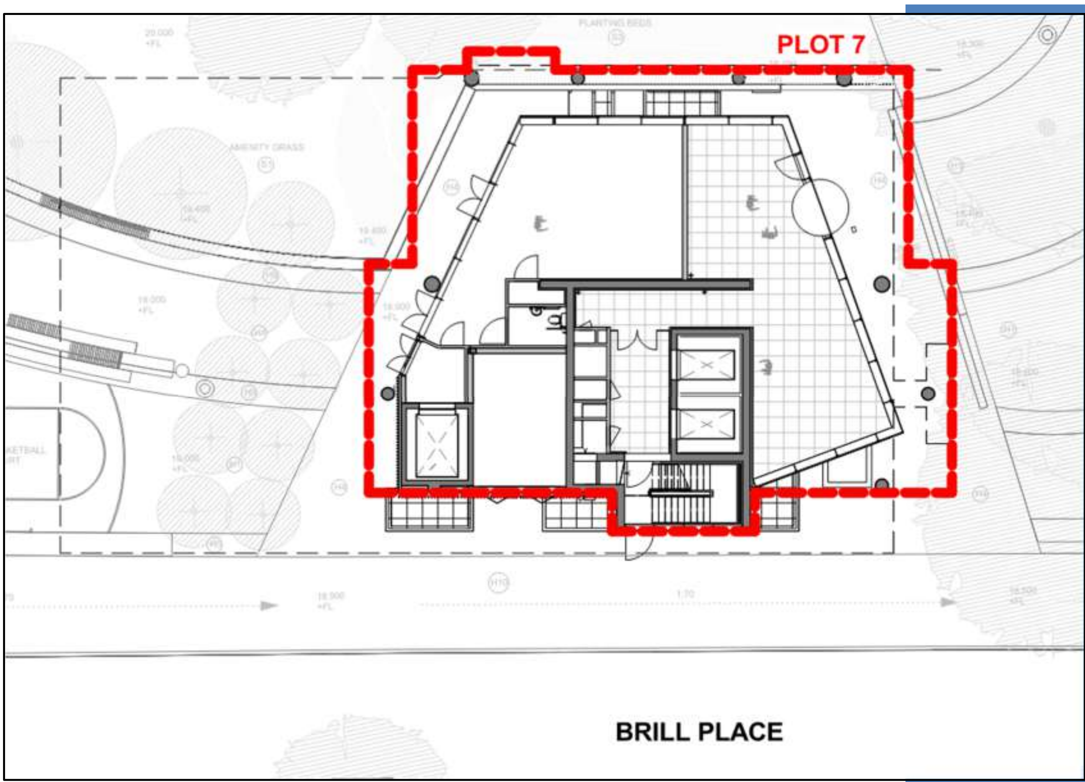
Brill Place, Grand Central

Energy Statement



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23/07/2021	2	Updated Policy Section

Contents

1.0 Executive Summary

This preliminary report considers the predicted energy demand for the proposed development at Brill Place, London.

This document complies with the requirements at both national and local level, as set out in the National Planning Policy Framework (2021), The New London Plan (2021), GLA Energy Assessment Guidance (2018) and the London Borough of Camden Local Plan (Adopted July 2017). This report has been prepared in reference to planning permission ref 2020/4631/P specifically to discharge condition 139.

As of January 2019, the GLAs energy assessment guidance encourages planning applications to utilise the updated (SAP 10) carbon emission factor in order to assess the expected carbon performance of new developments unless the application is connecting to a CHP heating network. Therefore, the following calculations are based on SAP 2012 carbon emission factors.

The energy requirements of the development have been modelled in compliance with Part L of the Building Regulations 2013 and are based on the site layout plans provided by Stiff and Trevillion Architects.

This report includes annualised baseline calculations which predict the likely energy consumption and associated CO_2 emissions for the entire development. The total baseline energy and carbon emissions for the entire development, taking into account regulated energy demands are:

- **364,499.65 kWh/Annum**
- **90.73 Tonnes CO_2/Annum**

Unregulated energy use is not covered by existing regulations and includes energy consumed by the occupants through activities and appliances; in this case it would typically be small power usage (computers, equipment, appliances *etc*.). The following unregulated energy use for the development was calculated:

- **164,631.05 kWh/Annum**
- **82.56 Tonnes CO_2/Annum**

The following energy hierarchy has been adhered to in order to determine the most appropriate strategy for the development:

1. Be Lean, Reduce energy and carbon emissions through the use of passive design and energy efficiency measures;
2. Be Clean, Reduce energy and carbon emissions by investigating the possibility of installing a site wide CHP system or connecting to an existing decentralised Combined Heat and Power (CHP) network;
3. Be Green, Reduce energy and carbon emissions by installing Low or Zero Carbon (LZC) Technologies such as Solar panels, Photovoltaics, Wind Turbines etc.

4. A requirement for all major development to 'be seen' i.e. to monitor and report its energy performance post-construction to ensure that the actual carbon performance of the development is aligned with the Mayor's net zero carbon target. (Be Seen Policy)

Be Lean

In order to initially reduce carbon emissions from a base Part L 2013 compliant development, passive design and energy efficiency measures have been incorporated, such as:

- Additional improvements to the thermal performance of the fabric of the buildings;
- The provision of energy efficient lighting;
- The provision of time and temperature zone controls.

Further examples of the proposed measures to be provided are in Section 7.0 'Passive Design and Energy Efficiency Measures' of this report.

