167.64	x	1.22	=	2644.52	(365)
less credit energy for electricity	-608.88	x	3.07	=	-1869.26	(366)
Primary energy from other sources (space heating)						
Efficiency of boilers	94.00					(367b)
Primary energy from boilers [(307b)+(310b)] x 100 ÷ (367b) =	959.67	x	1.22	=	1170.79	(368)
Electrical energy for community heat distribution	36.08	x	3.07	=	110.78	(372)
Total primary energy associated with community systems					2747.84	(373)
Total primary energy associated with space and water heating					2747.84	(376)
Pumps and fans	33.49	x	3.07	=	102.80	(378)
Electricity for lighting	230.50	x	3.07	=	707.64	(379)
Primary energy kWh/year					3558.29	(383)
Dwelling primary energy rate kWh/m2/year					71.62	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	25/11/2016
Address	A-L00-28 A Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m^2)			Average storey height (m)			Volume (m^3)	
Lowest occupied		73.69	(1a)	x	2.50	(2a)	=	184.23	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	73.69	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			184.23	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(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) =	0.17	(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	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.20	(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	N/A	(23c)

c) whole house extract ventilation or positive input ventilation from outside

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(24c)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			23.06	x	1.24	=	28.50			(27)
Ground floor			73.69	x	0.20	=	14.74			(28a)
External wall			20.99	x	0.18	=	3.78			(29a)
Party wall			56.27	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			117.74							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	47.01	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		8.56	(36)
Total fabric heat loss	(33) + (36) =	55.58	(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)	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40	(38)
Heat transfer coefficient, W/K (37)m + (38)m	85.97	85.97	85.97	85.97	85.97	85.97	85.97	85.97	85.97	85.97	85.97	85.97	
Average = ∑(39)1...12/12 =												85.97	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	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	2.33	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	89.59	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	98.55	94.97	91.38	87.80	84.22	80.63	80.63	84.22	87.80	91.38	94.97	98.55	
∑(44)1...12 =												1075.10	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	146.15	127.82	131.90	114.99	110.34	95.21	88.23	101.25	102.45	119.40	130.34	141.54	
∑(45)1...12 =												1409.62	(45)
Distribution loss 0.15 x (45)m	21.92	19.17	19.79	17.25	16.55	14.28	13.23	15.19	15.37	17.91	19.55	21.23	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

201.42	177.75	187.18	168.49	165.62	148.71	143.51	156.52	155.95	174.68	183.83	196.81	(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

201.42	177.75	187.18	168.49	165.62	148.71	143.51	156.52	155.95	174.68	183.83	196.81

∑(64)1...12 = 2060.46 (64)

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

92.82	82.44	88.08	81.03	80.91	74.45	73.56	77.89	76.86	83.92	86.13	91.28	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	116.61	116.61	116.61	116.61	116.61	116.61	116.61	116.61	116.61	116.61	116.61	116.61	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.34	16.29	13.25	10.03	7.50	6.33	6.84	8.89	11.93	15.15	17.68	18.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	205.75	207.89	202.51	191.05	176.59	163.00	153.93	151.79	157.17	168.63	183.08	196.67	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	-93.29	(71)
Water heating gains (Table 5)	124.75	122.68	118.38	112.54	108.75	103.41	98.87	104.69	106.75	112.80	119.63	122.69	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	406.83	404.85	392.13	371.61	350.83	330.73	317.62	323.35	333.84	354.56	378.38	396.20	(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	23.06	x	36.79	x 0.9 x	0.40	x	0.80	=	188.16	(79)

Solar gains in watts ∑(74)m...(82)m

188.16	320.50	438.52	543.35	608.60	604.19	582.51	533.83	474.83	354.22	225.37	161.02	(83)

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

594.99	725.34	830.65	914.96	959.42	934.92	900.13	857.18	808.67	708.78	603.75	557.22	(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	0.98	0.95	0.88	0.75	0.57	0.42	0.46	0.68	0.91	0.98	0.99	(86)

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

19.93	20.14	20.42	20.70	20.90	20.98	21.00	20.99	20.95	20.69	20.24	19.87	(87)

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

19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	19.95	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.97	0.94	0.85	0.69	0.48	0.32	0.35	0.60	0.88	0.98	0.99	(89)

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

18.54	18.85	19.24	19.62	19.86	19.93	19.95	19.94	19.91	19.61	18.99	18.46	(90)

Living area fraction — Living area ÷ (4) = 0.39 (91)

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

19.07	19.35	19.70	20.04	20.26	20.34	20.35	20.35	20.31	20.03	19.47	19.00	(92)

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

19.07	19.35	19.70	20.04	20.26	20.34	20.35	20.35	20.31	20.03	19.47	19.00	(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	0.93	0.85	0.71	0.52	0.36	0.39	0.63	0.88	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	587.60	703.64	774.67	778.47	677.95	483.23	321.16	337.44	508.79	625.80	587.52	552.01	(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]	1270.16	1242.46	1134.56	957.62	735.62	493.16	322.42	339.50	533.98	810.37	1063.42	1272.48	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	507.82	362.08	267.76	128.99	42.91	0.00	0.00	0.00	0.00	137.32	342.65	536.03	

	∑(98)1...5, 10...12 =	2325.56	(98)
Space heating requirement kWh/m²/year	(98) ÷ (4)	31.56	(99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.25	(303a)
Fraction of community heat from CHP		0.75	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.75	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.25	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	2325.56			(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	1831.38	(307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	610.46	(307b)

Water heating

Annual water heating requirement	2060.46			(64)
Water heat from CHP		(64) x (303a) x (305a) x (306) =	1622.62	(310a)

Water heat from boilers				(64) x (303b) x (305a) x (306) =	540.87	(310b)
Electricity used for heat distribution				0.01 × [(307a)...(307e) + (310a)...(310e)] =	46.05	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)						
mechanical ventilation fans - balanced, extract or positive input from outside			49.67			(330a)
Total electricity for the above, kWh/year					49.67	(331)
Electricity for lighting (Appendix L)					323.94	(332)
Energy saving/generation technologies						
electricity generated by PV (Appendix M)					-53.23	(333)
Total delivered energy for all uses				(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4925.70	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	1831.38	x	2.97	x 0.01 =	54.39	(340a)
Space heating from boilers	610.46	x	4.24	x 0.01 =	25.88	(340b)
Water heating from CHP	1622.62	x	2.97	x 0.01 =	48.19	(342a)
Water heating from boilers	540.87	x	4.24	x 0.01 =	22.93	(342b)
Pumps and fans	49.67	x	13.19	x 0.01 =	6.55	(349)
Electricity for lighting	323.94	x	13.19	x 0.01 =	42.73	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-53.23	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		320.68	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.13	(357)
SAP value	84.17	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	2774.3769	x	0.2160	=	599.2654	(363)
less credit emissions for electricity		-779.3100	x	0.5190	=	-404.4619	(364)
Water heated by CHP		2458.1194	x	0.2160	=	530.9538	(365)
less credit emissions for electricity		-690.4747	x	0.5190	=	-358.3564	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1224.82	x	0.216	=	264.56	(368)
Electrical energy for community heat distribution		46.05	x	0.52	=	23.90	(372)
Total CO2 associated with community systems						655.86	(373)
Total CO2 associated with space and water heating						655.86	(376)
Pumps and fans		49.67	x	0.52	=	25.78	(378)
Electricity for lighting		323.94	x	0.52	=	168.13	(379)

Energy saving/generation technologies						
pv savings	-53.23	x	0.52	=	-27.63	(380)
Total CO_2, kg/year				(376)..(382) =	822.14	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	11.16	(384)
EI value					90.72	
EI rating (section 14)					91	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)						
Power efficiency of CHP unit	28.09					(361)
Heat efficiency of CHP unit	66.01					(362)
Space heating from CHP (307a) × 100 ÷ (362) =	2774.38	x	1.22	=	3384.74	(363)
less credit energy for electricity	-779.31	x	3.07	=	-2392.48	(364)
Water heated by CHP	2458.12	x	1.22	=	2998.91	(365)
less credit energy for electricity	-690.47	x	3.07	=	-2119.76	(366)
Primary energy from other sources (space heating)						
Efficiency of boilers	94.00					(367b)
Primary energy from boilers [(307b)+(310b)] x 100 ÷ (367b) =	1224.82	x	1.22	=	1494.28	(368)
Electrical energy for community heat distribution	46.05	x	3.07	=	141.38	(372)
Total primary energy associated with community systems					3507.07	(373)
Total primary energy associated with space and water heating					3507.07	(376)
Pumps and fans	49.67	x	3.07	=	152.49	(378)
Electricity for lighting	323.94	x	3.07	=	994.50	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-53.23	x	3.07	=	-163.43	(380)
Primary energy kWh/year					4490.63	(383)
Dwelling primary energy rate kWh/m2/year					60.94	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	25/11/2016
Address	A-L03-19 A Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		87.58	(1a)	x	2.50	(2a)	=	218.95	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	87.58	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			218.95	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(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) =	0.17	(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	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.20	(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	N/A	(23c)

c) whole house extract ventilation or positive input ventilation from outside

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)

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	
0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			29.45	x	1.24	=	36.39			(27)
External wall			21.97	x	0.18	=	3.95			(29a)
Party wall			57.05	x	0.00	=	0.00			(32)
Roof			87.58	x	0.16	=	14.01			(30)
Total area of external elements ∑A, m²			139.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	54.36	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		7.51	(36)
Total fabric heat loss	(33) + (36) =	61.87	(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)	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	(38)
Heat transfer coefficient, W/K (37)m + (38)m	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	98.00	
Average = ∑(39)1...12/12 =												98.00	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	
Average = ∑(40)1...12/12 =												1.12	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.59	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	95.74	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	105.31	101.48	97.65	93.82	89.99	86.17	86.17	89.99	93.82	97.65	101.48	105.31	
∑(44)1...12 =												1148.87	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	156.18	136.59	140.95	122.89	117.91	101.75	94.28	108.19	109.49	127.59	139.28	151.25	
∑(45)1...12 =												1506.35	(45)
Distribution loss 0.15 x (45)m	23.43	20.49	21.14	18.43	17.69	15.26	14.14	16.23	16.42	19.14	20.89	22.69	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

