HODKINSON

Energy Statement

Designated Contractors Ltd

17-27 & 25 Ferdinand Street

Final

S Gowing
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ABOUT HODKINSON CONSULTANCY

Our team of technical specialists offer advanced levels of expertise and experience to our clients. We have a wide experience of the construction and development industry and tailor teams to suit each individual project.

We are able to advise at all stages of projects from planning applications to handover.

Our emphasis is to provide innovative and cost effective solutions that respond to increasing demands for quality and construction efficiency.

Executive Summary

This Energy Statement provides an energy strategy for the development at 17, 25 and 27 Ferdinand Street which comprises of the erection of additional 4th and 5th floors, 5 storey extension to courtyard (west) elevation, single storey extension to east elevation at 17 and 27 Ferdinand Street and redevelopment of 25 Ferdinand Street to create a 5 storey building to provide 10 additional residential units (19 units in total including 9 in situ) and 103m^2 Class B1a office floorspace.

The energy strategy 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 Regulated CO_2 emissions through the application of this Hierarchy with a cost-effective, viable and technically appropriate approach.

The development will be registered to Approved Document (AD) Part L1B (dwellings) and AD Part L2B (office). Conversions (and change of use) require special attention to ensure a holistic approach to energy reductions includes other considerations such as moisture management, ventilation, and traditional look. However, significant CO_2 reduction can be achieved with through-through performance uplifts benefiting the development.

A range of advanced ***Be Lean*** energy efficiency measures are proposed including upgrading all thermal elements in the conversion and for the new builds; low U-values psi-values (and thermal bridge).

The ***Be Lean*** measures enable the development to meet the energy efficiency requirements of AD Part L1B and L2B (2013). Improving existing thermal elements in the conversion, reducing air leakiness, and selective high performing materials for new thermal elements all assist in the conversions to exceed the original buildings CO_2 baseline by **49.5%**.

Target Emissions Rate (TER) and Target Fabric Energy Efficiency (TFEE) have been taken from energy assessments based on the pre-developed building specification. In this manner we can state the improvement upon the existing building in terms of Regulated CO_2 emissions end fabric energy efficiency.

This represents a good level of sustainable design and construction and indicates the Applicant's commitment to reducing energy demands across the site.

In line with the London Plan, the feasibility of decentralised energy production as a ***Be Clean*** measure has been carefully examined. There are no existing district heat networks in proximity to the site. Due to the small number of dwellings and space restrictions of the Development site a sitewide communal heating scheme has not been deemed viable, this is inline with the Greater London Authority (GLA) guidance on energy statements.

Significant CO_2 emissions savings have been maximised and made at the ***Be Lean*** stage. Although not selected, the full spectrum of ***Be Green*** renewable energy generating technologies has been considered.

The 35% reduction in on-site Regulated CO_2 emissions has been exceeded and the development is considered compliant with London Plan Policy 5.2 and Camden's CC01 policy. Policy 5.7 (B) of the London Plan states provision of renewables is 'within the framework of the energy hierarchy', which firmly requires energy efficiency measures to be prioritised.

Table 1 below summarises the anticipated Domestic CO_2 emissions savings across the scheme. As shown, the combination of ***Be Lean*** measures results in an exceedance of the 35% CO_2 reduction requirement. ***Be Clean*** and ***Be Green*** measures are shown in the table for completion, although the on-site policy target if wholly met within the ***Be Lean*** Measures.

In line with the GLA Housing Supplementary Planning Guidance, the development will commit to offset the remaining domestic CO_2 emissions. The remaining CO_2 emissions to be offset should be based upon **32.62 Tonnes CO_2 per annum**.

Table 1: Domestic Carbon Dioxide Emissions and Savings after each stage of the Energy Hierarchy

Stage	**Carbon Dioxide Emissions (Tonnes CO_2 per Annum)**	
	Regulated	**Unregulated**
Baseline	64.51	23.58
After *Be Lean* Measures	32.62	23.58
After *Be Clean* Measures	32.62	23.58
After *Be Green* Measures	32.62	23.58
After Carbon off-setting	0	23.58
Stage	**Regulated Carbon Dioxide Savings**	
	Tonnes CO_2 per Annum	**Percentage**
Savings from *Be Lean* Measures	31.89	49.4%
Savings from *Be Clean* Measures	0	0%
Savings from *Be Green* Measures	0	0%
After Carbon off-setting	32.62	50.6%
Cumulative Savings	64.51	100%

The Non-domestic area is expected to realise a 50% reduction in Regulated CO_2 emissions, see Table 2 below.

Table 2: Non-Domestic Carbon Dioxide Emissions and Savings after each stage of the Energy Hierarchy

Stage	**Carbon Dioxide Emissions (Tonnes CO_2 per Annum)**	
	Regulated	**Unregulated**
Baseline	6.82	2.25
After *Be Lean* Measures	3.39	2.25
After *Be Clean* Measures	3.39	2.25
After *Be Green* Measures	3.39	2.25
Stage	**Regulated Carbon Dioxide Savings**	
	Tonnes CO_2 per Annum	**Percentage**
Savings from *Be Lean* Measures	3.43	50.3%
Savings from *Be Clean* Measures	0	0%
Savings from *Be Green* Measures	0	0%
Cumulative Savings	3.43	50.3%

Following the energy hierarchy and accounting for Carbon Offsetting the Proposed Development is expected to reduce 95.3% of the developments Regulated CO_2 emissions, see Table 3 below.

Table 3: Total Carbon Dioxide Emissions and Savings after each stage of the Energy Hierarchy

Stage	**Carbon Dioxide Emissions (Tonnes CO_2 per Annum)**	
	Regulated	**Unregulated**
Baseline	71.33	25.83
After *Be Lean* Measures	36.01	25.83
After *Be Clean* Measures	36.01	25.83
After *Be Green* Measures	36.01	25.83
After Carbon off-setting	3.39	25.83
Stage	**Regulated Carbon Dioxide Savings**	
	Tonnes CO_2 per Annum	**Percentage**
Savings from *Be Lean* Measures	35.32	49.5%
Savings from *Be Clean* Measures	0	0%
Savings from *Be Green* Measures	0	0%
After Carbon off-setting	32.62	45.8%
Cumulative Savings	67.94	95.3%

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1. INTRODUCTION

1.1 This document has been prepared by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development.

1.2 The Energy Statement sets out the energy strategy on behalf of Designated Contractors Ltd (The 'Applicant') in respect to the planning application for the development of 17, 25 and 27 Ferdinand Street, which includes additional floors creating 10 additional dwellings (to the 9 already in situ) and 103m^2 of office space.

1.3 The energy strategy for the Site has been formulated to achieve the maximum viable reduction in Regulated CO_2 emissions in line with the Energy Hierarchy outlined in the London Plan. The following understanding of the hierarchy will be used to construct the energy strategy:

> Initially implementing ***Be Lean*** measures to reduce energy consumption through improvements to building fabric performance and auxiliary systems; then

> Consideration, and implementation of, ***Be Clean*** options, including the use of decentralised energy generation; and finally

> Reviewing the feasibility of ***Be Green*** measures, in order to generate renewable energy, and implementing them where appropriate.

1.4 A baseline CO_2 emission rate will be initially established for the development using the latest relevant methodology in Part L (2013) of the Building Regulations 2010.

1.5 The dwellings within the conversion and top floor extension to the upper floors will be assessed under Part L1B. The proposed office space will be assessed under Part L2B.

1.6 The baseline emissions will be based on a combination of the current building's specification and of the new build.

2. DEVELOPMENT OVERVIEW

Site Location

2.1 The development site at 17, 25 & 27 Ferdinand Street in the London Borough of Camden is located between Chalk Farm Road, Ferdinand Street, and Mead Close, as shown in Figure 1 below. The current building is used for a range of commercial units and 9 existing dwellings. The proposed scheme comprises the erection of additional 4th and 5th floors, 5 storey extension to courtyard (west) elevation, single storey extension to east elevation at 17 and 27 Ferdinand Street and redevelopment of 25 Ferdinand Street to create a 5 storey building to provide 10 additional residential units (19 units in total including 9 in situ) and 103m^2 Class B1a office floorspace.

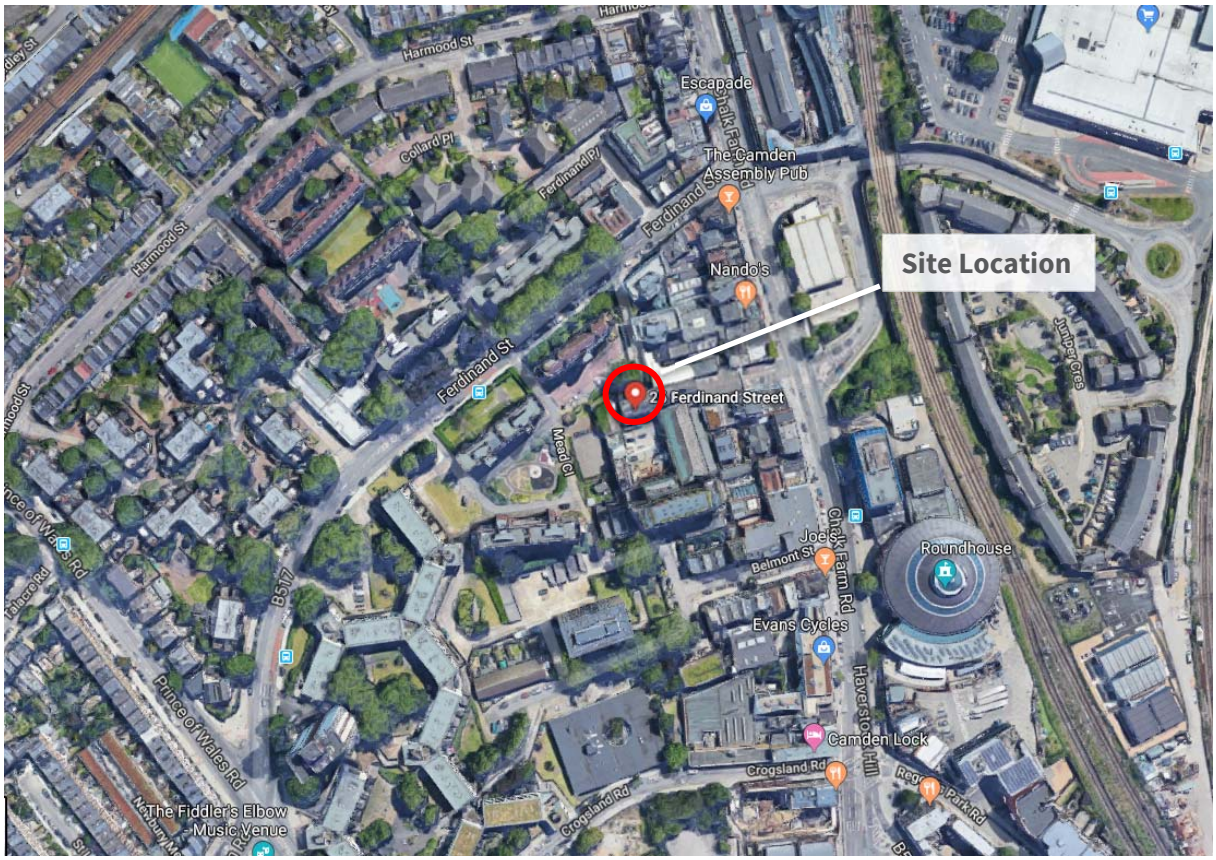

Figure 1: Site Location – Map data © 2018 Google

Proposed Development

2.2 The Proposed Development is described as follows:

"Variation of condition 2 (approved plans) of planning permission 2015/0925/P dated 27/11/2015 for the 'Erection of additional 4th and 5th floors, 5 storey extension to courtyard (west) elevation, single storey extension to east elevation all at 17 and 27 Ferdinand Street and redevelopment of 25 Ferdinand Street to create 5 storey building to provide 10 additional residential units (9 units already in situ) and Class B1a office floorspace', namely to extend the approved single storey east elevation extension to 5 storeys."

2.3 The Proposed Second Floor Plan in Figure 2 below illustrates the site location in more detail.

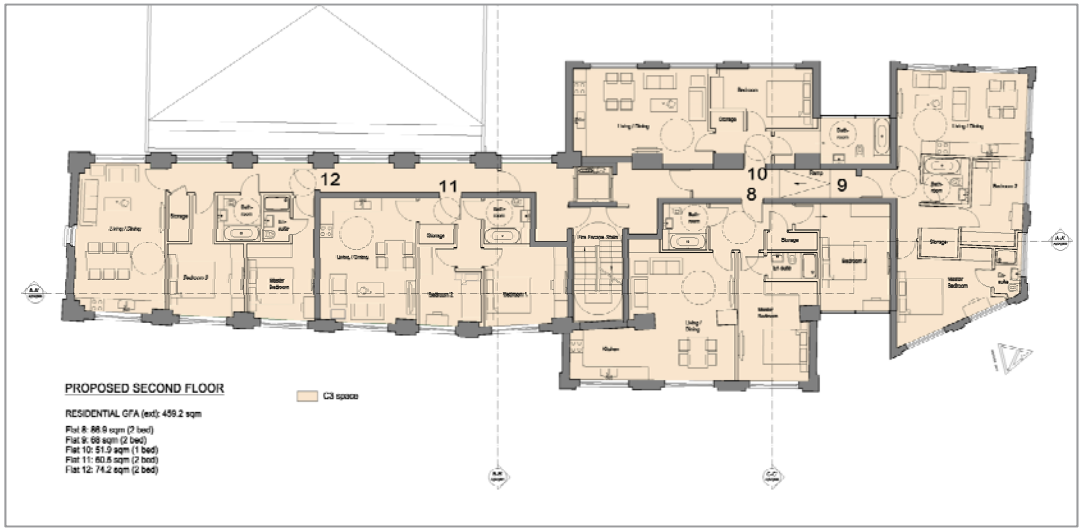

Figure 2: Proposed Second Floor - 2019 (Contemporary Design Solutions)

3. RELEVANT PLANNING POLICY

3.1 The following planning policies and requirements have informed the sustainable design of the proposed development.

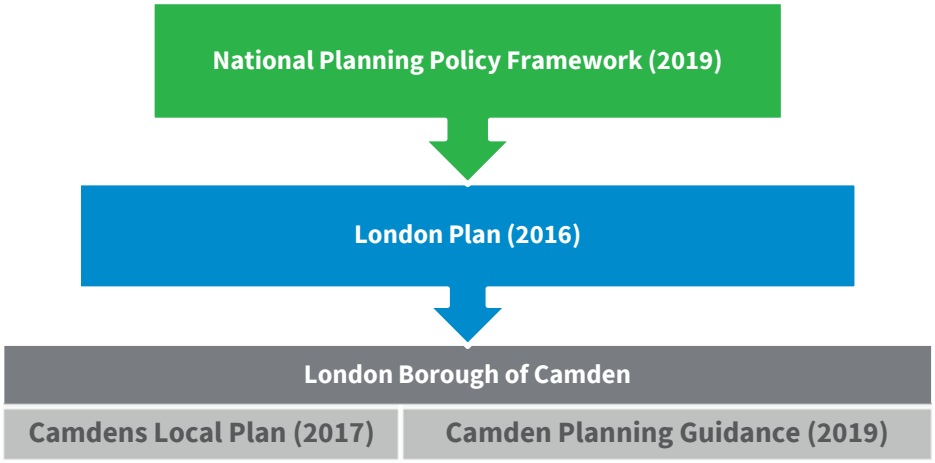

Figure 3: Relevant Planning Policy Documents

National Policy: NPPF

3.2 The revised National Planning Policy Framework (NPPF) was published on the 19th February 2019 and sets out the Government's planning policies for England.

3.3 The NPPF provides a framework for achieving sustainable development, which has been summarised as "*meeting the needs of the present without compromising the ability of future generations to meet their own needs*" (Resolution 42/187 of the United National General Assembly). At the heart of the framework is a **presumption in favour of sustainable development**.

3.4 The document states that the planning system has three overarching objectives which are interdependent and need to be pursued in mutually supportive ways:

a) **An economic objective** – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;

b) **A social objective** – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed and safe built environment, with

accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and

c) **An environmental objective** – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

Regional Policy: The London Plan

3.5 The draft London Plan showing Minor Suggested Changes (published on 13th August 2018) has recently been considered by a formal Examination in Public. It is now with the Panel of Inspectors to report the findings and provide any recommendations, with the final published New London Plan expected in early 2020. Once adopted, it will inform decisions on London's development between 2019 and 2041.

3.6 The existing London Plan sets out an integrated economic, environmental, transport and social framework for the development of London. The following policies are considered relevant to the proposed development and this Statement:

3.7 **Policy 5.3 – Sustainable Design and Construction** states that the highest standards of sustainable design and construction should be achieved in London to improve the environmental performance of new developments and to adapt to the effects of climate change over their lifetime.

3.8 Development proposals should demonstrate that sustainable design standards are integral to the proposal, including its construction and operation, and ensure that they are considered at the beginning of the design process.

3.9 Major development proposals should meet the minimum standards outlined in the Mayor's supplementary planning guidance and this should be clearly demonstrated within a design and access statement. The standards include measures to achieve other policies in the London Plan and the following sustainable design principles:

> Minimising carbon dioxide emissions across the site, including the building and services (such as heating and cooling systems).

> Avoiding internal overheating and contributing to the urban heat island effect.

> Efficient use of natural resources (including water), including making the most of natural systems both within and around buildings.

> Minimising pollution (including noise, air and urban runoff).

> Ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions.

> Securing sustainable procurement of materials, using local supplies where feasible, and

> Promoting and protecting biodiversity and green infrastructure.

3.10 **Policy 5.2 – Minimising Carbon Dioxide Emissions** requires development proposals to make the fullest contribution to minimising carbon dioxide emissions in accordance with the Energy Hierarchy: Be Lean, Be Clean and Be Green. This includes a requirement for all residential buildings to achieve Zero Carbon status from 2016.

3.11 GLA Definition: '*Zero carbon'* homes are 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 be ring fenced to secure delivery of carbon dioxide savings elsewhere.

3.12 **Policy 5.5 – Decentralised Energy Networks** states that the Mayor expects 25 per cent of the heat and power used in London to be generated through the use of localised decentralised energy systems by 2025. The Mayor will prioritise the development of decentralised heating and cooling networks at the development and area wide levels, including larger scale heat transmission networks.

3.13 **Policy 5.6 – Decentralised Energy** requires that all developments should evaluate the feasibility of Combined Heat and Power (CHP) systems and examine the opportunities to extend the system beyond the site boundary to adjacent sites.

3.14 **Policy 5.7 – Renewable Energy** states that within the framework of the energy hierarchy, major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.

3.15 **Policy 5.8 – Innovative Energy Technologies** encourages the more widespread use of innovative energy technologies to reduce use of fossil fuels and carbon dioxide emissions.

3.16 **Policy 5.9 – Overheating and Cooling** seeks to reduce the impact of the urban heat island effect, reduce potential overheating and reduce reliance on air conditioning systems in line with the cooling hierarchy.

Local Policy: London Borough of Camden

Camden Local Plan 2016-2031

3.17 The London Borough of Camden's Local Plan 2013-2031 document was adopted in July 2017 and sets out the Councils Strategy for the next 12 years. The following policies are considered relevant to this Statement:

3.18 **Policy CC1: Climate Change Mitigation** – Promotes Zero Carbon though use of the Energy Hierarchy and encourages the highest financially feasible environmental standards (during construction and occupation). The energy strategy should first optimise resource efficiency, then assess decentralised energy networks, and monitor any low carbon generation.

3.19 **Policy CC2: Adapting to Climate Change** – Requires measures to reduce the impact of urban and dwelling overheating including application of the cooling hierarchy which aims to reduce the need for active cooling.

Camden Planning Guidance (CPG)

The guidance was adopted 15th March 2019 and provides key messages (not policy) that should be considered. These include:

> Energy Strategies should reduce regulated CO_2 emissions in accordance with the energy hierarchy (***Be Lean***, ***Be Clean***, ***Be Green***)

> Natural 'passive' measures should be priorities over active-measures to reduce energy

> Major development to assess feasibility of decentralised energy network;

> Targeting a 20% CO_2 reduction through onsite renewable energy technologies.

Summary

3.20 The Development should follow the London Plan Policies and the Energy Assessment Guidance (2018). A minimum 35% CO_2 reduction over the existing development baseline will be targeted, remaining CO_2 emission will be offset through a cash-in-lieu payment to the Council.

4. BUILDING REGULATIONS BASELINE

Methodology

4.1 In line with London Plan policy and GLA Energy Assessment Guidance (2018), this report first establishes a baseline assessment of the energy demands and associated CO_2 emissions for the development site based on AD Part L (2013) of the Building Regulations.

4.2 The estimated annual energy demand for the residential portion of the Proposed Development has been calculated using Standard Assessment Procedure (SAP 2012) methodology. SAP calculates the Regulated energy demands associated with hot water, space heating and fixed electrical items.

4.3 The Unregulated domestic energy demands for appliances and cooking are taken from Chapter 16 of the SAP methodology and converted into CO_2 emissions. This methodology is similar to the BREEDEM methodology and consider then same sources of unregulated CO_2.

4.4 Unregulated Non-domestic energy demands, and associated CO_2 emissions have been taken from the BRUKL report. The equipment consumption (kWh/m2) is multiplied by the unit's area and the carbon factor of electricity (0.519) to provide the unregulated non-domestic CO_2 emissions.

4.5 SAP calculations have been carried out for representative home types. Three units have been selected and assessed; a mid-floor, mid-floor with exposed roof, and a top-floor unit. This represents a fair aggregation of units at the site.

4.6 In order to provide energy demands across the Proposed Development, a selection of dwelling types have been modelled and extrapolated up to provide a reasonable estimation of the Proposed Developments energy demands and use.

4.7 The Commercial Unit has been assessed following the methodology within the Simplified Building Energy Model (SBEM). Area weighted energy demands, and CO_2 emission have been applied to a similar shell and core office assessment.

Baseline Calculation

4.8 As the development is a conversion of an existing building the dwellings will be registered under AD Part L1B of the Building Regulations. Therefore, the Proposed Development SAP calculations will be compared to the Dwelling Emission Rate (DER) calculated from the pre-developed building specification using values detailed in the SAP (2012) methodology. This process is in line with the GLA guidance on Energy Statements (October 2018).