Following the incorporation of the above measures the total baseline energy and carbon emissions for the development, taking into account regulated energy demands, are reduced to:

- **329,468.22 kWh/Annum**
- **86.57 Tonnes CO_2/Annum**

Be Clean

The following two 'be clean' strategies have been considered for the development:

1. Connection to an existing Combined Cooling Heat and Power (CCHP) / Combined Heat and Power (CHP) distribution Networks.

    - There are currently no existing CHP distribution networks available to connect to.

2. A Gas fired site wide CCHP/CHP

    - A site wide CHP heating network is suggested for the development due to the high heating and hot water load due to the fact the development is largely residential. The CHP network will provide 75% of the heating and domestic hot water demand within the development.

Be Green

After analysing the various renewable energy options, it is considered that the most appropriate low or zero carbon (LZC) technology are Air Source Heat Pumps (ASHP) which will provide the heating and cooling demands within the retail unit on the ground floor of the development.

Further details of the feasibility analysis of low or zero carbon technologies are detailed within Section 9.0 'Renewable Energy' of this report.

Following the inclusion of the CHP network and ASHP (Retail unit only), the total baseline energy and carbon emissions for the development, taking into account regulated energy demands have further reduced to:

- **127,500.90 kWh/Annum**
- **39.49 Tonnes CO_2/Annum**

Proposed Energy Strategy for the Brill Place development:

In summary the energy strategy comprises of:

- Passive Design and Energy Efficient Measures (Section 7.0)
- CHP site wide heating network (Section 8.0)
- Air Source Heat Pumps (ASHP in Retail unit only) (Section 9.0)

The strategy takes into consideration the site layout and requirements for the building type to produce a design that incorporates the most appropriate technologies available to the site. This provides a scheme that is commercially viable whilst targeting compliance with all policies applicable to this development. The Energy Strategy consists of passive design and energy efficient measures such as the provision of energy efficient lighting, the provision of time and temperature zone heating controls, and accredited construction details for the development. The use of further/ emerging technologies may be included for use within this development if their feasibility increases in the future, in line with best practice.

The Energy Centre Building Management / Control system shall incorporate the necessary software & interfaces to allow the performance of the Air Source Heat Pumps to be monitored post construction. The software shall obtain both recorded, historical & 'live' data at 5-minute intervals. The system shall allow remote interrogation from each Apartment as well as the BMS.

This review has resulted in the formation of an Energy Strategy to be adopted for the development which involves the use of passive design and energy efficiency measures, and the use of a CHP community heating network as well as ASHP.

The strategy for the residential areas of the development is shown in Table 1.1 below.

Residential Element Energy Strategy	
Heating	On-Site Communal Heating Network via CHP (75% of the annual heating and hot water demand) and high efficiency boilers (25% of the annual heating and hot water demand)
Hot water (DHW)	On-Site Communal Heating Network via CHP (75% of the annual heating and hot water demand) and high efficiency boilers (25% of the annual heating and hot water demand)
Cooling	Central chilled water system (occupied areas only)
Ventilation	Natural Ventilation via openable windows, and MVHR where required
Lighting	Energy efficient LED lighting where applicable

Table 1.1 Proposed Energy Strategy for the residential elements of the development

The strategy for the commercial areas of the development is shown in Table 1.2 below.

Commercial Element Energy Strategy	
Heating	On-Site Communal Heating Network via CHP (75% of the annual heating and hot water demand) and high efficiency boilers (25% of the annual heating and hot water demand)
Hot water (DHW)	On-Site Communal Heating Network via CHP (75% of the annual heating and hot water demand) and high efficiency boilers (25% of the annual heating and hot water demand)
Cooling	Split system Direct Expansion units with high efficiency (Retail unit)
Ventilation	Mechanical ventilation to meet Approved Document Part F requirements
Lighting	Energy efficient LED lighting where applicable

Table 1.2 Proposed Energy Strategy for the commercial elements of the development

Table 1.3 – 1.6, highlight the carbon and energy savings that are currently anticipated for the entire development from a base Part L 2013 compliant build.

Development	Predicted Energy Consumption (kWh/Annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	364,499.65	164,631.05
After Energy Efficient and Passive Measures	329,468.22	-
After CHP + ASHP (Retail unit only)	127,500.90	-

Table 1.3 Predicted Energy Consumption

Development	Regulated Energy Savings	
	kWh/Annum	%
Savings from Passive	35,031.43	9.61%
Savings from CHP + ASHP	201,967.33	55.41%
Total Cumulative Saving	**236,998.76**	**65.02%**

Table 1.4 Regulated Energy Savings

Development	Carbon Dioxide Emissions (Tonnes/Annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	90.73	82.56
After Energy Efficient and Passive Measures	86.57	80.08
After CHP + ASHP (Retail unit only)	39.49	-

Table 1.5 Predicted Carbon Emissions

Development	Regulated Carbon Dioxide Emissions	
	Tonnes/Annum	%
Savings from Passive	4.16	4.58%
Savings from CHP + ASHP	47.08	51.89%
Total Cumulative Saving	**51.24**	**56.47%**

Table 1.6 Regulated Carbon Emissions

The development shall have an anticipated CO_2 improvement of 56.47% beyond Part L 2013, complying with local policy requirements. The energy and carbon calculations for the development, as well as the building rating at each stage (baseline, passive measures, CHP and ASHP), are displayed in full within Appendix A. Furthermore, sample SAP calculations for the residential element are displayed in Appendix E and the SBEM/BRUKL documents for the commercial element are displayed in Appendix D. The development's energy consumption and carbon emissions are shown in Figures 1.1 and 1.2.