211.45	186.52	196.23	176.38	173.19	155.24	149.56	163.47	162.98	182.87	192.77	206.53	(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

211.45	186.52	196.23	176.38	173.19	155.24	149.56	163.47	162.98	182.87	192.77	206.53

∑(64)1...12 = 2157.19 (64)

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

96.15	85.36	91.09	83.65	83.43	76.63	75.57	80.20	79.20	86.65	89.11	94.51	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	129.56	129.56	129.56	129.56	129.56	129.56	129.56	129.56	129.56	129.56	129.56	129.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.91	18.57	15.10	11.43	8.55	7.22	7.80	10.14	13.60	17.27	20.16	21.49	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	234.55	236.99	230.85	217.80	201.31	185.82	175.47	173.04	179.17	192.23	208.71	224.21	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.96	35.96	35.96	35.96	35.96	35.96	35.96	35.96	35.96	35.96	35.96	35.96	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	-103.65	(71)
Water heating gains (Table 5)	129.23	127.02	122.43	116.19	112.13	106.43	101.57	107.79	110.00	116.46	123.76	127.03	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	446.57	444.45	430.26	407.29	383.86	361.33	346.71	352.83	364.64	387.83	414.50	434.60	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	29.45	x	36.79	x 0.9 x	0.40	x	0.80	=	240.29	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	240.29	409.31	560.04	693.91	777.24	771.62	743.92	681.76	606.40	452.37	287.82	205.64	(83)
Total gains - internal and solar (73)m + (83)m	686.86	853.76	990.29	1101.20	1161.10	1132.95	1090.64	1034.59	971.04	840.21	702.32	640.24	(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)	0.99	0.98	0.95	0.87	0.72	0.54	0.39	0.43	0.66	0.91	0.98	1.00	(86)

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

19.97	20.20	20.48	20.75	20.92	20.99	21.00	21.00	20.96	20.72	20.28	19.91	(87)

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

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

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.97	0.93	0.83	0.66	0.46	0.30	0.34	0.58	0.87	0.98	0.99	(89)

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

18.63	18.96	19.35	19.72	19.92	19.98	19.98	19.98	19.96	19.69	19.08	18.55	(90)

Living area fraction — Living area ÷ (4) = 0.34 (91)

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

19.09	19.39	19.74	20.07	20.26	20.32	20.33	20.33	20.30	20.04	19.49	19.01	(92)

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

19.09	19.39	19.74	20.07	20.26	20.32	20.33	20.33	20.30	20.04	19.49	19.01	(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	0.93	0.83	0.68	0.49	0.33	0.37	0.60	0.87	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	678.99	827.66	918.02	919.02	788.21	553.04	364.84	383.72	586.13	734.93	683.88	634.87	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1449.54	1419.78	1297.51	1094.66	838.95	560.78	365.73	385.24	607.84	925.51	1213.90	1451.82	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	573.29	397.91	282.34	126.46	37.75	0.00	0.00	0.00	0.00	141.79	381.62	607.81	

∑(98)1...5, 10...12 = 2548.97 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 29.10 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.25	(303a)
Fraction of community heat from CHP		0.75	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.75	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.25	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	2548.97			(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	2007.31	(307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	669.10	(307b)

Water heating

Annual water heating requirement	2157.19			(64)
Water heat from CHP		(64) x (303a) x (305a) x (306) =	1698.79	(310a)

Water heat from boilers				(64) x (303b) x (305a) x (306) =	566.26	(310b)
Electricity used for heat distribution				0.01 × [(307a)...(307e) + (310a)...(310e)] =	49.41	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)						
mechanical ventilation fans - balanced, extract or positive input from outside			55.56			(330a)
Total electricity for the above, kWh/year					55.56	(331)
Electricity for lighting (Appendix L)					369.29	(332)
Energy saving/generation technologies						
electricity generated by PV (Appendix M)					-53.23	(333)
Total delivered energy for all uses				(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	5313.08	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	2007.31	x	2.97	x 0.01 =	59.62	(340a)
Space heating from boilers	669.10	x	4.24	x 0.01 =	28.37	(340b)
Water heating from CHP	1698.79	x	2.97	x 0.01 =	50.45	(342a)
Water heating from boilers	566.26	x	4.24	x 0.01 =	24.01	(342b)
Pumps and fans	55.56	x	13.19	x 0.01 =	7.33	(349)
Electricity for lighting	369.29	x	13.19	x 0.01 =	48.71	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-53.23	x	13.19	x 0.01 =	0.00	(352)
Total energy cost				(340a)...(342e) + (345)...(354) =	338.49	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.07	(357)
SAP value	85.04	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	3040.9017	x	0.2160	=	656.8348	(363)
less credit emissions for electricity		-854.1757	x	0.5190	=	-443.3172	(364)
Water heated by CHP		2573.5136	x	0.2160	=	555.8789	(365)
less credit emissions for electricity		-722.8884	x	0.5190	=	-375.1791	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1314.22	x	0.216	=	283.87	(368)
Electrical energy for community heat distribution		49.41	x	0.52	=	25.65	(372)
Total CO2 associated with community systems						703.74	(373)
Total CO2 associated with space and water heating						703.74	(376)
Pumps and fans		55.56	x	0.52	=	28.84	(378)
Electricity for lighting		369.29	x	0.52	=	191.66	(379)

Energy saving/generation technologies						
pv savings	-53.23	x	0.52	=	-27.63	(380)
Total CO_2, kg/year				(376)..(382) =	896.60	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.24	(384)
EI value					90.94	
EI rating (section 14)					91	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)						
Power efficiency of CHP unit	28.09					(361)
Heat efficiency of CHP unit	66.01					(362)
Space heating from CHP (307a) × 100 ÷ (362) =	3040.90	x	1.22	=	3709.90	(363)
less credit energy for electricity	-854.18	x	3.07	=	-2622.32	(364)
Water heated by CHP	2573.51	x	1.22	=	3139.69	(365)
less credit energy for electricity	-722.89	x	3.07	=	-2219.27	(366)
Primary energy from other sources (space heating)						
Efficiency of boilers	94.00					(367b)
Primary energy from boilers [(307b)+(310b)] x 100 ÷ (367b) =	1314.22	x	1.22	=	1603.35	(368)
Electrical energy for community heat distribution	49.41	x	3.07	=	151.70	(372)
Total primary energy associated with community systems					3763.05	(373)
Total primary energy associated with space and water heating					3763.05	(376)
Pumps and fans	55.56	x	3.07	=	170.57	(378)
Electricity for lighting	369.29	x	3.07	=	1133.72	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-53.23	x	3.07	=	-163.43	(380)
Primary energy kWh/year					4903.91	(383)
Dwelling primary energy rate kWh/m2/year					55.99	(384)

DER Worksheet
Design - Draft

NHER

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

Assessor name	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	25/11/2016
Address	A-L03-48 A Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m^2)			Average storey height (m)			Volume (m^3)	
Lowest occupied		87.21	(1a)	x	2.50	(2a)	=	218.03	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	87.21	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	218.03	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(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) =	0.17	(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	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.20	(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	N/A	(23c)

c) whole house extract ventilation or positive input ventilation from outside

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)

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	
0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			23.17	x	1.24	=	28.63			(27)
External wall			23.10	x	0.18	=	4.16			(29a)
Party wall			63.52	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			46.27							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.79	(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		6.50	(36)
Total fabric heat loss	(33) + (36) =	39.29	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	(38)
Heat transfer coefficient, W/K (37)m + (38)m	75.26	75.26	75.26	75.26	75.26	75.26	75.26	75.26	75.26	75.26	75.26	75.26	
Average = ∑(39)1...12/12 =												75.26	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	
Average = ∑(40)1...12/12 =												0.86	(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	2.59	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	95.61	(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)	105.17	101.34	97.52	93.70	89.87	86.05	86.05	89.87	93.70	97.52	101.34	105.17	
∑(44)1...12 =												1147.29	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	155.96	136.40	140.76	122.72	117.75	101.61	94.15	108.04	109.33	127.42	139.09	151.04	
∑(45)1...12 =												1504.28	(45)
Distribution loss 0.15 x (45)m	23.39	20.46	21.11	18.41	17.66	15.24	14.12	16.21	16.40	19.11	20.86	22.66	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

211.24	186.33	196.03	176.21	173.03	155.10	149.43	163.32	162.83	182.70	192.58	206.32	(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

211.24	186.33	196.03	176.21	173.03	155.10	149.43	163.32	162.83	182.70	192.58	206.32

∑(64)1...12 = 2155.12 (64)

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

96.08	85.30	91.02	83.60	83.37	76.58	75.53	80.15	79.15	86.59	89.04	94.44	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	129.28	129.28	129.28	129.28	129.28	129.28	129.28	129.28	129.28	129.28	129.28	129.28	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.85	18.52	15.06	11.40	8.52	7.19	7.77	10.11	13.56	17.22	20.10	21.43	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	233.85	236.28	230.16	217.14	200.71	185.27	174.95	172.52	178.64	191.65	208.09	223.53	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	-103.42	(71)
Water heating gains (Table 5)	129.14	126.93	122.34	116.11	112.06	106.36	101.52	107.72	109.93	116.38	123.67	126.94	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	445.62	443.51	429.35	406.44	383.08	360.60	346.02	352.13	363.91	387.04	413.64	433.68	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	2.09	x	10.63	x 0.9 x	0.40	x	0.80	=	4.93	(74)
NorthEast	0.77	x	21.08	x	11.28	x 0.9 x	0.40	x	0.80	=	52.74	(75)

Solar gains in watts ∑(74)m...(82)m

57.67	116.78	209.44	343.38	461.64	492.31	460.48	366.97	254.94	142.42	72.45	47.18	(83)