4.9 The existing building and the baseline emission rate calculation includes the following existing and default performance standards:

- Single glazing with a U-value of 4.8 W/m^{2}K;
- External wall U-value – 1.21 W/m^{2}K (330mm solid brick with drylining)
- Sheltered wall to corridor – 2.1 W/m^{2}K (290mm brick wall with ISO 6946 shelter factor);
- Party wall – Solid brick to have an effective 0.00W/m^{2}K;
- Ground floor U-value – 1.2 W/m^{2}K;
- Flat and Mansard roof U-values – 1.5 W/m^{2}K; and
- Natural ventilation with intermittent extract fans with an air leakage rate of 15m^3/m^2/hr (default untested).

4.10 The proposed heating strategy is applied to the existing and proposed dwellings. This ensures CO_2 emissions are not over estimated. Heating systems are the most likely to be in line with recent energy efficiency minimum standards. A boiler efficiency of 89.1% based on a commercially available boiler has also been incorporated within the commercial unit as the baseline case.

4.11 Each of the SAP calculations carried out has been multiplied up by the unit's floor area, and then by the number of homes proposed for that unit type, across the development. A table showing the homes selected, the total floor area (TFA) of that unit, and proposed number of homes is shown in **Appendix A.**

4.12 Using the Baseline discussed above a Target Emission Rate and Target Fabric Energy Efficiency can be applied.

4.13 Table 4 shows the Regulated and Unregulated baseline CO_2 emissions rates for both the residential and non-domestic elements. Pre-conversion DER worksheets for the dwellings and Pre-conversion BRUKL reports are provided in **Appendices B and C** to support these.

Table 4: Regulated and Unregulated Carbon Dioxide Emissions Baseline

	Carbon Dioxide Emissions (Tonnes CO_2 per Annum)		
	Domestic	**Non-Domestic**	**Cumulative**
Regulated	64.51	6.82	**71.33**
Unregulated	23.58	2.25	**25.83**

5. *BE LEAN*: DEMAND REDUCTION

5.1 In line with the London Plan Energy Hierarchy, several measures are proposed in order to reduce energy demands across the development.

5.2 The indicative specifications outlined achieve the following standards that the Developer is committing to achieve:

> The AD Part L1B and L2B (2013) CO_2 baseline through energy efficiency measures alone;

5.3 Similar specifications may be utilised during detailed design to achieve the above performance standards.

5.4 Throughout the design process to date, the Applicant has given consideration to building form and massing, and what impacts these have on energy use, daylighting and overheating. The objective of this consideration is to carefully balance these sometimes-opposing objectives.

Domestic units (Part L1B)

Fabric Performance

5.5 The converted units will promote energy efficiency by improving the fabric.

5.6 Upgraded and new thermal elements of the fabric should target or improve on the performance U-values detailed in Building Regulations Part L1B. These are detailed below in Table 5 and Table 6.

Table 5: Upgrading retained thermal elements (Part L1B)

Element	Threshold U-value	Minimum improvement value U-value
External Wall – Cavity insulation	0.70 W/m²K	0.55 W/m²K
External Wall – external or internal insulation	0.70 W/m²K	0.30 W/m²K
Floor	0.70 W/m²K	0.25 W/m²K
Pitched Roof – insulation at ceiling level	0.70 W/m²K	0.16 W/m²K
Pitched Roof – insulation between rafters	0.35 W/m²K	0.18 W/m²K
Flat Roof	0.35 W/m²K	0.18 W/m²K

5.7 New elements within the extension will meet or improve upon the maximum U-values shown in Table 6.

Table 6: Standards for new thermal elements (Part L1B)	
Element	**Limiting U-value**
Wall	0.28 W/m²K
Pitched Roof – insulation at ceiling level	0.16 W/m²K
Pitched Roof – insulation between rafters	0.18 W/m²K
Flat Roof	0.18 W/m²K
Floors	0.22 W/m²K
Windows	1.6 W/m²K (WER* Band C)
Doors	1.8 W/m²K (DSER** Band E)

***Window Energy rating, ** Door set energy rating**

5.8 It is expected that the converted dwellings will incorporate improved U-values and on average achieve the following:

> External wall U-values of 0.28 W/m²K (e.g. 125mm mineral wool, 70mm of internal phenolic insulation, or 50mm aerogel such as 'Spacetherm');

> New External Walls should target 0.18W/m²K;

> Top floor curtain walling U-value of 1.80W/m²K

> Party walls will be either solid or fully filled and sealed or solid (achieving an effective U-value of 0.00 W/m²K);

> Walls to corridor of 0.28 W/m²K including sheltering factors (e.g. 90mm insulation between steel frame either side of 50mm cavity);

> Double glazing with whole unit U-value of 1.30 W/m²K, (with a default g-factor of 0.63);

> Roofs to achieve a U-value of 0.18 W/m²K;

> Floors with a U-value of 0.22 W/m²K.

Air Tightness & Ventilation

5.9 Natural ventilation with intermittent extract fans (system 1) is proposed allowing simple solution to ventilate the dwelling and remove stale or humid air from the kitchen and wet rooms.

5.10 All homes will have openable windows and therefore the ability to increase ventilation should the occupant desire. This will facilitate convective ventilation and night purging of heat, as illustrated in Figure 4

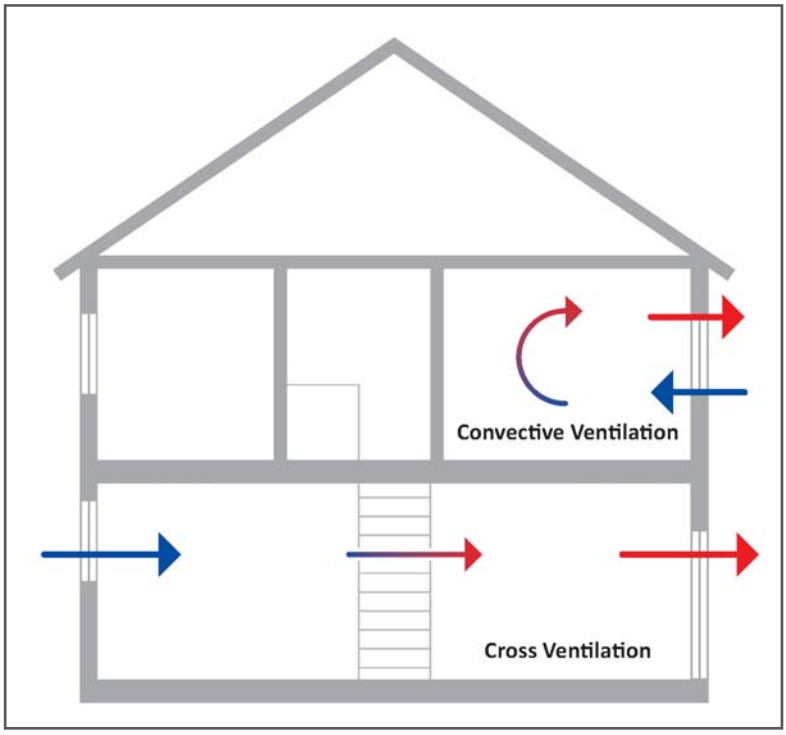

Figure 4: Natural Ventilation

5.11 In order to minimise ventilate heat losses, uncontrolled ventilation will be reduced through targeting a low air permeability (building leakage) figure of 6m^3/hr/m^2. This has been used in the Energy Statement calculations.

5.12 Consideration to air tightness membranes, detailing, and suitable construction skills will be required to ensure the target air permeability will be achieved when air tested upon completion.

Thermal Bridging

5.13 Low thermal bridge heat loss values cannot be designed into conversions as the existing building limits the ability for specific detailing.

5.14 However, best practice will be followed where possible such as ACDs for window surrounds.

Space Heating & Hot Water

5.15 The development will include individual high efficiency condensing gas boilers.

5.16 Sophisticated heated controls will allow heating time and temperature to be allocated to different zones of the dwelling.

Lighting

5.17 Energy efficient lighting will be installed in 100% of internal fittings in the homes.

Unregulated Energy Demands

5.18 Unregulated energy demands are typically defined as the energy needed for cooking and powering appliances within the home. There is difficulty in reducing the energy associated with these uses as they are entirely dependent on the occupant of a home and can vary substantially. However, the Applicant is committed to ensuring that all efforts are made to enable the residents to minimise their unregulated electricity consumption.

Mitigation against Summer Overheating

5.19 In line with the Cooling Hierarchy within London Plan Policy 5.9, it is proposed to reduce the need for active cooling as far as possible.

5.20 Reducing the summertime overheating risk will be done through the specification of non-mechanical measures such as good thermal insulation and air tightness. When combined with cross ventilation and openable windows to non-noise sensitive dwellings, the risk of overheating has been reduced to appropriate levels. This is demonstrated in section 9 of the DER worksheet in Appendix E.

Non- Domestic unit (Part L2B)

Fabric Performance

5.21 The office space will promote energy efficiency by improving the fabric.

5.22 Upgraded and new thermal elements of the fabric should target or improve on the performance U-values detailed in Building Regulations AD Part L2B. These are detailed below in Table 5 and Table 6.

Table 7: Upgrading retained thermal elements (Part L2B)

Element	Threshold U-value	Minimum improvement value U-value
External Wall – Cavity insulation	0.70 W/m^{2}K	0.55 W/m^{2}K
External Wall – external or internal insulation	0.70 W/m^{2}K	0.30 W/m^{2}K
Floor	0.70 W/m^{2}K	0.25 W/m^{2}K
Pitched Roof – insulation at ceiling level	0.70 W/m^{2}K	0.16 W/m^{2}K
Pitched Roof – insulation between rafters	0.35 W/m^{2}K	0.18 W/m^{2}K
Flat Roof	0.35 W/m^{2}K	0.18 W/m^{2}K

Table 8: Standards for new thermal elements (Part L2B)	
Element	**Limiting U-value**
Wall	0.28 W/m²K
Pitched Roof – insulation at ceiling level	0.16 W/m²K
Pitched Roof – insulation between rafters	0.18 W/m²K
Flat Roof	0.18 W/m²K
Floors	0.22 W/m²K
Domestic in character windows	1.6 W/m²K (WER* Band C)
All other windows (roof lights etc.)	1.8 W/m²K
Doors - Pedestrian/ High usage pedestrian / Vehicles	1.8 W/m²K /3.5 W/m²K /1.5 W/m²K

***Window Energy rating, ** Door set energy rating**

5.23 It is expected that the office will incorporate improved U-values and on average achieve the following:

> External wall U-values of 0.28 W/m²K (e.g. 125mm mineral wool, 60mm of internal phenolic insulation, or 40mm aerogel such as 'Spacetherm');

> Curtain walling U-value of 1.80W/m²K

> Party walls will be either solid or fully filled and sealed or solid (achieving an effective U-value of 0.00 W/m²K);

> Walls to corridor of 0.28 W/m²K including sheltering factors (e.g. 90mm insulation between steel frame either side of 50mm cavity);

> Double glazing with whole unit U-value of 1.30 W/m²K, (with a default g-factor of 0.5 and light transmittance of 0.74);

> Roofs to achieve a U-value of 0.18 W/m²K;

> Floors with a U-value of 0.22 W/m²K.

Air Tightness & Ventilation

5.24 It is expected that ventilation is provided by a mechanical ventilation and heat recovery system. This system allows heat to be recovered reducing the heating demands for they system. Low specific fan powers and high heat recovery efficiencies should be considered when selecting the unit at the detailed design stage.

5.25 Due to the small size of the office unit it is not required to be pressure tested. Therefore, the default air permeability has been used in the Energy Statement calculations.

Thermal Bridging

5.26 Low thermal bridge heat loss values cannot be designed into conversions as the existing building limits the ability for specific detailing.

5.27 However, best practice will be followed where possible such as ACDs for window surrounds and openings.

Space Heating & Hot Water

5.28 The commercial ambient space heating demands, and low hot water demands) are more suited an efficient heating ventilation and air conditioning (HVAC) system.

5.29 The office will include individual high efficiency Air Source Heat Pumps (ASHP) with compensators (e.g. weather compensators) to further increase the efficiency. An SCOP from a similar completed project of 3.04 has been used in the calculations.

5.30 Sophisticated heated controls will allow heating time and temperature to be allocated to different zones of the dwelling.

5.31 Hot water is expected to be provide by a point of use electric water heater.

Lighting

5.32 Energy efficient lighting will be installed in 100% of internal fittings and be sub-metered. Photoelectric switching reduces light usage when not required and provides energy savings.

Mitigation against Summer Overheating

5.33 In line with the Cooling Hierarchy within London Plan Policy 5.9, it is proposed to reduce the need for active cooling as far as possible.

5.34 Reducing the summertime overheating risk will be done through the specification of non-mechanical measures such as good thermal insulation. However, it is expected that cooling is supplied from the ASHP. Existing product Energy Efficiency Rating (EER) 2.64 has been used in the calculations, taken from a similar completed project.

5.35 The heating, ventilation, and cooling systems described meet the minimum requirements of the Building Services Guide.

CO_2 Emissions at *Be Lean* Stage

5.36 Table 4, below, details the site wide Regulated CO_2 emissions of the development after the application of the performance standards specified above. It can be seen that these measures enable the targets in Part L (2013) of the Building Regulations, to be met through energy efficiency measures alone. A summary table of these results is presented in **Appendix A**. DER worksheets supporting these calculations are presented in **Appendices C and D**.

Table 9: Regulated Carbon Dioxide Emissions at *Be Lean* Stage

	Carbon Dioxide Emissions (Tonnes CO_2 per Annum)		
	Domestic	**Non-Domestic**	**Cumulative**
Baseline	64.51	6.82	**71.33**
After ***Be Lean*** Measures	32.62	3.39	36.01
Total Emissions Reduction	**31.89**	**3.43**	**35.32**
Percentage Reduction	**49.4%**	**50.3%**	**49.5%**

5.37 Other than the U-values stated in AD Part L1B there is not a Fabric Energy Efficiency (FEE) criteria. To show how the development is expected to improve on the existing buildings fabric a baseline Target FEE (TFEE) has been calculation from the baseline specification. This allows the developments average Dwelling Fabric Energy Efficiency (DFEE) to be compared to the pre-developed building. The DFEE weighted by the net internal floor areas of the dwellings, has been calculated as 74.8 kWh/m^2. This represents a 59% improvement over the pre-conversion FEE calculated at the baseline stage. A summary of the FEE scores for each dwelling are presented in **Appendix A**.

6. *BE CLEAN*: HEATING INFRASTRUCTURE

6.1 In line with Policy 5.6 of the London Plan and the CPG, the energy systems required on site have been evaluated and optimised based on the Proposed Development's scale and density. The London Plan outlines the following order of preference for energy generation:

> Connection to existing heating or cooling networks;

> Site wide CHP network;

> Communal heating and cooling.

6.2 The inclusion of a decentralised heating and cooling network has been investigated in terms of appropriateness to the Proposed Development and, to be in line with the priorities for this energy strategy, whether it is the best technology to provide the greatest reductions in CO_2 emissions.

Local Networks

6.3 The London Borough of Camden have ascertained that the area has potential for a future district heating network and are seeking to deliver area-wide heat networks. Figure 5 shows the existing Gospel Oak heat network (red line) is 720m away for the development site (red circle) and the proposed initial network corridor (230m away) which runs across Prince of Wales Road (black line).

6.4 It would be technically difficult to connect due to the Proposed Developments location as the development's location is bounded by the adjacent buildings and surrounded by private land. The access road is small and would increase a heat network connection length and cost.

6.5 For this reason, connection to an offsite energy network is not proposed.

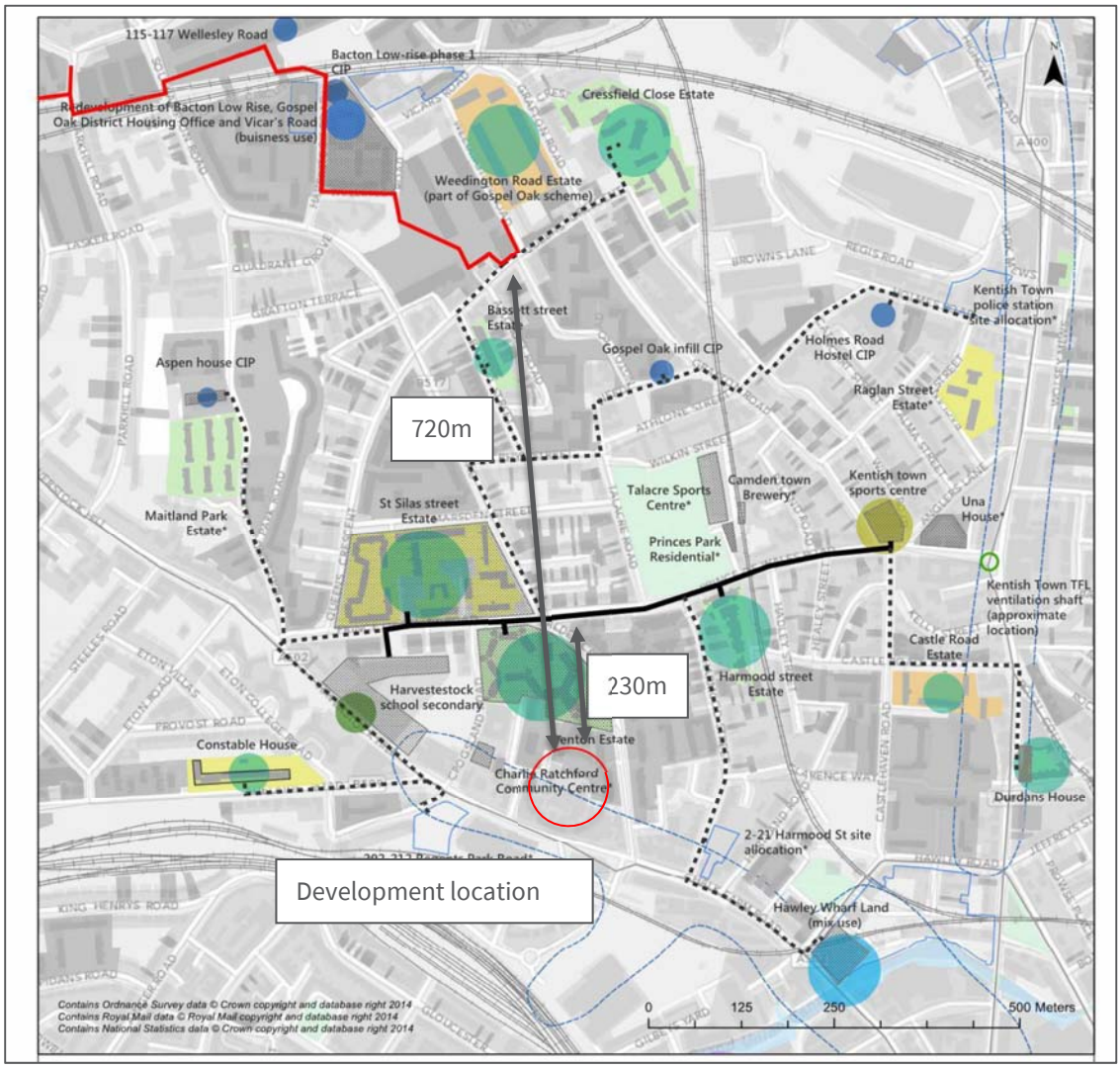

Figure 5: Borough Wide Heat Demand and Heat Source mapping (Copyright © 1976 - 2015 BuroHappold Engineering)

Site-Wide Heat Network

6.6 Incorporating a sitewide energy network would require plant rooms or energy centres and increased riser space. With only the possibility of a future connection a site wide network becomes unfeasible. Recuperating high capital costs and high fixed operation and maintenance costs associated with operating an energy centre divided between so few final customers becomes significantly expensive for the occupants.

6.7 This has been considered in line with Camden's Policy CC1 which encourages the **highest financially feasible** environmental standards (during construction **and occupation**).

6.8 A site-wide heat network would be uneconomical for 19 small units with minimised heat demands. The following details specific disadvantages associated with applying an on-site community heating scheme:

> **Diversity of demand:** Communal boilers can run more efficiently in developments where there is a diversity of energy demand resulting in a more constant load. A large mixed-use scheme, or a large residential scheme (>1000 homes) will have extended periods of the day in which there is a continuous demand for heat. On a small residential scheme such as this, there will be long periods of low or very low heat demand with two sharp peaks in demand for hot water in the morning and evening. Sharp peaks in demand must be dealt with the specification of an oversized communal boiler, which would run efficiently at lower loads.

> **Space:** The is not space on site to house a communal plant room to house a communal boiler and associated equipment.

> **Distribution Heat Losses:** Even the best insulated heating distribution networks have large standing heat losses. When communal systems satisfy a small and intermittent demand, these standing losses will represent a large part (often over 30%) of total demand. CO_2 savings gained within the dwelling through association with a heat network (and potential low carbon heat) may be considerably reduced by the additional losses associated with the network. Furthermore, the build-up of this heat in residential circulation spaces proves hard to dissipate and can increase to an uncomfortable level. Strategies for the rapid ventilation of this heat reduce the efficiency of the system as a whole by throwing heat away.

> **Installed Costs:** The installed cost of a heat distribution network benefits from economies of scale when compared with individual heating systems. On a smaller scheme the upfront cost of commercial heating plant must be divided into relatively few numbers of units.

> **Running Costs:** Fixed costs associated with the management and operation of a communal plant room must be shared by occupants as part of an energy standing charge; hence the fewer the number of units, the greater the cost for the individual occupant.

6.9 It has been concluded that both a connection to a heat network or an onsite heat network (community heating) would be uneconomical and incur high resident heating cost in terms of service charges.

6.10 As such the individual gas boiler strategy (and ASHP for the office) from the ***Be Lean*** stage will be kept.

CO_2 Emissions at *Be Clean* Stage

6.11 Table 10 details the site wide Regulated CO_2 emission reduction of the development after the implementation any ***Be Clean*** measures.