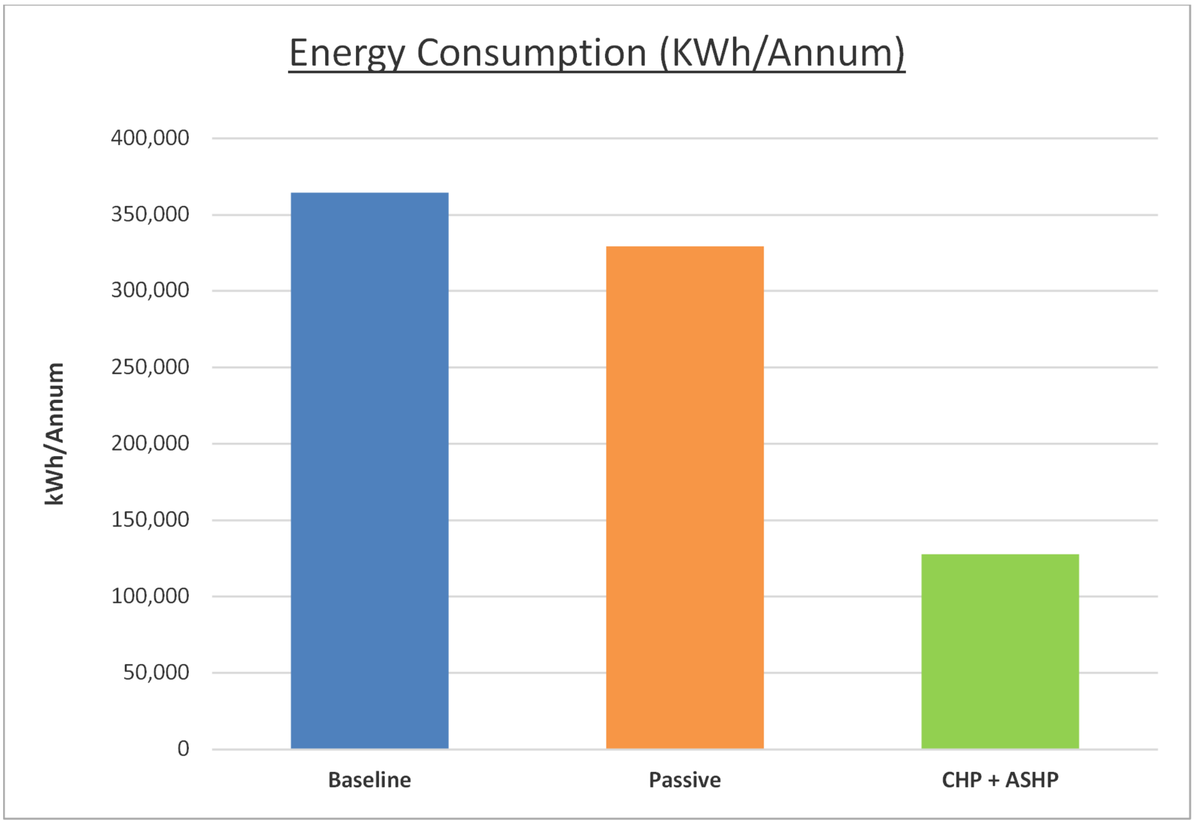


Figure 1.1 Annual Energy Consumption for the development

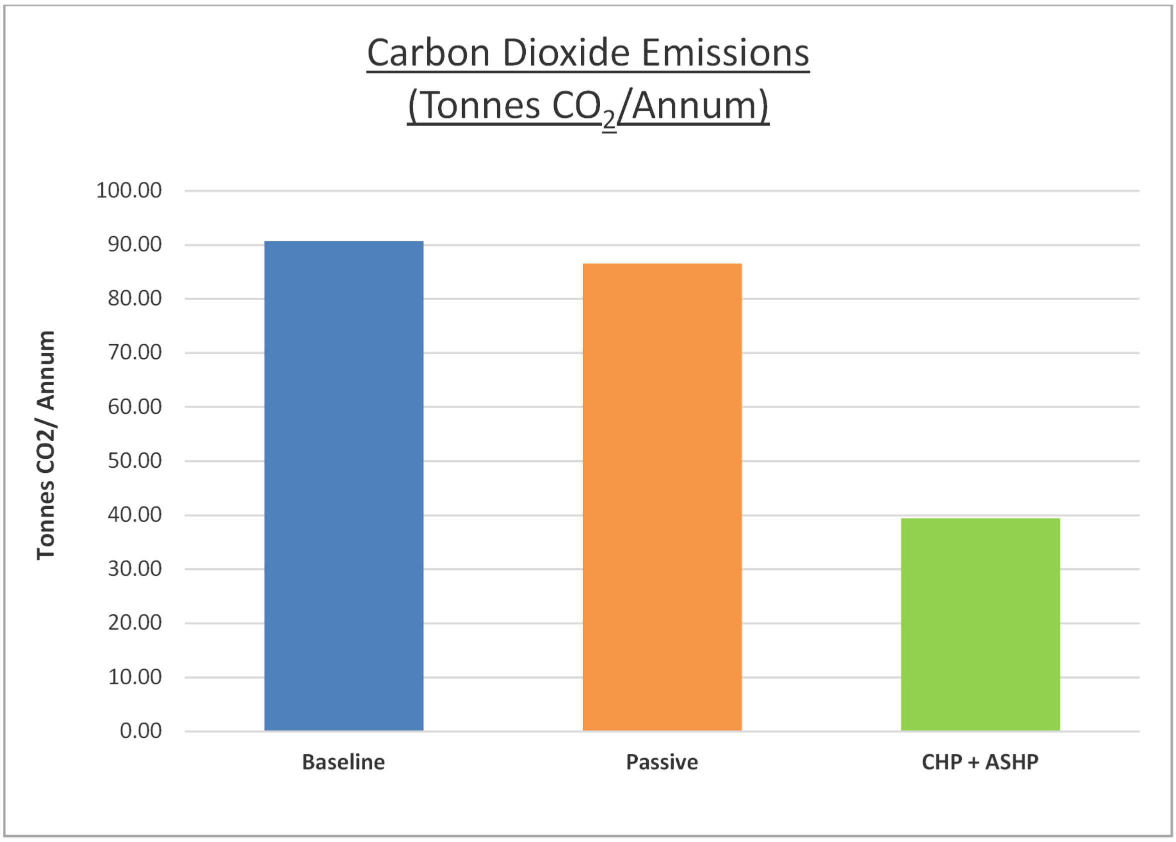


Figure 1.2 Annual Carbon Emissions for the development

2.0 Introduction

This report has been prepared by Cudd Bentley Consulting to develop an energy strategy for the Brill Place development in Camden as part of the planning application.

Government policies now require significant energy reductions from proposed buildings. Building a greener future sets a planned trajectory outlined via Part L 2013 of the Building Regulations. These commitments have been the key focus point in addressing policies and strategies to reduce energy use and carbon emissions through energy efficiency and low or zero carbon technologies (LZC). This report has been prepared in reference to planning permission ref 2020/4631/P specifically to discharge condition 139.

In line with best practice the following approach has been adopted in forming the energy strategy for the development:

1. To propose to improve the building fabric from minimum Part L 2013 Building Regulations requirements; (**BE LEAN**)

2. To propose to reduce energy consumption and carbon dioxide emissions through passive and energy efficiency measures; (**BE LEAN**)

3. Investigate the feasibility of connecting into an existing district heat network and where this is not available investigate the feasibility of providing a central CHP Plant to serve the base heating and hot water requirements for the development; (**BE CLEAN**)

4. To propose to reduce energy consumption and carbon dioxide emissions further through the use of on-site renewable / LZC energy technologies. (**BE GREEN**)

The recommended strategy takes into consideration the site layout and requirements for the building to produce a design that incorporates the most appropriate technologies available to the site that are commercially viable, whilst targeting compliance with all policies applicable to this development.

3.0 Policy Review

3.1 National Planning Policy

An effective planning system is required to contribute to achieving sustainable development. The ***National Planning Policy Framework*** (NPPF), 2021, outlines what the government deems as sustainable development in England.

Sustainable development is defined as having the following three overarching objectives which are interdependent and need to be pursued in mutually supportive ways: an economic objective, a social objective, and an environmental objective.

1. 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;

2. 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

3. 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.