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

503.29	560.29	638.79	749.82	844.72	852.92	806.50	719.10	618.86	529.46	486.09	480.86	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	1.00	0.99	0.93	0.77	0.56	0.41	0.48	0.78	0.97	1.00	1.00	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)												
20.14	20.26	20.48	20.76	20.95	20.99	21.00	21.00	20.96	20.70	20.36	20.11	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)												
20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	(88)
Utilisation factor for gains for rest of dwelling n2,m												
1.00	0.99	0.98	0.91	0.72	0.49	0.34	0.40	0.71	0.96	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)												
19.04	19.21	19.53	19.92	20.15	20.20	20.20	20.20	20.17	19.84	19.36	18.99	(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2												
19.38	19.53	19.82	20.18	20.40	20.44	20.45	20.45	20.41	20.11	19.67	19.34	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate												
19.38	19.53	19.82	20.18	20.40	20.44	20.45	20.45	20.41	20.11	19.67	19.34	(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	0.91	0.73	0.51	0.36	0.42	0.73	0.96	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m												
501.71	556.53	625.13	683.57	620.17	436.57	289.26	303.79	451.09	506.73	482.65	479.72	(95)
Monthly average external temperature from Table U1												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]												
1135.29	1101.48	1002.57	849.11	654.45	439.74	289.53	304.53	475.00	715.47	946.24	1139.47	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m												
471.38	366.20	280.81	119.19	25.51	0.00	0.00	0.00	0.00	155.31	333.78	490.85	

	∑(98)1...5, 10...12 =	2243.04	(98)
Space heating requirement kWh/m²/year	(98) ÷ (4)	25.72	(99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.25	(303a)
Fraction of community heat from CHP		0.75	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.75	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.25	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	2243.04			(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	1766.39	(307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	588.80	(307b)

Water heating

Annual water heating requirement	2155.12			(64)
Water heat from CHP		(64) x (303a) x (305a) x (306) =	1697.15	(310a)

Water heat from boilers			(64) x (303b) x (305a) x (306) =		565.72	(310b)
Electricity used for heat distribution			0.01 × [(307a)...(307e) + (310a)...(310e)] =		46.18	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)						
mechanical ventilation fans - balanced, extract or positive input from outside			55.33			(330a)
Total electricity for the above, kWh/year					55.33	(331)
Electricity for lighting (Appendix L)					368.18	(332)
Energy saving/generation technologies						
electricity generated by PV (Appendix M)					-53.23	(333)
Total delivered energy for all uses			(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =		4988.33	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	1766.39	x	2.97	x 0.01 =	52.46	(340a)
Space heating from boilers	588.80	x	4.24	x 0.01 =	24.97	(340b)
Water heating from CHP	1697.15	x	2.97	x 0.01 =	50.41	(342a)
Water heating from boilers	565.72	x	4.24	x 0.01 =	23.99	(342b)
Pumps and fans	55.33	x	13.19	x 0.01 =	7.30	(349)
Electricity for lighting	368.18	x	13.19	x 0.01 =	48.56	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-53.23	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		327.68	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.04	(357)
SAP value	85.48	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	2675.9278	x	0.2160	=	578.0004	(363)
less credit emissions for electricity		-751.6561	x	0.5190	=	-390.1095	(364)
Water heated by CHP		2571.0383	x	0.2160	=	555.3443	(365)
less credit emissions for electricity		-722.1932	x	0.5190	=	-374.8182	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1228.21	x	0.216	=	265.29	(368)
Electrical energy for community heat distribution		46.18	x	0.52	=	23.97	(372)
Total CO2 associated with community systems						657.68	(373)
Total CO2 associated with space and water heating						657.68	(376)
Pumps and fans		55.33	x	0.52	=	28.71	(378)
Electricity for lighting		368.18	x	0.52	=	191.09	(379)

Energy saving/generation technologies						
pv savings	-53.23	x	0.52	=	-27.63	(380)
Total CO_2, kg/year				(376)..(382) =	849.85	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.74	(384)
EI value					91.39	
EI rating (section 14)					91	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)						
Power efficiency of CHP unit	28.09					(361)
Heat efficiency of CHP unit	66.01					(362)
Space heating from CHP (307a) × 100 ÷ (362) =	2675.93	x	1.22	=	3264.63	(363)
less credit energy for electricity	-751.66	x	3.07	=	-2307.58	(364)
Water heated by CHP	2571.04	x	1.22	=	3136.67	(365)
less credit energy for electricity	-722.19	x	3.07	=	-2217.13	(366)
Primary energy from other sources (space heating)						
Efficiency of boilers	94.00					(367b)
Primary energy from boilers [(307b)+(310b)] x 100 ÷ (367b) =	1228.21	x	1.22	=	1498.41	(368)
Electrical energy for community heat distribution	46.18	x	3.07	=	141.77	(372)
Total primary energy associated with community systems					3516.77	(373)
Total primary energy associated with space and water heating					3516.77	(376)
Pumps and fans	55.33	x	3.07	=	169.85	(378)
Electricity for lighting	368.18	x	3.07	=	1130.31	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-53.23	x	3.07	=	-163.43	(380)
Primary energy kWh/year					4653.51	(383)
Dwelling primary energy rate kWh/m2/year					53.36	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	25/11/2016
Address	A-L04-60 A Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		49.39	(1a)	x	2.50	(2a)	=	123.48	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	49.39	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			123.48	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.16	(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	0.20	0.19	0.19	0.17	0.17	0.15	0.15	0.14	0.16	0.17	0.17	0.18	(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	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			12.36	x	1.24	=	15.27			(27)
External wall			6.99	x	0.18	=	1.26			(29a)
Party wall			53.62	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			19.35							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	16.53	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.11	(36)
Total fabric heat loss	(33) + (36) =	20.64	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.37	(38)
Heat transfer coefficient, W/K (37)m + (38)m	41.01	41.01	41.01	41.01	41.01	41.01	41.01	41.01	41.01	41.01	41.01	41.01	
Average = ∑(39)1...12/12 =												41.01	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	
Average = ∑(40)1...12/12 =												0.83	(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	1.67	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	73.91	(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)	81.31	78.35	75.39	72.44	69.48	66.52	66.52	69.48	72.44	75.39	78.35	81.31	
∑(44)1...12 =												886.96	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	120.57	105.45	108.82	94.87	91.03	78.55	72.79	83.53	84.53	98.51	107.53	116.77	
∑(45)1...12 =												1162.95	(45)
Distribution loss 0.15 x (45)m	18.09	15.82	16.32	14.23	13.65	11.78	10.92	12.53	12.68	14.78	16.13	17.52	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	175.85	155.38	164.10	148.36	146.31	132.05	128.07	138.81	138.02	153.78	161.02	172.05	(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	175.85	155.38	164.10	148.36	146.31	132.05	128.07	138.81	138.02	153.78	161.02	172.05	

∑(64)1...12 = 1813.79 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	84.31	75.01	80.40	74.34	74.49	68.91	68.42	71.99	70.90	76.98	78.55	83.05	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	83.61	83.61	83.61	83.61	83.61	83.61	83.61	83.61	83.61	83.61	83.61	83.61	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	12.98	11.53	9.38	7.10	5.31	4.48	4.84	6.29	8.45	10.73	12.52	13.35	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	145.65	147.16	143.35	135.24	125.01	115.39	108.96	107.45	111.26	119.37	129.60	139.22	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.36	31.36	31.36	31.36	31.36	31.36	31.36	31.36	31.36	31.36	31.36	31.36	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	-66.89	(71)
Water heating gains (Table 5)	113.32	111.62	108.07	103.25	100.12	95.71	91.97	96.77	98.47	103.46	109.09	111.62	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	320.04	318.39	308.88	293.68	278.52	263.67	253.86	258.59	266.26	281.64	299.30	312.27	(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	12.36	x	36.79	x 0.9 x	0.40	x	0.80	=	100.85	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	100.85	171.79	235.04	291.23	326.20	323.84	312.22	286.13	254.50	189.86	120.80	86.31	(83)
Total gains - internal and solar (73)m + (83)m	420.89	490.18	543.93	584.91	604.72	587.51	566.08	544.72	520.77	471.50	420.09	398.58	(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)	0.98	0.96	0.90	0.79	0.62	0.45	0.32	0.35	0.54	0.82	0.96	0.99	(86)

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

20.45	20.62	20.79	20.93	20.99	21.00	21.00	21.00	21.00	20.92	20.66	20.40	(87)

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

20.23	20.23	20.23	20.23	20.23	20.23	20.23	20.23	20.23	20.23	20.23	20.23	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.95	0.88	0.75	0.57	0.39	0.26	0.29	0.48	0.78	0.95	0.98	(89)

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

19.51	19.74	19.98	20.15	20.21	20.23	20.23	20.23	20.22	20.15	19.81	19.44	(90)

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

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

20.00	20.19	20.40	20.55	20.61	20.62	20.63	20.63	20.62	20.55	20.25	19.94	(92)

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

20.00	20.19	20.40	20.55	20.61	20.62	20.63	20.63	20.62	20.55	20.25	19.94	(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	0.89	0.77	0.60	0.42	0.29	0.32	0.51	0.80	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	411.61	465.14	482.70	448.34	360.14	246.61	165.07	173.24	265.84	376.06	398.96	392.01	(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]	643.86	627.26	570.06	477.89	365.54	247.09	165.11	173.31	267.48	407.91	539.43	645.52	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	172.79	108.95	64.99	21.27	4.02	0.00	0.00	0.00	0.00	23.70	101.14	188.62	

∑(98)1...5, 10...12 = 685.46 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.88 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.25	(303a)
Fraction of community heat from CHP		0.75	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.75	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.25	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	685.46		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	539.80	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	179.93	(307b)