Table 10: Regulated Carbon Dioxide Emissions at *Be Clean* Stage

	Carbon Dioxide Emissions (Tonnes CO_2 per Annum)		
	Domestic	**Non-Domestic**	**Cumulative**
After ***Be Lean*** Measures	32.62	3.39	36.01
After ***Be Clean*** Measures	32.62	3.39	36.01
Total Emissions Reduction	**0**	**0**	**0**
Percentage Reduction	**0%**	**0%**	**0%**

7. *BE GREEN*: RENEWABLE ENERGY

7.1 The final part of the London Plan Energy Hierarchy is ***Be Green*** which seeks for renewable energy technologies to be specified to provide, where feasible, a reduction in expected CO_2 emissions (Policy 5.7). Camden's key messages in the CGP also looks toward low and zero carbon technologies to reduce CO_2 a further 20%.

7.2 Due to the prioritisation and optimisation of energy efficiency measures, the requirement for low carbon and renewable energy technologies is reduced.

7.3 This section will summarise low carbon and renewable technologies along with their feasibility. A feasibility table is presented in **Appendix F**.

Biomass Boiler

7.4 Biomass boilers generate heat on a renewable basis as they are run on biomass fuel which can be considered as carbon neutral. A biomass boiler would require a central plant room and heat distribution network and would therefore be liable to high capital and running costs.

7.5 Additional plant equipment would be required to limit wood burning on the local air quality.

7.6 Biomass boilers have therefore been considered not appropriate for this scheme.

Ground and Air Source Heat Pumps (GSHPs and ASHPs)

7.7 Heat Pumps upgrade energy from the ground or air and utilise it for space heating and hot water. Heat Pumps are able to provide substantial reductions in energy. This space heating demand has been reduced by the energy efficiency measure detailed in the ***Be Lean*** chapter.

7.8 Ground Source Heat Pumps (GSHPs) require costly ground excavation works to bury the coils – boreholes would be required for the proposed development due to the high space requirements of ground coils and this is not possible on this site.

7.9 Air Source Heat Pumps (ASHPs) are a more economical alternative to GSHPs as they do not require ground works, but they require external space (e.g. roof or balcony) for the external unit. Suitable space for the individual external units is limited on the development.

7.10 ASHPs can provide efficient space heating, for low temperature systems. Hot water is still generally provided by electrical resistance immersion heating (to meet the required higher temperatures) and therefore requires space for a hot water cylinder within the unit.

7.11 Electricity is still significantly more expensive than gas, so energy bills are not necessarily reduced by heat pumps as much as by other simpler technologies. Gas boilers have lower maintenance costs than ASHP further reducing the resident's costs.

7.12 Considering the above heat pump technology has not been applied to domestic aspect of this development.

7.13 Non-domestic areas are more suited to the use of ASHPs as they are able to provide cooling negating the need for an additional air conditioning system. An ASHP has been applied to the non-domestic unit within the ***Be Lean*** part of the energy hierarchy as it also provides cooling and cannot be considered within the ***Be Green*** part of the hierarchy.

Wind Turbines

7.14 Wind turbines generate electricity via the rotation of the turbine's blades caused by wind. They generally need a minimum constant wind speed of ~5-7m/s. However, the Proposed Development is situated in an urban location. It has been shown that such locations often experience highly turbulent and low speed wind conditions. Because of this, and due to space requirements, the installation of wind turbines would not be a cost effective or appropriate method for the generation of renewable energy on this development.

7.15 Wind turbines will therefore not be installed on the site.

Solar Thermal Panels

7.16 Solar thermal panels use the sun's energy to generate hot water for each dwelling. Due to the seasonality of solar radiation, solar thermal panels can provide up to ~60% of a dwellings hot water demand, with the remainder being provided as top-up by the conventional gas boiler. They are a robust technology that provides substantial benefits to residents in terms of 'free' energy.

7.17 The developments building has some limited flat roof area suitable for solar thermal panel. However, the technical requirements for running the systems heat transfer liquid (usually glycol based) to each of the units on multiple floors would be difficult to practically install.

7.18 Solar thermal panels providing CO_2 reductions are linked to providing hot water which limits the CO_2 savings they would provide.

7.19 Considering the limited potential CO_2 savings and the technical difficulties (space and dwelling connection) solar thermal panels have not been included within this energy strategy.

Solar Photovoltaics (PV)

7.20 PV panels generate electricity from solar radiation. The generating potential of PV panels is not dependent on development demand, but only on available roof space for installation and ensuring that they are not over shaded.

7.21 The development is required to include green roofs to meet Camden's Policy CC2c; *"Incorporating bio-diverse roofs…"*. Green roofs increase the biodiversity in an urban area and reduce the urban heat island effect by cooling the local area through evapotranspiration. The prioritisation of green roofs reduces the available roof space for PV due to the additional weight loads and wind (ballast) required.

7.22 Therefore, it is not proposed to install any PV due to already achieving target CO_2 reductions by following the energy hierarchy in the most appropriate manner. This reflects Policy 5.7 (B) of the London Plan which states provision of renewables is '*within the framework of the energy hierarchy*', which firmly requires energy efficiency measures to be prioritised. In line with the hierarchy, the CO_2 reductions required by policy are achieved through ***Be Lean*** measures alone.

7.23 A roof plan is shown in **Appendix G**.

Be Green Summary

7.24 Significant CO_2 emissions savings have been made at the ***Be Lean*** stage. It is not proposed to install renewable energy technologies since the energy hierarchy has been appropriately followed to maximise CO_2 reductions in the most appropriate manner.

7.25 Roof mounted low and zero carbon technologies have been considered, but on balance a green roof would be a more suitable allocation of space providing biodiversity, pleasing view, and localised cooling.

8. ZERO CARBON HOMES

8.1 London Plan Policy 5.6 required all domestic major developments to be Zero Carbon by 2016. The GLA has stipulated that '*Zero Carbon'* requires all Regulated CO_2 emission to removed; where this cannot be achieved onsite this will be through a carbon offset payment to the Local Authority

8.2 Camden's Policy CC1 promotes Zero Carbon development. 'Zero Carbon' has been defined by the Government as reducing Regulated CO_2 to zero. The CPG state the Council may accept the provision of carbon reduction measures elsewhere in the borough or secure a S106 financial contribution to Camden's Carbon Offset Fund if the CO_2 standards have not been met. Camden has aligned their carbon offsetting price to the GLAs; £60 per tonnes per annum for 30 years.

8.3 The '*Zero Carbon'* Policy will only apply to dwellings. Domestic Regulated CO_2 emission after the application of ***Be Lean*** measures totals 32.62 Tonnes CO_2 per Annum (see).

8.4 The Applicant will offset this remaining CO_2 following further discussion and agreement with the London Borough of Camden.

Table 11: Zero Carbon Homes Offset Payment

Residential Residual CO_2 emissions (Tonnes CO_2 per Annum)	32.62 t.CO_2/a
Carbon Offset Price per Tonne CO_2	£60
Carbon Offset Price per Tonne CO_2 for lifetime of building (30 years)	£1,800
Total Carbon Offset Payment	£58,716.00

9. SUMMARY

9.1 This Energy Statement provides an energy strategy for the development at 17, 25 and 27 Ferdinand Street which comprises of the erection of additional 4th and 5th floors, 5 storey extension to courtyard (west) elevation, single storey extension to east elevation at 17 and 27 Ferdinand Street and redevelopment of 25 Ferdinand Street to create a 5 storey building to provide 10 additional residential units (19 units in total including 9 in situ) and 103m^2 Class B1a office floorspace.

9.2 The energy strategy 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 Regulated CO_2 emissions through the application of this Hierarchy with a cost-effective, viable and technically appropriate approach.

9.3 The development will be registered to Approved Document (AD) Part L1B (dwellings) and AD Part L2B (office). Conversions (and change of use) require special attention to ensure a holistic approach to energy reductions includes other considerations such as moisture management, ventilation, and traditional look. However, significant CO_2 reduction can be achieved with through-through performance uplifts benefiting the development.

9.4 A range of advanced ***Be Lean*** energy efficiency measures are proposed including upgrading all thermal elements in the conversion and for the new builds; low U-values psi-values (and thermal bridge).

9.5 The ***Be Lean*** measures enable the development to meet the energy efficiency requirements of AD Part L1B and L2B (2013). Improving existing thermal elements in the conversion, reducing air leakiness, and selective high performing materials for new thermal elements all assist in the conversions to exceed the original buildings CO_2 baseline by **49.5%**.

9.6 Target Emissions Rate (TER) and Target Fabric Energy Efficiency (TFEE) have been taken from energy assessments based on the pre-developed building specification. In this manner we can state the improvement upon the existing building in terms of Regulated CO_2 emissions end fabric energy efficiency.

9.7 This represents a good level of sustainable design and construction and indicates the Applicant's commitment to reducing energy demands across the site.

9.8 In line with the London Plan, the feasibility of decentralised energy production as a ***Be Clean*** measure has been carefully examined. There are no existing district heat networks in proximity to the site. Due to the small number of dwellings and space restrictions of the Development site a sitewide communal heating scheme has not been deemed viable, this is inline with the Greater London Authority (GLA) guidance on energy statements.

9.9 Significant CO_2 emissions savings have been maximised and made at the ***Be Lean*** stage. Although not selected, the full spectrum of ***Be Green*** renewable energy generating technologies has been considered.

9.10 The 35% reduction in on-site Regulated CO_2 emissions has been exceeded and the development is considered compliant with London Plan Policy 5.2 and Camden's CC01 policy. Policy 5.7 (B) of the London Plan states provision of renewables is 'within the framework of the energy hierarchy', which firmly requires energy efficiency measures to be prioritised.

9.11 Table 12 below summarises the anticipated Domestic CO_2 emissions savings across the scheme. As shown, the combination of ***Be Lean*** measures results in an exceedance of the 35% CO_2 reduction requirement. ***Be Clean*** and ***Be Green*** measures are shown in the table for completion, although the on-site policy target if wholly met within the ***Be Lean*** Measures.

9.12 In line with the GLA Housing Supplementary Planning Guidance, the development will commit to offset the remaining domestic CO_2 emissions. The remaining CO_2 emissions to be offset should be based upon **32.62 Tonnes CO_2 per annum**.

Table 12: Domestic Carbon Dioxide Emissions and Savings after each stage of the Energy Hierarchy

Stage	**Carbon Dioxide Emissions (Tonnes CO_2 per Annum)**	
	Regulated	**Unregulated**
Baseline	64.51	23.58
After *Be Lean* Measures	32.62	23.58
After *Be Clean* Measures	32.62	23.58
After *Be Green* Measures	32.62	23.58
After Carbon off-setting	0	23.58
Stage	**Regulated Carbon Dioxide Savings**	
	Tonnes CO_2 per Annum	**Percentage**
Savings from *Be Lean* Measures	31.89	49.4%
Savings from *Be Clean* Measures	0	0%
Savings from *Be Green* Measures	0	0%
After Carbon off-setting	32.62	50.6%
Cumulative Savings	64.51	100%

9.13 The Non-domestic area is expected to realise a 50% reduction in Regulated CO_2 emissions, see Table 13 below.

Table 13: Non-Domestic Carbon Dioxide Emissions and Savings after each stage of the Energy Hierarchy

Stage	**Carbon Dioxide Emissions (Tonnes CO_2 per Annum)**	
	Regulated	**Unregulated**
Baseline	6.82	2.25
After *Be Lean* Measures	3.39	2.25
After *Be Clean* Measures	3.39	2.25
After *Be Green* Measures	3.39	2.25
Stage	**Regulated Carbon Dioxide Savings**	
	Tonnes CO_2 per Annum	**Percentage**
Savings from *Be Lean* Measures	3.43	50.3%
Savings from *Be Clean* Measures	0	0%
Savings from *Be Green* Measures	0	0%
Cumulative Savings	3.43	50.3%

9.14 Following the energy hierarchy and accounting for Carbon Offsetting the Proposed Development is expected to reduce 95.3% of the developments Regulated CO_2 emissions, see Table 14 below.

Table 14: Total Carbon Dioxide Emissions and Savings after each stage of the Energy Hierarchy

Stage	**Carbon Dioxide Emissions (Tonnes CO_2 per Annum)**	
	Regulated	**Unregulated**
Baseline	71.33	25.83
After *Be Lean* Measures	36.01	25.83
After *Be Clean* Measures	36.01	25.83
After *Be Green* Measures	36.01	25.83
After Carbon off-setting	3.39	25.83
Stage	**Regulated Carbon Dioxide Savings**	
	Tonnes CO_2 per Annum	**Percentage**
Savings from *Be Lean* Measures	35.32	49.5%
Savings from *Be Clean* Measures	0	0%
Savings from *Be Green* Measures	0	0%
After Carbon off-setting	32.62	45.8%
Cumulative Savings	67.94	95.3%

APPENDICES

Appendix A
Summary Baseline and *Be Lean* CO_2 emissions and Fabric Energy Efficiency

Appendix B
Domestic Pre-Conversion DER Worksheets (TER baseline)

Appendix C
Non-Domestic Pre-Conversion BRUKL report (TER Baseline)

Appendix D
Domestic ***Be Lean*** Dwelling Emission Rate (DER) worksheets

Appendix E
Non- Domestic ***Be Lean*** BRUKL report

Appendix F
Low and Zero Carbon Technology Feasibility Table

Appendix G
Roof Plans

Appendix A

Summary Baseline and *Be Lean* CO_2 emissions and Fabric Energy Efficiency

Appendix A

CO_2 Emissions at Be Lean Stage

Unit Type Description	Individual			Total				
	Unit Floor Area	Dwelling Emissions Rate	Target Emissions Rate	Number of Units	Total Floor Area	Dwelling Emissions Rate	Target Emissions Rate	Emissions Rate Improvement
Domestic	m^2	kg CO^2/m^2/year	kg CO^2/m^2/year		m^2	kg CO^2/year	kg CO^2/year	-
Mid Floor dwelling	53	26.2	51.7	10	530	13,907	27,411	49.3%
Mid floor dwellings with heat loss roof and Ground Floors	68	23.2	51.9	7	475	11,035	24,669	55.3%
Top Floor dwellings	110	34.9	56.6	2	220	7,679	12,432	38.2%
			Domestic Subtotal	**19**	**1,225**	**32,621**	**64,512**	**49.4%**
Non-domestic								
Office	103	32.9	66.2	1	103	3,389	6,819	50.3%
			Non-Domestic Subtotal		**103**	**3,389**	**6,819**	**50.3%**
			Total for All Units		**1,328**	**36,010**	**71,331**	**49.5%**

Fabric Energy Efficiency

Unit Type Description	Individual			Total				Fabric Energy Efficiency Improvement
	Unit Floor Area	Dwelling Fabric Energy Efficiency	Target Fabric Energy Efficiency	Number of Units	Total Floor Area	Dwelling Fabric Energy Efficiency	Target Fabric Energy Efficiency	
Domestic								
Mid Floor dwelling	53	67.6	178.7	10	530	35,866	94,756	62.1%
Mid floor dwellings with heat loss roof and Ground Floors	68	61.5	175.6	7	475	29,203	83,469	65.0%
Top Floor dwellings	110	121.3	206.1	2	220	26,658	45,307	41.2%
			Floor Weighted Average	**19**	**1,225**	**74.8**	**182.4**	**59.0%**

Appendix B

Domestic Pre-Conversion DER Worksheets (TER baseline)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	Plot 04	**Issued on Date**	24/06/2019
Assessment Reference	Baseline	**Prop Type Ref**	MId
Property	Plot 014, Ferdinand Street, Camden, LONDON, LONDON, NW1 8EU		

SAP Rating	66 D	**DER**	51.68	**TER**	21.02
Environmental	64 D	**% DER<TER**	-145.87		
CO_2 Emissions (t/year)	2.25	**DFEE**	178.65	**TFEE**	56.54
General Requirements Compliance	Fail	**% DFEE<TFEE**	-215.95		

Assessor Details	Mr. Simon Gowing, Simon Gowing, Tel: 02036031616, Simon@hodkinsonconsultancy.com	**Assessor ID**	T271-0001
Client			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
Design SAP
elmhurst energy

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 53 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-------------------------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 21.02 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 51.68 kgCO□/m²Fail
Excess emissions =30.66 kgCO□/m²  (146.0%)
-------------------------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)178.7 kWh/m²/yrFail
Excess energy =122.2 kWh/m²/yr  (216.0%)
-------------------------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.96 (max. 0.30)        1.21 (max. 0.70)          Fail
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            (no roof)
Openings        4.43 (max. 2.00)        4.80 (max. 3.30)          Fail
-------------------------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15
-------------------------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         15.00 (assumed)                                   OK
-------------------------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Boiler system with radiators or underfloor - Mains gas
Data from database
Worcester Greenstar 29CDi Classic ErP
Combi boiler
Efficiency: 89.1% SEDBUK2009
Minimum: 88.0%                                  OK

Secondary heating system:               None
-------------------------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       No cylinder
-------------------------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Programmer and at least two room thermostats      OK


Hot water controls:                     No cylinder


Boiler interlock                        Yes                                               OK
-------------------------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                               OK
-------------------------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Not applicable
-------------------------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Slight                                            OK
Based on:
Overshading:                            Average
Windows facing West:                    19.56 m², No overhang
Air change rate:                        3.00 ach
Blinds/curtains:                        Dark-coloured curtain or roller blind, closed 100% of daylight hours
-------------------------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Door U-value                            1.00 W/m²K



-------------------------------------------------------------------------------------------------------------------
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.0400 (1b)	x	2.8000 (2b)	=	148.5120	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	53.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	148.5120	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			20.0000 / (5) =	0.1347	(8)
Pressure test				No	
Measured/design AP50				15.0000	
Infiltration rate				0.8847	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.8183	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	1.0434	1.0229	1.0024	0.9002	0.8797	0.7774	0.7774	0.7569	0.8183	0.8797	0.9206	0.9615	(22b)
Effective ac	1.0434	1.0229	1.0024	0.9051	0.8869	0.8022	0.8022	0.7865	0.8348	0.8869	0.9238	0.9623	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Orginal (Uw = 4.80)			19.5600	4.0268	78.7651			(27)
Corridor Door			2.1000	1.0000	2.1000			(26)
Corridor	42.0300	2.1000	39.9300	0.7266	29.0149			(29a)
Bick Wall	57.3200	19.5600	37.7600	1.2100	45.6896			(29a)
Total net area of external elements Aum(A, m2)			99.3500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	155.5696			(33)
Party Wall 1			5.8000	0.0000	0.0000			(32)
Party Floor 1			53.0400					(32d)
Party Ceilings 1			53.0400					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							14.9025	(36)
Total fabric heat loss						(33) + (36) =	170.4721	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.1338	50.1312	49.1286	44.3598	43.4675	39.3139	39.3139	38.5447	40.9138	43.4675	45.2725	47.1596	(38)
Heat transfer coeff	221.6059	220.6033	219.6007	214.8318	213.9396	209.7860	209.7860	209.0168	211.3859	213.9396	215.7446	217.6317	(39)
Average = Sum(39)m / 12 =												214.8227	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	4.1781	4.1592	4.1403	4.0504	4.0336	3.9552	3.9552	3.9407	3.9854	4.0336	4.0676	4.1032	(40)
HLP (average)												4.0502	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.7797	(42)
Average daily hot water use (litres/day)	76.4688	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	84.1157	81.0570	77.9982	74.9394	71.8807	68.8219	68.8219	71.8807	74.9394	77.9982	81.0570	84.1157	(44)
Energy conte	124.7412	109.0994	112.5808	98.1507	94.1779	81.2684	75.3071	86.4160	87.4481	101.9123	111.2453	120.8052	(45)
Energy content (annual)									Total = Sum(45)m =			1203.1524	(45)
Distribution loss (46)m = 0.15 x (45)m	18.7112	16.3649	16.8871	14.7226	14.1267	12.1903	11.2961	12.9624	13.1172	15.2868	16.6868	18.1208	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
Design SAP elmhurst energy

