HOARE LEA

3 Kidderpore Avenue.
London.
3 Kidderpore Avenue.

SUSTAINABILITY
ENERGY AND SUSTAINABILITY DOCUMENT

REVISION 01 – 13 APRIL 2018

Audit sheet.

Rev.	Date	Description	Prepared	Verified
00	02/03/2018	Issue for Planning Submission	JD	LH
01	13/04/2018	Updated with comments	JD	LH

Document reference: 180413 3KA Energy and Sustainabililty Document Rev 01

Contents.

Executive Summary.

This report describes the Energy Strategy and Sustainability Statement for the proposed development at 3 Kidderpore Avenue in London. The site image is shown in Figure 1.

Figure 1 Proposed Site Image (SIAW)

The development includes the demolition of the existing building on site and erection of a 3 storey dwelling.

Carbon Dioxide Emissions.

The London Borough of Camden's (LBC) Local Plan aims to tackle the causes of climate change in the borough by ensuring developments use less energy and assess the feasibility of decentralised energy and renewable technologies.

Policy CC1 Climate Change Mitigation requires all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation. New developments in Camden will be expected to be designed to minimise energy use and CO_2 emissions in operation through the application of the energy hierarchy.

In order to demonstrate compliance with Part L 2013 a SAP calculation was carried out on the proposed development. A Part L 2013 compliant baseline calculation was carried out to establish the regulated carbon dioxide emissions for the development.

These calculations included a number of the following passive and active energy efficiency measures.

The passive measures include the specification of a high performance building fabric including U-values and an air permeability that are significantly beyond the minimum requirements of the Building Regulations.

The active measures include:

- Low energy lighting;
- Variable speed pumping;
- Efficient mechanical ventilation systems with heat recovery; and
- Insulated pipework to reduce circulation losses.

As the building is one single dwelling there will not be a constant base heat load throughout the day and due to this reason CHP is not considered an appropriate technology.

A number of alternative renewable technologies were investigated with the view to be incorporated in the development, with Photo-Voltaic (PV) panels deemed the most appropriate for the site.

The assessment showed that a reduction in carbon emissions of 22% over a Part L 2013 compliant development can be achieved which is in line with the requirements of Camden's Local Plan.

Sustainability.

The wider sustainability measures include the following:

- The contractors will be selected with consideration of their ability to comply with the Considerate Constructors Scheme;
- Internal and external lighting will be designed to promote a healthy, and safe internal and external environment;
- Energy efficient light fittings will be installed for all external areas of the development. In addition, they will be automatically controlled for the prevention of operation during daylight hours;
- The proposed development will reduce potable water consumption through the specification of efficient sanitary ware;
- Materials with a low environmental impact will be implemented where feasible; and
- The design for the new landscape conserves the existing natural environment whilst enhancing the ecology of the overall site.

1. Introduction.

The proposed 3 Kidderpore Avenue is situated in a residential area of Camden, with the street consisting predominantly of large detached properties of late 19th/ early 20th century architectural characteristics.

The development includes the demolition of the existing building on site and erection of a 3 storey dwelling.

The site is highlighted in Figure 2.

Figure 2 Proposed Site

This Energy and Sustainability Document has been prepared in support of the planning appeal for the proposed development of 3 Kidderpore Avenue, hereafter referred to as the Proposed Development.

The document has been commissioned to address the fourth reason for refusal in the decision notice, as detailed below:

> *The applicant has failed to demonstrate that the proposed replacement dwelling would achieve a reduction in CO2 emissions through renewable technologies contrary to policies CC1 (Climate change mitigation) and CC2 (Adapting to climate change) of the Camden Local Plan 2017.*

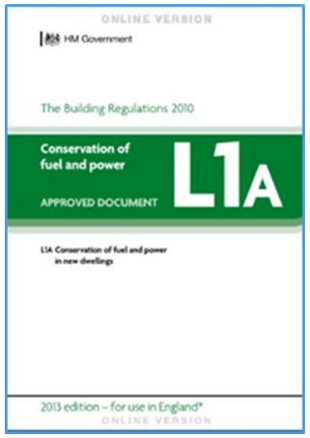
The purpose of this document is to set out the energy strategy and overall sustainability proposals for the Proposed Development. This document provides a summary of the key policies that are applicable to the Proposed Development and an energy strategy commensurate with the current building regulations as well as regional and local planning policies.

2. Policy Requirements & Building Regulations.

The policies and regulations that are required to be satisfied are summarised as follows.

2.1 The Building Regulations

Part L Conservation of Fuel and Power deals with energy efficiency requirements in the Building Regulations. New buildings will be assessed under Approved Document Part L1A (Domestic) of the Building Regulations.



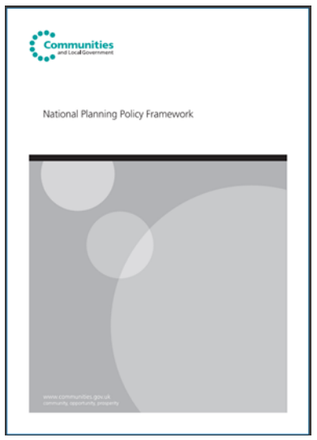
Part L1A 2013 of Building Regulations – New Domestic Elements

On a national level, Part L1A of the Building Regulations sets the energy efficiency requirements in new domestic buildings.

Under Building Regulations Approved Document Part L1A, compliance is achieved by demonstrating that the Dwelling Emission Rate (DER) does not exceed the Target Emission Rate (TER) and that the Dwelling Fabric Efficiency (DFEE) does not exceed the Target Fabric Efficiency (TFEE).

In addition, Part L1A also requires that the fabric elements and the fixed building services all meet minimum energy efficiency standards (Criterion 2), and reasonable provision for limiting solar gain through the building fabric (Criterion 3).

2.2 National Planning Guidance



The National Planning Policy Framework, March 2012

The National Planning Policy Framework (NPPF) was published in March 2012 and has superseded all Planning Policy Statements (PPS) and Planning Policy Guidelines (PPD) documents, with the exception of PPS10 (Waste). The NPPF sets out the Government's strategy on the delivery of sustainable development through the planning system.

The NPPF places responsibility for policy making with the Local Planning Authority, who shall communicate their policies through local core strategy documents and other supplementary planning guidance. The NPPF stated that there is a presumption in favour of sustainable development. The following is extracted from paragraph 14 of the NPPF:

"For decision-taking this means:

- Approving development proposals that accord with the development plan without delay; and
- Where the development plan is absent, silent or relevant policies are out-of-date, granting permission unless:
    - Any adverse impacts of doing so would significantly and demonstrably outweigh the benefits, when assessed against the policies in this Framework taken as a whole; or
    - Specific policies in this Framework indicate development should be restricted."

In respect of energy policy contained within the NPPF, paragraph 96 sets out that:

"In determining planning applications, local planning authorities should expect new developments to:

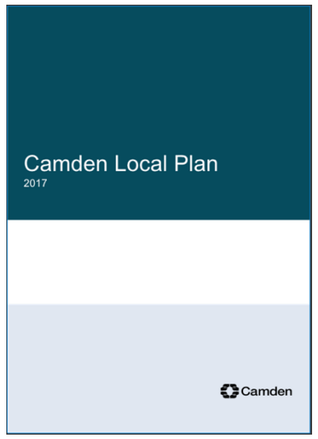
- Comply with adopted Local Plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and
- Take account of landform, layout, building orientation,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

At the heart of NPPF is a presumption in favour of sustainable development, which should be seen as a golden thread running through both plan-making and decision-taking.

The following NPPF objectives have been identified as being relevant to this development:

- Promoting Sustainable Transport
- Requiring Good Design
- Promoting Healthy Communities
- Meeting the Challenge of Climate Change, Flooding and Coastal Change
- Conserving and Enhancing the Natural Environment

2.3 Local Planning Guidance



Camden Local Plan 2017

The Local Plan sets out the Council's planning policies ensuring that Camden continues to have robust, effective and up-to-date planning policies that respond to changing circumstances and the borough's unique characteristics and contribute to delivering the Camden Plan and other local priorities.

The Council aims to tackle the causes of climate change in the borough by ensuring developments use less energy and assess the feasibility of decentralised energy and renewable energy technologies.

Green Action for Change: Camden's environmental sustainability plan (2011-2020) commits Camden to a 27% borough wide Carbon Dioxide (CO_2) reduction by 2017 and a 40% borough wide CO_2 reduction by 2020 (London carbon reduction target). Over 90% of Camden's carbon dioxide emissions are produced by the operation of buildings.

Any new development in Camden has the potential to increase carbon dioxide emissions in the borough. If we are to achieve local, and support national, carbon dioxide reduction targets, it is crucial that planning policy limits carbon dioxide emissions from new development wherever possible and supports sensitive energy efficiency improvements to existing buildings.

Policy CC1 Climate Change Mitigation requires all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

New developments in Camden will be expected to be designed to minimise energy use and CO_2 emissions in operation through the application of the energy hierarchy – Be Lean, Be Clean and Be Green.

All developments involving five or more dwellings and/or more than 500 sqm of (gross internal) any floor space will be required to submit an energy statement demonstrating how the energy hierarchy has been applied to make the fullest contribution to CO2 reduction. All new residential development will also be required to demonstrate a 19% CO_2 reduction below Part L 2013 Building Regulations (in addition to any requirements for renewable energy). This can be demonstrated through an energy statement or sustainability statement.

The Council will expect developments of five or more dwellings and/or more than 500 sqm of any gross internal floor space to achieve a 20% reduction in carbon dioxide emissions from on-site renewable energy generation (which can include sources of site related decentralised renewable energy), unless it can be demonstrated that such provision is not feasible. This is in line with stage three of the energy hierarchy 'Be green'. The 20% reduction should be calculated from the regulated CO_2 emissions of the development after all proposed energy efficiency measures and any CO_2 reduction from non-renewable decentralised energy (e.g. CHP) have been incorporated.