Water heating

Annual water heating requirement	1813.79		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	1428.36	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	476.12	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	26.24	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	33.29		(330a)
Total electricity for the above, kWh/year		33.29	(331)
Electricity for lighting (Appendix L)		229.32	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-53.23	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2833.59	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	539.80	x	2.97	x 0.01 =	16.03	(340a)
Space heating from boilers	179.93	x	4.24	x 0.01 =	7.63	(340b)
Water heating from CHP	1428.36	x	2.97	x 0.01 =	42.42	(342a)
Water heating from boilers	476.12	x	4.24	x 0.01 =	20.19	(342b)
Pumps and fans	33.29	x	13.19	x 0.01 =	4.39	(349)
Electricity for lighting	229.32	x	13.19	x 0.01 =	30.25	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-53.23	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		240.91	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.07	(357)
SAP value	85.05	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	817.7541	x	0.2160	=	176.6349	(363)
less credit emissions for electricity		-229.7035	x	0.5190	=	-119.2161	(364)
Water heated by CHP		2163.8390	x	0.2160	=	467.3892	(365)
less credit emissions for electricity		-607.8127	x	0.5190	=	-315.4548	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	697.93	x	0.216	=	150.75	(368)
Electrical energy for community heat distribution		26.24	x	0.52	=	13.62	(372)
Total CO2 associated with community systems						373.73	(373)
Total CO2 associated with space and water heating						373.73	(376)
Pumps and fans		33.29	x	0.52	=	17.28	(378)
Electricity for lighting		229.32	x	0.52	=	119.01	(379)
Energy saving/generation technologies							

pv savings	-53.23	x	0.52	=	-27.63	(380)
Total CO_2, kg/year				(376)..(382) =	482.39	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.77	(384)
EI value					93.15	
EI rating (section 14)					93	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	817.75	x	1.22	=	997.66	(363)
less credit energy for electricity		-229.70	x	3.07	=	-705.19	(364)
Water heated by CHP		2163.84	x	1.22	=	2639.88	(365)
less credit energy for electricity		-607.81	x	3.07	=	-1865.98	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	697.93	x	1.22	=	851.47	(368)
Electrical energy for community heat distribution		26.24	x	3.07	=	80.56	(372)
Total primary energy associated with community systems						1998.41	(373)
Total primary energy associated with space and water heating						1998.41	(376)
Pumps and fans		33.29	x	3.07	=	102.20	(378)
Electricity for lighting		229.32	x	3.07	=	704.00	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-53.23	x	3.07	=	-163.43	(380)
Primary energy kWh/year						2641.18	(383)
Dwelling primary energy rate kWh/m2/year						53.48	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	25/11/2016
Address	A-L04-65 A Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		77.30	(1a)	x	2.50	(2a)	=	193.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	77.30	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			193.25	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.16	(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	0.20	0.19	0.19	0.17	0.17	0.15	0.15	0.14	0.16	0.17	0.17	0.18	(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	N/A	(23c)

c) whole house extract ventilation or positive input ventilation from outside

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(24c)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			14.12	x	1.24	=	17.45			(27)
External wall			13.75	x	0.18	=	2.48			(29a)
Party wall			60.09	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			27.87							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	19.92	(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		4.23	(36)
Total fabric heat loss	(33) + (36) =	24.15	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	(38)
Heat transfer coefficient, W/K (37)m + (38)m	56.04	56.04	56.04	56.04	56.04	56.04	56.04	56.04	56.04	56.04	56.04	56.04	
Average = ∑(39)1...12/12 =												56.04	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	
Average = ∑(40)1...12/12 =												0.72	(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	2.41	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	91.43	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	100.57	96.91	93.26	89.60	85.94	82.29	82.29	85.94	89.60	93.26	96.91	100.57	
∑(44)1...12 =												1097.15	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	149.14	130.44	134.61	117.35	112.60	97.17	90.04	103.32	104.56	121.85	133.01	144.44	
∑(45)1...12 =												1438.53	(45)
Distribution loss 0.15 x (45)m	22.37	19.57	20.19	17.60	16.89	14.58	13.51	15.50	15.68	18.28	19.95	21.67	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

204.42	180.37	189.88	170.85	167.88	150.66	145.32	158.60	158.05	177.13	186.50	199.72	(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

204.42	180.37	189.88	170.85	167.88	150.66	145.32	158.60	158.05	177.13	186.50	199.72	

∑(64)1...12 = 2089.37 (64)

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

93.81	83.31	88.98	81.81	81.66	75.10	74.16	78.58	77.56	84.74	87.02	92.25	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	120.48	120.48	120.48	120.48	120.48	120.48	120.48	120.48	120.48	120.48	120.48	120.48	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.11	16.98	13.81	10.45	7.81	6.60	7.13	9.26	12.43	15.79	18.43	19.64	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	213.71	215.92	210.33	198.44	183.42	169.31	159.88	157.66	163.25	175.14	190.16	204.28	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.05	35.05	35.05	35.05	35.05	35.05	35.05	35.05	35.05	35.05	35.05	35.05	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	-96.39	(71)
Water heating gains (Table 5)	126.09	123.98	119.59	113.63	109.76	104.31	99.68	105.61	107.72	113.89	120.86	123.99	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	418.05	416.02	402.88	381.67	360.14	339.36	325.83	331.68	342.55	363.97	388.59	407.05	(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	
NorthEast	0.77	x	14.12	x	11.28	x 0.9 x	0.40	x	0.80	=	35.33	(75)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	35.33	71.91	129.57	212.79	286.03	304.94	285.26	227.41	157.88	87.89	44.45	28.85	(83)
Total gains - internal and solar (73)m + (83)m	453.38	487.94	532.45	594.45	646.17	644.29	611.09	559.09	500.43	451.86	433.05	435.90	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	1.00	0.98	0.93	0.77	0.55	0.40	0.46	0.74	0.96	0.99	1.00	(86)

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

20.36	20.45	20.62	20.84	20.97	21.00	21.00	21.00	20.98	20.80	20.54	20.33	(87)

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

20.32	20.32	20.32	20.32	20.32	20.32	20.32	20.32	20.32	20.32	20.32	20.32	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.98	0.91	0.72	0.50	0.34	0.39	0.68	0.95	0.99	1.00	(89)

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

19.46	19.59	19.83	20.13	20.29	20.32	20.32	20.32	20.30	20.09	19.72	19.42	(90)

Living area fraction — Living area ÷ (4) = 0.34 (91)

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

19.76	19.88	20.10	20.37	20.52	20.55	20.55	20.55	20.53	20.33	19.99	19.72	(92)

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

19.76	19.88	20.10	20.37	20.52	20.55	20.55	20.55	20.53	20.33	19.99	19.72	(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	0.91	0.74	0.52	0.36	0.42	0.70	0.95	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	451.57	484.18	520.49	542.18	476.17	331.94	221.13	232.19	350.86	427.51	429.04	434.58	(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]	866.52	839.33	761.92	642.55	494.08	333.17	221.20	232.40	360.40	545.36	722.62	869.93	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	308.73	238.66	179.62	72.26	13.33	0.00	0.00	0.00	0.00	87.67	211.38	323.90	

	∑(98)1...5, 10...12 =	1435.55	(98)
Space heating requirement kWh/m²/year	(98) ÷ (4)	18.57	(99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.25	(303a)
Fraction of community heat from CHP		0.75	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.75	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.25	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1435.55			(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	1130.50	(307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	376.83	(307b)

Water heating

Annual water heating requirement	2089.37			(64)
Water heat from CHP		(64) x (303a) x (305a) x (306) =	1645.38	(310a)
Water heat from boilers		(64) x (303b) x (305a) x (306) =	548.46	(310b)

Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] =		37.01	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)					
mechanical ventilation fans - balanced, extract or positive input from outside		52.10			(330a)
Total electricity for the above, kWh/year				52.10	(331)
Electricity for lighting (Appendix L)				337.53	(332)
Energy saving/generation technologies					
electricity generated by PV (Appendix M)				-53.23	(333)
Total delivered energy for all uses		(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =		4037.57	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	1130.50	x	2.97	x 0.01 =	33.58	(340a)
Space heating from boilers	376.83	x	4.24	x 0.01 =	15.98	(340b)
Water heating from CHP	1645.38	x	2.97	x 0.01 =	48.87	(342a)
Water heating from boilers	548.46	x	4.24	x 0.01 =	23.25	(342b)
Pumps and fans	52.10	x	13.19	x 0.01 =	6.87	(349)
Electricity for lighting	337.53	x	13.19	x 0.01 =	44.52	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-53.23	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		293.07	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.01	(357)
SAP value	85.96	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	1712.6044	x	0.2160	=	369.9226	(363)
less credit emissions for electricity		-481.0629	x	0.5190	=	-249.6717	(364)
Water heated by CHP		2492.6050	x	0.2160	=	538.4027	(365)
less credit emissions for electricity		-700.1616	x	0.5190	=	-363.3839	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	984.35	x	0.216	=	212.62	(368)
Electrical energy for community heat distribution		37.01	x	0.52	=	19.21	(372)
Total CO2 associated with community systems						527.10	(373)
Total CO2 associated with space and water heating						527.10	(376)
Pumps and fans		52.10	x	0.52	=	27.04	(378)
Electricity for lighting		337.53	x	0.52	=	175.18	(379)
Energy saving/generation technologies							

pv savings	-53.23	x	0.52	=	-27.63	(380)
Total CO_2, kg/year				(376)..(382) =	701.69	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.08	(384)
EI value					92.31	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)						
Power efficiency of CHP unit	28.09					(361)
Heat efficiency of CHP unit	66.01					(362)
Space heating from CHP (307a) × 100 ÷ (362) =	1712.60	x	1.22	=	2089.38	(363)
less credit energy for electricity	-481.06	x	3.07	=	-1476.86	(364)
Water heated by CHP	2492.60	x	1.22	=	3040.98	(365)
less credit energy for electricity	-700.16	x	3.07	=	-2149.50	(366)
Primary energy from other sources (space heating)						
Efficiency of boilers	94.00					(367b)
Primary energy from boilers [(307b)+(310b)] x 100 ÷ (367b) =	984.35	x	1.22	=	1200.91	(368)
Electrical energy for community heat distribution	37.01	x	3.07	=	113.63	(372)
Total primary energy associated with community systems					2818.53	(373)
Total primary energy associated with space and water heating					2818.53	(376)
Pumps and fans	52.10	x	3.07	=	159.96	(378)
Electricity for lighting	337.53	x	3.07	=	1036.22	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-53.23	x	3.07	=	-163.43	(380)
Primary energy kWh/year					3851.28	(383)
Dwelling primary energy rate kWh/m2/year					49.82	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	25/11/2016
Address	A-L06-73 A Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		72.32	(1a)	x	2.50	(2a)	=	180.80	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	72.32	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	180.80	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(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) =	0.17	(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	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.20	(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	N/A	(23c)

c) whole house extract ventilation or positive input ventilation from outside

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			21.34	x	1.24	=	26.37			(27)
External wall			11.81	x	0.18	=	2.13			(29a)
Party wall			51.97	x	0.00	=	0.00			(32)
Roof			72.32	x	0.16	=	11.57			(30)
Total area of external elements ∑A, m²			105.47							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	40.07	(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		4.81	(36)
Total fabric heat loss	(33) + (36) =	44.88	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	29.83	29.83	29.83	29.83	29.83	29.83	29.83	29.83	29.83	29.83	29.83	29.83	(38)
Heat transfer coefficient, W/K (37)m + (38)m	74.71	74.71	74.71	74.71	74.71	74.71	74.71	74.71	74.71	74.71	74.71	74.71	
Average = ∑(39)1...12/12 =												74.71	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	
Average = ∑(40)1...12/12 =												1.03	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.30	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.85	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	97.74	94.18	90.63	87.07	83.52	79.97	79.97	83.52	87.07	90.63	94.18	97.74	
∑(44)1...12 =												1066.22	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	144.94	126.77	130.81	114.04	109.43	94.43	87.50	100.41	101.61	118.41	129.26	140.37	
∑(45)1...12 =												1397.98	(45)
Distribution loss 0.15 x (45)m	21.74	19.01	19.62	17.11	16.41	14.16	13.13	15.06	15.24	17.76	19.39	21.06	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