The above objectives can be described as an energy trilemma, this is demonstrated in Figure 3.1 below. Each dimension is dependent on each other and sustainable development proposals should adhere to each role. This energy statement shall ensure the proposed Development is one that contributes economically, socially and environmentally in accordance with the NPPF, 2021.

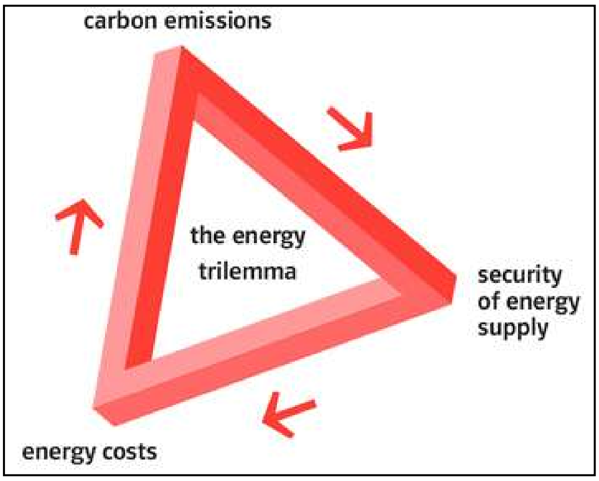


Figure 3.1 The Energy Trilemma

Guidance has been followed from the (NPPF) 2021, to provide an energy strategy which reduces energy use and carbon emissions, in line with best practice. This will provide a balanced scheme which focuses on optimal use of non-renewable resources (energy efficiency measures) whilst providing a renewable energy strategy best suited to the sites and their building uses. Below are some key extracts relevant to the development from Chapter fourteen 'Meeting the Challenge of Climate Change, Flooding & Coastal Change':

Paragraph 153

Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures53. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure.

Paragraph 154

New development should be planned for in ways that:

a. avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and
b. can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

Paragraph 155

To help increase the use and supply of renewable and low carbon energy and heat, plans should:

a. provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);
b. consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and
c. identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

Paragraph 156

Local planning authorities should support community-led initiatives for renewable and low carbon energy, including developments outside areas identified in local plans or other strategic policies that are being taken forward through neighbourhood planning.

Paragraph 157

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

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

3.2 Local Planning Policy

The New London Plan (March 2021)

Policy SI2 Minimising greenhouse gas emissions

A) Major development should be net zero-carbon. This means reducing greenhouse emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:
   1. be lean: use less energy and manage demand during operation.
   2. be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly.
   3. be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site.
   4. be seen: monitor, verify and report energy performance.

B) Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.

C) A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:
   1. through a cash in lieu contribution to the borough's carbon offset fund, or
   2. off-site provided that an alternative proposal is identified and delivery is certain.

D) Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.

E) Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.

F) Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.