Policy CC2 Adapting to Climate Change requires development to be resilient to climate change.

All development should adopt appropriate climate change adaptation measures such as:

- the protection of existing green spaces and promoting new appropriate green infrastructure;
- not increasing, and wherever possible reducing, surface water run-off through increasing permeable surfaces and use of Sustainable Drainage Systems;
- incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and
- measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

Any development involving 5 or more residential units or 500 sqm or more of any additional floor space is required to demonstrate the above in a Sustainability Statement.

3. Carbon Dioxide Emissions.

Local policy requires a 19% reduction over Part L 2013 as a minimum with a 20% reduction being achieved from on-site renewable energy sources.

Policy CC1 Climate Change Mitigation refers to the approach taken to reduce the building's carbon dioxide emissions in line with the following energy hierarchy:

1. Be Lean: Use Less Energy
2. Be Clean: Supply Energy Efficiently
3. Be Green: Use Renewable Energy

The energy assessment comprised the following stages:

1. Estimating a target for total regulated CO_2 emissions of the proposed development. The estimates are based primarily on Part L approved software modelling results.
2. Estimating savings in regulated CO_2 emissions of the proposed development through the incorporation of passive and active energy efficiency measures. The estimates are based primarily on Part L approved software modelling results.
3. Estimating the potential contribution to carbon dioxide reductions that could be achieved by the use of energy networks including CHP.
4. Estimating the potential contribution to carbon dioxide reductions that could be achieved by the use of renewable technologies.

The regulated CO_2 emissions assuming the development complied with Part L 2013 of the Building Regulations using approved compliance software are established. The Building Regulations approved compliance software. NHER v6.3.4 was used to assess the site. The Target Emission Rate (TER) output from this assessment was then used to calculate the baseline CO_2 emissions.

The TER Report is located in Appendix A.

4. Be Lean.

4.1 Passive Measures

In order to reduce the energy demand of the development, the fabric of the development will be improved significantly beyond the minimum requirements of Criterion 2 of Part L1A 2013. Table 1 shows the typical envelope performance characteristics that will be incorporated into the scheme design to limit the buildings energy consumption.

Table 1 Element U-Values

Element		
Floor U - Value (W/m²K)		0.10
Roof U - Value (W/m²K)		0.10
External Walls U - Value (W/m²K)		0.15
Glazing Glazed doors	U-value (W/m²K)	1.40
	Frame type	u-PVC
	G-value	0.60
	Fraction Glazed	0.70
Opaque Door (W/m²K)		1.0
Air permeability (m³/hm² (@ 50Pa)		3
Thermal Bridge Specification		Default

4.2 Active Measures

The energy consumption will be further reduced by the incorporation of active energy efficiency measures in the design of the mechanical and electrical engineering systems. The following energy efficiency measures will be incorporated:

- Windows carefully designed to balance daylight, heat loss and heat gain;
- Solar control measures;
- High energy efficient heat recovery ventilation; and
- Low energy lighting.

4.3 Be Lean Results

The dwelling has been assessed to gain SAP results. The measurements were taken from drawings issued by SIAW Architects.

Figure 3Figure 1 below shows that the regulated carbon dioxide emissions of the Energy Efficient Scheme are approximately 7% below that of the Baseline Scheme.

The Be Lean DER Worksheet is located within Appendix B.

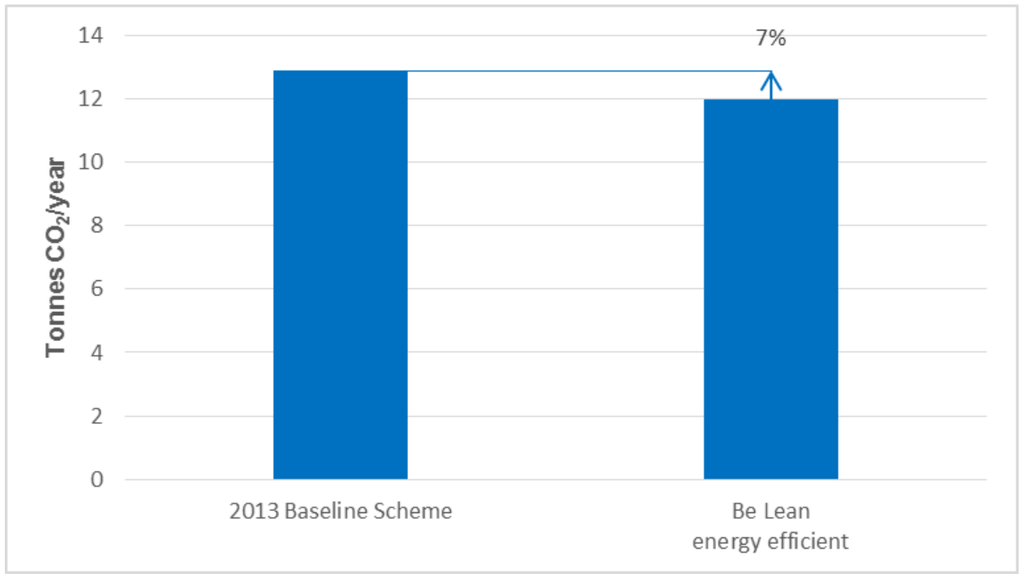


Figure 3 Be Lean Regulated Carbon Dioxide Emissions

4.4 Overheating and Cooling

Policy CC2 Adapting to Climate Change requires developments to be resilient to climate change. All development should adopt appropriate climate change adaptation including: measures to reduce the impact of urban and dwelling overheating.

Below are the steps and proposals to demonstrate mitigation against overheating

1. Minimise internal heat generation through energy efficient design.
   - Heat generation will be minimised through the specification of energy efficient ventilation systems, insulation on pipework and low energy lighting.
2. Reduce the amount of heat entering a building in summer through orientation, shading, fenestration, albedo and insulation.
   - The amount of heat entering the building will be reduced by:
     - Energy efficient facades with appropriate proportions of glazing; and
     - A glazing shading coefficient carefully selected to minimise solar gain in the summer, but also to maximise solar gain in winter.
3. Manage the heat within the building through exposed internal thermal mass and high ceilings.
   - Ceiling heights in the development have been maximised within the constraints of the overall building height and massing.
4. Passive Ventilation
   - Passive ventilation (openable windows) has been incorporated within the development. In addition, there will be a small amount of natural ventilation through infiltration
5. Mechanical Ventilation
   - Background ventilation will be provided by MVHR units. These units will incorporate a summer by-pass, which will allow the unit to supply fresh air without heat being transferred from the extract air into the supply air.
6. Active Cooling Systems
   - The current strategy is for cooling to be provided to all living areas and bedrooms within the dwelling.

5. Be Clean.

These measures are those which serve to reduce the overall emissions of the development through the inclusion of low-carbon technologies such as Combined Heat and Power (CHP) engines.

5.1 Area Wide Heat Networks

The first step in selecting energy systems is to consider a connection to an existing heating and cooling network.

An investigation has been carried out to determine if there are any area wide heat networks currently existing in the area or if any are planned in the future. The London Heat Map for the area, shown in Figure 4, reveals that there are no existing or potential area wide heat networks in the vicinity of the Proposed Development site. As a result it has been assumed that no connection is possible

The London Heat Map has identified that the Proposed Development is not located within an area that has the potential for decentralised energy.

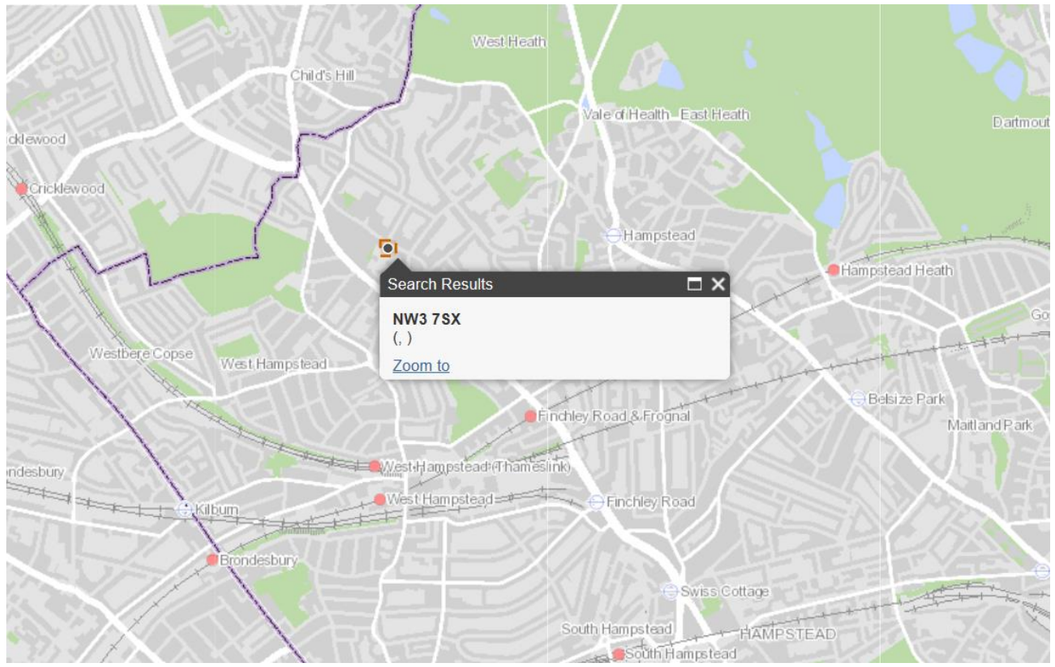


Figure 4 London Heat Map

5.2 Site Wide Heat Networks

Due to the development consisting of a single dwelling a central energy centre is not appropriate and therefore no site wide heat network can be established.