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	39.0655	35.2470	38.9628	37.6374	38.8421	37.5317	38.7469	38.8087	37.5893	38.9129	37.7371	39.0457	(61)
Total heat required for water heating calculated for each month	163.8067	144.3464	151.5437	135.7881	133.0201	118.8001	114.0540	125.2247	125.0374	140.8252	148.9824	159.8508	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	163.8067	144.3464	151.5437	135.7881	133.0201	118.8001	114.0540	125.2247	125.0374	140.8252	148.9824	159.8508	(64)
								Total per year (kWh/year) = Sum(64)m =				1661.2796	(64)
Heat gains from water heating, kWh/month	51.2428	45.0873	47.1738	42.0445	41.0247	36.4047	34.7263	38.4355	38.4738	43.6141	46.4233	49.9291	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.8292	12.2830	9.9892	7.5624	5.6530	4.7725	5.1569	6.7031	8.9969	11.4236	13.3330	14.2135	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	155.1214	156.7311	152.6747	144.0393	133.1386	122.8935	116.0491	114.4394	118.4958	127.1312	138.0319	148.2770	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	(71)
Water heating gains (Table 5)	68.8748	67.0942	63.4057	58.3951	55.1407	50.5620	46.6752	51.6606	53.4359	58.6211	64.4769	67.1090	(72)
Total internal gains	290.5214	288.8043	278.7657	262.6929	246.6284	230.9241	220.5773	225.4992	233.6246	249.8720	268.5379	282.2957	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
West	19.5600	19.6403	0.6300	0.8000	0.7700	134.1776	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	134.1776	262.4798	432.2668	630.4354	772.6223	790.9164	752.9846	646.8027	502.7442	311.4544	167.3037	110.3411	(83)
Total gains	424.6990	551.2841	711.0325	893.1283	1019.2507	1021.8405	973.5619	872.3019	736.3688	561.3264	435.8416	392.6368	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	16.6211	16.6966	16.7729	17.1452	17.2167	17.5576	17.5576	17.6222	17.4247	17.2167	17.0727	16.9246	
alpha	2.1081	2.1131	2.1182	2.1430	2.1478	2.1705	2.1705	2.1748	2.1616	2.1478	2.1382	2.1283	
util living area	0.9908	0.9835	0.9673	0.9311	0.8680	0.7719	0.6662	0.7177	0.8723	0.9607	0.9861	0.9923	(86)
MIT	17.2567	17.5578	18.1383	18.9517	19.7172	20.3510	20.6783	20.6062	20.0469	19.0430	18.0296	17.2390	(87)
Th 2	18.2766	18.2824	18.2882	18.3168	18.3222	18.3484	18.3484	18.3534	18.3382	18.3222	18.3112	18.2998	(88)
util rest of house	0.9869	0.9764	0.9522	0.8951	0.7857	0.5915	0.3472	0.4156	0.7478	0.9328	0.9789	0.9890	(89)
MIT 2	15.2202	15.5214	16.0968	16.8991	17.6071	18.1352	18.3147	18.2996	17.9351	17.0121	16.0078	15.2139	(90)
Living area fraction										fLA = Living area / (4) =		0.4796	(91)
MIT	16.1970	16.4981	17.0760	17.8836	18.6192	19.1980	19.4484	19.4060	18.9480	17.9862	16.9775	16.1852	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.0470	16.3481	16.9260	17.7336	18.4692	19.0480	19.2984	19.2560	18.7980	17.8362	16.8275	16.0352	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9816	0.9684	0.9405	0.8839	0.7918	0.6530	0.4901	0.5491	0.7786	0.9248	0.9723	0.9845	(94)
Useful gains	416.8947	533.8444	668.7539	789.4017	807.0311	667.2633	477.1056	478.9782	573.3092	519.1034	423.7683	386.5450	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2603.2015	2525.4953	2289.5512	1897.7465	1448.2035	933.1243	566.0830	596.9418	993.0892	1548.1106	2098.6660	2575.7134	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1626.6122	1338.3894	1205.8732	798.0083	477.0323	0.0000	0.0000	0.0000	0.0000	765.5814	1205.9263	1628.7412	(98)
Space heating												9046.1643	(98)
Space heating per m2											(98) / (4) =	170.5536	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												10051.2937	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1626.6122	1338.3894	1205.8732	798.0083	477.0323	0.0000	0.0000	0.0000	0.0000	765.5814	1205.9263	1628.7412	(98)
Space heating efficiency (main heating system 1)													
	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)													
	1807.3469	1487.0993	1339.8591	886.6759	530.0358	0.0000	0.0000	0.0000	0.0000	850.6460	1339.9181	1809.7125	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	163.8067	144.3464	151.5437	135.7881	133.0201	118.8001	114.0540	125.2247	125.0374	140.8252	148.9824	159.8508	(64)
Efficiency of water heater												86.7000	(216)
(217)m	89.6877	89.6677	89.6192	89.5046	89.2592	86.7000	86.7000	86.7000	86.7000	89.4709	89.6249	89.6949	(217)
Fuel for water heating, kWh/month													
	182.6413	160.9792	169.0974	151.7108	149.0267	137.0243	131.5502	144.4345	144.2184	157.3978	166.2288	178.2162	(219)
Water heating fuel used												1872.5255	(219)
Annual totals kWh/year													
Space heating fuel - main system												10051.2937	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												244.2277	(232)
Total delivered energy for all uses												12243.0469	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	10051.2937	0.2160	2171.0794	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1872.5255	0.2160	404.4655	(264)
Space and water heating			2575.5449	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	244.2277	0.5190	126.7542	(268)
Total CO2, kg/year			2741.2241	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			51.6800	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		51.6800	ZC1
Total Floor Area	TFA	53.0400	
Assumed number of occupants	N	1.7797	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.3306	ZC2
CO2 emissions from cooking, equation (L16)		3.0489	ZC3
Total CO2 emissions		72.0595	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		72.0595	ZC8

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.0400 (1b)	x	2.8000 (2b)	=	148.5120 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	53.0400				(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	148.5120 (5)	

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)
								Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =							20.0000 / (5) =	0.1347	(8)
Pressure test								No	
Measured/design AP50								15.0000	
Infiltration rate								0.8847	(18)
Number of sides sheltered								1	(19)
Shelter factor							(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor							(21) = (18) x (20) =	0.8183	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate													
	1.0434	1.0229	1.0024	0.9002	0.8797	0.7774	0.7774	0.7569	0.8183	0.8797	0.9206	0.9615	(22b)
Effective ac	1.0434	1.0229	1.0024	0.9051	0.8869	0.8022	0.8022	0.7865	0.8348	0.8869	0.9238	0.9623	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Orginal (Uw = 4.80)			19.5600	4.0268	78.7651			(27)
Corridor Door			2.1000	1.0000	2.1000			(26)
Corridor	42.0300	2.1000	39.9300	0.7266	29.0149			(29a)
Bick Wall	57.3200	19.5600	37.7600	1.2100	45.6896			(29a)
Total net area of external elements Aum(A, m2)			99.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		155.5696			(33)
Party Wall 1			5.8000	0.0000	0.0000			(32)
Party Floor 1			53.0400					(32d)
Party Ceilings 1			53.0400					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							14.9025	(36)
Total fabric heat loss					(33) + (36) =		170.4721	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.1338	50.1312	49.1286	44.3598	43.4675	39.3139	39.3139	38.5447	40.9138	43.4675	45.2725	47.1596	(38)
Heat transfer coeff													
	221.6059	220.6033	219.6007	214.8318	213.9396	209.7860	209.7860	209.0168	211.3859	213.9396	215.7446	217.6317	(39)
Average = Sum(39)m / 12 =												214.8227	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	4.1781	4.1592	4.1403	4.0504	4.0336	3.9552	3.9552	3.9407	3.9854	4.0336	4.0676	4.1032	(40)
HLP (average)												4.0502	(40)
Days in month													
	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.7797	(42)
Average daily hot water use (litres/day)	76.4688	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	84.1157	81.0570	77.9982	74.9394	71.8807	68.8219	68.8219	71.8807	74.9394	77.9982	81.0570	84.1157	(44)
Energy conte	124.7412	109.0994	112.5808	98.1507	94.1779	81.2684	75.3071	86.4160	87.4481	101.9123	111.2453	120.8052	(45)
Energy content (annual)										Total = Sum(45)m =		1203.1524	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	26.5075	23.1836	23.9234	20.8570	20.0128	17.2695	16.0028	18.3634	18.5827	21.6564	23.6396	25.6711	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	13.8292	12.2830	9.9892	7.5624	5.6530	4.7725	5.1569	6.7031	8.9969	11.4236	13.3330	14.2135	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	155.1214	156.7311	152.6747	144.0393	133.1386	122.8935	116.0491	114.4394	118.4958	127.1312	138.0319	148.2770	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	(71)
Water heating gains (Table 5)													
	35.6284	34.4994	32.1551	28.9681	26.8989	23.9855	21.5091	24.6820	25.8093	29.1080	32.8328	34.5042	(72)
Total internal gains													
	254.2750	253.2096	244.5151	230.2659	215.3866	201.3476	192.4112	195.5206	202.9981	217.3589	233.8938	246.6908	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
West	19.5600	19.6403	0.6300	0.8000	0.7700	134.1776	(80)

Solar gains	134.1776	262.4798	432.2668	630.4354	772.6223	790.9164	752.9846	646.8027	502.7442	311.4544	167.3037	110.3411	(83)
Total gains	388.4526	515.6894	676.7820	860.7013	988.0089	992.2639	945.3958	842.3233	705.7423	528.8133	401.1975	357.0319	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	16.6211	16.6966	16.7729	17.1452	17.2167	17.5576	17.5576	17.6222	17.4247	17.2167	17.0727	16.9246	
alpha	2.1081	2.1131	2.1182	2.1430	2.1478	2.1705	2.1705	2.1748	2.1616	2.1478	2.1382	2.1283	
util living area													
	0.9923	0.9855	0.9701	0.9354	0.8742	0.7805	0.6764	0.7290	0.8805	0.9648	0.9882	0.9936	(86)
MIT	17.2164	17.5189	18.1025	18.9210	19.6928	20.3341	20.6676	20.5922	20.0225	19.0093	17.9911	17.1988	(87)
Th 2	18.2766	18.2824	18.2882	18.3168	18.3222	18.3484	18.3484	18.3534	18.3382	18.3222	18.3112	18.2998	(88)
util rest of house													
	0.9890	0.9792	0.9563	0.9012	0.7943	0.6022	0.3560	0.4272	0.7607	0.9395	0.9820	0.9909	(89)
MIT 2	15.1803	15.4833	16.0626	16.8716	17.5886	18.1271	18.3130	18.2965	17.9190	16.9810	15.9701	15.1741	(90)
Living area fraction									fLA = Living area / (4) =			0.4796	(91)
MIT	16.1569	16.4597	17.0410	17.8546	18.5979	19.1857	19.4423	19.3976	18.9279	17.9538	16.9394	16.1453	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.1569	16.4597	17.0410	17.8546	18.5979	19.1857	19.4423	19.3976	18.9279	17.9538	16.9394	16.1453	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9848	0.9726	0.9465	0.8928	0.8053	0.6739	0.5192	0.5795	0.7981	0.9340	0.9769	0.9874	(94)
Useful gains	382.5526	501.5503	640.6005	768.4762	795.6743	668.7198	490.8547	488.1285	563.2740	493.9250	391.9156	352.5199	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2627.5572	2550.1026	2314.8161	1923.7298	1475.7261	962.0147	596.2850	626.5522	1020.5552	1573.2784	2122.8021	2599.6668	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1670.2834	1376.6271	1245.6164	831.7826	505.9586	0.0000	0.0000	0.0000	0.0000	803.0389	1246.2383	1671.8773	(98)
Space heating												9351.4226	(98)
Space heating per m2											(98) / (4) =	176.3089	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1971.9882	1552.4162	1588.5276	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.5143	0.5842	0.5369	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1014.1176	906.8872	852.9170	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1226.8405	1170.7738	1051.3010	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	153.1606	196.3316	147.5977	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												497.0899	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
Design SAP elmhurst energy

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Intermittency factor (Table 10b)

	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	38.2901	49.0829	36.8994	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												124.2725	(107)
Space cooling per m2												2.3430	(108)
Energy for space heating												176.3089	(99)
Energy for space cooling												2.3430	(108)
Total												178.6519	(109)
Dwelling Fabric Energy Efficiency (DFEE)												178.7	(109)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	Plot 14	**Issued on Date**	24/06/2019
Assessment Reference	Baseline	**Prop Type Ref**	Mid With Heat loss
Property	Plot 014, Ferdinand Street, Camden, LONDON, LONDON, NW1 8EU		

SAP Rating	64 D	**DER**	51.91	**TER**	18.97
Environmental	60 D	**% DER<TER**	-173.63		
CO_2 Emissions (t/year)	2.89	**DFEE**	175.64	**TFEE**	51.86
General Requirements Compliance	Fail	**% DFEE<TFEE**	-238.69		

Assessor Details	Mr. Simon Gowing, Simon Gowing, Tel: 02036031616, Simon@hodkinsonconsultancy.com	**Assessor ID**	T271-0001
Client			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 68 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-------------------------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.97 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 51.91 kgCO□/m²Fail
Excess emissions =32.94 kgCO□/m²  (174.0%)
-------------------------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)51.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)175.6 kWh/m²/yrFail
Excess energy =123.7 kWh/m²/yr  (238.0%)
-------------------------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   1.19 (max. 0.30)        1.21 (max. 0.70)          Fail
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            1.50 (max. 0.20)        1.50 (max. 0.35)          Fail
Openings        4.52 (max. 2.00)        4.80 (max. 3.30)          Fail
-------------------------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15
-------------------------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         15.00 (assumed)                                   OK
-------------------------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Boiler system with radiators or underfloor - Mains gas
Data from database
Worcester Greenstar 29CDi Classic ErP
Combi boiler
Efficiency: 89.1% SEDBUK2009
Minimum: 88.0%                                  OK

Secondary heating system:               None
-------------------------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       No cylinder
-------------------------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Programmer and at least two room thermostats      OK

Hot water controls:                     No cylinder

Boiler interlock                        Yes                                               OK
-------------------------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:0%
Minimum                                 75%                                               Fail
-------------------------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Not applicable
-------------------------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Slight                                            OK
Based on:
Overshading:                            Average
Windows facing North East:              11.46 m², No overhang
Windows facing East:                    7.64 m², No overhang
Windows facing North West:              7.64 m², No overhang
Air change rate:                        3.00 ach
Blinds/curtains:                        Dark-coloured curtain or roller blind, closed 100% of daylight hours
-------------------------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Door U-value                            1.00 W/m²K



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	67.8900 (1b)	x	2.8000 (2b)	=	190.0920	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	67.8900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	190.0920	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			20.0000 / (5) =	0.1052	(8)
Pressure test				No	
Measured/design AP50				15.0000	
Infiltration rate				0.8552	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.7911	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	1.0086	0.9888	0.9691	0.8702	0.8504	0.7515	0.7515	0.7317	0.7911	0.8504	0.8900	0.9295	(22b)
Effective ac	1.0086	0.9889	0.9695	0.8786	0.8616	0.7824	0.7824	0.7677	0.8129	0.8616	0.8960	0.9320	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Normal Window (Uw = 4.80)			26.7400	4.0268	107.6779			(27)
Corridor Door			2.1000	1.0000	2.1000			(26)
Corridor	3.7000	2.1000	1.6000	0.7266	1.1626			(29a)
Bick Wall	73.2200	26.7400	46.4800	1.2100	56.2408			(29a)
External Roof 1	23.7500		23.7500	1.5000	35.6250			(30)
Total net area of external elements Aum(A, m2)			100.6700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	202.8063			(33)
Party Wall 1			29.7900	0.0000	0.0000			(32)
Party Floor 1			67.8900					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	15.1005	(36)
Total fabric heat loss (33) + (36) =	217.9068	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	63.2708	62.0341	60.8197	55.1152	54.0479	49.0796	49.0796	48.1595	50.9933	54.0479	56.2070	58.4643	(38)
Heat transfer coeff	281.1776	279.9409	278.7264	273.0220	271.9547	266.9864	266.9864	266.0663	268.9001	271.9547	274.1138	276.3711	(39)
Average = Sum(39)m / 12 =												273.0167	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	4.1417	4.1234	4.1056	4.0215	4.0058	3.9326	3.9326	3.9191	3.9608	4.0058	4.0376	4.0709	(40)
HLP (average)												4.0215	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.1938 (42)
Average daily hot water use (litres/day)	86.3034 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	94.9338	91.4816	88.0295	84.5774	81.1252	77.6731	77.6731	81.1252	84.5774	88.0295	91.4816	94.9338	(44)
Energy conte	140.7840	123.1306	127.0598	110.7738	106.2901	91.7203	84.9923	97.5299	98.6947	115.0192	125.5524	136.3418	(45)
Energy content (annual)										Total = Sum(45)m =		1357.8890	(45)
Distribution loss (46)m = 0.15 x (45)m	21.1176	18.4696	19.0590	16.6161	15.9435	13.7580	12.7488	14.6295	14.8042	17.2529	18.8329	20.4513	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
Design SAP elmhurst energy

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	39.2379	35.3922	39.1071	37.7582	38.9533	37.6236	38.8321	38.9107	37.6969	39.0435	37.8852	39.2126	(61)
Total heat required for water heating calculated for each month	180.0219	158.5228	166.1668	148.5320	145.2434	129.3438	123.8244	136.4406	136.3917	154.0627	163.4377	175.5544	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	180.0219	158.5228	166.1668	148.5320	145.2434	129.3438	123.8244	136.4406	136.3917	154.0627	163.4377	175.5544	(64)
								Total per year (kWh/year) = Sum(64)m =				1817.5423	(64)
Heat gains from water heating, kWh/month	56.6202	49.7890	52.0241	46.2718	45.0798	39.9029	37.9680	42.1564	42.2402	48.0048	51.2175	55.1368	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	34.2915	30.4574	24.7696	18.7522	14.0175	11.8342	12.7872	16.6213	22.3091	28.3265	33.0612	35.2446	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	192.3232	194.3189	189.2898	178.5834	165.0684	152.3663	143.8805	141.8847	146.9139	157.6203	171.1353	183.8374	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	(71)
Water heating gains (Table 5)	76.1024	74.0908	69.9249	64.2664	60.5911	55.4207	51.0322	56.6618	58.6670	64.5225	71.1354	74.1086	(72)
Total internal gains	361.6245	357.7745	342.8918	320.5094	298.5844	278.5285	266.6073	274.0753	286.7974	309.3768	334.2393	352.0980	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	11.4600	11.2829	0.6300	0.8000	0.7700	45.1617	(75)
East	7.6400	19.6403	0.6300	0.8000	0.7700	52.4088	(76)
Northwest	7.6400	11.2829	0.6300	0.8000	0.7700	30.1078	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	127.6784	255.7362	444.8822	699.5836	911.1587	958.5877	901.8554	737.1378	532.7297	308.8908	160.0563	104.5674	(83)
Total gains	489.3029	613.5107	787.7740	1020.0931	1209.7432	1237.1162	1168.4627	1011.2131	819.5271	618.2676	494.2956	456.6654	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	16.7673	16.8414	16.9147	17.2681	17.3359	17.6585	17.6585	17.7196	17.5328	17.3359	17.1994	17.0589	
alpha	2.1178	2.1228	2.1276	2.1512	2.1557	2.1772	2.1772	2.1813	2.1689	2.1557	2.1466	2.1373	
util living area	0.9925	0.9874	0.9750	0.9434	0.8821	0.7871	0.6871	0.7482	0.8974	0.9703	0.9891	0.9937	(86)
MIT	17.2302	17.4992	18.0563	18.8735	19.6695	20.3252	20.6586	20.5703	19.9753	18.9721	17.9891	17.2172	(87)
Th 2	18.2878	18.2935	18.2991	18.3262	18.3314	18.3562	18.3562	18.3609	18.3465	18.3314	18.3209	18.3101	(88)
util rest of house	0.9894	0.9820	0.9632	0.9128	0.8057	0.6110	0.3665	0.4488	0.7886	0.9485	0.9834	0.9910	(89)
MIT 2	15.1995	15.4695	16.0240	16.8344	17.5772	18.1294	18.3188	18.2984	17.8931	16.9517	15.9732	15.1975	(90)
Living area fraction											fLA = Living area / (4) =		0.3450	(91)
MIT	15.9000	16.1697	16.7251	17.5378	18.2990	18.8869	19.1260	19.0822	18.6114	17.6487	16.6686	15.8943	(92)
Temperature adjustment												-0.1500	
adjusted MIT	15.7500	16.0197	16.5751	17.3878	18.1490	18.7369	18.9760	18.9322	18.4614	17.4987	16.5186	15.7443	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9843	0.9743	0.9509	0.8964	0.7982	0.6456	0.4663	0.5398	0.7960	0.9368	0.9766	0.9865	(94)
Useful gains	481.6048	597.7360	749.1260	914.3865	965.5944	798.7275	544.7979	545.8677	652.3821	579.2214	482.7355	450.5124	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	3219.4917	3112.8621	2808.1989	2317.3679	1753.8328	1104.4925	634.3500	673.7212	1172.7784	1876.1219	2581.7720	3190.4966	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	2036.9879	1690.1648	1531.9503	1010.1466	586.4493	0.0000	0.0000	0.0000	0.0000	964.8940	1511.3063	2038.5482	(98)
Space heating												11370.4474	(98)
Space heating per m2											(98) / (4) =	167.4834	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												12633.8304	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2036.9879	1690.1648	1531.9503	1010.1466	586.4493	0.0000	0.0000	0.0000	0.0000	964.8940	1511.3063	2038.5482	(98)
Space heating efficiency (main heating system 1)													
	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)													
	2263.3199	1877.9609	1702.1670	1122.3851	651.6104	0.0000	0.0000	0.0000	0.0000	1072.1044	1679.2292	2265.0536	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	180.0219	158.5228	166.1668	148.5320	145.2434	129.3438	123.8244	136.4406	136.3917	154.0627	163.4377	175.5544	(64)
Efficiency of water heater												86.7000	(216)
(217)m	89.7227	89.7072	89.6660	89.5630	89.3251	86.7000	86.7000	86.7000	86.7000	89.5308	89.6669	89.7292	(217)
Fuel for water heating, kWh/month													
	200.6426	176.7114	185.3175	165.8408	162.6009	149.1855	142.8193	157.3709	157.3145	172.0778	182.2720	195.6491	(219)
Water heating fuel used												2047.8023	(219)
Annual totals kWh/year													
Space heating fuel - main system												12633.8304	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												605.5987	(232)
Total delivered energy for all uses												15362.2315	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	12633.8304	0.2160	2728.9074	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2047.8023	0.2160	442.3253	(264)
Space and water heating			3171.2327	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	605.5987	0.5190	314.3057	(268)
Total CO2, kg/year			3524.4634	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			51.9100	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		51.9100	ZC1
Total Floor Area	TFA	67.8900	
Assumed number of occupants	N	2.1938	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.7870	ZC2
CO2 emissions from cooking, equation (L16)		2.5284	ZC3
Total CO2 emissions		71.2253	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		71.2253	ZC8

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	67.8900 (1b)	x	2.8000 (2b)	=	190.0920 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	67.8900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	190.0920	(5)

2. Ventilation rate

	main heating		secondary heating		other	=	total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1052	(8)
Pressure test			No	
Measured/design AP50			15.0000	
Infiltration rate			0.8552	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.7911	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate													
	1.0086	0.9888	0.9691	0.8702	0.8504	0.7515	0.7515	0.7317	0.7911	0.8504	0.8900	0.9295	(22b)
Effective ac	1.0086	0.9889	0.9695	0.8786	0.8616	0.7824	0.7824	0.7677	0.8129	0.8616	0.8960	0.9320	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Normal Window (Uw = 4.80)			26.7400	4.0268	107.6779			(27)
Corridor Door			2.1000	1.0000	2.1000			(26)
Corridor	3.7000	2.1000	1.6000	0.7266	1.1626			(29a)
Bick Wall	73.2200	26.7400	46.4800	1.2100	56.2408			(29a)
External Roof 1	23.7500		23.7500	1.5000	35.6250			(30)
Total net area of external elements Aum(A, m2)			100.6700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	202.8063			(33)
Party Wall 1			29.7900	0.0000	0.0000			(32)
Party Floor 1			67.8900					(32d)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							15.1005	(36)
Total fabric heat loss					(33) + (36) =		217.9068	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	63.2708	62.0341	60.8197	55.1152	54.0479	49.0796	49.0796	48.1595	50.9933	54.0479	56.2070	58.4643	(38)
Heat transfer coeff													
	281.1776	279.9409	278.7264	273.0220	271.9547	266.9864	266.9864	266.0663	268.9001	271.9547	274.1138	276.3711	(39)
Average = Sum(39)m / 12 =												273.0167	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	4.1417	4.1234	4.1056	4.0215	4.0058	3.9326	3.9326	3.9191	3.9608	4.0058	4.0376	4.0709	(40)
HLP (average)												4.0215	(40)
Days in month													
	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.1938	(42)
Average daily hot water use (litres/day)												86.3034	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	94.9338	91.4816	88.0295	84.5774	81.1252	77.6731	77.6731	81.1252	84.5774	88.0295	91.4816	94.9338	(44)
Energy conte	140.7840	123.1306	127.0598	110.7738	106.2901	91.7203	84.9923	97.5299	98.6947	115.0192	125.5524	136.3418	(45)
Energy content (annual)										Total = Sum(45)m =		1357.8890	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)