Policy SI 3 Energy infrastructure

A) Boroughs and developers should engage at an early stage with relevant energy companies and bodies to establish the future energy and infrastructure requirements arising from large-scale development proposals such as Opportunity Areas, Town Centres, other growth areas or clusters of significant new development.

B) Energy masterplans should be developed for large-scale development locations (such as those outlined in Part A and other opportunities) which establish the most effective energy supply options. Energy masterplans should identify:
   1) major heat loads (including anchor heat loads, with particular reference to sites such as universities, hospitals and social housing)
   2) heat loads from existing buildings that can be connected to future phases of a heat network
   3) major heat supply plant including opportunities to utilise heat from energy from waste plants
   4) secondary heat sources, including both environmental and waste heat
   5) opportunities for low and ambient temperature heat networks
   6) possible land for energy centres and/or energy storage
   7) possible heating and cooling network routes
   8) opportunities for futureproofing utility infrastructure networks to minimise the impact from road works
   9) infrastructure and land requirements for electricity and gas supplies
   10) implementation options for delivering feasible projects, considering issues of procurement, funding and risk, and the role of the public sector
   11) opportunities to maximise renewable electricity generation and incorporate demand-side response measures.

C) Development Plans should:
   1) identify the need for, and suitable sites for, any necessary energy infrastructure requirements including energy centres, energy storage and upgrades to existing infrastructure
   2) identify existing heating and cooling networks, identify proposed locations for future heating and cooling networks and identify opportunities for expanding and inter-connecting existing networks as well as establishing new networks.

D) Major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system:
   1) the heat source for the communal heating system should be selected in accordance with the following heating hierarchy:
      a) connect to local existing or planned heat networks
      b) use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)
      c) use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)
      d) use ultra-low NOx gas boilers
   2) CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements in Part B of Policy SI 1 Improving air quality

3) where a heat network is planned but not yet in existence the development should be designed to allow for the cost-effective connection at a later date.

E) Heat networks should achieve good practice design and specification standards for primary, secondary and tertiary systems comparable to those set out in the CIBSE/ADE Code of Practice CP1 or equivalent.

Be Seen Policy

A requirement for all major development to 'be seen' i.e. to monitor and report its energy performance post-construction to ensure that the actual carbon performance of the development is aligned with the Mayor's net zero carbon target. The process to be followed as part of the 'be seen' post construction monitoring requirement is another critical element of the energy hierarchy that will play an important role in keeping running costs low.

Appropriate quality assurance mechanisms and commitments that should be considered as part of the energy strategy include:

- Gaining quality assurance accreditation (e.g. Heat Trust)
- Following quality standards (e.g. CIBSE Code of Practice)
- Transparent billing, including separation of the ongoing maintenance and capital replacement aspects of the standing charge.
- Aftercare support (e.g. BREEAM Man 05 Aftercare)
- Heat tariffs options given to occupants
- Consumer choice for metering arrangements at no extra cost (e.g. Prepayment Meters (PPM))
- Thermal storage linked to pricing signals and renewable generation

Greater London Authority Sustainable Design and Construction Supplementary Planning Guidance (2014)
2.4 Energy and Carbon Dioxide Emissions

In line with The London Plan Policy 5.2 the following carbon savings are required:
Residential:
• 2013 – 2016 40% improvement beyond 2010 Building Regulations;
• 2016 – 2031 Zero carbon.

Non-domestic:
• 2013 – 2016 40% improvement beyond 2010 Building Regulations;
• 2016 – 2019 As per the Building Regulations requirements;
• 2019 – 2031 Zero carbon.

To avoid complexity and extra costs, the Mayor has adopted a flat carbon dioxide improvement beyond Part L 2013 of 35% for both residential and non-residential developments.

In order to be compliant with SPG minimum standards must be met the core values are as follows:

- Minimising carbon dioxide emissions across the site including the building and services (such as heating and cooling systems).
- Avoiding internal overheating contributing to the urban heat island effect.

- Efficient use of natural resources including water.
- Minimising pollution including noise, air and urban runoff.
- Avoiding impacts from natural hazards such as flooding.
- Ensuring developments are comfortable and secure for residents.
- Securing sustainable procurement of materials.
- Promoting and protecting biodiversity and green infrastructure.

In order to ensure that these values have been met a sustainability checklist has been completed and is attached in Appendix A for reference.

Greater London Authority Guidance on Preparing Energy Assessments as Part of Planning Applications (2018)

From January 2019, planning applicants are encouraged to use updated (SAP 10) carbon emission factors to assess the expected carbon performance of a new development. Applicants should continue to use the current Building Regulations methodology for estimating energy performance against Part L 2013 requirements but with the outputs manually converted for the SAP 10 emission factors.

Greater London Authority guidance on Preparing Energy Assessments as part of Planning Applications (April 2020)

Since January 2019, applicants submitting referable applications have been encouraged to use the SAP 10.0 emission factors in areas where there are no opportunities to connect to existing or planned district heat networks. This approach will remain in place until national government updates building regulations, so that new development better reflects the actual carbon emissions associated with their operation.

To comply with London Plan Policy SI 3, developments in Heat Network Priority Areas (HNPAs) (i.e. areas in London where the heat density is sufficient for heat networks to provide a competitive solution for supplying heat to buildings and consumers) should have a communal low-temperature heating system and should select a heat source in accordance with the following heating hierarchy:

a. connect to local existing or planned heat networks
b. use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)
c. use low-emission combined heat and power (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)
d. use ultra-low NOx gas boilers (CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements in Part B of London Plan Policy SI 1 Improving air quality)

London Borough of Camden Local Plan (Adopted July 2017)
Policy CC1 Climate change mitigation

The Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

We will:

a) promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;
b) require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;
c) ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;
d) support and encourage sensitive energy efficiency improvements to existing buildings;
e) require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and
f) expect all developments to optimise resource efficiency.