5.3 Gas-fired Combined Heat and Power (CHP)

A CHP uses a gas-fired reciprocating engine or turbine, connected to a generator to simultaneously generate both heat and power (electricity). Useable heat is generated by recovering the heat from the engine that, in a conventional generator, is rejected to atmosphere. In order to optimise the performance of the CHP engine it is important to provide consistent heating and electrical loads.

As the building is one single dwelling there will not be a constant base heat load throughout the day and due to this reason CHP is not considered an appropriate technology.

5.4 Be Clean Results

Figure 5 below shows the revised estimated reduction in regulated carbon dioxide emissions for the "Be Clean" case. As identified throughout this section there are no heat networks or CHP to add to the calculations therefore the results remain as the "Be Lean" case - approximately 7% below the baseline schemes.

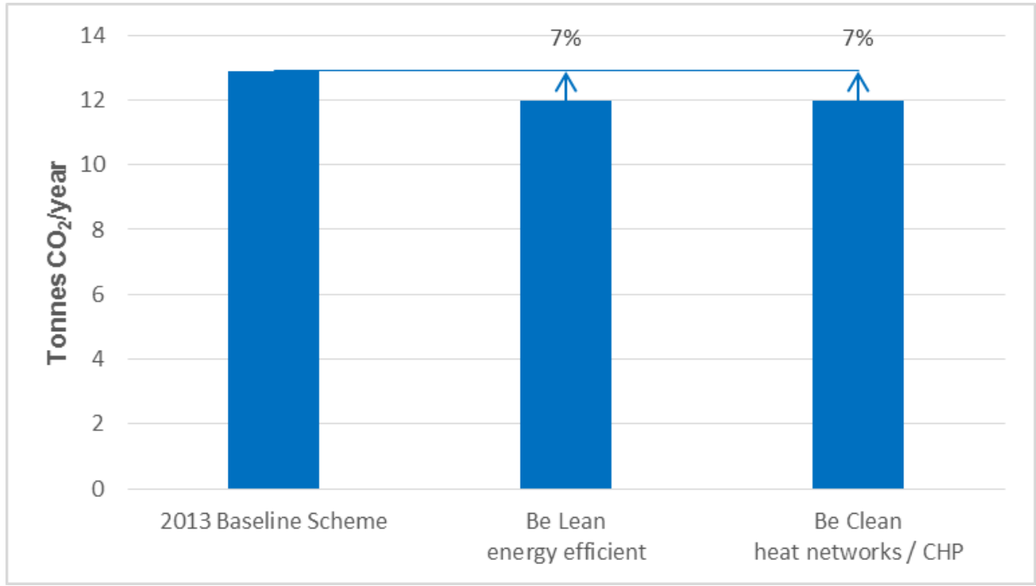


Figure 5 Be Clean Regulated Carbon Dioxide Emissions

6. Be Green.

These measures are those which serve to reduce the overall emissions of the development through the inclusion of renewable technologies such as Ground Source Heat Pump (GSHP), Solar Photovoltaics array (PV panels), besides others.

This section addresses the requirements of Policy CC1 (Climate Change Mitigation) of The Local Plan. The supporting text states the following:

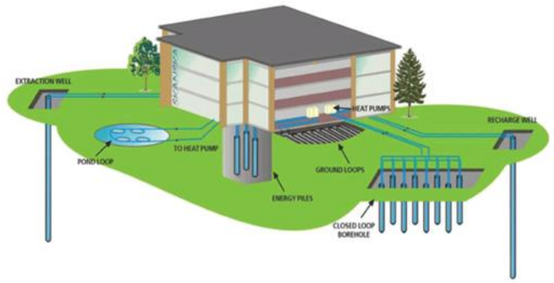
The Council will expect developments of five or more dwellings and/or more than 500 sqm of any gross internal floor space to achieve a 20% reduction in carbon dioxide emissions from on-site renewable energy generation (which can include sources of site related decentralised renewable energy), unless it can be demonstrated that such provision is not feasible. This is in line with stage three of the energy hierarchy 'Be green'. The 20% reduction should be calculated from the regulated CO2 emissions of the development after all proposed energy efficiency measures and any CO_2 reduction from non-renewable decentralised energy (e.g. CHP) have been incorporated.

6.1 Solar Water Heating Panels

Solar water heating systems use heat from the sun to heat domestic hot water. The system requires solar panels on the roof, ideally south facing, linked to hot water storage cylinders.

This technology is compatible with the design however compared to the carbon emission savings achieved through the installation of PV it does not perform as well and therefore is not proposed.

6.2 Ground Source Heat Pumps



Ground source heat pumps utilise either water extracted from an aquifer (open loop) or water circulated within underground pipework (closed loop) as the heat source in a refrigeration process. This enables them to produce hot water, typically at around 45°C that can be used as means of space heating in buildings. Due to the relatively constant temperature of the ground at depth (typically 10-14°C in the UK) this produces heat more efficiently in winter than an air source heat pump, and usually with lower carbon emissions than a gas-fired boiler.

Open loop systems require the water extracted to be re-injected into the aquifer at another borehole on another part of the site. A licence from the Environment Agency (EA) is required for both abstraction and discharge although these licences cannot be obtained until a test borehole has been constructed and the appropriate EA tests undertaken.

Installing a GSHP is not practically and financially viable and therefore is not proposed for this development.

6.3 Biomass Boilers

A biomass boiler uses a natural fuel such as wood chips or wood pellets for combustion. Since it uses a natural resource that can be replanted it is considered as a renewable energy source subject to the distance the fuel is transported. The carbon dioxide emitted from burning biomass is balanced by that absorbed during the fuel's production. Biomass heating therefore approaches a carbon neutral process.

The primary disadvantage of a biomass boiler are that large storage volumes are required for fuel, regular deliveries are required and biomass exhaust gases would require significant treatment to avoid degrading local air quality.

Biomass boilers are therefore not proposed for the development.

6.4 Wind Turbines

Wind turbines use the wind's lift forces to turn aerodynamic blades that turn a rotor thus generating electricity. There are three basic types to consider: horizontal axis (propeller type), vertical access (helical type) and building integrated (where the building design is adapted to suit the wind turbine).

Wind turbines have a significant visual impact and the roof space will be sensitive in townscape terms, which is likely to preclude wind turbines. They can create noise and vibration problems. Additionally, there is limited roof area across the site where clean air flows and good wind speeds can be realised and which are vital to delivering a useful electrical output. Even if a suitable location could be found, the output of a wind turbine and the consequential carbon dioxide emissions will be very limited when compared to the emissions of the whole development.

Wind turbines are therefore not proposed for the development.

6.5 Solar Photovoltaics

Solar photovoltaic (PV) cells generate electricity from the sun's energy. Solid PV panels can be either roof or façade mounted (although solar modules fitted on a south facing façade have only 75% the output of roof mounted modules).

Suitable roof area has been identified to locate a PV array to offset the electrical load. It has been estimated the array will be installed with south facing orientation and 30° angle to maximise the capacity to generate approximately 4.4kW (peak) of energy (approximately 20m^2 of PV).

Appendix C contains a roof plan showing the proposed layout for the PV array.

6.6 "Be Green" Results

Figure 6 below shows the revised estimated reduction in regulated carbon dioxide emissions taking into account the contribution of PV is approximately 23% below the "Be Clean", energy efficient and baseline schemes and 22% below the baseline.

The Be Green DER Worksheet is located within Appendix D.

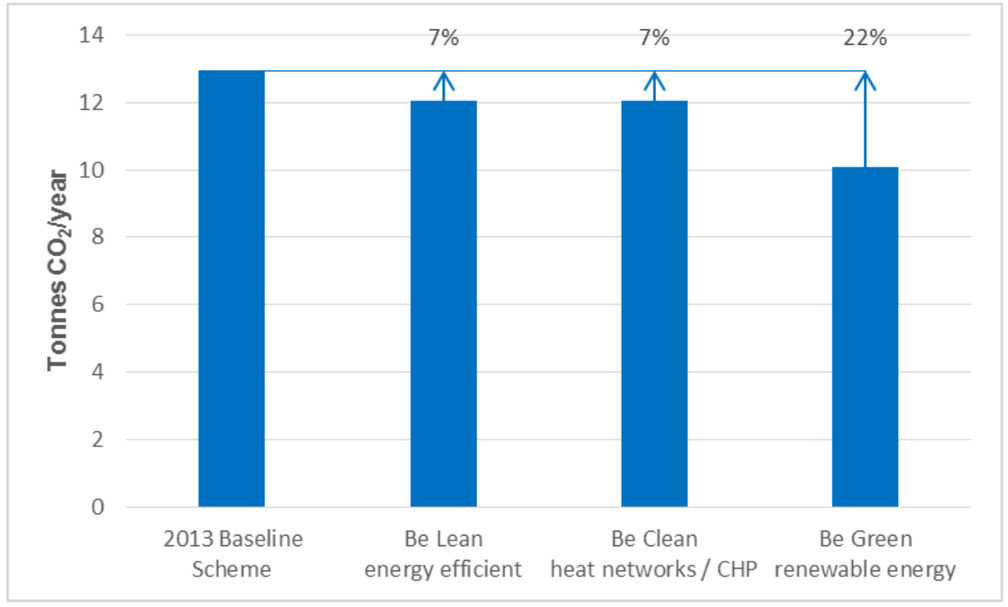


Figure 6 Be Green Regulated Carbon Dioxide Emissions

7. Sustainability.

Sustainability has been a key design consideration for this development from the onset of the project and consideration of the impact of design proposals and measures on the sustainable credentials of the development has been made throughout the design development to date and will continue throughout the design and construction process.