Heat gains from water heating, kWh/month

	29.9166	26.1653	27.0002	23.5394	22.5866	19.4906	18.0609	20.7251	20.9726	24.4416	26.6799	28.9726 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	17.1458	15.2287	12.3848	9.3761	7.0087	5.9171	6.3936	8.3107	11.1545	14.1633	16.5306	17.6223	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	192.3232	194.3189	189.2898	178.5834	165.0684	152.3663	143.8805	141.8847	146.9139	157.6203	171.1353	183.8374	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	(71)

Water heating gains (Table 5)

	40.2105	38.9364	36.2906	32.6937	30.3584	27.0702	24.2754	27.8563	29.1287	32.8516	37.0554	38.9417	(72)

Total internal gains

	305.5869	304.3914	293.8726	276.5605	258.3430	241.2610	230.4569	233.9592	243.1045	260.5426	280.6287	296.3088	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	11.4600	11.2829	0.6300	0.8000	0.7700	45.1617	(75)
East	7.6400	19.6403	0.6300	0.8000	0.7700	52.4088	(76)
Northwest	7.6400	11.2829	0.6300	0.8000	0.7700	30.1078	(81)

Solar gains	127.6784	255.7362	444.8822	699.5836	911.1587	958.5877	901.8554	737.1378	532.7297	308.8908	160.0563	104.5674	(83)
Total gains	433.2653	560.1276	738.7549	976.1442	1169.5017	1199.8487	1132.3122	971.0970	775.8342	569.4334	440.6850	400.8762	(84)

---

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	16.7673	16.8414	16.9147	17.2681	17.3359	17.6585	17.6585	17.7196	17.5328	17.3359	17.1994	17.0589	
alpha	2.1178	2.1228	2.1276	2.1512	2.1557	2.1772	2.1772	2.1813	2.1689	2.1557	2.1466	2.1373	
util living area	0.9942	0.9895	0.9779	0.9477	0.8883	0.7956	0.6978	0.7607	0.9063	0.9746	0.9914	0.9951	(86)
MIT	17.1810	17.4529	18.0153	18.8397	19.6438	20.3077	20.6469	20.5538	19.9457	18.9312	17.9419	17.1677	(87)
Th 2	18.2878	18.2935	18.2991	18.3262	18.3314	18.3562	18.3562	18.3609	18.3465	18.3314	18.3209	18.3101	(88)
util rest of house	0.9917	0.9849	0.9674	0.9191	0.8145	0.6220	0.3762	0.4628	0.8037	0.9556	0.9867	0.9931	(89)
MIT 2	15.1507	15.4240	15.9843	16.8035	17.5571	18.1207	18.3168	18.2944	17.8722	16.9132	15.9267	15.1483	(90)

Living area fraction fLA = Living area / (4) = 0.3450 (91)

MIT	15.8511	16.1239	16.6849	17.5059	18.2770	18.8751	19.1206	19.0738	18.5875	17.6094	16.6219	15.8450	(92)

Temperature adjustment 0.0000

adjusted MIT	15.8511	16.1239	16.6849	17.5059	18.2770	18.8751	19.1206	19.0738	18.5875	17.6094	16.6219	15.8450	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9878	0.9788	0.9572	0.9057	0.8124	0.6680	0.4983	0.5745	0.8182	0.9470	0.9817	0.9898	(94)
Useful gains	427.9856	548.2363	707.1184	884.1306	950.1113	801.4874	564.2081	557.8509	634.7512	539.2443	432.6107	396.7793	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)

Heat loss rate W

	3247.9178	3142.0290	2838.8097	2349.6050	1788.6353	1141.4008	672.9648	711.4137	1206.6986	1906.2339	2610.0888	3218.3305	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

Space heating kWh

	2098.0296	1743.0287	1585.9783	1055.1416	623.8619	0.0000	0.0000	0.0000	0.0000	1017.0402	1567.7842	2099.2341	(98)

Space heating 11790.0987 (98)

Space heating per m2 (98) / (4) = 173.6647 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	

Heat loss rate W

	0.0000	0.0000	0.0000	0.0000	0.0000	2509.6717	1975.6990	2022.1038	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.4964	0.5629	0.5028	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1245.9164	1112.0498	1016.7315	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1483.9358	1403.3564	1216.2243	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

Space cooling kWh

	0.0000	0.0000	0.0000	0.0000	0.0000	171.3740	216.7321	148.4226	0.0000	0.0000	0.0000	0.0000	(104)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
Design SAP elmhurst energy

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling 536.5287 (104)

Cooled fraction fC = cooled area / (4) = 1.0000 (105)

Intermittency factor (Table 10b)

	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)

Space cooling kWh

	0.0000	0.0000	0.0000	0.0000	0.0000	42.8435	54.1830	37.1057	0.0000	0.0000	0.0000	0.0000	(107)

Space cooling 134.1322 (107)

Space cooling per m2 1.9757 (108)

Energy for space heating 173.6647 (99)

Energy for space cooling 1.9757 (108)

Total 175.6405 (109)

Dwelling Fabric Energy Efficiency (DFEE) 175.6 (109)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	Plot 19	**Issued on Date**	24/06/2019
Assessment Reference	Baseline	**Prop Type Ref**	Top Floor Pent House
Property	Plot 019, Ferdinand Street, Camden, LONDON, LONDON, NW1 8EU		

SAP Rating	57 D	**DER**	56.55	**TER**	17.80
Environmental	49 E	**% DER<TER**	-217.74		
CO_2 Emissions (t/year)	5.13	**DFEE**	206.09	**TFEE**	59.16
General Requirements Compliance	Fail	**% DFEE<TFEE**	-248.34		

Assessor Details	Mr. Simon Gowing, Simon Gowing, Tel: 02036031616, Simon@hodkinsonconsultancy.com	**Assessor ID**	T271-0001
Client			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
Design SAP
elmhurst energy

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Top-floor flat, total floor area 110 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-------------------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.80 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 56.55 kgCO□/m²Fail
Excess emissions =38.75 kgCO□/m²  (218.0%)
-------------------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)206.1 kWh/m²/yrFail
Excess energy =146.9 kWh/m²/yr  (248.0%)
-------------------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   1.08 (max. 0.30)        1.21 (max. 0.70)          Fail
Floor           (no floor)
Roof            1.50 (max. 0.20)        1.50 (max. 0.35)          Fail
Openings        4.80 (max. 2.00)        4.80 (max. 3.30)          Fail
-------------------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15
-------------------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         15.00 (assumed)                                 OK
-------------------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Boiler system with radiators or underfloor - Mains gas
Data from database
Worcester Greenstar 24i System

Efficiency: 89.2% SEDBUK2009
Minimum: 88.0%                                  OK

Secondary heating system:               None
-------------------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Measured cylinder loss: 1.72 kWh/day
Permitted by DBSCG 2.30                 OK
Primary pipework insulated:             Yes                                             OK
-------------------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Programmer and at least two room thermostats    OK

Hot water controls:                     Cylinderstat                                    OK
                                        Independent timer for DHW                       OK

Boiler interlock                        Yes                                             OK
-------------------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:0%
Minimum                                 75%                                             Fail
-------------------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Not applicable
-------------------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Not significant                                 OK
Based on:
Overshading:                            Average
Windows facing North:                   10.13 m², No overhang
Windows facing South:                   10.13 m², No overhang
Windows facing West:                    5.15 m², No overhang
Air change rate:                        3.00 ach
Blinds/curtains:                        Light-coloured curtain or roller blind, closed 100% of daylight hours
-------------------------------------------------------------------------------------------------------------
10 Key features
None



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	109.9200 (1b)	x	3.0400 (2b)	=	334.1568 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.9200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	334.1568	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0898	(8)
Pressure test		No	
Measured/design AP50		15.0000	
Infiltration rate		0.8398	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.7768	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.9904	0.9710	0.9516	0.8545	0.8351	0.7380	0.7380	0.7185	0.7768	0.8351	0.8739	0.9127	(22b)
Effective ac	0.9905	0.9714	0.9527	0.8651	0.8487	0.7723	0.7723	0.7581	0.8017	0.8487	0.8818	0.9165	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
orginal (Uw = 4.80)			25.4100	4.0268	102.3221			(27)
Curtain Walling	98.4700	25.4100	73.0600	1.2100	88.4026			(29a)
External Wall 2	18.8500		18.8500	0.7266	13.6972			(29a)
Solid Core	3.7000		3.7000	0.3152	1.1662			(29a)
External Roof 1	109.9200		109.9200	1.5000	164.8800			(30)
Total net area of external elements Aum(A, m2)			230.9400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		370.4682			(33)
Party Floor 1			109.9200					(32d)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							34.6410	(36)
Total fabric heat loss						(33) + (36) =	405.1092	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	109.2197	107.1195	105.0610	95.3920	93.5830	85.1616	85.1616	83.6021	88.4054	93.5830	97.2426	101.0686	(38)
Heat transfer coeff	514.3289	512.2287	510.1702	500.5012	498.6922	490.2708	490.2708	488.7113	493.5146	498.6922	502.3518	506.1778	(39)
Average = Sum(39)m / 12 =												500.4925	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	4.6791	4.6600	4.6413	4.5533	4.5369	4.4603	4.4603	4.4461	4.4898	4.5369	4.5702	4.6050	(40)
HLP (average)												4.5532	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8143	(42)
Average daily hot water use (litres/day)	101.0407	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.1448	107.1031	103.0615	99.0199	94.9782	90.9366	90.9366	94.9782	99.0199	103.0615	107.1031	111.1448	(44)
Energy conte	164.8245	144.1565	148.7566	129.6896	124.4403	107.3825	99.5057	114.1842	115.5479	134.6600	146.9919	159.6237	(45)
Energy content (annual)										Total = Sum(45)m =		1589.7635	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7237	21.6235	22.3135	19.4534	18.6660	16.1074	14.9259	17.1276	17.3322	20.1990	22.0488	23.9436	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7200	(48)
Temperature factor from Table 2b												0.5400	(49)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
Design SAP elmhurst energy
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Enter (49) or (54) in (55)	0.9288	(55)

Total storage loss

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
28.7928	26.0064	28.7928	27.8640	28.7928	27.8640	28.7928	28.7928	27.8640	28.7928	27.8640	28.7928	(56)

If cylinder contains dedicated solar storage

28.7928	26.0064	28.7928	27.8640	28.7928	27.8640	28.7928	28.7928	27.8640	28.7928	27.8640	28.7928	(57)
Primary loss 23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)

Total heat required for water heating calculated for each month

216.8797	191.1741	200.8118	180.0656	176.4955	157.7585	151.5609	166.2394	165.9239	186.7152	197.3679	211.6789	(62)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
							Solar input (sum of months) = Sum(63)m =				0.0000	(63)

Output from w/h

216.8797	191.1741	200.8118	180.0656	176.4955	157.7585	151.5609	166.2394	165.9239	186.7152	197.3679	211.6789	(64)
							Total per year (kWh/year) = Sum(64)m =				2202.6715	(64)

Heat gains from water heating, kWh/month

96.4483	85.5461	91.1057	83.4226	83.0206	76.0055	74.7298	79.6104	78.7205	86.4186	89.1756	94.7190	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

48.3983	42.9870	34.9594	26.4665	19.7840	16.7025	18.0476	23.4590	31.4866	39.9795	46.6620	49.7435	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

271.4410	274.2577	267.1597	252.0489	232.9742	215.0466	203.0699	200.2532	207.3513	222.4621	241.5368	259.4643	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	(69)
Pumps, fans 3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	(71)

Water heating gains (Table 5)

129.6348	127.3008	122.4540	115.8647	111.5868	105.5632	100.4433	107.0032	109.3340	116.1540	123.8550	127.3105	(72)

Total internal gains

517.6893	512.7607	492.7882	462.5953	432.5601	405.5275	389.7760	398.9306	416.3870	446.8108	480.2689	504.7335	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.1300	10.6334	0.5000	0.8000	0.7700	29.8589	(74)
South	10.1300	46.7521	0.5000	0.8000	0.7700	131.2815	(78)
West	5.1500	19.6403	0.5000	0.8000	0.7700	28.0380	(80)

Solar gains	189.1785	326.9156	461.1682	597.0256	693.8154	700.2957	670.3412	596.0708	507.7331	364.9104	227.4083	161.3883	(83)
Total gains	706.8678	839.6763	953.9564	1059.6209	1126.3756	1105.8232	1060.1173	995.0015	924.1201	811.7211	707.6773	666.1218	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	14.8413	14.9022	14.9623	15.2514	15.3067	15.5696	15.5696	15.6193	15.4673	15.3067	15.1952	15.0803	
alpha	1.9894	1.9935	1.9975	2.0168	2.0204	2.0380	2.0380	2.0413	2.0312	2.0204	2.0130	2.0054	
util living area	0.9936	0.9905	0.9854	0.9753	0.9560	0.9193	0.8648	0.8848	0.9475	0.9800	0.9910	0.9944	(86)
MIT	16.9015	17.1382	17.6297	18.3518	19.1188	19.8695	20.3389	20.2699	19.6564	18.6804	17.6945	16.8902	(87)
Th 2	18.1454	18.1496	18.1538	18.1744	18.1784	18.1976	18.1976	18.2012	18.1901	18.1784	18.1704	18.1622	(88)
util rest of house	0.9909	0.9864	0.9782	0.9603	0.9192	0.8099	0.5657	0.6293	0.8776	0.9646	0.9862	0.9920	(89)
MIT 2	14.8089	15.0464	15.5378	16.2635	17.0186	17.7349	18.0997	18.0656	17.5487	16.5955	15.6111	14.8044	(90)
Living area fraction										fLA = Living area / (4) =		0.3281	(91)
MIT	15.4954	15.7326	16.2241	16.9486	17.7076	18.4352	18.8343	18.7887	18.2401	17.2795	16.2946	15.4886	(92)
Temperature adjustment												-0.1500	
adjusted MIT	15.3454	15.5826	16.0741	16.7986	17.5576	18.2852	18.6843	18.6387	18.0901	17.1295	16.1446	15.3386	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9861	0.9797	0.9689	0.9476	0.9051	0.8159	0.6584	0.7025	0.8730	0.9540	0.9799	0.9878	(94)
Useful gains	697.0528	822.6702	924.3329	1004.0675	1019.4537	902.2737	698.0189	698.9641	806.7806	774.3511	693.4777	658.0023	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	5680.9706	5471.9474	4884.3969	3953.2340	2921.1509	1806.7233	1021.8781	1094.0784	1969.1956	3256.2133	4543.5705	5638.1258	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	3708.0349	3124.3142	2946.2876	2123.3999	1414.8628	0.0000	0.0000	0.0000	0.0000	1846.5055	2772.0668	3705.2119	(98)
Space heating												21640.6836	(98)
Space heating per m2											(98) / (4) =	196.8767	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.2000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												23991.8887	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	3708.0349	3124.3142	2946.2876	2123.3999	1414.8628	0.0000	0.0000	0.0000	0.0000	1846.5055	2772.0668	3705.2119	(98)
Space heating efficiency (main heating system 1)													
	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)													
	4110.9034	3463.7630	3266.3942	2354.1019	1568.5840	0.0000	0.0000	0.0000	0.0000	2047.1236	3073.2448	4107.7737	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	216.8797	191.1741	200.8118	180.0656	176.4955	157.7585	151.5609	166.2394	165.9239	186.7152	197.3679	211.6789	(64)
Efficiency of water heater												79.5000	(216)
(217)m	89.5341	89.5054	89.4320	89.2609	88.8734	79.5000	79.5000	79.5000	79.5000	89.0988	89.4002	89.5487	(217)
Fuel for water heating, kWh/month													
	242.2313	213.5895	224.5415	201.7296	198.5921	198.4384	190.6426	209.1062	208.7094	209.5598	220.7689	236.3842	(219)
Water heating fuel used												2554.2936	(219)
Annual totals kWh/year													
Space heating fuel - main system												23991.8887	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												854.7297	(232)
Total delivered energy for all uses												27475.9119	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	23991.8887	0.2160	5182.2480	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2554.2936	0.2160	551.7274	(264)
Space and water heating			5733.9754	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	854.7297	0.5190	443.6047	(268)
Total CO2, kg/year			6216.5051	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			56.5500	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		56.5500	ZC1
Total Floor Area	TFA	109.9200	
Assumed number of occupants	N	2.8143	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.6334	ZC2
CO2 emissions from cooking, equation (L16)		1.6971	ZC3
Total CO2 emissions		72.8805	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		72.8805	ZC8

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
Design SAP elmhurst energy

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	109.9200 (1b)	x	3.0400 (2b)	=	334.1568 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.9200				(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	334.1568 (5)	

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2. Ventilation rate

---

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1197	(8)
Pressure test		No	
Measured/design AP50		15.0000	
Infiltration rate		0.8697	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.8045	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate													
	1.0257	1.0056	0.9855	0.8849	0.8648	0.7643	0.7643	0.7441	0.8045	0.8648	0.9050	0.9453	(22b)
Effective ac	1.0257	1.0056	0.9856	0.8915	0.8740	0.7920	0.7920	0.7769	0.8236	0.8740	0.9095	0.9468	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
orginal (Uw = 4.80)			25.4100	4.0268	102.3221			(27)
Curtain Walling	98.4700	25.4100	73.0600	1.2100	88.4026			(29a)
External Wall 2	18.8500		18.8500	0.7266	13.6972			(29a)
Solid Core	3.7000		3.7000	0.3152	1.1662			(29a)
External Roof 1	109.9200		109.9200	1.5000	164.8800			(30)
Total net area of external elements Aum(A, m2)			230.9400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		370.4682			(33)
Party Floor 1			109.9200					(32d)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							34.6410	(36)
Total fabric heat loss					(33) + (36) =		405.1092	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	113.1066	110.8888	108.6826	98.3123	96.3720	87.3397	87.3397	85.6671	90.8188	96.3720	100.2971	104.4007	(38)
Heat transfer coeff													
	518.2157	515.9979	513.7918	503.4214	501.4812	492.4489	492.4489	490.7763	495.9280	501.4812	505.4063	509.5098	(39)
Average = Sum(39)m / 12 =												503.4090	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	4.7145	4.6943	4.6742	4.5799	4.5622	4.4801	4.4801	4.4648	4.5117	4.5622	4.5979	4.6353	(40)
HLP (average)												4.5798	(40)
Days in month													
	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8143	(42)
Average daily hot water use (litres/day)												101.0407	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	111.1448	107.1031	103.0615	99.0199	94.9782	90.9366	90.9366	94.9782	99.0199	103.0615	107.1031	111.1448	(44)
Energy conte	164.8245	144.1565	148.7566	129.6896	124.4403	107.3825	99.5057	114.1842	115.5479	134.6600	146.9919	159.6237	(45)
Energy content (annual)										Total = Sum(45)m =		1589.7635	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.0252	30.6333	31.6108	27.5590	26.4436	22.8188	21.1450	24.2641	24.5539	28.6152	31.2358	33.9200	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.1992	21.4935	17.4797	13.2332	9.8920	8.3512	9.0238	11.7295	15.7433	19.9897	23.3310	24.8717	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	271.4410	274.2577	267.1597	252.0489	232.9742	215.0466	203.0699	200.2532	207.3513	222.4621	241.5368	259.4643	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	(71)
Water heating gains (Table 5)													
	47.0769	45.5852	42.4876	38.2765	35.5424	31.6928	28.4206	32.6131	34.1027	38.4614	43.3830	45.5914	(72)
Total internal gains													
	407.9323	406.5516	392.3422	368.7738	343.6238	320.3058	305.7296	309.8110	322.4124	346.1284	373.4660	395.1427	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.1300	10.6334	0.5000	0.8000	0.7700	29.8589	(74)
South	10.1300	46.7521	0.5000	0.8000	0.7700	131.2815	(78)
West	5.1500	19.6403	0.5000	0.8000	0.7700	28.0380	(80)

Solar gains	189.1785	326.9156	461.1682	597.0256	693.8154	700.2957	670.3412	596.0708	507.7331	364.9104	227.4083	161.3883	(83)
Total gains	597.1107	733.4672	853.5104	965.7994	1037.4392	1020.6015	976.0708	905.8818	830.1455	711.0387	600.8743	556.5310	(84)

---

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, n1l,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	14.7300	14.7933	14.8569	15.1629	15.2216	15.5008	15.5008	15.5536	15.3920	15.2216	15.1034	14.9817	
alpha	1.9820	1.9862	1.9905	2.0109	2.0148	2.0334	2.0334	2.0369	2.0261	2.0148	2.0069	1.9988	
util living area													
	0.9953	0.9926	0.9881	0.9792	0.9620	0.9294	0.8808	0.9006	0.9564	0.9844	0.9934	0.9960	(86)
MIT	16.8288	17.0682	17.5649	18.2952	19.0692	19.8285	20.3050	20.2320	19.6077	18.6216	17.6281	16.8188	(87)
Th 2	18.1377	18.1421	18.1465	18.1681	18.1723	18.1925	18.1925	18.1964	18.1846	18.1723	18.1638	18.1552	(88)
util rest of house													
	0.9933	0.9894	0.9822	0.9663	0.9294	0.8296	0.5948	0.6616	0.8962	0.9720	0.9898	0.9943	(89)
MIT 2	14.7335	14.9740	15.4711	16.2061	16.9705	17.7020	18.0842	18.0460	17.5055	16.5362	15.5427	14.7306	(90)
Living area fraction									fLA = Living area / (4) =			0.3281	(91)
MIT	15.4209	15.6610	16.1580	16.8914	17.6590	18.3996	18.8128	18.7631	18.1952	17.2203	16.2268	15.4157	(92)
Temperature adjustment												0.0000	
adjusted MIT	15.4209	15.6610	16.1580	16.8914	17.6590	18.3996	18.8128	18.7631	18.1952	17.2203	16.2268	15.4157	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9900	0.9844	0.9750	0.9563	0.9192	0.8424	0.7065	0.7492	0.8966	0.9644	0.9854	0.9914	(94)
Useful gains	591.1185	722.0186	832.1378	923.5763	953.6251	859.7682	689.5595	678.7265	744.3073	685.7430	592.1110	551.7486	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	5763.0037	5552.6712	4962.1872	4023.0621	2988.3274	1871.1264	1089.6776	1159.7720	2030.9102	3319.9632	4612.7442	5714.4844	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	3847.8826	3246.1986	3072.7568	2231.6298	1513.8185	0.0000	0.0000	0.0000	0.0000	1959.8598	2894.8559	3841.0755	(98)
Space heating												22608.0773	(98)
Space heating per m2											(98) / (4) =	205.6776	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	4629.0198	3644.1220	3729.8997	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.2658	0.3161	0.2924	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1230.3828	1151.8499	1090.7712	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1303.0507	1248.5727	1168.5157	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	52.3209	71.9617	57.8419	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												182.1246	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	13.0802	17.9904	14.4605	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												45.5311	(107)
Space cooling per m2												0.4142	(108)
Energy for space heating												205.6776	(99)
Energy for space cooling												0.4142	(108)
Total												206.0918	(109)
Dwelling Fabric Energy Efficiency (DFEE)												206.1	(109)