For decentralised energy networks, we will promote decentralised energy by:

g) working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;
h) protecting existing decentralised energy networks (e.g. at Gower Street, Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and
i) requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.

To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment.

4.0 Development Approach

This report adopts the following approach to provide compliance with the Local and National Planning Policies:

1. To propose to improve building fabric from minimum Part L (2013) Building Regulations requirements

2. To propose to reduce energy consumption and carbon dioxide emissions through passive and energy efficiency measures

3. Investigate the possibility of connection into existing District Heating / Cooling Networks

4. To propose to reduce energy consumption and carbon dioxide emissions further through the use of on-site renewable / LZC energy technologies.

Table 4.1 below outlines the Part L Building Regulations that the development shall be assessed under:

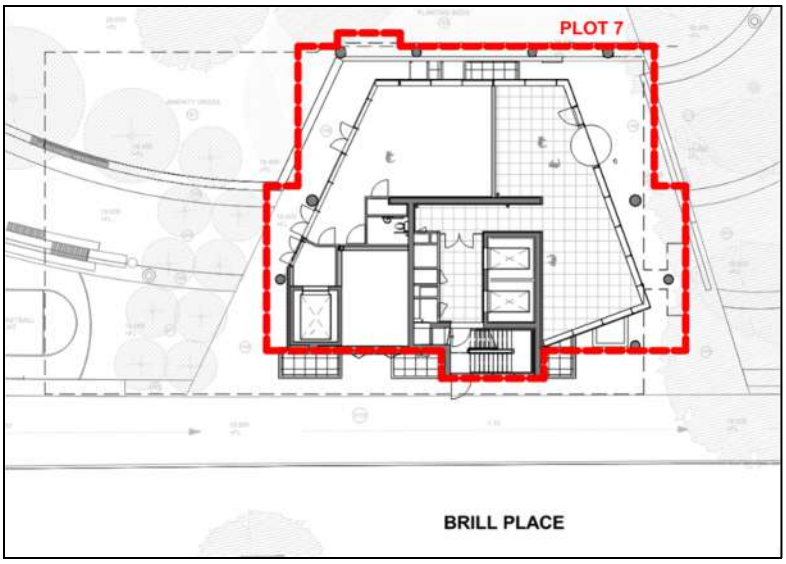
Building Element	Part L Building Regulations Applicable
Residential Element	Part L1A (2013)
Commercial units	Part L2A (2013)

Table 4.1 Part L Building Regulations Applicable

5.0 Details of Proposed Development

The proposed development is located in Camden and consists of a residential block, with one retail unit on the ground floor.

The site area and elevations of the development are shown in Figure 5.1.



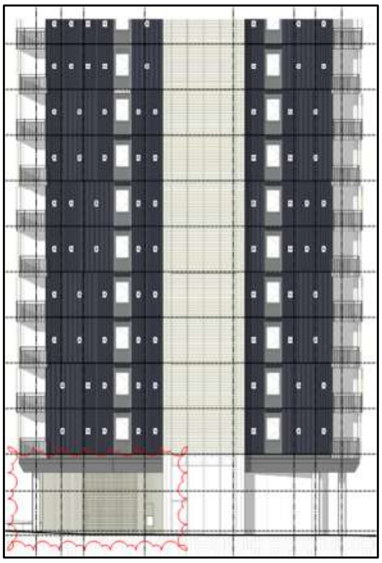


Figure 5.1 Site Area and South Elevation (Lower levels)

6.0 Assessment of Baseline Energy Demand

The primary energy demands of the development will be:

- Heating
- Lighting
- Hot Water
- General Power
- Cooling
- Ventilation

To assess the preliminary energy consumption of the proposed development, calculations have been completed using approved SBEM software (Hevacomp V8i SS1 SP10). The calculations generate annualised energy consumption for the buildings, from which the "carbon footprint" can be assessed.

The assessment of the energy demand for the site has been based on the notional development according to the building's uses, through the construction of a building model in compliance with the requirements of Part L 2013 of the Building Regulations.

The total baseline energy and carbon emissions for the entire development, taking into account regulated energy demands are:

- **364,499.65 kWh/Annum**
- **90.73 Tonnes CO_2/Annum**

(A full set of calculations supporting these figures included in Appendix A of this document)

7.0 Passive Design and Energy Efficient Measures

The 'U' values shown in Table 7.1 shall be targeted within the residential element of the development, in accordance with Part L1A (2013), these 'U' values go beyond the minimum requirements of Part L1A 2013.

Feature	U – Value (W/m².K)	
Curtain Walling	0.54	
Exposed Roofs	0.13	
Glazing	U=0.7	G'=0.4
Air Permeability	3 m³/hr/m²@ 50 Pa	

Table 7.1 U – Values targeted in the residential elements of the development.

Please note that Accredited Construction Details in accordance with Table K1 of Appendix K of Part L are to be achieved in all junctions.

The following 'U' values shall be targeted within the commercial element of the development, in accordance with Part L2A (2013), these 'U' values go beyond the minimum requirements of Part L2A 2013.

Feature	U – Value (W/m².K)	
External Walls	0.26	
Exposed Floors	0.22	
Glazing	U=1.4	G'=0.35
Air Permeability	4 m³/hr/m²@ 50 Pa	

Table 7.2 U – Values targeted in the commercial elements of the development.