200.22	176.69	186.09	167.54	164.70	147.92	142.78	155.69	155.10	173.69	182.75	195.64	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

200.22	176.69	186.09	167.54	164.70	147.92	142.78	155.69	155.10	173.69	182.75	195.64	

∑(64)1...12 = 2048.82 (64)

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

92.41	82.09	87.72	80.71	80.61	74.19	73.32	77.61	76.58	83.59	85.77	90.89	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)													
	115.06	115.06	115.06	115.06	115.06	115.06	115.06	115.06	115.06	115.06	115.06	115.06	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.07	16.05	13.05	9.88	7.39	6.23	6.74	8.76	11.75	14.92	17.42	18.57	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	202.65	204.75	199.45	188.17	173.93	160.55	151.61	149.50	154.80	166.08	180.32	193.71	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.51	34.51	34.51	34.51	34.51	34.51	34.51	34.51	34.51	34.51	34.51	34.51	(69)
Pump and fan gains (Table 5a)													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)													
	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	-92.04	(71)
Water heating gains (Table 5)													
	124.21	122.16	117.90	112.10	108.34	103.04	98.54	104.31	106.36	112.36	119.13	122.17	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
	402.45	400.48	387.92	367.67	347.18	327.34	314.40	320.09	330.43	350.88	374.39	391.96	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	21.34	x	36.79	x 0.9 x	0.40	x	0.80	=	174.12	(79)

Solar gains in watts ∑(74)m...(82)m

174.12	296.59	405.81	502.82	563.20	559.13	539.06	494.01	439.41	327.80	208.56	149.01	(83)

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

576.57	697.07	793.73	870.49	910.38	886.47	853.46	814.10	769.84	678.68	582.95	540.97	(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	0.86	0.71	0.53	0.38	0.42	0.64	0.90	0.98	0.99	(86)

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

20.10	20.31	20.56	20.80	20.94	20.99	21.00	21.00	20.97	20.78	20.38	20.05	(87)

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

20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.97	0.93	0.83	0.66	0.46	0.30	0.33	0.57	0.86	0.97	0.99	(89)

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

18.88	19.17	19.52	19.83	20.00	20.05	20.06	20.05	20.04	19.82	19.28	18.80	(90)

Living area fraction — Living area ÷ (4) = 0.28 (91)

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

19.22	19.49	19.81	20.10	20.27	20.31	20.32	20.32	20.30	20.09	19.59	19.15	(92)

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

19.22	19.49	19.81	20.10	20.27	20.31	20.32	20.32	20.30	20.09	19.59	19.15	(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	0.92	0.83	0.67	0.48	0.33	0.36	0.59	0.86	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	568.96	674.14	733.11	721.36	609.30	422.79	277.51	292.12	451.35	586.05	565.51	535.68	(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]	1114.76	1090.08	994.43	837.06	639.95	426.85	277.91	292.81	463.18	708.87	932.96	1116.77	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	406.07	279.51	194.42	83.30	22.81	0.00	0.00	0.00	0.00	91.38	264.56	432.33	

∑(98)1...5, 10...12 = 1774.40 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 24.54 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.25	(303a)
Fraction of community heat from CHP		0.75	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.75	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.25	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1774.40			(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	1397.34	(307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	465.78	(307b)

Water heating

Annual water heating requirement	2048.82			(64)
Water heat from CHP		(64) x (303a) x (305a) x (306) =	1613.44	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	537.81	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	40.14	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	45.88		(330a)
Total electricity for the above, kWh/year		45.88	(331)
Electricity for lighting (Appendix L)		319.06	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-53.23	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4326.09	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	1397.34	x	2.97	x 0.01 =	41.50	(340a)
Space heating from boilers	465.78	x	4.24	x 0.01 =	19.75	(340b)
Water heating from CHP	1613.44	x	2.97	x 0.01 =	47.92	(342a)
Water heating from boilers	537.81	x	4.24	x 0.01 =	22.80	(342b)
Pumps and fans	45.88	x	13.19	x 0.01 =	6.05	(349)
Electricity for lighting	319.06	x	13.19	x 0.01 =	42.08	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-53.23	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		300.11	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.07	(357)
SAP value	85.01	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	2116.8523	x	0.2160	=	457.2401	(363)
less credit emissions for electricity		-594.6143	x	0.5190	=	-308.6048	(364)
Water heated by CHP		2444.2232	x	0.2160	=	527.9522	(365)
less credit emissions for electricity		-686.5713	x	0.5190	=	-356.3305	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1067.65	x	0.216	=	230.61	(368)
Electrical energy for community heat distribution		40.14	x	0.52	=	20.83	(372)
Total CO2 associated with community systems						571.70	(373)
Total CO2 associated with space and water heating						571.70	(376)
Pumps and fans		45.88	x	0.52	=	23.81	(378)
Electricity for lighting		319.06	x	0.52	=	165.59	(379)

Energy saving/generation technologies						
pv savings	-53.23	x	0.52	=	-27.63	(380)
Total CO_2, kg/year				(376)..(382) =	733.48	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.14	(384)
EI value					91.62	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)						
Power efficiency of CHP unit	28.09					(361)
Heat efficiency of CHP unit	66.01					(362)
Space heating from CHP (307a) × 100 ÷ (362) =	2116.85	x	1.22	=	2582.56	(363)
less credit energy for electricity	-594.61	x	3.07	=	-1825.47	(364)
Water heated by CHP	2444.22	x	1.22	=	2981.95	(365)
less credit energy for electricity	-686.57	x	3.07	=	-2107.77	(366)
Primary energy from other sources (space heating)						
Efficiency of boilers	94.00					(367b)
Primary energy from boilers [(307b)+(310b)] x 100 ÷ (367b) =	1067.65	x	1.22	=	1302.54	(368)
Electrical energy for community heat distribution	40.14	x	3.07	=	123.24	(372)
Total primary energy associated with community systems					3057.05	(373)
Total primary energy associated with space and water heating					3057.05	(376)
Pumps and fans	45.88	x	3.07	=	140.85	(378)
Electricity for lighting	319.06	x	3.07	=	979.51	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-53.23	x	3.07	=	-163.43	(380)
Primary energy kWh/year					4013.98	(383)
Dwelling primary energy rate kWh/m2/year					55.50	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	25/11/2016
Address	B-L00-02 B Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		95.27	(1a)	x	2.50	(2a)	=	238.18	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	95.27	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	238.18	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(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) =	0.17	(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	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.20	(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	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			27.95	x	1.24	=	34.54			(27)
Ground floor			95.27	x	0.20	=	19.05			(28a)
External wall			25.22	x	0.18	=	4.54			(29a)
Party wall			63.29	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			148.44							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	58.13	(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		10.27	(36)
Total fabric heat loss	(33) + (36) =	68.41	(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)	39.30	39.30	39.30	39.30	39.30	39.30	39.30	39.30	39.30	39.30	39.30	39.30	(38)
Heat transfer coefficient, W/K (37)m + (38)m	107.70	107.70	107.70	107.70	107.70	107.70	107.70	107.70	107.70	107.70	107.70	107.70	

Average = ∑(39)1...12/12 = 107.70 (39)

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

Average = ∑(40)1...12/12 = 1.13 (40)

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

4. Water heating energy requirement

Assumed occupancy, N	2.69	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	98.12	(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)	107.93	104.00	100.08	96.15	92.23	88.30	88.30	92.23	96.15	100.08	104.00	107.93	

∑(44)1...12 = 1177.40 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	160.05	139.98	144.45	125.94	120.84	104.27	96.63	110.88	112.20	130.76	142.74	155.00	

∑(45)1...12 = 1543.75 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	24.01	21.00	21.67	18.89	18.13	15.64	14.49	16.63	16.83	19.61	21.41	23.25	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

215.33	189.91	199.73	179.43	176.12	157.77	151.90	166.16	165.70	186.04	196.23	210.28	(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

215.33	189.91	199.73	179.43	176.12	157.77	151.90	166.16	165.70	186.04	196.23	210.28	

∑(64)1...12 = 2194.59 (64)

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

97.44	86.49	92.25	84.67	84.40	77.47	76.35	81.09	80.10	87.70	90.26	95.76	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	134.56	134.56	134.56	134.56	134.56	134.56	134.56	134.56	134.56	134.56	134.56	134.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.15	19.67	16.00	12.11	9.05	7.64	8.26	10.74	14.41	18.30	21.35	22.76	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	248.45	251.02	244.53	230.70	213.24	196.83	185.87	183.29	189.79	203.62	221.08	237.48	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.46	36.46	36.46	36.46	36.46	36.46	36.46	36.46	36.46	36.46	36.46	36.46	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	-107.65	(71)
Water heating gains (Table 5)	130.97	128.70	123.99	117.60	113.44	107.59	102.62	108.99	111.25	117.88	125.35	128.71	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	464.93	462.77	447.89	423.77	399.10	375.43	360.12	366.38	378.82	403.16	431.15	452.33	(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	27.95	x	36.79	x 0.9 x	0.40	x	0.80	=	228.06	(79)

Solar gains in watts ∑(74)m...(82)m

228.06	388.46	531.51	658.57	737.65	732.32	706.03	647.03	575.51	429.33	273.16	195.17	(83)

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

692.99	851.23	979.40	1082.34	1136.75	1107.75	1066.15	1013.42	954.33	832.49	704.31	647.50	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	0.99	0.96	0.90	0.78	0.60	0.44	0.48	0.72	0.93	0.99	1.00	(86)