Appendix C

Non-Domestic Pre-Conversion BRUKL report (TER Baseline)

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

Office

As built

Date: Fri Jun 21 13:23:10 2019

Administrative information

Building Details

Address: London,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.a.1

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v6.1.0

BRUKL compliance check version: v5.6.a.1

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

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

The building does not comply with England Building Regulations Part L 2013

CO_2 emission rate from the notional building, kgCO_2/m^2.annum	18.3
Target CO_2 emission rate (TER), kgCO_2/m^2.annum	18.3
Building CO_2 emission rate (BER), kgCO_2/m^2.annum	66.2
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 fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the 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	1.21	1.21	01 Ground Floor - Office_W_8
Floor	0.25	1.2	1.2	01 Ground Floor - Office_F_3
Roof	0.25	-	-	"No heat loss roofs"
Windows***, roof windows, and rooflights	2.2	4.8	4.8	01 Ground Floor - Office_G_12
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

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

* 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	25

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	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Project HVAC

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.89	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

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

1- Project DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0.005
Standard value	1	N/A

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

Shell and core configuration

Zone	Excluded from calculation?
01 Ground Floor - Office	NO

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
01 Ground Floor - Office	28	-	-	5510

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?
01 Ground Floor - Office	YES (+11%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	250.1	250.1
External area [m²]	467.6	467.6
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	25	3
Average conductance [W/K]	807.06	228.15
Average U-value [W/m²K]	1.73	0.49
Alpha value* [%]	3.47	15.11

* 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 Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: 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/m²]

	Actual	Notional
Heating	131.96	30.95
Cooling	0	0
Auxiliary	2.13	1.01
Lighting	66.87	19.79
Hot water	3.68	3.34
Equipment*	42.18	42.18
TOTAL**	**204.64**	**55.09**

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

Energy Production by Technology [kWh/m²]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	576.11	232.39
Primary energy* [kWh/m²]	384.13	103.7
Total emissions [kg/m²]	66.2	18.3

* 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] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Natural Gas									
Actual	377.7	198.4	132	0	2.1	0.8	0	0.89	0
Notional	91.3	141.1	31	0	1	0.82	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 Building Control Body is advised to give particular attention to items whose specifications 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	1.21	01 Ground Floor - Office_W_8
Floor	0.2	1.2	01 Ground Floor - Office_F_3
Roof	0.15	-	"No heat loss roofs"
Windows, roof windows, and rooflights	1.5	4.8	01 Ground Floor - Office_G_12
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m^{2}K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m^{2}K)]

* 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	25

Appendix D

Domestic ***Be Lean*** Dwelling Emission Rate (DER) worksheets

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP elmhurst energy

Property Reference	Plot 04	**Issued on Date**	24/06/2019
Assessment Reference	Be Lean	**Prop Type Ref**	MId
Property	Plot 014, Ferdinand Street, Camden, LONDON, LONDON, NW1 8EU		

SAP Rating	79 C	**DER**	26.22	**TER**	21.02
Environmental	82 B	**% DER<TER**	-24.74		
CO_2 Emissions (t/year)	1.17	**DFEE**	67.62	**TFEE**	56.54
General Requirements Compliance	Fail	**% DFEE<TFEE**	-19.59		

Assessor Details	Mr. Simon Gowing, Simon Gowing, Tel: 02036031616, Simon@hodkinsonconsultancy.com	**Assessor ID**	T271-0001
Client			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP elmhurst energy

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 53 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-------------------------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 21.02 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 26.22 kgCO□/m²Fail
Excess emissions =5.20 kgCO□/m²  (24.7%)
-------------------------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)67.6 kWh/m²/yrFail
Excess energy =11.1 kWh/m²/yr  (19.6%)
-------------------------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.26 (max. 0.30)        0.30 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            (no roof)
Openings        1.27 (max. 2.00)        1.30 (max. 3.30)          OK
-------------------------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15
-------------------------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         6.00 (design value)
Maximum                                 10.0                                                    OK
-------------------------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Boiler system with radiators or underfloor - Mains gas
Data from database
Worcester Greenstar 29CDi Classic ErP
Combi boiler
Efficiency: 89.1% SEDBUK2009
Minimum: 88.0%                                  OK

Secondary heating system:               None
-------------------------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       No cylinder
-------------------------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Programmer and at least two room thermostats      OK


Hot water controls:                     No cylinder


Boiler interlock                        Yes                                               OK
-------------------------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                               OK
-------------------------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Not applicable
-------------------------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Medium                                            OK
Based on:
Oversha ding:                           Average
Windows facing West:                    19.56 m², No overhang
Air change rate:                        3.00 ach
Blinds/curtains:                        Dark-coloured curtain or roller blind, closed 100% of daylight hours
-------------------------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Door U-value                            1.00 W/m²K



-------------------------------------------------------------------------------------------------------------------
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.0400 (1b)	x	2.8000 (2b)	=	148.5120	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	53.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	148.5120	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1347	(8)
Pressure test		Yes	
Measured/design AP50		6.0000	
Infiltration rate		0.4347	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4021	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5126	0.5026	0.4925	0.4423	0.4322	0.3820	0.3820	0.3719	0.4021	0.4322	0.4523	0.4724	(22b)
Effective ac	0.6314	0.6263	0.6213	0.5978	0.5934	0.5729	0.5729	0.5692	0.5808	0.5934	0.6023	0.6116	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Normal Window (Uw = 1.30)			19.5600	1.2357	24.1711			(27)
Corridor Door			2.1000	1.0000	2.1000			(26)
Corridor	42.0300	2.1000	39.9300	0.2300	9.1830			(29a)
Bick Wall	57.3200	19.5600	37.7600	0.3000	11.3280			(29a)
Total net area of external elements Aum(A, m2)			99.3500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	46.7821			(33)
Party Wall 1			5.8000	0.0000	0.0000			(32)
Party Floor 1			53.0400					(32d)
Party Ceilings 1			53.0400					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							14.9025	(36)
Total fabric heat loss						(33) + (36) =	61.6846	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	30.9442	30.6941	30.4490	29.2978	29.0824	28.0796	28.0796	27.8939	28.4659	29.0824	29.5181	29.9737	(38)
Heat transfer coeff	92.6288	92.3787	92.1336	90.9823	90.7669	89.7642	89.7642	89.5785	90.1504	90.7669	91.2027	91.6582	(39)
Average = Sum(39)m / 12 =												90.9813	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7464	1.7417	1.7371	1.7154	1.7113	1.6924	1.6924	1.6889	1.6997	1.7113	1.7195	1.7281	(40)
HLP (average)												1.7153	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		1.7797 (42)
Average daily hot water use (litres/day)		76.4688 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	84.1157	81.0570	77.9982	74.9394	71.8807	68.8219	68.8219	71.8807	74.9394	77.9982	81.0570	84.1157	(44)
Energy conte	124.7412	109.0994	112.5808	98.1507	94.1779	81.2684	75.3071	86.4160	87.4481	101.9123	111.2453	120.8052	(45)
Energy content (annual)										Total = Sum(45)m =		1203.1524	(45)
Distribution loss (46)m = 0.15 x (45)m	18.7112	16.3649	16.8871	14.7226	14.1267	12.1903	11.2961	12.9624	13.1172	15.2868	16.6868	18.1208	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
Design SAP elmhurst energy

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	39.0655	35.2470	38.9628	37.6374	38.8421	37.5317	38.7469	38.8087	37.5893	38.9129	37.7371	39.0457	(61)
Total heat required for water heating calculated for each month	163.8067	144.3464	151.5437	135.7881	133.0201	118.8001	114.0540	125.2247	125.0374	140.8252	148.9824	159.8508	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	163.8067	144.3464	151.5437	135.7881	133.0201	118.8001	114.0540	125.2247	125.0374	140.8252	148.9824	159.8508	(64)
								Total per year (kWh/year) = Sum(64)m =				1661.2796	(64)
Heat gains from water heating, kWh/month	51.2428	45.0873	47.1738	42.0445	41.0247	36.4047	34.7263	38.4355	38.4738	43.6141	46.4233	49.9291	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.8292	12.2830	9.9892	7.5624	5.6530	4.7725	5.1569	6.7031	8.9969	11.4236	13.3330	14.2135	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	155.1214	156.7311	152.6747	144.0393	133.1386	122.8935	116.0491	114.4394	118.4958	127.1312	138.0319	148.2770	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	(71)
Water heating gains (Table 5)	68.8748	67.0942	63.4057	58.3951	55.1407	50.5620	46.6752	51.6606	53.4359	58.6211	64.4769	67.1090	(72)
Total internal gains	290.5214	288.8043	278.7657	262.6929	246.6284	230.9241	220.5773	225.4992	233.6246	249.8720	268.5379	282.2957	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
West	19.5600	19.6403	0.6300	0.8000	0.7700	134.1776	(80)
Solar gains	134.1776	262.4798	432.2668	630.4354	772.6223	790.9164	752.9846	646.8027	502.7442	311.4544	167.3037	110.3411	(83)
Total gains	424.6990	551.2841	711.0325	893.1283	1019.2507	1021.8405	973.5619	872.3019	736.3688	561.3264	435.8416	392.6368	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)		21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.7645	39.8721	39.9782	40.4841	40.5801	41.0334	41.0334	41.1185	40.8576	40.5801	40.3863	40.1855	
alpha	3.6510	3.6581	3.6652	3.6989	3.7053	3.7356	3.7356	3.7412	3.7238	3.7053	3.6924	3.6790	
util living area	0.9935	0.9832	0.9511	0.8609	0.7079	0.5316	0.3973	0.4569	0.7174	0.9353	0.9872	0.9951	(86)
MIT	19.2033	19.4890	19.9447	20.4670	20.8030	20.9495	20.9868	20.9782	20.8490	20.3270	19.6565	19.1591	(87)
Th 2	19.5078	19.5111	19.5144	19.5299	19.5328	19.5463	19.5463	19.5488	19.5411	19.5328	19.5269	19.5208	(88)
util rest of house	0.9912	0.9773	0.9343	0.8173	0.6295	0.4234	0.2701	0.3201	0.6087	0.9043	0.9817	0.9934	(89)
MIT 2	17.9302	18.2148	18.6590	19.1492	19.4214	19.5280	19.5439	19.5443	19.4730	19.0457	18.3951	17.8960	(90)
Living area fraction										fLA = Living area / (4) =		0.4796	(91)
MIT	18.5408	18.8260	19.2757	19.7812	20.0840	20.2098	20.2360	20.2320	20.1330	19.6602	19.0001	18.5018	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3908	18.6760	19.1257	19.6312	19.9340	20.0598	20.0860	20.0820	19.9830	19.5102	18.8501	18.3518	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9887	0.9729	0.9289	0.8208	0.6526	0.4631	0.3183	0.3719	0.6449	0.9037	0.9783	0.9914	(94)
Useful gains	419.9207	536.3338	660.4437	733.0508	665.1242	473.1842	309.8421	324.3844	474.8690	507.2479	426.3723	389.2511	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1305.2145	1272.6068	1163.2502	976.3520	747.3785	490.0952	312.9158	329.8311	530.3562	808.7539	1071.6421	1297.1293	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	658.6586	494.7754	374.0880	175.1768	61.1972	0.0000	0.0000	0.0000	0.0000	224.3204	464.5943	675.4613	(98)
Space heating												3128.2721	(98)
Space heating per m2											(98) / (4) =	58.9795	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	843.7833	664.2549	680.7965	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9120	0.9473	0.9256	0.0000	0.0000	0.0000	0.0000	(101)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	769.4992	629.2608	630.1549	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1253.4171	1195.9399	1078.2796	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	348.4209	421.6092	333.4048	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1103.4349	(104)
Cooled fraction										fC = cooled area / (4) =		1.8854	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	164.2255	198.7223	157.1478	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												520.0956	(107)
Space cooling per m2												9.8057	(108)

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3475.8579	(211)
Cooling System Energy Efficiency Ratio (see Table 10c)												4.0000	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	658.6586	494.7754	374.0880	175.1768	61.1972	0.0000	0.0000	0.0000	0.0000	224.3204	464.5943	675.4613	(98)
Space heating efficiency (main heating system 1)													
	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)													
	731.8429	549.7505	415.6534	194.6409	67.9969	0.0000	0.0000	0.0000	0.0000	249.2449	516.2158	750.5126	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	163.8067	144.3464	151.5437	135.7881	133.0201	118.8001	114.0540	125.2247	125.0374	140.8252	148.9824	159.8508	(64)
Efficiency of water heater												86.7000	(216)
(217)m	89.3229	89.2329	89.0231	88.5286	87.7134	86.7000	86.7000	86.7000	86.7000	88.6980	89.1758	89.3492	(217)
Fuel for water heating, kWh/month													
	183.3872	161.7636	170.2296	153.3833	151.6531	137.0243	131.5502	144.4345	144.2184	158.7694	167.0659	178.9057	(219)
Water heating fuel used												1882.3852	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	41.0564	49.6806	39.2870	0.0000	0.0000	0.0000	0.0000	(221)
Cooling												130.0239	(221)
Annual totals kWh/year													
Space heating fuel - main system												3475.8579	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												244.2277	(232)
Total delivered energy for all uses												5807.4948	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3475.8579	0.2160	750.7853	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1882.3852	0.2160	406.5952	(264)
Space and water heating			1157.3805	(265)
Space cooling	130.0239	0.5190	67.4824	(266)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	244.2277	0.5190	126.7542	(268)
Total CO2, kg/year			1390.5421	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			26.2200	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		26.2200	ZC1
Total Floor Area	TFA	53.0400	
Assumed number of occupants	N	1.7797	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.3306	ZC2
CO2 emissions from cooking, equation (L16)		3.0489	ZC3
Total CO2 emissions		46.5995	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		46.5995	ZC8

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
Design SAP elmhurst energy

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.0400 (1b)	x	2.8000 (2b)	=	148.5120 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	53.0400				(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	148.5120	(5)

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2. Ventilation rate

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	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)
							Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =							20.0000 / (5) =	0.1347	(8)
Pressure test								Yes	
Measured/design AP50								6.0000	
Infiltration rate								0.4347	(18)
Number of sides sheltered								1	(19)
Shelter factor							(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor							(21) = (18) x (20) =	0.4021	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate													
	0.5126	0.5026	0.4925	0.4423	0.4322	0.3820	0.3820	0.3719	0.4021	0.4322	0.4523	0.4724	(22b)
Effective ac	0.6314	0.6263	0.6213	0.5978	0.5934	0.5729	0.5729	0.5692	0.5808	0.5934	0.6023	0.6116	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Normal Window (Uw = 1.30)			19.5600	1.2357	24.1711			(27)
Corridor Door			2.1000	1.0000	2.1000			(26)
Corridor	42.0300	2.1000	39.9300	0.2300	9.1830			(29a)
Bick Wall	57.3200	19.5600	37.7600	0.3000	11.3280			(29a)
Total net area of external elements Aum(A, m2)			99.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.7821			(33)
Party Wall 1			5.8000	0.0000	0.0000			(32)
Party Floor 1			53.0400					(32d)
Party Ceilings 1			53.0400					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							14.9025	(36)
Total fabric heat loss					(33) + (36) =		61.6846	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	30.9442	30.6941	30.4490	29.2978	29.0824	28.0796	28.0796	27.8939	28.4659	29.0824	29.5181	29.9737	(38)
Heat transfer coeff													
	92.6288	92.3787	92.1336	90.9823	90.7669	89.7642	89.7642	89.5785	90.1504	90.7669	91.2027	91.6582	(39)
Average = Sum(39)m / 12 =												90.9813	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7464	1.7417	1.7371	1.7154	1.7113	1.6924	1.6924	1.6889	1.6997	1.7113	1.7195	1.7281	(40)
HLP (average)												1.7153	(40)
Days in month													
	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.7797	(42)
Average daily hot water use (litres/day)	76.4688	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	84.1157	81.0570	77.9982	74.9394	71.8807	68.8219	68.8219	71.8807	74.9394	77.9982	81.0570	84.1157	(44)
Energy conte	124.7412	109.0994	112.5808	98.1507	94.1779	81.2684	75.3071	86.4160	87.4481	101.9123	111.2453	120.8052	(45)
Energy content (annual)										Total = Sum(45)m =		1203.1524	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	26.5075	23.1836	23.9234	20.8570	20.0128	17.2695	16.0028	18.3634	18.5827	21.6564	23.6396	25.6711	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	88.9870	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	13.8292	12.2830	9.9892	7.5624	5.6530	4.7725	5.1569	6.7031	8.9969	11.4236	13.3330	14.2135	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	155.1214	156.7311	152.6747	144.0393	133.1386	122.8935	116.0491	114.4394	118.4958	127.1312	138.0319	148.2770	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	31.8987	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	-71.1896	(71)
Water heating gains (Table 5)													
	35.6284	34.4994	32.1551	28.9681	26.8989	23.9855	21.5091	24.6820	25.8093	29.1080	32.8328	34.5042	(72)
Total internal gains													
	254.2750	253.2096	244.5151	230.2659	215.3866	201.3476	192.4112	195.5206	202.9981	217.3589	233.8938	246.6908	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
West	19.5600	19.6403	0.6300	0.8000	0.7700	134.1776	(80)

Solar gains	134.1776	262.4798	432.2668	630.4354	772.6223	790.9164	752.9846	646.8027	502.7442	311.4544	167.3037	110.3411	(83)
Total gains	388.4526	515.6894	676.7820	860.7013	988.0089	992.2639	945.3958	842.3233	705.7423	528.8133	401.1975	357.0319	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.7645	39.8721	39.9782	40.4841	40.5801	41.0334	41.0334	41.1185	40.8576	40.5801	40.3863	40.1855	
alpha	3.6510	3.6581	3.6652	3.6989	3.7053	3.7356	3.7356	3.7412	3.7238	3.7053	3.6924	3.6790	
util living area													
	0.9952	0.9863	0.9574	0.8719	0.7216	0.5447	0.4083	0.4714	0.7360	0.9450	0.9902	0.9964	(86)
MIT	19.1468	19.4357	19.8995	20.4375	20.7893	20.9453	20.9855	20.9758	20.8348	20.2864	19.6036	19.1031	(87)
Th 2	19.5078	19.5111	19.5144	19.5299	19.5328	19.5463	19.5463	19.5488	19.5411	19.5328	19.5269	19.5208	(88)
util rest of house													
	0.9934	0.9815	0.9425	0.8305	0.6439	0.4349	0.2780	0.3311	0.6284	0.9176	0.9859	0.9952	(89)
MIT 2	17.8742	18.1627	18.6167	19.1248	19.4126	19.5262	19.5437	19.5437	19.4654	19.0098	18.3432	17.8403	(90)
Living area fraction									fLA = Living area / (4) =			0.4796	(91)
MIT	18.4846	18.7733	19.2320	19.7544	20.0729	20.2069	20.2352	20.2306	20.1222	19.6221	18.9477	18.4460	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4846	18.7733	19.2320	19.7544	20.0729	20.2069	20.2352	20.2306	20.1222	19.6221	18.9477	18.4460	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9917	0.9783	0.9390	0.8377	0.6745	0.4866	0.3409	0.3989	0.6752	0.9197	0.9836	0.9938	(94)
Useful gains	385.2430	504.4996	635.4693	720.9883	666.4239	482.8303	322.2702	335.9729	476.5118	486.3323	394.6331	354.8284	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1313.8998	1281.5952	1173.0407	987.5574	759.9847	503.2960	326.3146	343.1398	542.9041	818.9051	1080.5458	1305.7631	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	690.9206	522.2082	399.9531	191.9297	69.6092	0.0000	0.0000	0.0000	0.0000	247.4342	493.8571	707.4954	(98)
Space heating												3323.4076	(98)
Space heating per m2											(98) / (4) =	62.6585	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	843.7833	664.2549	680.7965	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9071	0.9441	0.9205	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	765.3799	627.1258	626.6865	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1226.8405	1170.7738	1051.3010	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	332.2517	404.4741	315.9132	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1052.6389	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
Design SAP elmhurst energy

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Intermittency factor (Table 10b)

	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	83.0629	101.1185	78.9783	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												263.1597	(107)
Space cooling per m2												4.9615	(108)
Energy for space heating												62.6585	(99)
Energy for space cooling												4.9615	(108)
Total												67.6200	(109)
Dwelling Fabric Energy Efficiency (DFEE)												67.6	(109)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	Plot 14	**Issued on Date**	24/06/2019
Assessment Reference	Be Lean	**Prop Type Ref**	Mid With Heat loss
Property	Plot 014, Ferdinand Street, Camden, LONDON, LONDON, NW1 8EU		

SAP Rating	80 C	**DER**	23.22	**TER**	18.97
Environmental	83 B	**% DER<TER**	-22.40		
CO_2 Emissions (t/year)	1.30	**DFEE**	61.45	**TFEE**	51.86
General Requirements Compliance	Fail	**% DFEE<TFEE**	-18.50		

Assessor Details	Mr. Simon Gowing, Simon Gowing, Tel: 02036031616, Simon@hodkinsonconsultancy.com	**Assessor ID**	T271-0001
Client			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
Design SAP
elmhurst energy