The following is a summary of the key sustainability issues that form the overall strategy for the project.

7.1 Management

To encourage an integrated design process, the project delivery stakeholders will identify and define roles, responsibilities for each of the key phases of project delivery.

To ensure that the construction site is managed in an environmentally and socially considerate, responsible and accountable manner, the contractor will be selected with consideration of their ability to comply with the Considerate Constructors Scheme.

7.2 Health and Wellbeing

The development will be designed to encourage a healthy and safe internal and external environment.

All external lighting will be photocell and time controlled. Luminaires will be carefully selected to limit night sky pollution.

7.3 Energy

An Energy Strategy has been devised in line with the Local Plan. Please refer to Sections 4-6 of this report for further details on energy performance.

Energy efficient light fittings will be installed for all external areas of the development.

Heat recovery will be incorporated into the mechanical ventilation reducing the overall energy demand.

7.4 Transport

The site is located in a residential area in West Hampstead. The PTAL rating for the site is 3 with rail and bus links approximately 12 minutes' walk from the site.

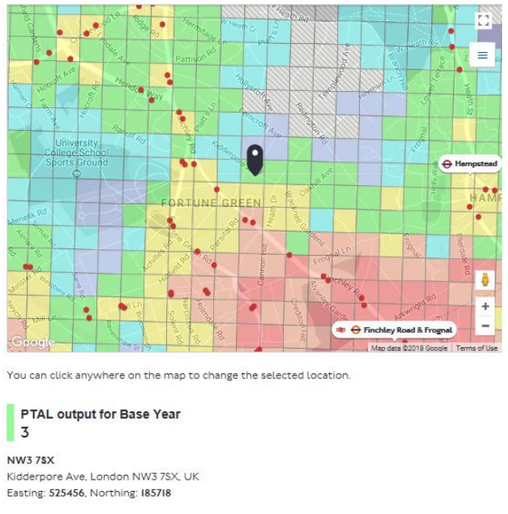


Figure 7 PTAL Map

7.5 Water

Reducing the consumption of potable water will be a significant consideration in the design process. Water use will be reduced as much as possible mainly through the specification of efficient sanitary ware.

The dwelling will be designed to comply with the requirements of Building Regulations Part G.

A water meter will be specified on the mains water supply to the building, ensuring that water consumption can be monitored and managed and therefore encourage reductions.

7.6 Materials

Materials with low environmental impact will be implemented were feasible. Recycled, sustainable and locally sourced materials will be used where possible.

Thermal insulation used in the building fabric and services will be selected with consideration of their embodied environmental impact relative to its thermal properties.

7.7 Waste

Storage facilities for waste and recycling will be provided in accordance with, as a minimum, BS5906.

The refuse and recyclable storage will be located on hard, level surface and easily accessible to all users.

7.8 Land Use and Ecology

An improvement in ecological value is being targeted for the site with external landscaped areas provided for the residents.

At least 75% of the proposed development's footprint is on an area of land which has previously been occupied by an existing building.

7.9 Pollution

The site is located in Flood Zone 1. There will be no increase in surface water run-off from the development as it is being built on an existing brownfield site.

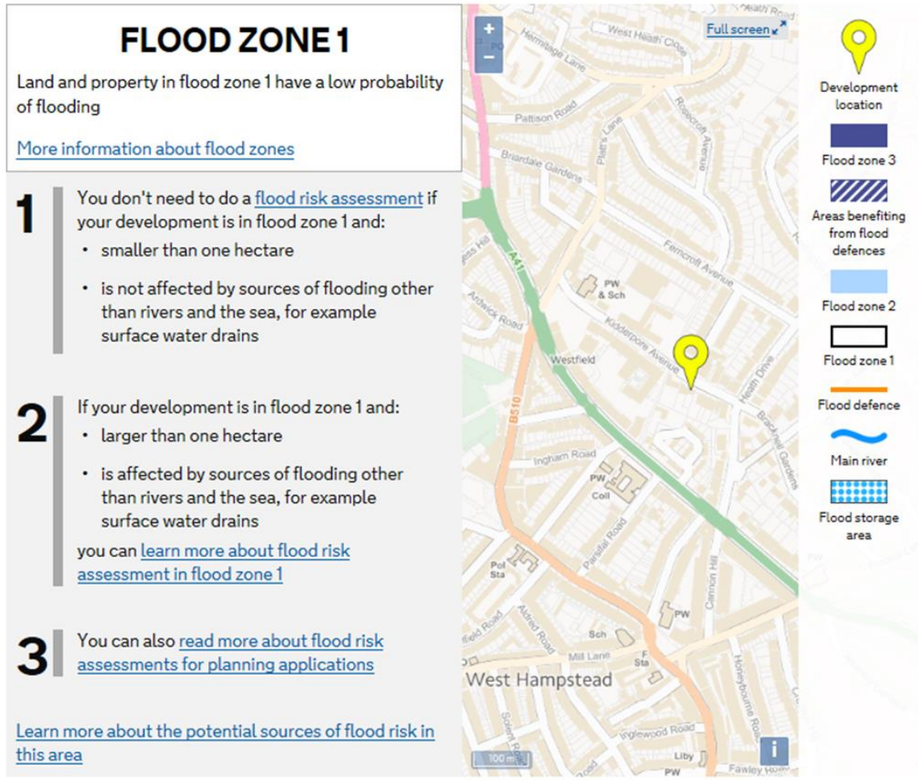


Figure 8 Environment Agency Flood Mapping

The materials used for the landscaping will be selected with consideration of reducing the flood risk. Such materials include permeable paving and other porous finishes. The types of materials and finishes will help promote infiltration into the ground.

External lighting will be designed to ensure upward lighting is minimised, reducing unnecessary light pollution, energy consumption and nuisance to neighbouring properties.

8. Conclusion.

An energy assessment has been undertaken to address the London Borough of Camden's Local Plan.

A range of passive and active energy efficiency measures will be employed on the Proposed Development.

No area wide low carbon heating distribution network exists in close proximity to the Proposed Development. Due to the site being a single dwelling a site wide energy centre and provision of CHP is not appropriate.

A number of renewable technologies have been appraised in terms of their technical, physical and financial feasibility, as potential renewable systems for use on the project. A PV array will be incorporated to maximise the on-site carbon savings.

8.1 Energy

Table 2 below shows the site wide regulated carbon dioxide emissions and savings.

Table 2 Site Wide Regulated CO_2 Emissions and Savings

	Regulated Carbon Dioxide Savings	
	(Tonnes of CO_2 per annum)	(%)
Savings from energy demand reduction	1	7%
Savings from heat network / CHP	0	0%
Savings from renewable energy	2	15%
Cumulative on site savings	**3**	**22%**

The overall predicted reduction in CO_2 emissions from the Baseline development model (which is Part L 2013 compliant) is approximately 22% which represents an annual saving of approximately 3 tonnes of CO_2, which more than meets the requirements of Camden's Local Plan.

Figure 9 below sets out how the proposed development energy efficiency measures and LZC systems reduce CO_2 emissions in line with the London Plan Energy Hierarchy.

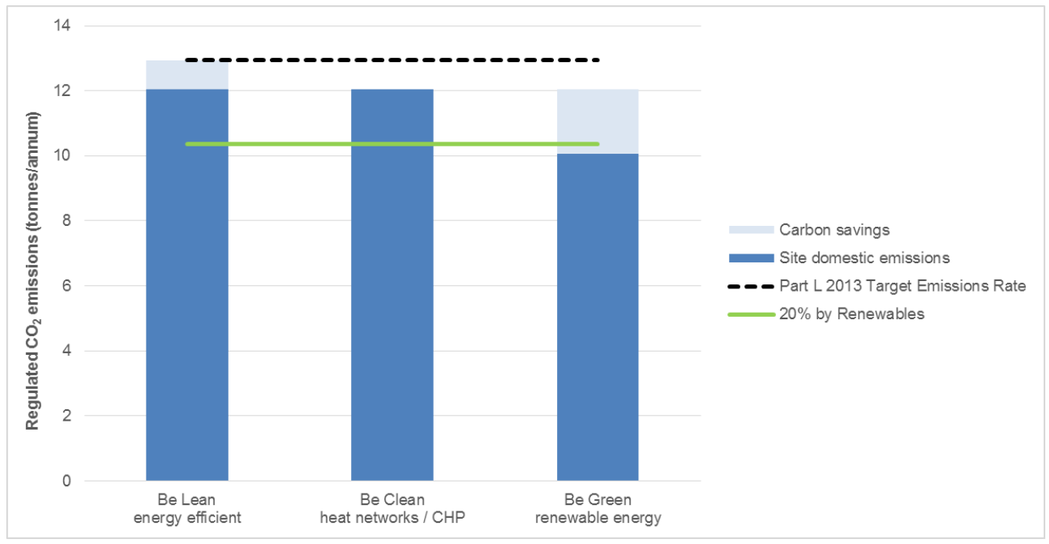


Figure 9 Energy Hierarchy and targets

8.2 Sustainability

The sustainability measures include the following:

- The project design team will identify and define roles, responsibilities of each of the key phases of project delivery;
- The contractors will be selected with consideration of their ability to comply with the Considerate Constructors Scheme;
- Internal and external lighting will be designed to promote a healthy, and safe internal and external environment;
- An energy assessment has been carried out in line with the Energy Hierarchy described in Policy 5.2 of the London Plan;
- Energy efficient light fittings will be installed for all external areas of the development. In addition, they will be automatically controlled for the prevention of operation during daylight hours;
- The proposed development will reduce potable water consumption through the specification of efficient sanitary ware;
- Materials with a low environmental impact will be implemented where feasible;
- The design for the new landscape conserves the existing natural environment whilst enhancing the ecology of the overall site; and
- External lighting will be designed to reduce night time light pollution.