In conjunction with the GLAs Energy Assessment Guidance, the domestic element of the development has targeted a 10% carbon emission improvement beyond Part L from passive and energy efficiency measures. Similarly, the non-domestic development has targeted at least a 15% carbon emission improvement beyond Part L from energy efficiency. The total energy and carbon missions taking into account the following energy efficiency and passive measures will be calculated:

- The provision of energy efficient lighting
- Provision of PIR controls and occupancy sensing in relevant areas;
- The provision of zonal thermal and lighting controls;
- Electric power factor correction;
- Provision of MVHR with heat recovery of seasonal efficiency beyond minimum requirements;
- The provision of variable speed pumps and fans;
- The enhancement of pipework and ductwork, thermal insulation;
- Specific Fan Powers improved beyond Part L requirements;
- High performance double glazing with low G values and shading co-efficient to limit the effects of solar gain;
- The provision of time and temperature zone control on HVAC systems.

The commercial space and each residential unit will be able to monitor their energy usage via electrical, heat and water meters. The landlord energy usage will also be monitored to help the landlord reduce their energy usage as well. All major items of plant equipment will be monitored, and the systems will be monitored to enable a minimum of 90% of the energy used in the building to be easily attributed to an end use. Electrical supplies will be metered by smart meters. Heat will be billed and metered as required by the Metering and Billing Regulations 2014.

From the utilisation of the above measures the total energy and carbon emissions for the development (built to Part L 2013) are reduced to:

- **329,468.22 kWh/Annum**
- **86.57 Tonnes CO_2/Annum**

(A full set of calculations supporting these figures included in Appendix A of this document)

7.1 Fabric Energy Efficiency (FEE)

The development's overall Part L Fabric Energy Efficiency (FEE) performance has been considered and calculated for the 'be lean' as compared to the baseline stage of the energy hierarchy, see below in Table 7.3. Note the amount of energy (MWh/annum) which is saved that would be required to maintain comfortable internal temperatures in each dwelling type.

Unit	Area	Quantity	Baseline	Passive	% Improvement	MWh/Annum
			TFEE (kWh/m2 /annum)	DFEE (kWh/m2 /annum)		
1 Bed First Floor	55.1	2	59.54	50.92	14.48	5.61
2 Bed First Floor	71	2	56.34	44.31	21.35	6.29
1 bed Midd Floor	55.1	31	48.09	42.66	11.29	72.87
2 Bed Midd Floor	71	30	45.43	36.33	20.03	77.38
3 Bed Top Floor	135.6	3	45.38	34.67	23.60	14.10

Table 7.3 Fabric Energy Efficiency Performance

7.2 Cooling

In order to prevent and mitigate any potential overheating risks and minimise excessive heat generation contributing to the urban heat island effect, in accordance with Policy 5.9 of the London Plan 2015, the following design strategies have been considered for inclusion within the development following the GLA cooling hierarchy displayed in Table 7.4.

Cooling Hierarchy	Design Strategy
Minimise internal heat generation through energy efficient design.	Energy efficient measures as per the list above in section 7.0.
Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls.	Effective double glazing to be provided with low G values and shading co-efficient to limit the effects of areas with large proportions of glazing. High performance internal blinds optional.
Manage the heat within the building through exposed internal thermal mass and high ceilings.	The majority residential nature of the development limits the feasibility due to the proposed floor levels and heights.
Passive ventilation.	Openable windows.
Mechanical ventilation.	Mechanical ventilation with high efficiency plate heat exchanger heat recovery units are to be installed.
Active cooling systems (ensuring they are the lowest carbon options).	The commercial element will utilise ASHPs for cooling which are considered as low or zero carbon technology.

Table 7.4 Part L Building Regulations Applicable

The actual and notional cooling demand of the commercial units has been calculated via the SBEM modelling software and is displayed below in Table 7.5. Please note, as required by the GLA Energy Planning Guidance (2018), the area weighted average actual cooling demand is less than the area weighted notional cooling demand.

Area Weighted Average Cooling Demand (MJ/m^2)	
	Commercial
Actual	344.6
Notional	410.89

Table 7.5 Non-Domestic Cooling Demand

8.0 Decentralised Energy

Decentralised energy refers to energy that is generated off the main grid, which may include micro-renewables, heating and cooling. It can refer to energy from waste plants, combined heat and power, district heating and cooling, as well as geothermal, biomass or solar energy. Decentralised Energy schemes can serve a single building or a whole community, even being built out across entire cities.

In line with the Draft London Plan, Policy SI3 Energy infrastructure, major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system that adheres to the following:

The heat source for the communal heating system should be selected in accordance with the following heating hierarchy:

1. Connect to local or existing planned heat networks
    a. Use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)
    b. Use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network)
    c. Use ultra-low NOx gas boilers
2. CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements of policy Sl1 (A)
3. Where a heat network is planned but not yet in existence the development should be designed for connection at a later date.

8.1 Existing Community Heating Network

Existing District Heating Networks have been investigated through the UK CHP Development Map which confirms there is no district heating network to which a connection is technically feasible (As shown in Appendix C). Furthermore, as the development has less than 800 dwellings, GLA Energy Assessment Guidance suggests that a connection with an ESCO wide heat network is unlikely to be a feasible option.

8.2 Site Wide Heat Network

The use of CHP and high efficiency boilers is proposed in a communal heat network which will provide heating and hot water for the residential units, and the hot water for the commercial element. A future connection to an external district heating network shall be provided from the plant rooms of each building.