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 68 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-------------------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.97 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 23.22 kgCO□/m²Fail
Excess emissions =4.25 kgCO□/m²  (22.4%)
-------------------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)51.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)61.5 kWh/m²/yrFail
Excess energy =9.6 kWh/m²/yr  (18.5%)
-------------------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.30 (max. 0.30)        0.30 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            0.13 (max. 0.20)        0.13 (max. 0.35)          OK
Openings        1.28 (max. 2.00)        1.30 (max. 3.30)          OK
-------------------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15
-------------------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         6.00 (design value)
Maximum                                 10.0                                        OK
-------------------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Boiler system with radiators or underfloor - Mains gas
Data from database
Worcester Greenstar 29CDi Classic ErP
Combi boiler
Efficiency: 89.1% SEDBUK2009
Minimum: 88.0%                                  OK

Secondary heating system:               None
-------------------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       No cylinder
-------------------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Programmer and at least two room thermostats      OK


Hot water controls:                     No cylinder


Boiler interlock                        Yes                                         OK
-------------------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                         OK
-------------------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Not applicable
-------------------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Medium                                      OK
Based on:
Overshading:                            Average
Windows facing North East:              11.46 m², No overhang
Windows facing East:                    7.64 m², No overhang
Windows facing North West:              7.64 m², No overhang
Air change rate:                        3.00 ach
Blinds/curtains:                        Dark-coloured curtain or roller blind, closed 100% of daylight hours
-------------------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Door U-value                            1.00 W/m²K



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SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	67.8900 (1b)	x	2.8000 (2b)	=	190.0920 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	67.8900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	190.0920	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1052	(8)
Pressure test		Yes	
Measured/design AP50		6.0000	
Infiltration rate		0.4052	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3748	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4779	0.4685	0.4592	0.4123	0.4029	0.3561	0.3561	0.3467	0.3748	0.4029	0.4217	0.4404	(22b)
Effective ac	0.6142	0.6098	0.6054	0.5850	0.5812	0.5634	0.5634	0.5601	0.5702	0.5812	0.5889	0.5970	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Normal Window (Uw = 1.30)			26.7400	1.2357	33.0437			(27)
Corridor Door			2.1000	1.0000	2.1000			(26)
Corridor	3.7000	2.1000	1.6000	0.2300	0.3680			(29a)
Bick Wall	73.2200	26.7400	46.4800	0.3000	13.9440			(29a)
External Roof 1	23.7500		23.7500	0.1300	3.0875			(30)
Total net area of external elements Aum(A, m2)			100.6700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		52.5432			(33)
Party Wall 1			29.7900	0.0000	0.0000			(32)
Party Floor 1			67.8900					(32d)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							15.1005	(36)
Total fabric heat loss					(33) + (36) =		67.6437	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.5285	38.2504	37.9777	36.6971	36.4575	35.3421	35.3421	35.1355	35.7717	36.4575	36.9422	37.4489	(38)
Heat transfer coeff	106.1722	105.8941	105.6214	104.3408	104.1012	102.9858	102.9858	102.7792	103.4154	104.1012	104.5859	105.0926	(39)
Average = Sum(39)m / 12 =												104.3396	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5639	1.5598	1.5558	1.5369	1.5334	1.5170	1.5170	1.5139	1.5233	1.5334	1.5405	1.5480	(40)
HLP (average)												1.5369	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.1938 (42)
Average daily hot water use (litres/day)	86.3034 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	94.9338	91.4816	88.0295	84.5774	81.1252	77.6731	77.6731	81.1252	84.5774	88.0295	91.4816	94.9338	(44)
Energy conte	140.7840	123.1306	127.0598	110.7738	106.2901	91.7203	84.9923	97.5299	98.6947	115.0192	125.5524	136.3418	(45)
Energy content (annual)										Total = Sum(45)m =		1357.8890	(45)
Distribution loss (46)m = 0.15 x (45)m	21.1176	18.4696	19.0590	16.6161	15.9435	13.7580	12.7488	14.6295	14.8042	17.2529	18.8329	20.4513	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	39.2379	35.3922	39.1071	37.7582	38.9533	37.6236	38.8321	38.9107	37.6969	39.0435	37.8852	39.2126	(61)
Total heat required for water heating calculated for each month	180.0219	158.5228	166.1668	148.5320	145.2434	129.3438	123.8244	136.4406	136.3917	154.0627	163.4377	175.5544	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	180.0219	158.5228	166.1668	148.5320	145.2434	129.3438	123.8244	136.4406	136.3917	154.0627	163.4377	175.5544	(64)
								Total per year (kWh/year) = Sum(64)m =				1817.5423	(64)
Heat gains from water heating, kWh/month	56.6202	49.7890	52.0241	46.2718	45.0798	39.9029	37.9680	42.1564	42.2402	48.0048	51.2175	55.1368	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.1458	15.2287	12.3848	9.3761	7.0087	5.9171	6.3936	8.3107	11.1545	14.1633	16.5306	17.6223	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	192.3232	194.3189	189.2898	178.5834	165.0684	152.3663	143.8805	141.8847	146.9139	157.6203	171.1353	183.8374	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	(71)
Water heating gains (Table 5)	76.1024	74.0908	69.9249	64.2664	60.5911	55.4207	51.0322	56.6618	58.6670	64.5225	71.1354	74.1086	(72)
Total internal gains	344.4788	342.5458	330.5069	311.1333	291.5757	272.6114	260.2137	265.7646	275.6429	295.2135	317.7087	334.4757	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	11.4600	11.2829	0.6300	0.8000	0.7700	45.1617	(75)
East	7.6400	19.6403	0.6300	0.8000	0.7700	52.4088	(76)
Northwest	7.6400	11.2829	0.6300	0.8000	0.7700	30.1078	(81)

Solar gains	127.6784	255.7362	444.8822	699.5836	911.1587	958.5877	901.8554	737.1378	532.7297	308.8908	160.0563	104.5674	(83)
Total gains	472.1572	598.2820	775.3892	1010.7170	1202.7344	1231.1992	1162.0691	1002.9025	808.3725	604.1044	477.7650	439.0431	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	44.4051	44.5217	44.6366	45.1845	45.2885	45.7790	45.7790	45.8710	45.5888	45.2885	45.0786	44.8612	
alpha	3.9603	3.9681	3.9758	4.0123	4.0192	4.0519	4.0519	4.0581	4.0393	4.0192	4.0052	3.9907	
util living area	0.9961	0.9898	0.9659	0.8784	0.7060	0.5147	0.3847	0.4594	0.7487	0.9552	0.9922	0.9971	(86)
MIT	19.3242	19.5676	19.9919	20.5158	20.8461	20.9670	20.9920	20.9843	20.8597	20.3462	19.7347	19.2873	(87)
Th 2	19.6399	19.6430	19.6459	19.6599	19.6626	19.6748	19.6748	19.6771	19.6701	19.6626	19.6572	19.6517	(88)
util rest of house	0.9947	0.9862	0.9539	0.8402	0.6324	0.4168	0.2715	0.3332	0.6489	0.9329	0.9888	0.9960	(89)
MIT 2	18.1490	18.3928	18.8101	19.3065	19.5743	19.6625	19.6733	19.6736	19.6034	19.1714	18.5713	18.1212	(90)
Living area fraction											fLA = Living area / (4) =	0.3450	(91)
MIT	18.5544	18.7981	19.2178	19.7237	20.0131	20.1125	20.1282	20.1258	20.0368	19.5767	18.9726	18.5235	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.4044	18.6481	19.0678	19.5737	19.8631	19.9625	19.9782	19.9758	19.8868	19.4267	18.8226	18.3735	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9929	0.9825	0.9473	0.8373	0.6443	0.4388	0.2978	0.3625	0.6672	0.9277	0.9859	0.9946	(94)
Useful gains	468.8015	587.8153	734.5412	846.2965	774.9664	540.2299	346.0635	363.5283	539.3189	560.4322	471.0136	436.6741	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1497.4947	1455.8374	1327.4291	1113.6989	849.7831	552.2657	347.9070	367.5141	598.4442	918.8662	1226.0201	1489.5302	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	765.3477	583.3109	441.1086	192.5297	55.6637	0.0000	0.0000	0.0000	0.0000	266.6749	543.6047	783.3249	(98)
Space heating												3631.5651	(98)
Space heating per m2											(98) / (4) =	53.4919	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	968.0661	762.0946	781.1219	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9340	0.9620	0.9379	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	904.2018	733.1056	732.6449	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1512.2863	1430.1132	1245.0298	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	437.8208	518.5737	381.2143	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1337.6088	(104)
Cooled fraction									fC = cooled area / (4) =			1.4730	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	161.2243	190.9610	140.3794	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												492.5647	(107)
Space cooling per m2												7.2553	(108)

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4035.0723	(211)
Cooling System Energy Efficiency Ratio (see Table 10c)												4.0000	(209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	765.3477	583.3109	441.1086	192.5297	55.6637	0.0000	0.0000	0.0000	0.0000	266.6749	543.6047	783.3249	(98)
Space heating efficiency (main heating system 1)													
	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)													
	850.3863	648.1232	490.1207	213.9219	61.8485	0.0000	0.0000	0.0000	0.0000	296.3054	604.0052	870.3610	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	180.0219	158.5228	166.1668	148.5320	145.2434	129.3438	123.8244	136.4406	136.3917	154.0627	163.4377	175.5544	(64)
Efficiency of water heater												86.7000	(216)
(217)m	89.3524	89.2739	89.0723	88.5325	87.5898	86.7000	86.7000	86.7000	86.7000	88.7629	89.2151	89.3772	(217)
Fuel for water heating, kWh/month													
	201.4741	177.5691	186.5527	167.7712	165.8223	149.1855	142.8193	157.3709	157.3145	173.5666	183.1952	196.4197	(219)
Water heating fuel used												2059.0612	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	40.3061	47.7403	35.0949	0.0000	0.0000	0.0000	0.0000	(221)
Cooling												123.1412	(221)
Annual totals kWh/year													
Space heating fuel - main system												4035.0723	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												302.7994	(232)
Total delivered energy for all uses												6595.0740	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4035.0723	0.2160	871.5756	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2059.0612	0.2160	444.7572	(264)
Space and water heating			1316.3328	(265)
Space cooling	123.1412	0.5190	63.9103	(266)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	302.7994	0.5190	157.1529	(268)
Total CO2, kg/year			1576.3210	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			23.2200	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		23.2200	ZC1
Total Floor Area	TFA	67.8900	
Assumed number of occupants	N	2.1938	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.7870	ZC2
CO2 emissions from cooking, equation (L16)		2.5284	ZC3
Total CO2 emissions		42.5353	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		42.5353	ZC8

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	67.8900 (1b)	x	2.8000 (2b)	=	190.0920 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	67.8900				(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	190.0920 (5)	

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)
							Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =							20.0000 / (5) =	0.1052	(8)
Pressure test								Yes	
Measured/design AP50								6.0000	
Infiltration rate								0.4052	(18)
Number of sides sheltered								1	(19)
Shelter factor							(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor							(21) = (18) x (20) =	0.3748	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate													
	0.4779	0.4685	0.4592	0.4123	0.4029	0.3561	0.3561	0.3467	0.3748	0.4029	0.4217	0.4404	(22b)
Effective ac	0.6142	0.6098	0.6054	0.5850	0.5812	0.5634	0.5634	0.5601	0.5702	0.5812	0.5889	0.5970	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Normal Window (Uw = 1.30)			26.7400	1.2357	33.0437			(27)
Corridor Door			2.1000	1.0000	2.1000			(26)
Corridor	3.7000	2.1000	1.6000	0.2300	0.3680			(29a)
Bick Wall	73.2200	26.7400	46.4800	0.3000	13.9440			(29a)
External Roof 1	23.7500		23.7500	0.1300	3.0875			(30)
Total net area of external elements Aum(A, m2)			100.6700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.5432			(33)
Party Wall 1			29.7900	0.0000	0.0000			(32)
Party Floor 1			67.8900					(32d)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							15.1005	(36)
Total fabric heat loss					(33) + (36) =		67.6437	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.5285	38.2504	37.9777	36.6971	36.4575	35.3421	35.3421	35.1355	35.7717	36.4575	36.9422	37.4489	(38)
Heat transfer coeff													
	106.1722	105.8941	105.6214	104.3408	104.1012	102.9858	102.9858	102.7792	103.4154	104.1012	104.5859	105.0926	(39)
Average = Sum(39)m / 12 =												104.3396	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5639	1.5598	1.5558	1.5369	1.5334	1.5170	1.5170	1.5139	1.5233	1.5334	1.5405	1.5480	(40)
HLP (average)												1.5369	(40)
Days in month													
	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.1938	(42)
Average daily hot water use (litres/day)		86.3034	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	94.9338	91.4816	88.0295	84.5774	81.1252	77.6731	77.6731	81.1252	84.5774	88.0295	91.4816	94.9338	(44)
Energy conte	140.7840	123.1306	127.0598	110.7738	106.2901	91.7203	84.9923	97.5299	98.6947	115.0192	125.5524	136.3418	(45)
Energy content (annual)										Total = Sum(45)m =		1357.8890	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month												
	29.9166	26.1653	27.0002	23.5394	22.5866	19.4906	18.0609	20.7251	20.9726	24.4416	26.6799	28.9726 (65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	109.6914	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	17.1458	15.2287	12.3848	9.3761	7.0087	5.9171	6.3936	8.3107	11.1545	14.1633	16.5306	17.6223	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	192.3232	194.3189	189.2898	178.5834	165.0684	152.3663	143.8805	141.8847	146.9139	157.6203	171.1353	183.8374	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	33.9691	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	-87.7531	(71)
Water heating gains (Table 5)													
	40.2105	38.9364	36.2906	32.6937	30.3584	27.0702	24.2754	27.8563	29.1287	32.8516	37.0554	38.9417	(72)
Total internal gains													
	305.5869	304.3914	293.8726	276.5605	258.3430	241.2610	230.4569	233.9592	243.1045	260.5426	280.6287	296.3088	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	11.4600	11.2829	0.6300	0.8000	0.7700	45.1617	(75)
East	7.6400	19.6403	0.6300	0.8000	0.7700	52.4088	(76)
Northwest	7.6400	11.2829	0.6300	0.8000	0.7700	30.1078	(81)

Solar gains	127.6784	255.7362	444.8822	699.5836	911.1587	958.5877	901.8554	737.1378	532.7297	308.8908	160.0563	104.5674	(83)
Total gains	433.2653	560.1276	738.7549	976.1442	1169.5017	1199.8487	1132.3122	971.0970	775.8342	569.4334	440.6850	400.8762	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	44.4051	44.5217	44.6366	45.1845	45.2885	45.7790	45.7790	45.8710	45.5888	45.2885	45.0786	44.8612	
alpha	3.9603	3.9681	3.9758	4.0123	4.0192	4.0519	4.0519	4.0581	4.0393	4.0192	4.0052	3.9907	
util living area													
	0.9971	0.9919	0.9707	0.8885	0.7190	0.5264	0.3943	0.4730	0.7667	0.9627	0.9941	0.9979	(86)
MIT	19.2749	19.5205	19.9509	20.4892	20.8354	20.9643	20.9913	20.9826	20.8462	20.3089	19.6883	19.2387	(87)
Th 2	19.6399	19.6430	19.6459	19.6599	19.6626	19.6748	19.6748	19.6771	19.6701	19.6626	19.6572	19.6517	(88)
util rest of house													
	0.9961	0.9890	0.9602	0.8522	0.6458	0.4270	0.2785	0.3437	0.6686	0.9434	0.9916	0.9972	(89)
MIT 2	18.1000	18.3463	18.7711	19.2841	19.5674	19.6614	19.6731	19.6732	19.5958	19.1373	18.5255	18.0728	(90)
Living area fraction									fLA = Living area / (4) =			0.3450	(91)
MIT	18.5053	18.7514	19.1781	19.6999	20.0048	20.1109	20.1278	20.1249	20.0272	19.5415	18.9266	18.4750	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5053	18.7514	19.1781	19.6999	20.0048	20.1109	20.1278	20.1249	20.0272	19.5415	18.9266	18.4750	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9949	0.9863	0.9556	0.8535	0.6659	0.4607	0.3187	0.3887	0.6979	0.9411	0.9896	0.9962	(94)
Useful gains	431.0510	552.4711	705.9275	833.1173	778.7851	552.8038	360.8447	377.4853	541.4824	535.9154	436.1126	399.3580	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1508.2098	1466.7806	1339.0789	1126.8657	864.5402	567.5406	363.3180	382.8409	612.9590	930.8167	1236.8967	1500.1942	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	801.4061	614.4160	471.0647	211.4988	63.8018	0.0000	0.0000	0.0000	0.0000	293.8065	576.5646	819.0222	(98)
Space heating												3851.5807	(98)
Space heating per m2											(98) / (4) =	56.7327	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	968.0661	762.0946	781.1219	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9304	0.9597	0.9336	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	900.6617	731.3471	729.2589	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1483.9358	1403.3564	1216.2243	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	419.9574	499.9749	362.3023	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling	1282.2345	(104)
Cooled fraction	fC = cooled area / (4) = 1.0000	(105)
Intermittency factor (Table 10b)		
0.0000 0.0000 0.0000 0.0000 0.0000 0.2500 0.2500 0.2500 0.0000 0.0000 0.0000 0.0000		(106)
Space cooling kWh		
0.0000 0.0000 0.0000 0.0000 0.0000 104.9893 124.9937 90.5756 0.0000 0.0000 0.0000 0.0000		(107)
Space cooling	320.5586	(107)
Space cooling per m2	4.7217	(108)
Energy for space heating	56.7327	(99)
Energy for space cooling	4.7217	(108)
Total	61.4544	(109)
Dwelling Fabric Energy Efficiency (DFEE)	61.5	(109)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	Plot 19	**Issued on Date**	24/06/2019
Assessment Reference	Be Lean	**Prop Type Ref**	Top Floor Pent House
Property	Plot 019, Ferdinand Street, Camden, LONDON, LONDON, NW1 8EU		

SAP Rating	72 C	**DER**	34.93	**TER**	18.05
Environmental	69 C	**% DER<TER**	-93.50		
CO_2 Emissions (t/year)	3.15	**DFEE**	121.26	**TFEE**	60.48
General Requirements Compliance	Fail	**% DFEE<TFEE**	-100.48		

Assessor Details	Mr. Simon Gowing, Simon Gowing, Tel: 02036031616, Simon@hodkinsonconsultancy.com	**Assessor ID**	T271-0001
Client			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
Design SAP
elmhurst energy

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS DESIGNED

Top-floor flat, total floor area 110 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
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1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.05 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 34.93 kgCO□/m²Fail
Excess emissions =16.88 kgCO□/m²  (93.5%)
-------------------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)60.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)121.3 kWh/m²/yrFail
Excess energy =60.8 kWh/m²/yr  (100.0%)
-------------------------------------------------------------------------------------------------------------
2 Fabric U-values
Element          Average                 Highest
External wall    0.24 (max. 0.30)        0.32 (max. 0.70)          OK
Floor            (no floor)
Roof             0.13 (max. 0.20)        0.13 (max. 0.35)          OK
Openings and
curtain wall     1.72 (max. 2.00)        1.80 (max. 3.30)          OK
-------------------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15
-------------------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:          6.00 (design value)
Maximum                                  10.0                                              OK
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4 Heating efficiency
Main heating system:                     Boiler system with radiators or underfloor - Mains gas
Data from database
Worcester Greenstar 24i System

Efficiency: 89.2% SEDBUK2009
Minimum: 88.0%                                 OK

Secondary heating system:                None
-------------------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                        Measured cylinder loss: 1.72 kWh/day
Permitted by DBSCG 2.30                        OK
Primary pipework insulated:              Yes                                               OK
-------------------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                  Programmer and at least two room thermostats      OK


Hot water controls:                      Cylinderstat                                      OK
                                         Independent timer for DHW                         OK

Boiler interlock                         Yes                                               OK
-------------------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                  75%                                               OK
-------------------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Not applicable
-------------------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):        Not significant                                   OK
Based on:
Overshading:                             Average
Windows facing North:                    10.13 m², No overhang
Windows facing South:                    10.13 m², No overhang
Windows facing West:                     5.15 m², No overhang
Air change rate:                         3.00 ach
Blinds/curtains:                         Light-coloured curtain or roller blind, closed 100% of daylight hours
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10 Key features
None



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	109.9200 (1b)	x	3.0400 (2b)	=	334.1568 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.9200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	334.1568	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0898	(8)
Pressure test		Yes	
Measured/design AP50		6.0000	
Infiltration rate		0.3898	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3605	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4597	0.4507	0.4417	0.3966	0.3876	0.3425	0.3425	0.3335	0.3605	0.3876	0.4056	0.4236	(22b)
Effective ac	0.6057	0.6016	0.5975	0.5786	0.5751	0.5587	0.5587	0.5556	0.5650	0.5751	0.5823	0.5897	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.50)			25.4100	1.4151	35.9575			(27)
Curtain Walling	98.4700	25.4100	73.0600	1.8000	131.5080			(29a)
External Wall 2	18.8500		18.8500	0.2300	4.3351			(29a)
Solid Core	3.7000		3.7000	0.3152	1.1662			(29a)
External Roof 1	109.9200		109.9200	0.1300	14.2896			(30)
Total net area of external elements Aum(A, m2)			230.9400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		187.2564			(33)
Party Floor 1			109.9200					(32d)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							34.6410	(36)
Total fabric heat loss						(33) + (36) =	221.8974	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	66.7871	66.3347	65.8912	63.8083	63.4185	61.6043	61.6043	61.2684	62.3031	63.4185	64.2069	65.0312	(38)
Heat transfer coeff	288.6845	288.2321	287.7886	285.7056	285.3159	283.5017	283.5017	283.1657	284.2005	285.3159	286.1043	286.9286	(39)
Average = Sum(39)m / 12 =												285.7038	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.6263	2.6222	2.6182	2.5992	2.5957	2.5792	2.5792	2.5761	2.5855	2.5957	2.6028	2.6103	(40)
HLP (average)												2.5992	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8143	(42)
Average daily hot water use (litres/day)	101.0407	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.1448	107.1031	103.0615	99.0199	94.9782	90.9366	90.9366	94.9782	99.0199	103.0615	107.1031	111.1448	(44)
Energy conte	164.8245	144.1565	148.7566	129.6896	124.4403	107.3825	99.5057	114.1842	115.5479	134.6600	146.9919	159.6237	(45)
Energy content (annual)										Total = Sum(45)m =		1589.7635	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7237	21.6235	22.3135	19.4534	18.6660	16.1074	14.9259	17.1276	17.3322	20.1990	22.0488	23.9436	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7200	(48)
Temperature factor from Table 2b												0.5400	(49)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
Design SAP elmhurst energy