Appendix A: TER Worksheet.

TER Worksheet
Design - Draft

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

Assessor name	Mr Robert Coffey	Assessor number	99
Client		Last modified	02/03/2018
Address	3 Kidderpore Avenue, London, NW3 7SX		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		355.42	(1a)	x	3.70	(2a)	=	1315.05	(3a)
+1		295.45	(1b)	x	3.50	(2b)	=	1034.08	(3b)
+2		273.01	(1c)	x	3.60	(2c)	=	982.84	(3c)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	923.88	(4)						
Dwelling volume						(3a) + (3b) + (3c) + (3d)...(3n) =		3331.97	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 40	÷ (5) =	0.01	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.26	(18)
Number of sides on which the dwelling is sheltered	0	(19)
Shelter factor	1 - [0.075 x (19)] = 1.00	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.26	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.33	0.33	0.32	0.29	0.28	0.25	0.25	0.24	0.26	0.28	0.29	0.31	(22b)

Calculate effective air change rate for the applicable case:

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

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.56	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.55	(24d)

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

0.56	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.55	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			183.02	x 1.33	= 242.64			(27)
Roof window			24.55	x 1.59	= 39.08			(27a)
Door			4.81	x 1.00	= 4.81			(26)
Ground floor			355.42	x 0.13	= 46.20			(28a)
External wall			611.35	x 0.18	= 110.04			(29a)
Roof			327.01	x 0.13	= 42.51			(30)
Total area of external elements ∑A, m²			1506.16					(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	485.29 (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		75.31 (36)
Total fabric heat loss	(33) + (36) =	560.59 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	611.13	608.74	606.41	595.44	593.39	583.83	583.83	582.07	587.51	593.39	597.54	601.88	(38)
Heat transfer coefficient, W/K (37)m + (38)m	1171.72	1169.34	1167.00	1156.03	1153.98	1144.43	1144.43	1142.66	1148.11	1153.98	1158.13	1162.47	
Average = ∑(39)1...12/12 = 1156.02 (39)													
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.27	1.27	1.26	1.25	1.25	1.24	1.24	1.24	1.24	1.25	1.25	1.26	
Average = ∑(40)1...12/12 = 1.25 (40)													
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	3.94 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	127.85 (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)	140.63	135.52	130.40	125.29	120.17	115.06	115.06	120.17	125.29	130.40	135.52	140.63	
∑(44)1...12 = 1534.15 (44)													
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	208.55	182.40	188.22	164.09	157.45	135.87	125.90	144.48	146.20	170.38	185.99	201.97	
∑(45)1...12 = 2011.51 (45)													
Distribution loss 0.15 x (45)m	31.28	27.36	28.23	24.61	23.62	20.38	18.89	21.67	21.93	25.56	27.90	30.30	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1000.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	4.51 (48)
Temperature factor from Table 2b	0.54 (49)
Energy lost from water storage (kWh/day) (48) x (49)	2.43 (50)
Enter (50) or (54) in (55)	2.43 (55)
Water storage loss calculated for each month (55) x (41)m	

75.41	68.12	75.41	72.98	75.41	72.98	75.41	75.41	72.98	75.41	72.98	75.41	(56)

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

75.41	68.12	75.41	72.98	75.41	72.98	75.41	75.41	72.98	75.41	72.98	75.41	(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

307.23	271.53	286.90	259.59	256.13	231.36	224.58	243.15	241.69	269.06	281.48	300.65	(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

307.23	271.53	286.90	259.59	256.13	231.36	224.58	243.15	241.69	269.06	281.48	300.65	

∑(64)1...12 = 3173.34 (64)

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

148.28	131.95	141.52	130.96	131.29	121.57	120.80	126.98	125.01	135.59	138.24	146.10	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	197.15	197.15	197.15	197.15	197.15	197.15	197.15	197.15	197.15	197.15	197.15	197.15	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	77.39	68.73	55.90	42.32	31.63	26.71	28.86	37.51	50.35	63.92	74.61	79.54	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	868.04	877.04	854.35	806.02	745.02	687.69	649.39	640.39	663.08	711.41	772.41	829.74	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	42.71	42.71	42.71	42.71	42.71	42.71	42.71	42.71	42.71	42.71	42.71	42.71	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	(71)
Water heating gains (Table 5)	199.31	196.35	190.22	181.88	176.47	168.85	162.37	170.67	173.62	182.25	191.99	196.37	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	1229.87	1227.28	1185.61	1115.37	1038.27	968.39	925.77	933.71	972.19	1042.73	1124.15	1190.78	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	55.57	x	10.63	x 0.9 x	0.63	x	0.70	=	180.59	(74)
East	0.77	x	35.82	x	19.64	x 0.9 x	0.63	x	0.70	=	215.00	(76)
South	0.77	x	74.66	x	46.75	x 0.9 x	0.63	x	0.70	=	1066.74	(78)
West	0.77	x	16.97	x	19.64	x 0.9 x	0.63	x	0.70	=	101.86	(80)
Horizontal	1.00	x	24.55	x	26.00	x 0.9 x	0.63	x	0.70	=	253.34	

Solar gains in watts ∑(74)m...(82)m

1817.53	3238.18	4768.08	6407.54	7585.30	7697.30	7352.52	6456.79	5337.59	3673.77	2203.87	1537.51	(83)

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

3047.41	4465.46	5953.69	7522.91	8623.57	8665.70	8278.29	7390.50	6309.78	4716.50	3328.03	2728.29	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	1.00	1.00	0.97	0.90	0.75	0.58	0.66	0.90	0.99	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.36	19.57	19.90	20.34	20.70	20.92	20.98	20.96	20.78	20.27	19.73	19.33	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.87	19.87	19.87	19.88	19.88	19.89	19.89	19.89	19.89	19.88	19.88	19.87	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	1.00	0.99	0.96	0.86	0.65	0.45	0.53	0.85	0.99	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	17.65	17.97	18.46	19.08	19.58	19.83	19.88	19.88	19.69	19.00	18.20	17.61	(90)

Living area fraction | Living area ÷ (4) = | 0.20 | (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	17.99	18.29	18.74	19.33	19.81	20.05	20.10	20.09	19.91	19.25	18.50	17.95	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	17.99	18.29	18.74	19.33	19.81	20.05	20.10	20.09	19.91	19.25	18.50	17.95	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	0.99	0.96	0.86	0.67	0.48	0.55	0.85	0.98	1.00	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	3046.32	4456.18	5894.81	7192.51	7387.02	5802.41	3938.55	4087.20	5347.53	4642.43	3324.16	2727.71	(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]	16041.73	15651.76	14289.27	12060.06	9356.05	6235.88	4005.98	4219.29	6671.09	9981.34	13207.78	15987.07	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	9668.58	7523.42	6245.48	3504.64	1464.95	0.00	0.00	0.00	0.00	3972.15	7116.20	9864.96	

∑(98)1...5, 10...12 = | 49360.39 | (98)

Space heating requirement kWh/m²/year | (98) ÷ (4) | 53.43 | (99)

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

Space heating

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

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

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

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	10340.73	8046.44	6679.66	3748.27	1566.80	0.00	0.00	0.00	0.00	4248.29	7610.91	10550.76	

∑(211)1...5, 10...12 = | 52791.86 | (211)

Water heating

Efficiency of water heater

90.13	90.08	89.97	89.67	88.73	79.80	79.80	79.80	79.80	89.74	90.04	90.14

(217)

Water heating fuel, kWh/month

340.88	301.43	318.88	289.49	288.66	289.93	281.43	304.70	302.88	299.83	312.61	333.52

∑(219a)1...12 = 3664.24 (219)

Annual totals

Space heating fuel - main system 1	52791.86	
Water heating fuel	3664.24	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	1366.66	(232)
Total delivered energy for all uses	57897.77	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	52791.86	x	3.48	x 0.01 =	1837.16	(240)
Water heating	3664.24	x	3.48	x 0.01 =	127.52	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	1366.66	x	13.19	x 0.01 =	180.26	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	2274.83	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	0.99	(257)
SAP value	86.24	
SAP rating (section 13)	86	(258)
SAP band	B	

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

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	52791.86	x	0.216	=	11403.04	(261)
Water heating	3664.24	x	0.216	=	791.48	(264)
Space and water heating			(261) + (262) + (263) + (264) =		12194.52	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	1366.66	x	0.519	=	709.30	(268)
Total CO_2, kg/year				(265)...(271) =	12942.74	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	14.01	(273)
EI value					82.10	
EI rating (section 14)					82	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	52791.86	x	1.22	=	64406.07	(261)
Water heating	3664.24	x	1.22	=	4470.38	(264)

Space and water heating				(261) + (262) + (263) + (264) =	68876.45	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	1366.66	x	3.07	=	4195.65	(268)
Primary energy kWh/year					73302.35	(272)
Dwelling primary energy rate kWh/m2/year					79.34	(273)

Appendix B: Be Lean DER Worksheet.