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

19.90	20.12	20.39	20.68	20.89	20.98	21.00	20.99	20.94	20.66	20.21	19.85	(87)

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

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

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.98	0.95	0.87	0.72	0.51	0.34	0.38	0.63	0.91	0.98	1.00	(89)

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

18.53	18.83	19.22	19.62	19.87	19.96	19.97	19.97	19.93	19.60	18.97	18.45	(90)

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

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

19.09	19.36	19.70	20.05	20.29	20.38	20.39	20.39	20.35	20.04	19.48	19.02	(92)

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

19.09	19.36	19.70	20.05	20.29	20.38	20.39	20.39	20.35	20.04	19.48	19.02	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.95	0.88	0.74	0.55	0.38	0.42	0.67	0.91	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	687.32	832.99	928.54	948.36	840.67	607.37	406.68	426.80	634.95	755.09	691.18	643.60	(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]	1593.14	1557.39	1421.86	1201.18	924.90	622.24	408.58	429.95	672.92	1016.46	1333.21	1596.45	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	673.93	486.79	367.03	182.03	62.67	0.00	0.00	0.00	0.00	194.46	462.26	708.92	

∑(98)1...5, 10...12 = 3138.08 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 32.94 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.25	(303a)
Fraction of community heat from CHP		0.75	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.75	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.25	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	3138.08			(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	2471.24	(307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	823.75	(307b)

Water heating

Annual water heating requirement	2194.59			(64)
Water heat from CHP		(64) x (303a) x (305a) x (306) =	1728.24	(310a)

Water heat from boilers		(64) x (303b) x (305a) x (306) =	576.08	(310b)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] =	55.99	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)				
mechanical ventilation fans - balanced, extract or positive input from outside	60.44			(330a)
Total electricity for the above, kWh/year			60.44	(331)
Electricity for lighting (Appendix L)			391.16	(332)
Energy saving/generation technologies				
electricity generated by PV (Appendix M)			-53.23	(333)
Total delivered energy for all uses		(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	5997.67	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	2471.24	x	2.97	x 0.01 =	73.40	(340a)
Space heating from boilers	823.75	x	4.24	x 0.01 =	34.93	(340b)
Water heating from CHP	1728.24	x	2.97	x 0.01 =	51.33	(342a)
Water heating from boilers	576.08	x	4.24	x 0.01 =	24.43	(342b)
Pumps and fans	60.44	x	13.19	x 0.01 =	7.97	(349)
Electricity for lighting	391.16	x	13.19	x 0.01 =	51.59	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-53.23	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		363.64	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.09	(357)
SAP value	84.81	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	3743.7107	x	0.2160	=	808.6415	(363)
less credit emissions for electricity		-1051.5916	x	0.5190	=	-545.7760	(364)
Water heated by CHP		2618.1322	x	0.2160	=	565.5165	(365)
less credit emissions for electricity		-735.4216	x	0.5190	=	-381.6838	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1489.18	x	0.216	=	321.66	(368)
Electrical energy for community heat distribution		55.99	x	0.52	=	29.06	(372)
Total CO2 associated with community systems						797.42	(373)
Total CO2 associated with space and water heating						797.42	(376)
Pumps and fans		60.44	x	0.52	=	31.37	(378)
Electricity for lighting		391.16	x	0.52	=	203.01	(379)

Energy saving/generation technologies						
pv savings	-53.23	x	0.52	=	-27.63	(380)
Total CO_2, kg/year				(376)..(382) =	1004.17	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.54	(384)
EI value					90.41	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)						
Power efficiency of CHP unit	28.09					(361)
Heat efficiency of CHP unit	66.01					(362)
Space heating from CHP (307a) × 100 ÷ (362) =	3743.71	x	1.22	=	4567.33	(363)
less credit energy for electricity	-1051.59	x	3.07	=	-3228.39	(364)
Water heated by CHP	2618.13	x	1.22	=	3194.12	(365)
less credit energy for electricity	-735.42	x	3.07	=	-2257.74	(366)
Primary energy from other sources (space heating)						
Efficiency of boilers	94.00					(367b)
Primary energy from boilers [(307b)+(310b)] x 100 ÷ (367b) =	1489.18	x	1.22	=	1816.80	(368)
Electrical energy for community heat distribution	55.99	x	3.07	=	171.90	(372)
Total primary energy associated with community systems					4264.01	(373)
Total primary energy associated with space and water heating					4264.01	(376)
Pumps and fans	60.44	x	3.07	=	185.55	(378)
Electricity for lighting	391.16	x	3.07	=	1200.87	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-53.23	x	3.07	=	-163.43	(380)
Primary energy kWh/year					5487.00	(383)
Dwelling primary energy rate kWh/m2/year					57.59	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	25/11/2016
Address	B-L00-05 B Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		63.47	(1a)	x	2.50	(2a)	=	158.68	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	63.47	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			158.68	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.16	(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	0.20	0.19	0.19	0.17	0.17	0.15	0.15	0.14	0.16	0.17	0.17	0.18	(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	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			12.76	x	1.24	=	15.77			(27)
Door			2.32	x	1.80	=	4.18			(26)
Ground floor			63.47	x	0.20	=	12.69			(28a)
External wall			7.89	x	0.18	=	1.42			(29a)
Party wall			57.47	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			86.44							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	34.06	(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		5.06	(36)
Total fabric heat loss	(33) + (36) =	39.11	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	26.18	26.18	26.18	26.18	26.18	26.18	26.18	26.18	26.18	26.18	26.18	26.18	(38)
Heat transfer coefficient, W/K (37)m + (38)m	65.30	65.30	65.30	65.30	65.30	65.30	65.30	65.30	65.30	65.30	65.30	65.30	
Average = ∑(39)1...12/12 =												65.30	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	
Average = ∑(40)1...12/12 =												1.03	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.08	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	83.55	(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)	91.90	88.56	85.22	81.88	78.54	75.19	75.19	78.54	81.88	85.22	88.56	91.90	
∑(44)1...12 =												1002.59	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	136.29	119.20	123.00	107.24	102.90	88.79	82.28	94.42	95.54	111.35	121.55	131.99	
∑(45)1...12 =												1314.55	(45)
Distribution loss 0.15 x (45)m	20.44	17.88	18.45	16.09	15.43	13.32	12.34	14.16	14.33	16.70	18.23	19.80	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss for each month from Table 3

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

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

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

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

191.57	169.13	178.28	160.73	158.17	142.29	137.56	149.69	149.04	166.63	175.04	187.27	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

191.57	169.13	178.28	160.73	158.17	142.29	137.56	149.69	149.04	166.63	175.04	187.27

∑(64)1...12 = 1965.39 (64)

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

89.54	79.58	85.12	78.45	78.43	72.32	71.58	75.62	74.56	81.24	83.21	88.11	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	103.89	103.89	103.89	103.89	103.89	103.89	103.89	103.89	103.89	103.89	103.89	103.89	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	16.19	14.38	11.69	8.85	6.62	5.59	6.04	7.85	10.53	13.37	15.61	16.64	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	181.61	183.49	178.74	168.63	155.87	143.88	135.86	133.98	138.73	148.84	161.60	173.59	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	-83.11	(71)
Water heating gains (Table 5)	120.35	118.42	114.41	108.96	105.42	100.44	96.21	101.63	103.56	109.20	115.57	118.43	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	372.31	370.46	359.01	340.61	322.08	304.07	292.28	297.63	306.99	325.58	346.94	362.83	(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	
NorthEast	0.77	x	12.76	x	11.28	x 0.9 x	0.40	x	0.80	=	31.93	(75)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	31.93	64.99	117.09	192.29	258.48	275.56	257.79	205.51	142.67	79.42	40.17	26.07	(83)
Total gains - internal and solar (73)m + (83)m	404.24	435.44	476.10	532.91	580.56	579.64	550.06	503.14	449.66	405.00	387.12	388.90	(84)

7. Mean internal temperature (heating season)

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

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

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

1.00	1.00	0.99	0.96	0.86	0.68	0.52	0.58	0.85	0.98	0.99	1.00	(86)

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

19.96	20.07	20.28	20.58	20.84	20.97	20.99	20.99	20.89	20.57	20.21	19.93	(87)

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

20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	20.06	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.98	0.94	0.82	0.60	0.41	0.47	0.78	0.96	0.99	1.00	(89)

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

18.67	18.82	19.14	19.56	19.90	20.04	20.06	20.05	19.97	19.56	19.04	18.62	(90)

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

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

19.36	19.49	19.75	20.11	20.41	20.54	20.56	20.56	20.47	20.10	19.67	19.32	(92)

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

19.36	19.49	19.75	20.11	20.41	20.54	20.56	20.56	20.47	20.10	19.67	19.32	(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	0.95	0.84	0.64	0.47	0.53	0.81	0.96	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	402.44	432.24	467.92	503.91	486.03	372.52	256.46	267.17	364.79	390.63	383.81	387.50	(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]	983.65	952.79	865.23	731.82	568.56	387.68	258.64	271.44	415.85	620.40	820.56	987.59	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	432.42	349.81	295.60	164.09	61.40	0.00	0.00	0.00	0.00	170.95	314.46	446.47	

∑(98)1...5, 10...12 = 2235.19 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 35.22 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.25	(303a)
Fraction of community heat from CHP		0.75	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.75	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.25	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	2235.19			(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	1760.22	(307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	586.74	(307b)

Water heating

Annual water heating requirement	1965.39	(64)