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Enter (49) or (54) in (55)	0.9288	(55)

Total storage loss

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
28.7928	26.0064	28.7928	27.8640	28.7928	27.8640	28.7928	28.7928	27.8640	28.7928	27.8640	28.7928	(56)

If cylinder contains dedicated solar storage

28.7928	26.0064	28.7928	27.8640	28.7928	27.8640	28.7928	28.7928	27.8640	28.7928	27.8640	28.7928	(57)
Primary loss 23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)

Total heat required for water heating calculated for each month

216.8797	191.1741	200.8118	180.0656	176.4955	157.7585	151.5609	166.2394	165.9239	186.7152	197.3679	211.6789	(62)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
							Solar input (sum of months) = Sum(63)m =				0.0000	(63)

Output from w/h

216.8797	191.1741	200.8118	180.0656	176.4955	157.7585	151.5609	166.2394	165.9239	186.7152	197.3679	211.6789	(64)
							Total per year (kWh/year) = Sum(64)m =				2202.6715	(64)

Heat gains from water heating, kWh/month

96.4483	85.5461	91.1057	83.4226	83.0206	76.0055	74.7298	79.6104	78.7205	86.4186	89.1756	94.7190	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.1992	21.4935	17.4797	13.2332	9.8920	8.3512	9.0238	11.7295	15.7433	19.9897	23.3310	24.8717	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	271.4410	274.2577	267.1597	252.0489	232.9742	215.0466	203.0699	200.2532	207.3513	222.4621	241.5368	259.4643	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	(71)
Water heating gains (Table 5)													
	129.6348	127.3008	122.4540	115.8647	111.5868	105.5632	100.4433	107.0032	109.3340	116.1540	123.8550	127.3105	(72)
Total internal gains													
	493.4902	491.2672	475.3085	449.3620	422.6681	397.1762	380.7522	387.2012	400.6437	426.8210	456.9380	479.8618	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.1300	10.6334	0.5000	0.8000	0.7700	29.8589	(74)
South	10.1300	46.7521	0.5000	0.8000	0.7700	131.2815	(78)
West	5.1500	19.6403	0.5000	0.8000	0.7700	28.0380	(80)

Solar gains	189.1785	326.9156	461.1682	597.0256	693.8154	700.2957	670.3412	596.0708	507.7331	364.9104	227.4083	161.3883	(83)
Total gains	682.6687	818.1828	936.4768	1046.3877	1116.4836	1097.4719	1051.0935	983.2720	908.3768	791.7314	684.3463	641.2501	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	26.4418	26.4833	26.5241	26.7175	26.7540	26.9252	26.9252	26.9571	26.8590	26.7540	26.6802	26.6036	
alpha	2.7628	2.7656	2.7683	2.7812	2.7836	2.7950	2.7950	2.7971	2.7906	2.7836	2.7787	2.7736	
util living area	0.9961	0.9932	0.9876	0.9746	0.9459	0.8862	0.7959	0.8299	0.9337	0.9813	0.9938	0.9968	(86)
MIT	18.2117	18.4210	18.8103	19.3525	19.9197	20.4293	20.7215	20.6700	20.2463	19.5186	18.7726	18.1781	(87)
Th 2	18.9485	18.9508	18.9531	18.9638	18.9658	18.9752	18.9752	18.9769	18.9716	18.9658	18.9617	18.9575	(88)
util rest of house	0.9946	0.9904	0.9819	0.9609	0.9088	0.7798	0.5593	0.6195	0.8670	0.9685	0.9906	0.9955	(89)
MIT 2	16.5582	16.7682	17.1570	17.6998	18.2500	18.7144	18.9172	18.8952	18.5672	17.8701	17.1269	16.5306	(90)
Living area fraction										fLA = Living area / (4) =		0.3281	(91)
MIT	17.1006	17.3104	17.6994	18.2420	18.7977	19.2770	19.5091	19.4774	19.1181	18.4109	17.6668	17.0711	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.9506	17.1604	17.5494	18.0920	18.6477	19.1270	19.3591	19.3274	18.9681	18.2609	17.5168	16.9211	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9921	0.9865	0.9758	0.9520	0.9003	0.7911	0.6205	0.6710	0.8668	0.9614	0.9870	0.9934	(94)
Useful gains	677.2621	807.1415	913.8492	996.1402	1005.1447	868.2458	652.2438	659.7762	787.3922	761.1810	675.4722	636.9947	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	3652.0461	3533.8361	3179.8811	2626.2078	1982.3037	1283.4152	782.2185	828.9418	1383.5055	2185.7827	2980.2922	3650.0381	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	2213.2393	1832.3387	1685.9277	1173.6487	727.0063	0.0000	0.0000	0.0000	0.0000	1059.9037	1659.4704	2241.7043	(98)
Space heating												12593.2390	(98)
Space heating per m2											(98) / (4) =	114.5673	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	2664.9160	2097.9126	2152.0596	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.4737	0.5522	0.5175	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1262.4833	1158.4000	1113.7795	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1376.9212	1320.5953	1242.9059	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	82.3952	120.6733	96.0700	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												299.1386	(104)
Cooled fraction										fC = cooled area / (4) =		0.9098	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	18.7398	27.4457	21.8500	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												68.0355	(107)
Space cooling per m2												0.6190	(108)

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	13961.4623	(211)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.0000	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2213.2393	1832.3387	1685.9277	1173.6487	727.0063	0.0000	0.0000	0.0000	0.0000	1059.9037	1659.4704	2241.7043	(98)
Space heating efficiency (main heating system 1)													
	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)													
	2453.7021	2031.4177	1869.0995	1301.1626	805.9936	0.0000	0.0000	0.0000	0.0000	1175.0595	1839.7676	2485.2598	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	216.8797	191.1741	200.8118	180.0656	176.4955	157.7585	151.5609	166.2394	165.9239	186.7152	197.3679	211.6789	(64)
Efficiency of water heater												79.5000	(216)
(217)m	89.1294	89.0674	88.9261	88.6136	87.8892	79.5000	79.5000	79.5000	79.5000	88.4176	88.9278	89.1646	(217)
Fuel for water heating, kWh/month													
	243.3312	214.6397	225.8187	203.2032	200.8158	198.4384	190.6426	209.1062	208.7094	211.1742	221.9418	237.4025	(219)
Water heating fuel used												2565.2237	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	4.6850	6.8614	5.4625	0.0000	0.0000	0.0000	0.0000	(221)
Cooling												17.0089	(221)
Annual totals kWh/year													
Space heating fuel - main system												13961.4623	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												427.3648	(232)
Total delivered energy for all uses												17046.0598	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	13961.4623	0.2160	3015.6759	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2565.2237	0.2160	554.0883	(264)
Space and water heating			3569.7642	(265)
Space cooling	17.0089	0.5190	8.8276	(266)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	427.3648	0.5190	221.8023	(268)
Total CO2, kg/year			3839.3191	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			34.9300	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER	34.9300	ZC1
Total Floor Area TFA	109.9200	
Assumed number of occupants N	2.8143	
CO2 emission factor in Table 12 for electricity displaced from grid EF	0.5190	
CO2 emissions from appliances, equation (L14)	14.6334	ZC2
CO2 emissions from cooking, equation (L16)	1.6971	ZC3
Total CO2 emissions	51.2605	ZC4
Residual CO2 emissions offset from biofuel CHP	0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year	0.0000	ZC6
Resulting CO2 emisions offset from additional allowable electricity generation	0.0000	ZC7
Net CO2 emissions	51.2605	ZC8

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
Design SAP elmhurst energy

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	109.9200 (1b)	x	3.0400 (2b)	=	334.1568 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.9200				(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	334.1568 (5)	

---

2. Ventilation rate

---

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1197	(8)
Pressure test		Yes	
Measured/design AP50		6.0000	
Infiltration rate		0.4197	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3882	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate													
	0.4950	0.4853	0.4756	0.4270	0.4173	0.3688	0.3688	0.3591	0.3882	0.4173	0.4368	0.4562	(22b)
Effective ac	0.6225	0.6177	0.6131	0.5912	0.5871	0.5680	0.5680	0.5645	0.5754	0.5871	0.5954	0.6040	(25)

---

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.50)			25.4100	1.4151	35.9575			(27)
Curtain Walling	98.4700	25.4100	73.0600	1.8000	131.5080			(29a)
External Wall 2	18.8500		18.8500	0.2300	4.3351			(29a)
Solid Core	3.7000		3.7000	0.3152	1.1662			(29a)
External Roof 1	109.9200		109.9200	0.1300	14.2896			(30)
Total net area of external elements Aum(A, m2)			230.9400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		187.2564			(33)
Party Floor 1			109.9200					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	34.6410	(36)
Total fabric heat loss (33) + (36) =	221.8974	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.6449	68.1204	67.6062	65.1911	64.7392	62.6357	62.6357	62.2462	63.4459	64.7392	65.6533	66.6090	(38)
Heat transfer coeff													
	290.5423	290.0177	289.5036	287.0884	286.6366	284.5331	284.5331	284.1436	285.3433	286.6366	287.5507	288.5063	(39)
Average = Sum(39)m / 12 =												287.0863	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.6432	2.6384	2.6338	2.6118	2.6077	2.5885	2.5885	2.5850	2.5959	2.6077	2.6160	2.6247	(40)
HLP (average)												2.6118	(40)
Days in month													
	31	28	31	30	31	30	31	31	30	31	30	31	(41)

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8143	(42)
Average daily hot water use (litres/day)	101.0407	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	111.1448	107.1031	103.0615	99.0199	94.9782	90.9366	90.9366	94.9782	99.0199	103.0615	107.1031	111.1448	(44)
Energy conte	164.8245	144.1565	148.7566	129.6896	124.4403	107.3825	99.5057	114.1842	115.5479	134.6600	146.9919	159.6237	(45)
Energy content (annual)										Total = Sum(45)m =		1589.7635	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.0252	30.6333	31.6108	27.5590	26.4436	22.8188	21.1450	24.2641	24.5539	28.6152	31.2358	33.9200	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	140.7172	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.1992	21.4935	17.4797	13.2332	9.8920	8.3512	9.0238	11.7295	15.7433	19.9897	23.3310	24.8717	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	271.4410	274.2577	267.1597	252.0489	232.9742	215.0466	203.0699	200.2532	207.3513	222.4621	241.5368	259.4643	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	37.0717	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	-112.5738	(71)
Water heating gains (Table 5)													
	47.0769	45.5852	42.4876	38.2765	35.5424	31.6928	28.4206	32.6131	34.1027	38.4614	43.3830	45.5914	(72)
Total internal gains													
	407.9323	406.5516	392.3422	368.7738	343.6238	320.3058	305.7296	309.8110	322.4124	346.1284	373.4660	395.1427	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.1300	10.6334	0.5000	0.8000	0.7700	29.8589	(74)
South	10.1300	46.7521	0.5000	0.8000	0.7700	131.2815	(78)
West	5.1500	19.6403	0.5000	0.8000	0.7700	28.0380	(80)

Solar gains	189.1785	326.9156	461.1682	597.0256	693.8154	700.2957	670.3412	596.0708	507.7331	364.9104	227.4083	161.3883	(83)
Total gains	597.1107	733.4672	853.5104	965.7994	1037.4392	1020.6015	976.0708	905.8818	830.1455	711.0387	600.8743	556.5310	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	26.2727	26.3202	26.3670	26.5888	26.6307	26.8276	26.8276	26.8644	26.7514	26.6307	26.5460	26.4581	
alpha	2.7515	2.7547	2.7578	2.7726	2.7754	2.7885	2.7885	2.7910	2.7834	2.7754	2.7697	2.7639	
util living area													
	0.9972	0.9949	0.9901	0.9791	0.9542	0.9016	0.8197	0.8531	0.9457	0.9857	0.9955	0.9978	(86)
MIT	18.1408	18.3519	18.7449	19.2941	19.8686	20.3901	20.6941	20.6381	20.1994	19.4605	18.7081	18.1096	(87)
Th 2	18.9390	18.9417	18.9443	18.9567	18.9590	18.9698	18.9698	18.9719	18.9656	18.9590	18.9543	18.9494	(88)
util rest of house													
	0.9961	0.9927	0.9856	0.9675	0.9217	0.8038	0.5898	0.6530	0.8879	0.9756	0.9933	0.9969	(89)
MIT 2	16.4816	16.6938	17.0869	17.6391	18.1998	18.6835	18.9031	18.8775	18.5252	17.8097	17.0581	16.4571	(90)
Living area fraction									fLA = Living area / (4) =			0.3281	(91)
MIT	17.0259	17.2377	17.6308	18.1820	18.7472	19.2433	19.4906	19.4551	19.0744	18.3513	17.5994	16.9992	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.0259	17.2377	17.6308	18.1820	18.7472	19.2433	19.4906	19.4551	19.0744	18.3513	17.5994	16.9992	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9944	0.9899	0.9810	0.9609	0.9167	0.8225	0.6703	0.7203	0.8926	0.9708	0.9908	0.9955	(94)
Useful gains	593.7898	726.0387	837.3160	928.0526	951.0614	839.4190	654.2396	652.5379	740.9938	690.2886	595.3593	553.9993	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	3697.4080	3578.1619	3222.4000	2664.7587	2019.9959	1321.1859	822.4799	868.0880	1419.4166	2221.7941	3019.1081	3692.6526	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	2309.0920	1916.6268	1774.5024	1250.4284	795.2872	0.0000	0.0000	0.0000	0.0000	1139.4401	1745.0991	2335.1580	(98)
Space heating												13265.6340	(98)
Space heating per m2											(98) / (4) =	120.6844	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	2674.6111	2105.5449	2159.4911	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.4512	0.5278	0.4915	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1206.7719	1111.2613	1061.4893	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1303.0507	1248.5727	1168.5157	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	69.3208	102.1597	79.6276	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												251.1081	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	17.3302	25.5399	19.9069	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												62.7770	(107)
Space cooling per m2												0.5711	(108)
Energy for space heating												120.6844	(99)
Energy for space cooling												0.5711	(108)
Total												121.2556	(109)
Dwelling Fabric Energy Efficiency (DFEE)												121.3	(109)

Appendix E

Non- Domestic ***Be Lean*** BRUKL report

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

Office

As built

Date: Fri Jun 21 13:20:33 2019

Administrative information

Building Details

Address: London,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.a.1

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v6.1.0

BRUKL compliance check version: v5.6.a.1

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

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

The building does not comply with England Building Regulations Part L 2013

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	20.9
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	20.9
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	32.9
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 fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the 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	0.28	0.28	01 Ground Floor - Office_W_8
Floor	0.25	0.22	0.22	01 Ground Floor - Office_F_3
Roof	0.25	-	-	"No heat loss roofs"
Windows***, roof windows, and rooflights	2.2	1.3	1.3	01 Ground Floor - Office_G_12
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

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

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	25

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	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Project HVAC

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.04	2.64	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

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

1- Project DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0.005
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
01 Ground Floor - Office	-	-	-	1.4	-	-	-	-	-	0.69	0.5

Shell and core configuration

Zone	Excluded from calculation?
01 Ground Floor - Office	NO

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			
	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
01 Ground Floor - Office	65	-	-	2331

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?
01 Ground Floor - Office	NO (-27%)	NO

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]	250.1	250.1
External area [m^2]	467.6	467.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	25	3
Average conductance [W/K]	185.18	228.15
Average U-value [W/m^2K]	0.4	0.49
Alpha value* [%]	15.12	15.11

* 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 Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: 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	11.71	5.73
Cooling	17.69	11.03
Auxiliary	5.46	2.7
Lighting	24.87	19.79
Hot water	3.68	3.34
Equipment*	42.18	42.18
TOTAL**	**63.42**	**42.58**

* Energy used by equipment does not count towards the total for consumption or 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]	238.81	192.99
Primary energy* [kWh/m^2]	194.71	121.14
Total emissions [kg/m^2]	32.9	20.9

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	119.5	119.4	11.7	17.7	5.5	2.83	1.87	3.04	2.64
	Notional	50.1	142.9	5.7	11	2.7	2.43	3.6	----	----

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 Building Control Body is advised to give particular attention to items whose specifications 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	0.28	01 Ground Floor - Office_W_8
Floor	0.2	0.22	01 Ground Floor - Office_F_3
Roof	0.15	-	"No heat loss roofs"
Windows, roof windows, and rooflights	1.5	1.3	01 Ground Floor - Office_G_12
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

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

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

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	25

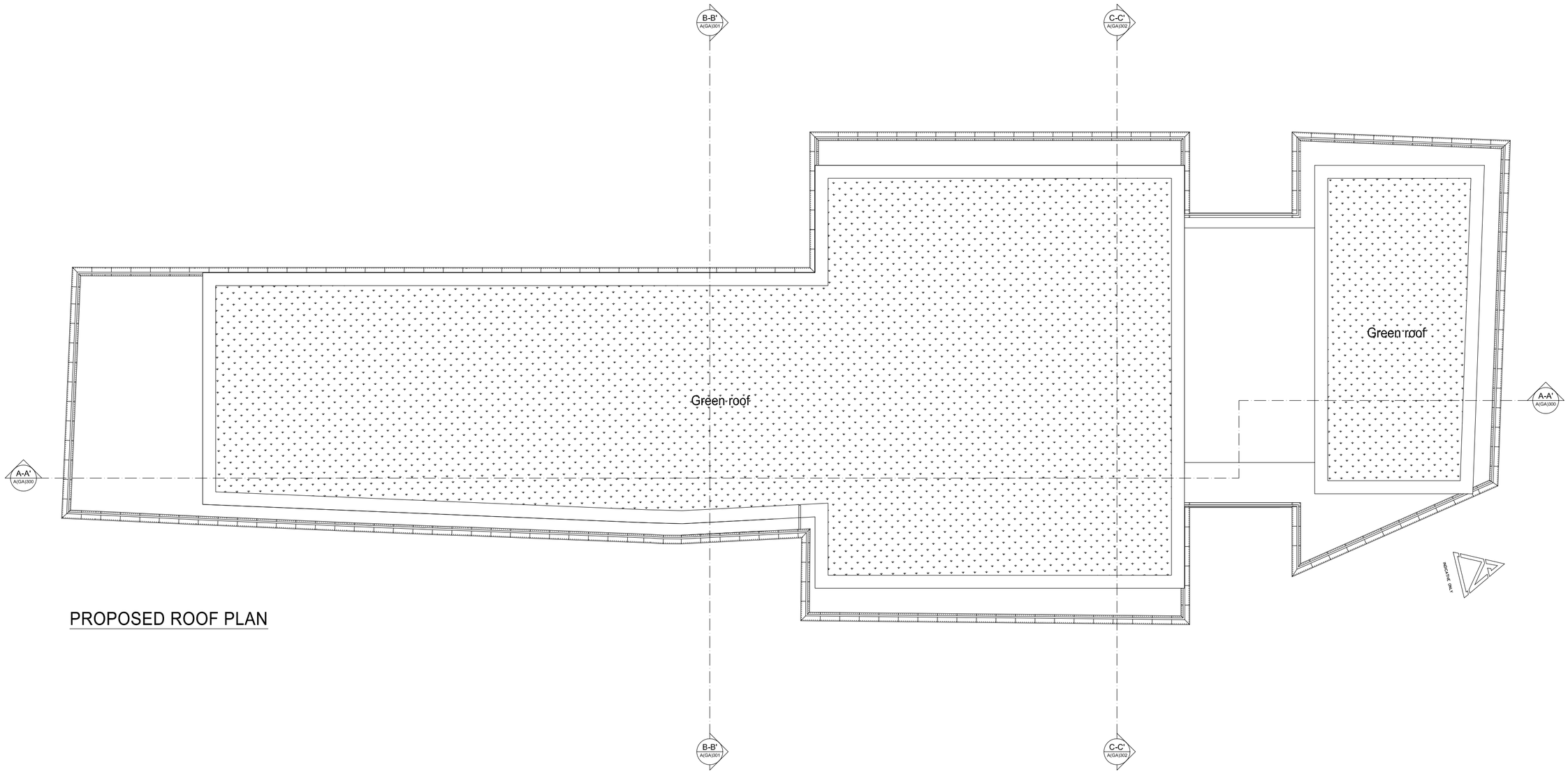
Appendix F
Low and Zero Carbon Technology Feasibility Table

Feasibility Study Table

Technology	Sufficient Energy Generated?	Payback	Land Use Issues	Local Planning Requirements	Noise	Carbon Payback	Available Grants	Feasible?	Reason not Feasible or Selected
Combined Heat & Power (CHP)	Yes	Medium	Air quality in residential area	Encouraged for large scale developments	In Plant Room	Yes	Tax Relief - ECA, RHI	No	No available connection. High maintennce costs increaing resident bills.
Biomass	Yes	None	Air quality in residential area	Encouraged for large scale developments	In Plant Room	Yes	RHI; Bio-energy Capital Grants Scheme	No	Requires distirct heating to be suitable. District heating not suitable due to high costs (as CHP).
Solar Thermal	Yes	High	Sufficient roof space required	Encouraged	None	~2 years	RHI	No	No suitable roof space (green roof instead), technical difficulties for in dwelling use.
Solar Photovoltaic (PV)	Yes	Very High	Sufficient roof space required	Encouraged	None	2-5 years	No	No	No suitable roof space (green roof instead)
Ground Source Heat Pumps (GSHPs)	Yes	High	Requires large area for coils or borehole	Encouraged	None	Low	RHI	No	No suitable space (expensive boreholes required) High resident costs.
Air Source Heat Pumps (ASHPs)	Yes	Very High	Visual intrusion of external units	None	Low	Low	RHI	No	No suitable external space for domestic areas High resident costs.
Wind Power	No	Low	Urban Area - low and turbulent wind; Visual impact	Encouraged for large scale developments	Yes	~1 year	No	No	Wind speeds in area insufficient
Hydro Power	No	Medium	Requires suitable water resource; Visual impact	None	Low	~1 year	No	No	No nearby sources

RHI - Renewable Heat Incentive
FiT - Feed in Tarriff

Appendix G
Roof Plans



PROPOSED ROOF PLAN