DER Worksheet
Design - Draft

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

Assessor name	Mr Robert Coffey	Assessor number	99
Client		Last modified	02/03/2018
Address	3 Kidderpore Avenue, London, NW3 7SX		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		355.42	(1a) x	3.70	(2a) =	1315.05	(3a)
+1		295.45	(1b) x	3.50	(2b) =	1034.08	(3b)
+2		273.01	(1c) x	3.60	(2c) =	982.84	(3c)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	923.88	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	3331.97	(5)

2. Ventilation rate

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

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	0	(19)
Shelter factor	1 - [0.075 x (19)] = 1.00	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.15	(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	0.19	0.19	0.18	0.17	0.16	0.14	0.14	0.14	0.15	0.16	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	76.50	(23c)

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

	0.31	0.31	0.30	0.28	0.28	0.26	0.26	0.26	0.27	0.28	0.29	0.29	(24a)

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

0.31	0.31	0.30	0.28	0.28	0.26	0.26	0.26	0.27	0.28	0.29	0.29

(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			183.02 x	1.33 =	242.64			(27)
Roof window			24.55 x	1.33 =	32.55			(27a)
Door			4.81 x	1.40 =	6.73			(26)
Ground floor			355.42 x	0.10 =	35.54			(28a)
External wall			611.35 x	0.15 =	91.70			(29a)
Roof			327.01 x	0.10 =	32.70			(30)
Total area of external elements ∑A, m²			1506.16					(31)

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 441.87 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 225.92 (36)

Total fabric heat loss (33) + (36) = 667.79 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	339.49	335.36	331.24	310.62	306.50	285.88	285.88	281.76	294.13	306.50	314.75	322.99	(38)
Heat transfer coefficient, W/K (37)m + (38)m	1007.28	1003.15	999.03	978.41	974.29	953.67	953.67	949.55	961.92	974.29	982.54	990.78	
Average = ∑(39)1...12/12 = 977.38 (39)													
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.09	1.09	1.08	1.06	1.05	1.03	1.03	1.03	1.04	1.05	1.06	1.07	
Average = ∑(40)1...12/12 = 1.06 (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 3.94 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 127.85 (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)	140.63	135.52	130.40	125.29	120.17	115.06	115.06	120.17	125.29	130.40	135.52	140.63	
∑(44)1...12 = 1534.15 (44)													
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	208.55	182.40	188.22	164.09	157.45	135.87	125.90	144.48	146.20	170.38	185.99	201.97	
∑(45)1...12 = 2011.51 (45)													
Distribution loss 0.15 x (45)m	31.28	27.36	28.23	24.61	23.62	20.38	18.89	21.67	21.93	25.56	27.90	30.30	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel 1000.00 (47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.01 (51)

Volume factor from Table 2a 0.49 (52)

Temperature factor from Table 2b 0.54 (53)

Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53) 2.74 (54)

Enter (50) or (54) in (55) | 2.74 | (55)

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

84.95	76.73	84.95	82.21	84.95	82.21	84.95	84.95	82.21	84.95	82.21	84.95	(56)

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

84.95	76.73	84.95	82.21	84.95	82.21	84.95	84.95	82.21	84.95	82.21	84.95	(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

316.76	280.14	296.43	268.82	265.67	240.59	234.12	252.69	250.92	278.60	290.71	310.18	(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

316.76	280.14	296.43	268.82	265.67	240.59	234.12	252.69	250.92	278.60	290.71	310.18	

∑(64)1...12 = 3285.63 (64)

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

155.91	138.84	149.15	138.34	138.92	128.95	128.43	134.61	132.39	143.22	145.62	153.73	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	197.15	197.15	197.15	197.15	197.15	197.15	197.15	197.15	197.15	197.15	197.15	197.15	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	77.39	68.73	55.90	42.32	31.63	26.71	28.86	37.51	50.35	63.92	74.61	79.54	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	868.04	877.04	854.35	806.02	745.02	687.69	649.39	640.39	663.08	711.41	772.41	829.74	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	42.71	42.71	42.71	42.71	42.71	42.71	42.71	42.71	42.71	42.71	42.71	42.71	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	(71)
Water heating gains (Table 5)	209.56	206.61	200.48	192.14	186.73	179.10	172.63	180.93	183.87	192.50	202.25	206.62	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	1240.13	1237.53	1195.86	1125.62	1048.53	978.65	936.02	943.97	982.45	1052.98	1134.41	1201.04	(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	55.57	x	10.63	x 0.9 x	0.60	x	0.70	=	171.99	(74)
East	0.77	x	35.82	x	19.64	x 0.9 x	0.60	x	0.70	=	204.76	(76)
South	0.77	x	74.66	x	46.75	x 0.9 x	0.60	x	0.70	=	1015.95	(78)
West	0.77	x	16.97	x	19.64	x 0.9 x	0.60	x	0.70	=	97.01	(80)
Horizontal	1.00	x	24.55	x	26.00	x 0.9 x	0.60	x	0.70	=	241.28	

Solar gains in watts ∑(74)m...(82)m

1730.99	3083.98	4541.03	6102.42	7224.09	7330.76	7002.40	6149.32	5083.42	3498.83	2098.93	1464.29	(83)

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

2971.11	4321.51	5736.89	7228.04	8272.62	8309.41	7938.42	7093.29	6065.87	4551.81	3233.33	2665.33	(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	0.77	0.62	0.48	0.54	0.77	0.94	0.99	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	18.85	19.13	19.56	20.08	20.49	20.75	20.85	20.83	20.60	20.02	19.34	18.82	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.01	20.01	20.02	20.03	20.04	20.06	20.06	20.06	20.05	20.04	20.03	20.02	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.99	0.98	0.94	0.86	0.73	0.55	0.39	0.45	0.71	0.92	0.98	0.99	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	17.07	17.49	18.11	18.87	19.43	19.78	19.88	19.86	19.60	18.80	17.80	17.03	(90)

Living area fraction — Living area ÷ (4) = 0.20 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	17.42	17.82	18.40	19.11	19.64	19.97	20.07	20.05	19.80	19.04	18.11	17.39	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	17.27	17.67	18.25	18.96	19.49	19.82	19.92	19.90	19.65	18.89	17.96	17.24	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.96	0.92	0.83	0.70	0.53	0.38	0.44	0.69	0.90	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	2928.77	4167.27	5284.28	6029.49	5803.92	4421.69	3016.41	3103.17	4166.01	4089.24	3146.88	2636.66	(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]	13067.50	12806.91	11735.00	9842.03	7593.08	4978.35	3167.09	3327.73	5338.47	8077.57	10666.70	12919.12	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	7543.22	5805.84	4799.33	2745.03	1331.14	0.00	0.00	0.00	0.00	2967.32	5414.27	7650.15	

∑(98)1...5, 10...12 = 38256.29 (98)

Space heating requirement kWh/m²/year (98) ÷ (4) = 41.41 (99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm	0.00	0.00	0.00	0.00	0.00	8964.53	7057.18	7216.58	0.00	0.00	0.00	0.00	(100)
Utilisation factor for loss ηm	0.00	0.00	0.00	0.00	0.00	0.76	0.83	0.79	0.00	0.00	0.00	0.00	(101)
Useful loss ηmLm (watts) (100)m x (101)m	0.00	0.00	0.00	0.00	0.00	6845.39	5831.81	5677.03	0.00	0.00	0.00	0.00	(102)
Gains	0.00	0.00	0.00	0.00	0.00	9668.82	9243.99	8313.50	0.00	0.00	0.00	0.00	(103)
Space cooling requirement, whole dwelling, continuous (kWh) 0.024 x [(103)m - (102)m] x (41)m	0.00	0.00	0.00	0.00	0.00	2032.87	2538.66	1961.53	0.00	0.00	0.00	0.00	

∑(104)6...8 =	6533.06	(104)
Cooled fraction — cooled area ÷ (4) =	0.67	(105)

Intermittency factor (Table 10)

0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.25	0.00	0.00	0.00	0.00

∑(106)6...8 = 0.75 (106)

Space cooling requirement (104)m x (105) x (106)m

0.00	0.00	0.00	0.00	0.00	340.02	424.61	328.08	0.00	0.00	0.00	0.00

∑(107)6...8 = 1092.71 (107)

Space cooling requirement kWh/m²/year — (107) ÷ (4) = 1.18 (108)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)	0.00	(201)
Fraction of space heat from main system(s) — 1 - (201) =	1.00	(202)
Fraction of space heat from main system 2	0.00	(202)
Fraction of total space heat from main system 1 — (202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2 — (202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)	93.90	(206)
Cooling system energy efficiency ratio (Table 10c)	4.05	(209)

Space heating fuel (main system 1), kWh/month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
8033.25	6183.00	5111.11	2923.35	1417.61	0.00	0.00	0.00	0.00	3160.08	5765.99	8147.12

∑(211)1...5, 10...12 = 40741.52 (211)

Water heating

Efficiency of water heater

90.41	90.35	90.20	89.83	88.93	80.20	80.20	80.20	80.20	89.87	90.29	90.43

(217)

Water heating fuel, kWh/month

350.35	310.08	328.64	299.25	298.75	299.99	291.92	315.07	312.87	310.00	321.99	343.01

∑(219a)1...12 = 3781.91 (219)

Space cooling fuel, kWh/month

0.00	0.00	0.00	0.00	0.00	83.95	104.84	81.01	0.00	0.00	0.00	0.00

∑(221)6...8 = 269.81 (221)

Annual totals

Space heating fuel - main system 1	40741.52	
Water heating fuel	3781.91	
Space cooling fuel	269.81	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
mechanical ventilation fans - balanced, extract or positive input from outside	2947.12	(230a)
central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	3022.12	(231)
Electricity for lighting (Appendix L)	1366.66	(232)
Total delivered energy for all uses — (211)...(221) + (231) + (232)...(237b) =	49182.02	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	40741.52	x	3.48	x 0.01 =	1417.81	(240)
Water heating	3781.91	x	3.48	x 0.01 =	131.61	(247)