Water heat from CHP	(64) x (303a) x (305a) x (306) =	1547.75	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	515.92	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	44.11	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	42.78		(330a)
Total electricity for the above, kWh/year		42.78	(331)
Electricity for lighting (Appendix L)		285.93	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-53.23	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4686.09	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	1760.22	x	2.97	x 0.01 =	52.28	(340a)
Space heating from boilers	586.74	x	4.24	x 0.01 =	24.88	(340b)
Water heating from CHP	1547.75	x	2.97	x 0.01 =	45.97	(342a)
Water heating from boilers	515.92	x	4.24	x 0.01 =	21.87	(342b)
Pumps and fans	42.78	x	13.19	x 0.01 =	5.64	(349)
Electricity for lighting	285.93	x	13.19	x 0.01 =	37.71	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-53.23	x	13.19	x 0.01 =	0.00	(352)
Total energy cost				(340a)...(342e) + (345)...(354) =	308.36	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.19	(357)
SAP value	83.34	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	2666.5716	x	0.2160	=	575.9795	(363)
less credit emissions for electricity		-749.0280	x	0.5190	=	-388.7455	(364)
Water heated by CHP		2344.6983	x	0.2160	=	506.4548	(365)
less credit emissions for electricity		-658.6153	x	0.5190	=	-341.8213	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1173.04	x	0.216	=	253.38	(368)
Electrical energy for community heat distribution		44.11	x	0.52	=	22.89	(372)
Total CO2 associated with community systems						628.13	(373)
Total CO2 associated with space and water heating						628.13	(376)
Pumps and fans		42.78	x	0.52	=	22.20	(378)

Electricity for lighting	285.93	x	0.52	=	148.40	(379)
Energy saving/generation technologies						
pv savings	-53.23	x	0.52	=	-27.63	(380)
Total CO_2, kg/year				(376)..(382) =	771.10	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	12.15	(384)
EI value					90.47	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)						
Power efficiency of CHP unit	28.09					(361)
Heat efficiency of CHP unit	66.01					(362)
Space heating from CHP (307a) × 100 ÷ (362) =	2666.57	x	1.22	=	3253.22	(363)
less credit energy for electricity	-749.03	x	3.07	=	-2299.52	(364)
Water heated by CHP	2344.70	x	1.22	=	2860.53	(365)
less credit energy for electricity	-658.62	x	3.07	=	-2021.95	(366)
Primary energy from other sources (space heating)						
Efficiency of boilers	94.00					(367b)
Primary energy from boilers [(307b)+(310b)] x 100 ÷ (367b) =	1173.04	x	1.22	=	1431.10	(368)
Electrical energy for community heat distribution	44.11	x	3.07	=	135.41	(372)
Total primary energy associated with community systems					3358.79	(373)
Total primary energy associated with space and water heating					3358.79	(376)
Pumps and fans	42.78	x	3.07	=	131.34	(378)
Electricity for lighting	285.93	x	3.07	=	877.79	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-53.23	x	3.07	=	-163.43	(380)
Primary energy kWh/year					4204.50	(383)
Dwelling primary energy rate kWh/m2/year					66.24	(384)

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	Miss Jayna Parmar	Assessor number	6549
Client		Last modified	25/11/2016
Address	B-L04-26 B Centric Close, London, N8		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		49.68	(1a)	x	2.50	(2a)	=	124.20	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	49.68	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			124.20	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.20	(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) =	0.17	(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	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.20	(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	N/A	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(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			15.15	x	1.24	=	18.72			(27)
External wall			11.17	x	0.18	=	2.01			(29a)
Party wall			44.15	x	0.00	=	0.00			(32)
Roof			49.68	x	0.16	=	7.95			(30)
Total area of external elements ∑A, m²			76.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	28.68	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.30	(36)
Total fabric heat loss	(33) + (36) =	32.98	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	20.49	20.49	20.49	20.49	20.49	20.49	20.49	20.49	20.49	20.49	20.49	20.49	(38)
Heat transfer coefficient, W/K (37)m + (38)m	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	
Average = ∑(39)1...12/12 =												53.48	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	
Average = ∑(40)1...12/12 =												1.08	(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	74.12	(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)	81.53	78.56	75.60	72.63	69.67	66.70	66.70	69.67	72.63	75.60	78.56	81.53	
∑(44)1...12 =												889.39	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	120.90	105.74	109.12	95.13	91.28	78.77	72.99	83.76	84.76	98.78	107.82	117.09	
∑(45)1...12 =												1166.14	(45)
Distribution loss 0.15 x (45)m	18.14	15.86	16.37	14.27	13.69	11.82	10.95	12.56	12.71	14.82	16.17	17.56	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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

176.18	155.67	164.39	148.62	146.56	132.26	128.27	139.03	138.25	154.05	161.32	172.37	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

176.18	155.67	164.39	148.62	146.56	132.26	128.27	139.03	138.25	154.05	161.32	172.37

∑(64)1...12 = 1816.98 (64)

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

84.42	75.10	80.50	74.43	74.57	68.99	68.49	72.07	70.98	77.06	78.65	83.15	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)													
	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	84.03	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	13.05	11.59	9.43	7.14	5.34	4.50	4.87	6.33	8.49	10.78	12.58	13.41	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	146.40	147.92	144.09	135.94	125.66	115.99	109.53	108.01	111.84	119.99	130.27	139.94	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40	(69)
Pump and fan gains (Table 5a)													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)													
	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	-67.23	(71)
Water heating gains (Table 5)													
	113.47	111.76	108.20	103.37	100.23	95.81	92.06	96.87	98.58	103.58	109.23	111.77	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
	321.14	319.48	309.93	294.66	279.43	264.51	254.66	259.41	267.12	282.56	300.30	313.33	(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	
North	0.77	x	2.09	x	10.63	x 0.9 x	0.40	x	0.80	=	4.93	(74)
NorthEast	0.77	x	13.06	x	11.28	x 0.9 x	0.40	x	0.80	=	32.68	(75)

Solar gains in watts ∑(74)m...(82)m

37.61	75.93	135.84	222.52	299.18	319.12	298.46	237.80	165.27	92.50	47.20	30.79	(83)

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

358.74	395.42	445.78	517.18	578.62	583.63	553.12	497.21	432.39	375.06	347.49	344.13	(84)

7. Mean internal temperature (heating season)

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

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

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

1.00	0.99	0.98	0.92	0.77	0.57	0.42	0.49	0.77	0.96	0.99	1.00	(86)

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

19.97	20.10	20.35	20.67	20.90	20.98	21.00	20.99	20.93	20.62	20.24	19.94	(87)

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

20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.02	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.99	0.97	0.89	0.71	0.49	0.33	0.39	0.69	0.94	0.99	0.99	(89)

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

18.66	18.85	19.20	19.65	19.93	20.01	20.02	20.02	19.97	19.59	19.04	18.61	(90)

Living area fraction — Living area ÷ (4) = 0.47 (91)

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

19.28	19.44	19.75	20.13	20.39	20.47	20.48	20.48	20.42	20.08	19.61	19.24	(92)

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

19.28	19.44	19.75	20.13	20.39	20.47	20.48	20.48	20.42	20.08	19.61	19.24	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.97	0.90	0.74	0.53	0.37	0.44	0.72	0.94	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	355.92	389.95	430.78	463.92	426.52	308.41	206.88	216.62	312.70	351.82	342.22	341.93	(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]	801.18	777.60	708.31	600.66	464.76	313.94	207.60	218.19	338.10	506.92	668.85	804.05	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	331.27	260.50	206.48	98.46	28.45	0.00	0.00	0.00	0.00	115.39	235.18	343.82	

∑(98)1...5, 10...12 = 1619.54 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 32.60 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.25	(303a)
Fraction of community heat from CHP		0.75	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.75	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.25	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1619.54			(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	1275.39	(307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	425.13	(307b)

Water heating

Annual water heating requirement	1816.98	(64)

Water heat from CHP	(64) x (303a) x (305a) x (306) =	1430.87	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	476.96	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	36.08	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	33.49		(330a)
Total electricity for the above, kWh/year		33.49	(331)
Electricity for lighting (Appendix L)		230.50	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-53.23	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3819.10	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	1275.39	x	2.97	x 0.01 =	37.88	(340a)
Space heating from boilers	425.13	x	4.24	x 0.01 =	18.03	(340b)
Water heating from CHP	1430.87	x	2.97	x 0.01 =	42.50	(342a)
Water heating from boilers	476.96	x	4.24	x 0.01 =	20.22	(342b)
Pumps and fans	33.49	x	13.19	x 0.01 =	4.42	(349)
Electricity for lighting	230.50	x	13.19	x 0.01 =	30.40	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-53.23	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		273.44	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.21	(357)
SAP value	83.08	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		28.09					(361)
Heat efficiency of CHP unit		66.01					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	1932.1019	x	0.2160	=	417.3340	(363)
less credit emissions for electricity		-542.7188	x	0.5190	=	-281.6710	(364)
Water heated by CHP		2167.6404	x	0.2160	=	468.2103	(365)
less credit emissions for electricity		-608.8805	x	0.5190	=	-316.0090	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	959.67	x	0.216	=	207.29	(368)
Electrical energy for community heat distribution		36.08	x	0.52	=	18.73	(372)
Total CO2 associated with community systems						513.88	(373)
Total CO2 associated with space and water heating						513.88	(376)
Pumps and fans		33.49	x	0.52	=	17.38	(378)

Electricity for lighting	230.50	x	0.52	=	119.63	(379)
Energy saving/generation technologies						
pv savings	-53.23	x	0.52	=	-27.63	(380)
Total CO_2, kg/year				(376)..(382) =	623.26	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	12.55	(384)
EI value					91.18	
EI rating (section 14)					91	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)						
Power efficiency of CHP unit	28.09					(361)
Heat efficiency of CHP unit	66.01					(362)
Space heating from CHP (307a) × 100 ÷ (362) =	1932.10	x	1.22	=	2357.16	(363)
less credit energy for electricity	-542.72	x	3.07	=	-1666.15	(364)
Water heated by CHP	2167.64	x	1.22	=	2644.52	(365)
less credit energy for electricity	-608.88	x	3.07	=	-1869.26	(366)
Primary energy from other sources (space heating)						
Efficiency of boilers	94.00					(367b)
Primary energy from boilers [(307b)+(310b)] x 100 ÷ (367b) =	959.67	x	1.22	=	1170.79	(368)
Electrical energy for community heat distribution	36.08	x	3.07	=	110.78	(372)
Total primary energy associated with community systems					2747.84	(373)
Total primary energy associated with space and water heating					2747.84	(376)
Pumps and fans	33.49	x	3.07	=	102.80	(378)
Electricity for lighting	230.50	x	3.07	=	707.64	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-53.23	x	3.07	=	-163.43	(380)
Primary energy kWh/year					3394.86	(383)
Dwelling primary energy rate kWh/m2/year					68.33	(384)

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Centric Close_Commercial Space Combined (Be Lean)