Space cooling	269.81	x	13.19	x 0.01 =	35.59	(248)
Pumps and fans	3022.12	x	13.19	x 0.01 =	398.62	(249)
Electricity for lighting	1366.66	x	13.19	x 0.01 =	180.26	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	2283.88	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	0.99	(257)
SAP value	86.19	
SAP rating (section 13)	86	(258)
SAP band	B	

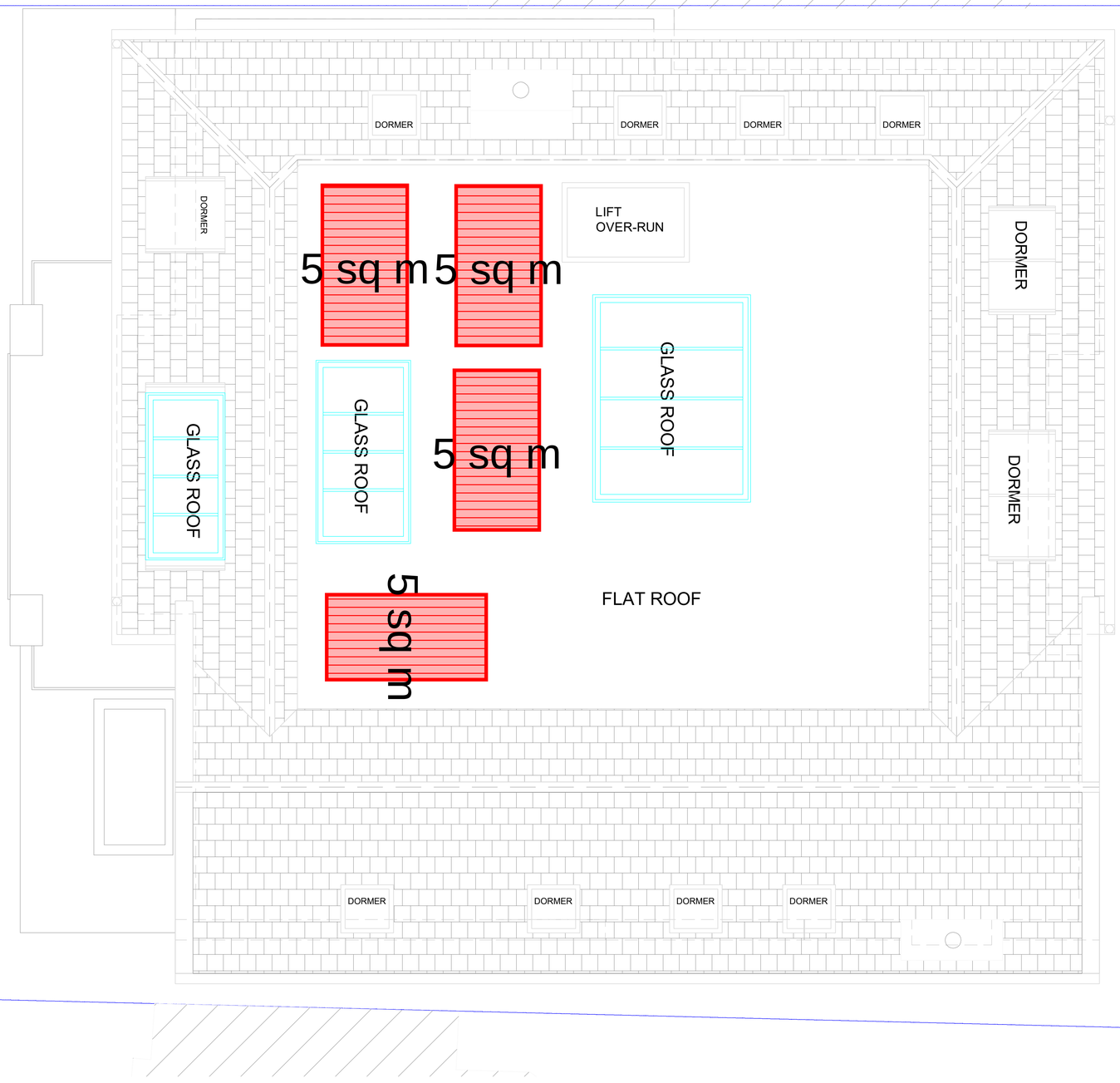
12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	40741.52	x	0.216	=	8800.17	(261)
Water heating	3781.91	x	0.216	=	816.89	(264)
Space and water heating			(261) + (262) + (263) + (264) =		9617.06	(265)
Space cooling	269.81	x	0.519	=	140.03	(266)
Pumps and fans	3022.12	x	0.519	=	1568.48	(267)
Electricity for lighting	1366.66	x	0.519	=	709.30	(268)
Total CO_2, kg/year				(265)...(271) =	12034.87	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	13.03	(273)
EI value					83.36	
EI rating (section 14)					83	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	40741.52	x	1.22	=	49704.66	(261)
Water heating	3781.91	x	1.22	=	4613.93	(264)
Space and water heating			(261) + (262) + (263) + (264) =		54318.58	(265)
Space cooling	269.81	x	3.07	=	828.30	(266)
Pumps and fans	3022.12	x	3.07	=	9277.92	(267)
Electricity for lighting	1366.66	x	3.07	=	4195.65	(268)
Primary energy kWh/year					68620.46	(272)
Dwelling primary energy rate kWh/m2/year					74.27	(273)

Appendix C: Roof Layout.



General Notes:

Report all errors, omissions and discrepancies.

Verify all dimensions on site before commencing any work on site or preparing any shop drawings.

All materials, components and workmanship are to comply with the relevant British Standarts, Codes of Practice and appropriate manufacturers' recommendations that from time to time shall apply.

this drawing and design remains the property of SIAW and may not be

NOTES

NB: BASEMENT AND LANDSCAPING AS PER PLANNING CONSENT 2013/3641/P

METRES 0 1 2 3 4 5
1:100

METRES 0 1 2 3
1:50

Rev	Date	Initials	REVISION

PROJECT
3 KIDDERPORE AVENUE
LONDON
NW3 7SX

CLIENT

A1 SHEET

ZONE	DISCIPLINE	STATUS
A	ARCHITECTURE	PLANNING
LEVEL	DRAWING NUMBER	REVISION
A	KP16–PP–204	
CAD FILE	XREF FILE	
JOB NO.	CI/SfB	
DRAWING TITLE	PROPOSED ROOF PLAN	
SCALE	DATE	DRAWN	CHECKED
1:50	02.06.2016	AW	IS

S. ILAN ARCHITECTURAL WORKSHO
Winston House, Suite 332, 2 Dollis Park, London
T. 020 8346 0628 F. 020 8346 0635 E. inf

PROJECT TITLE 3 KIDDERPORE AVENUE

Appendix D: Be Green DER Worksheet.

DER Worksheet
Design - Draft

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

Assessor name	Mr Robert Coffey	Assessor number	99
Client		Last modified	13/04/2018
Address	3 Kidderpore Avenue, London, NW3 7SX		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		355.42	(1a) x	3.70	(2a) =	1315.05	(3a)
+1		295.45	(1b) x	3.50	(2b) =	1034.08	(3b)
+2		273.01	(1c) x	3.60	(2c) =	982.84	(3c)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	923.88	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	3331.97	(5)

2. Ventilation rate

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

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

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	0	(19)
Shelter factor	1 - [0.075 x (19)] = 1.00	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.15	(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	0.19	0.19	0.18	0.17	0.16	0.14	0.14	0.14	0.15	0.16	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	76.50	(23c)

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

	0.31	0.31	0.30	0.28	0.28	0.26	0.26	0.26	0.27	0.28	0.29	0.29	(24a)

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

0.31	0.31	0.30	0.28	0.28	0.26	0.26	0.26	0.27	0.28	0.29	0.29

(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			183.02	x 1.33	= 242.64			(27)
Roof window			24.55	x 1.33	= 32.55			(27a)
Door			4.81	x 1.40	= 6.73			(26)
Ground floor			355.42	x 0.10	= 35.54			(28a)
External wall			611.35	x 0.15	= 91.70			(29a)
Roof			327.01	x 0.10	= 32.70			(30)
Total area of external elements ∑A, m²			1506.16					(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	441.87 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		100.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		225.92 (36)
Total fabric heat loss	(33) + (36) =	667.79 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	339.49	335.36	331.24	310.62	306.50	285.88	285.88	281.76	294.13	306.50	314.75	322.99	(38)
Heat transfer coefficient, W/K (37)m + (38)m	1007.28	1003.15	999.03	978.41	974.29	953.67	953.67	949.55	961.92	974.29	982.54	990.78	
Average = ∑(39)1...12/12 = 977.38 (39)													
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.09	1.09	1.08	1.06	1.05	1.03	1.03	1.03	1.04	1.05	1.06	1.07	
Average = ∑(40)1...12/12 = 1.06 (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	3.94 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	127.85 (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)	140.63	135.52	130.40	125.29	120.17	115.06	115.06	120.17	125.29	130.40	135.52	140.63	
∑(44)1...12 = 1534.15 (44)													
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	208.55	182.40	188.22	164.09	157.45	135.87	125.90	144.48	146.20	170.38	185.99	201.97	
∑(45)1...12 = 2011.51 (45)													
Distribution loss 0.15 x (45)m	31.28	27.36	28.23	24.61	23.62	20.38	18.89	21.67	21.93	25.56	27.90	30.30	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1000.00 (47)
Water storage loss:	
b) Manufacturer's declared loss factor is not known	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.01 (51)
Volume factor from Table 2a	0.49 (52)
Temperature factor from Table 2b	0.54 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	2.74 (54)

Enter (50) or (54) in (55) | 2.74 | (55)

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

84.95	76.73	84.95	82.21	84.95	82.21	84.95	84.95	82.21	84.95	82.21	84.95	(56)

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

84.95	76.73	84.95	82.21	84.95	82.21	84.95	84.95	82.21	84.95	82.21	84.95	(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

316.76	280.14	296.43	268.82	265.67	240.59	234.12	252.69	250.92	278.60	290.71	310.18	(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

316.76	280.14	296.43	268.82	265.67	240.59	234.12	252.69	250.92	278.60	290.71	310.18	

∑(64)1...12 = 3285.63 (64)

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

155.91	138.84	149.15	138.34	138.92	128.95	128.43	134.61	132.39	143.22	145.62	153.73	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	197.15	197.15	197.15	197.15	197.15	197.15	197.15	197.15	197.15	197.15	197.15	197.15	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	77.39	68.73	55.90	42.32	31.63	26.71	28.86	37.51	50.35	63.92	74.61	79.54	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	868.04	877.04	854.35	806.02	745.02	687.69	649.39	640.39	663.08	711.41	772.41	829.74	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	42.71	42.71	42.71	42.71	42.71	42.71	42.71	42.71	42.71	42.71	42.71	42.71	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	-157.72	(71)
Water heating gains (Table 5)	209.56	206.61	200.48	192.14	186.73	179.10	172.63	180.93	183.87	192.50	202.25	206.62	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	1240.13	1237.53	1195.86	1125.62	1048.53	978.65	936.02	943.97	982.45	1052.98	1134.41	1201.04	(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	55.57	x	10.63	x 0.9 x	0.60	x	0.70	=	171.99	(74)
East	0.77	x	35.82	x	19.64	x 0.9 x	0.60	x	0.70	=	204.76	(76)
South	0.77	x	74.66	x	46.75	x 0.9 x	0.60	x	0.70	=	1015.95	(78)
West	0.77	x	16.97	x	19.64	x 0.9 x	0.60	x	0.70	=	97.01	(80)
Horizontal	1.00	x	24.55	x	26.00	x 0.9 x	0.60	x	0.70	=	241.28	

Solar gains in watts ∑(74)m...(82)m

1730.99	3083.98	4541.03	6102.42	7224.09	7330.76	7002.40	6149.32	5083.42	3498.83	2098.93	1464.29	(83)

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

2971.11	4321.51	5736.89	7228.04	8272.62	8309.41	7938.42	7093.29	6065.87	4551.81	3233.33	2665.33	(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	0.77	0.62	0.48	0.54	0.77	0.94	0.99	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)												
18.85	19.13	19.56	20.08	20.49	20.75	20.85	20.83	20.60	20.02	19.34	18.82	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)												
20.01	20.01	20.02	20.03	20.04	20.06	20.06	20.06	20.05	20.04	20.03	20.02	(88)
Utilisation factor for gains for rest of dwelling n2,m												
0.99	0.98	0.94	0.86	0.73	0.55	0.39	0.45	0.71	0.92	0.98	0.99	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)												
17.07	17.49	18.11	18.87	19.43	19.78	19.88	19.86	19.60	18.80	17.80	17.03	(90)

Living area fraction Living area ÷ (4) = 0.20 (91)

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

17.42	17.82	18.40	19.11	19.64	19.97	20.07	20.05	19.80	19.04	18.11	17.39	(92)

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

17.27	17.67	18.25	18.96	19.49	19.82	19.92	19.90	19.65	18.89	17.96	17.24	(93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm												
0.99	0.96	0.92	0.83	0.70	0.53	0.38	0.44	0.69	0.90	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m												
2928.77	4167.27	5284.28	6029.49	5803.92	4421.69	3016.41	3103.17	4166.01	4089.24	3146.88	2636.66	(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]												
13067.50	12806.91	11735.00	9842.03	7593.08	4978.35	3167.09	3327.73	5338.47	8077.57	10666.70	12919.12	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m												
7543.22	5805.84	4799.33	2745.03	1331.14	0.00	0.00	0.00	0.00	2967.32	5414.27	7650.15	

∑(98)1...5, 10...12 = 38256.29 (98)

Space heating requirement kWh/m²/year (98) ÷ (4) = 41.41 (99)

8c. Space cooling requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm												
0.00	0.00	0.00	0.00	0.00	8964.53	7057.18	7216.58	0.00	0.00	0.00	0.00	(100)
Utilisation factor for loss ηm												
0.00	0.00	0.00	0.00	0.00	0.76	0.83	0.79	0.00	0.00	0.00	0.00	(101)
Useful loss ηmLm (watts) (100)m x (101)m												
0.00	0.00	0.00	0.00	0.00	6845.39	5831.81	5677.03	0.00	0.00	0.00	0.00	(102)
Gains												
0.00	0.00	0.00	0.00	0.00	9668.82	9243.99	8313.50	0.00	0.00	0.00	0.00	(103)
Space cooling requirement, whole dwelling, continuous (kWh) 0.024 x [(103)m - (102)m] x (41)m												
0.00	0.00	0.00	0.00	0.00	2032.87	2538.66	1961.53	0.00	0.00	0.00	0.00	

∑(104)6...8 =	6533.06	(104)
Cooled fraction — cooled area ÷ (4) =	0.67	(105)

Intermittency factor (Table 10)

0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.25	0.00	0.00	0.00	0.00

∑(106)6...8 =	0.75	(106)

Space cooling requirement (104)m x (105) x (106)m

0.00	0.00	0.00	0.00	0.00	340.02	424.61	328.08	0.00	0.00	0.00	0.00

∑(107)6...8 =	1092.71	(107)
Space cooling requirement kWh/m²/year — (107) ÷ (4) =	1.18	(108)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)	0.00	(201)
Fraction of space heat from main system(s) — 1 - (201) =	1.00	(202)
Fraction of space heat from main system 2	0.00	(202)
Fraction of total space heat from main system 1 — (202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2 — (202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)	93.90	(206)
Cooling system energy efficiency ratio (Table 10c)	4.05	(209)

Space heating fuel (main system 1), kWh/month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
8033.25	6183.00	5111.11	2923.35	1417.61	0.00	0.00	0.00	0.00	3160.08	5765.99	8147.12

∑(211)1...5, 10...12 =	40741.52	(211)

Water heating

Efficiency of water heater

90.41	90.35	90.20	89.83	88.93	80.20	80.20	80.20	80.20	89.87	90.29	90.43

(217)

Water heating fuel, kWh/month

350.35	310.08	328.64	299.25	298.75	299.99	291.92	315.07	312.87	310.00	321.99	343.01

∑(219a)1...12 =	3781.91	(219)

Space cooling fuel, kWh/month

0.00	0.00	0.00	0.00	0.00	83.95	104.84	81.01	0.00	0.00	0.00	0.00

∑(221)6...8 =	269.81	(221)

Annual totals

Space heating fuel - main system 1	40741.52	
Water heating fuel	3781.91	
Space cooling fuel	269.81	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
mechanical ventilation fans - balanced, extract or positive input from outside	2947.12	(230a)
central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	3022.12	(231)
Electricity for lighting (Appendix L)	1366.66	(232)
Energy saving/generation technologies		
electricity generated by PV (Appendix M)	-3799.93	(233)
Total delivered energy for all uses — (211)...(221) + (231) + (232)...(237b) =	45382.10	(238)

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

	Fuel kWh/year	Fuel price	Fuel cost £/year

Space heating - main system 1	40741.52	x	3.48	x 0.01 =	1417.81	(240)
Water heating	3781.91	x	3.48	x 0.01 =	131.61	(247)
Space cooling	269.81	x	13.19	x 0.01 =	35.59	(248)
Pumps and fans	3022.12	x	13.19	x 0.01 =	398.62	(249)
Electricity for lighting	1366.66	x	13.19	x 0.01 =	180.26	(250)
Additional standing charges					120.00	(251)
Energy saving/generation technologies						
pv savings	-3799.93	x	13.19	x 0.01 =	-501.21	(252)
Total energy cost				(240)...(242) + (245)...(254) =	1782.67	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	0.77	(257)
SAP value	89.22	
SAP rating (section 13)	89	(258)
SAP band	B	

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

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	40741.52	x	0.216	=	8800.17	(261)
Water heating	3781.91	x	0.216	=	816.89	(264)
Space and water heating			(261) + (262) + (263) + (264) =		9617.06	(265)
Space cooling	269.81	x	0.519	=	140.03	(266)
Pumps and fans	3022.12	x	0.519	=	1568.48	(267)
Electricity for lighting	1366.66	x	0.519	=	709.30	(268)
Energy saving/generation technologies						
pv savings	-3799.93	x	0.519	=	-1972.16	(269)
Total CO_2, kg/year				(265)...(271) =	10062.71	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	10.89	(273)
EI value					86.08	
EI rating (section 14)					86	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	40741.52	x	1.22	=	49704.66	(261)
Water heating	3781.91	x	1.22	=	4613.93	(264)
Space and water heating			(261) + (262) + (263) + (264) =		54318.58	(265)
Space cooling	269.81	x	3.07	=	828.30	(266)
Pumps and fans	3022.12	x	3.07	=	9277.92	(267)
Electricity for lighting	1366.66	x	3.07	=	4195.65	(268)
Energy saving/generation technologies						
Electricity generated - PVs	-3799.93	x	3.07	=	-11665.77	(269)
Primary energy kWh/year					56954.69	(272)
Dwelling primary energy rate kWh/m2/year					61.65	(273)

HOARE LEA

JO DRANE
PRINCIPAL SUSTAINABILITY ASSESSOR

+44 1202 654 600
jodrane@hoarelea.com

HOARELEA.COM

Enterprise House
Old School Close
Ferndown
Bournemouth
BH22 9UN
England