As designed

Date: Thu Dec 22 15:42:11 2016

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.5

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.5

BRUKL compliance check version: v5.2.g.3

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

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

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	18.2
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	18.2
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	15.7
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	0.18	0.18	GF000005:Surf[2]
Floor	0.25	0.2	0.2	BS000000:Surf[0]
Roof	0.25	0.16	0.16	GF000005:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.3	1.3	GF000005:Surf[3]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

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

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	4

Building services

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

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

1- Commercial Space

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.94	4.5	0	0	0.85
Standard value	0.91*	3.2	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

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

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
Basement_Commercial Space 1_Storage	-	1.2	0	-	-	-	-	-	-	-	N/A
Basement_Commercial Space 1	-	1.2	0	-	-	-	-	-	-	-	N/A
Basement_Commercial Space 2	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 3	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 4	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 2	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 2	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 2	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 2	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 1	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 1	-	1.2	0	-	-	-	-	-	-	-	N/A

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Basement_Commercial Space 1_Storage	60	-	-	29
Basement_Commercial Space 1	60	-	-	1930
Basement_Commercial Space 2	60	-	-	3283

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
GF_Commercial Space 3	60	-	-	1111
GF_Commercial Space 4	60	-	-	1107
GF_Commercial Space 2	60	-	-	1041
GF_Commercial Space 2	60	-	-	813
GF_Commercial Space 2	60	-	-	221
GF_Commercial Space 2	60	-	-	312
GF_Commercial Space 1	60	-	-	1135
GF_Commercial Space 1	60	-	-	630

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_Commercial Space 1_Storage	N/A	N/A
Basement_Commercial Space 1	N/A	N/A
Basement_Commercial Space 2	NO (-100%)	NO
GF_Commercial Space 3	NO (-83.7%)	YES
GF_Commercial Space 4	NO (-81.4%)	YES
GF_Commercial Space 2	NO (-89%)	YES
GF_Commercial Space 2	NO (-99.9%)	NO
GF_Commercial Space 2	NO (-52.8%)	YES
GF_Commercial Space 2	NO (-83.9%)	YES
GF_Commercial Space 1	NO (-93.9%)	YES
GF_Commercial Space 1	NO (-72.6%)	YES

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 [m^2]	1155.4	1155.4
External area [m^2]	1962.6	1962.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	4	3
Average conductance [W/K]	509.06	698.19
Average U-value [W/m^2K]	0.26	0.36
Alpha value* [%]	10	10

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

Building Use

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

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	6.46	10.09
Cooling	2.72	4.95
Auxiliary	4.43	2.06
Lighting	19.04	23.39
Hot water	3.19	3.13
Equipment*	41.6	41.6
TOTAL**	**35.84**	**43.62**

* 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/m^2]

	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/m^2]	54.42	98.84
Primary energy* [kWh/m^2]	92.18	107.12
Total emissions [kg/m^2]	15.7	18.2

* 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] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	21.4	33	6.5	2.7	4.4	0.92	3.36	0.94	4.5
	Notional	31.3	67.5	10.1	4.9	2.1	0.86	3.79	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	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	0.18	GF000005:Surf[2]
Floor	0.2	0.2	BS000000:Surf[0]
Roof	0.15	0.16	GF000005:Surf[1]
Windows, roof windows, and rooflights	1.5	1.3	GF000005:Surf[3]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

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

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

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

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	4

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Centric Close_Commercial Space Combined (Be Clean)

As designed

Date: Thu Dec 22 15:45:13 2016

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.5

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.5

BRUKL compliance check version: v5.2.g.3

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

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

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	18.2
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	18.2
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	14.1
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.18	0.18	GF000005:Surf[2]
Floor	0.25	0.2	0.2	BS000000:Surf[0]
Roof	0.25	0.16	0.16	GF000005:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.3	1.3	GF000005:Surf[3]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	4

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- Commercial Space

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.94	4.5	0	0	0.85
Standard value	0.91*	3.2	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

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

1- CHECK2-CHP

	CHPQA quality index	CHP electrical efficiency
This building	0	0.28
Standard value	Not provided	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_Commercial Space 1_Storage	-	1.2	0	-	-	-	-	-	-	-	N/A
Basement_Commercial Space 1	-	1.2	0	-	-	-	-	-	-	-	N/A
Basement_Commercial Space 2	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 3	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 4	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 2	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 2	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 2	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 2	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 1	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 1	-	1.2	0	-	-	-	-	-	-	-	N/A

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Basement_Commercial Space 1_Storage	60	-	-	29

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Basement_Commercial Space 1	60	-	-	1930
Basement_Commercial Space 2	60	-	-	3283
GF_Commercial Space 3	60	-	-	1111
GF_Commercial Space 4	60	-	-	1107
GF_Commercial Space 2	60	-	-	1041
GF_Commercial Space 2	60	-	-	813
GF_Commercial Space 2	60	-	-	221
GF_Commercial Space 2	60	-	-	312
GF_Commercial Space 1	60	-	-	1135
GF_Commercial Space 1	60	-	-	630

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_Commercial Space 1_Storage	N/A	N/A
Basement_Commercial Space 1	N/A	N/A
Basement_Commercial Space 2	NO (-100%)	NO
GF_Commercial Space 3	NO (-83.7%)	YES
GF_Commercial Space 4	NO (-81.4%)	YES
GF_Commercial Space 2	NO (-89%)	YES
GF_Commercial Space 2	NO (-99.9%)	NO
GF_Commercial Space 2	NO (-52.8%)	YES
GF_Commercial Space 2	NO (-83.9%)	YES
GF_Commercial Space 1	NO (-93.9%)	YES
GF_Commercial Space 1	NO (-72.6%)	YES

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 [m^2]	1155.4	1155.4
External area [m^2]	1962.6	1962.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	4	3
Average conductance [W/K]	509.06	698.19
Average U-value [W/m^{2}K]	0.26	0.36
Alpha value* [%]	10	10

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

Building Use

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

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	8.59	10.09
Cooling	2.72	4.95
Auxiliary	4.43	2.06
Lighting	19.04	23.39
Hot water	4.31	3.13
Equipment*	41.6	41.6
TOTAL**	**35.4**	**43.62**

* 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/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	3.69	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	54.42	98.84
Primary energy* [kWh/m^2]	82.81	107.12
Total emissions [kg/m^2]	14.1	18.2

* 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] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	21.4	33	0.4	2.7	4.4	0.92	3.36	0.94	4.5
	Notional	31.3	67.5	10.1	4.9	2.1	0.86	3.79	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	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	0.18	GF000005:Surf[2]
Floor	0.2	0.2	BS000000:Surf[0]
Roof	0.15	0.16	GF000005:Surf[1]
Windows, roof windows, and rooflights	1.5	1.3	GF000005:Surf[3]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

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

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

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	4

BRUKL Output Document

Compliance with England Building Regulations Part L 2013

HM Government

Project name

Centric Close_Commercial Space Combined (Be Green)

As designed

Date: Thu Dec 22 16:23:35 2016

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.5

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.5

BRUKL compliance check version: v5.2.g.3

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

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

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	18.2
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	18.2
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	11.8
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	0.18	0.18	GF000005:Surf[2]
Floor	0.25	0.2	0.2	BS000000:Surf[0]
Roof	0.25	0.16	0.16	GF000005:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.3	1.3	GF000005:Surf[3]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

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

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	4

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- Commercial Space

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.94	4.5	0	0	0.85
Standard value	0.91*	3.2	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

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

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

1- CHECK2-CHP

	CHPQA quality index	CHP electrical efficiency
This building	0	0.28
Standard value	Not provided	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_Commercial Space 1_Storage	-	1.2	0	-	-	-	-	-	-	-	N/A
Basement_Commercial Space 1	-	1.2	0	-	-	-	-	-	-	-	N/A
Basement_Commercial Space 2	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 3	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 4	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 2	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 2	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 2	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 2	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 1	-	1.2	0	-	-	-	-	-	-	-	N/A
GF_Commercial Space 1	-	1.2	0	-	-	-	-	-	-	-	N/A

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Basement_Commercial Space 1_Storage	60	-	-	29

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
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GF_Commercial Space 4	60	-	-	1107
GF_Commercial Space 2	60	-	-	1041
GF_Commercial Space 2	60	-	-	813
GF_Commercial Space 2	60	-	-	221
GF_Commercial Space 2	60	-	-	312
GF_Commercial Space 1	60	-	-	1135
GF_Commercial Space 1	60	-	-	630

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_Commercial Space 1_Storage	N/A	N/A
Basement_Commercial Space 1	N/A	N/A
Basement_Commercial Space 2	NO (-100%)	NO
GF_Commercial Space 3	NO (-83.7%)	YES
GF_Commercial Space 4	NO (-81.4%)	YES
GF_Commercial Space 2	NO (-89%)	YES
GF_Commercial Space 2	NO (-99.9%)	NO
GF_Commercial Space 2	NO (-52.8%)	YES
GF_Commercial Space 2	NO (-83.9%)	YES
GF_Commercial Space 1	NO (-93.9%)	YES
GF_Commercial Space 1	NO (-72.6%)	YES

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 [m^2]	1155.4	1155.4
External area [m^2]	1962.6	1962.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	4	3
Average conductance [W/K]	509.06	698.19
Average U-value [W/m^2K]	0.26	0.36
Alpha value* [%]	10	10

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

Building Use

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

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	8.59	10.09
Cooling	2.72	4.95
Auxiliary	4.43	2.06
Lighting	19.04	23.39
Hot water	4.31	3.13
Equipment*	41.6	41.6
TOTAL**	**35.4**	**43.62**

* 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/m^2]

	Actual	Notional
Photovoltaic systems	4.42	0
Wind turbines	0	0
CHP generators	3.69	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	54.42	98.84
Primary energy* [kWh/m^2]	82.81	107.12
Total emissions [kg/m^2]	11.8	18.2

* 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] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	21.4	33	0.4	2.7	4.4	0.92	3.36	0.94	4.5
	Notional	31.3	67.5	10.1	4.9	2.1	0.86	3.79	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	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	0.18	GF000005:Surf[2]
Floor	0.2	0.2	BS000000:Surf[0]
Roof	0.15	0.16	GF000005:Surf[1]
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Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

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

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

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

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	4