The technical viability of installing a single site wide CHP system has been explored to deliver the heating and hot water demand of the units. It is considered viable for the following reasons:

- A total of 4,000 running hours per year are required in order for the CHP system to be feasible. Based on the building type being residential, there is a high hot water demand throughout the year which is anticipated to require circa 4,368 running hours per year. Thus, the implementation of a CHP unit to provide the heating and hot water demand is viable, shown below in Table 8.1.

Months	Load per Day (hrs)	Load per week (hrs)	Load per month (hrs)	Load for 6 months (hrs)	
April to Sept	10	70	280	1,680	
October to March	16	112	448	2,688	
		Total approximate load for a year (hours)			4,368
		Minimum required hours			4,000

Table 8.1 CHP Analysis

In order to reduce distribution losses, the use of variable flow control systems to lower flow rates and lower return temperatures at part-load is to be investigated and included within the heat loss calculation. At the design stage it is recommended that careful attention is paid to ensure that condensing boilers operate with low return water temperatures, in line with the CIBSE Heat Networks: Code of Practice for the UK.

Please note, details of the district heating network have been taken the from the Hoare Lea report *'REP-2323397-5A-TH-20191122-Part L TM59 Inputs Results-Rev03'* as no details were received from the district heating network provider.

9.0 Renewable Energy

The use of renewable and low or zero carbon (LZC) technologies within the development has been addressed and the following, Table 9.1, reviews the primary options for generation of on-site renewable / LZC energy and considers their suitability for use on the development.

<table>
<tr><th colspan="2">Renewable Technology Feasibility Assessment</th><th>Feasible?</th></tr>
<tr><td>Bio Fuel Boilers
</td><td>Bio-fuel boilers are specifically designed to burn solid biomass or liquid bio-fuel in order to heat water or raise steam. This can then be used for space heating or domestic hot water (DHW) supply.

Bio-fuel boilers are not proposed for use within the development for the following reasons

1. Biomass boilers generate increased Oxides of Nitrogen (NOx) and particulates (PM10) which would affect air quality

2. The requirement of bio-fuel would involve a vehicular movement of articulated lorries fortnightly delivering to the site. As this is a city centre location, this would not be desirable

3. The storage requirements for the biofuel would require a large plant space, with an auxiliary storage facility to allow for a two-week period where delivery of fuel might not be available</td><td rowspan="2">No</td></tr>
<tr><td colspan="2"><u>Land Use</u>

Large volumes of storage are required for fuel at ground level or basement level with sufficient vehicular access for fuel delivered.

<u>Noise</u>

Noise levels are generated by the operation of the bio-fuel boiler and associated deliveries of the bio-fuel. The plant room enclosure would have to be attenuated to acceptable levels imposed by planning and Acoustician recommendations. Delivery schedules would have to be scheduled to minimise potential noise issues.</td></tr>
</table>

<table>
<tr><th colspan="2">Renewable Technology Feasibility Assessment</th><th>Feasible?</th></tr>
<tr><td>Wind Turbines
</td><td>Wind turbines convert the kinetic energy in the wind into mechanical energy which is then converted into electricity. Wind turbines can provide electrical power either directly to a load or via a battery system.

Wind Turbines are not proposed for use within the development for the following reasons:

1. Wind turbines are considered inappropriate on spatial, planning, aesthetic and noise grounds due to the urban location. Noise pollution from commercial wind turbines can be quite significant within a few hundred metres

2. The site is not ideal; an ideal site is a hill with a flat, clear exposure. It should be free from strong turbulence and obstructions like large trees, houses or other buildings. As the building is located in an urban area, other buildings will produce turbulence

3. The financial viability of a small-scale installation on the site would be compromised by the operational efficiency of the units (circa 30%)

4. Wind turbines can cause electrical interference within a 2km radius

5. Wind speeds for the site can be seen in Appendix B, which shows that at 10m the site has a wind speed of 5.0mph. A minimum of 5.5mph is recommended.</td><td rowspan="2">No</td></tr>
<tr><td colspan="2"><u>Land Use</u>

The site plans demonstrate that there is in-sufficient space for the allocation of a suitably sized wind turbine.

<u>Noise</u>

Noise levels are generated by the rotating blades; these noise levels will vary dependent on wind velocity and will need to be in acceptable levels imposed by planning and Acoustician recommendations.</td></tr>
</table>

Renewable Technology Feasibility Assessment		Feasible?
Ground Source Heat Pumps 	Space cooling and heating can be provided by circulating water cooled or heated directly by the ground or via subterranean water. Ground water cooling and heating through the use of aquifers makes use of the relatively stable ground/ water temperature which is available at a temperature range of 10 – 14ºC. The use of Ground Source Heat Pumps is not recommended for this development for the following reasons: 1. Cost of boreholes may be prohibitive (subject to site geological conditions). 2. Favourable ground conditions may not exist. 3. Problems can arise with boreholes silting up (open-loop). Changes in local ground conditions could affect water quality and the amount that can be extracted (open-loop).	No
Land Use This installation would require Environment Agency approval. Ground and Hydrology analysis would be required to investigate if favourable conditions exist.		
Solar Water Heating 	Solar Water Heating systems use radiant energy from the sun to heat water. Systems comprise of a roof mounted heat collector piped to a coil located within a hot water storage cylinder. Solar Panels are not proposed for use within the proposed development for the following reasons: 1. Heating and hot water demand to be provided via CHP	No
Land Use Roof space is required for the installation of solar panels; optimum installation is south facing at an angle of 30 degrees. Noise Noise levels are generated by pumps at roof level, these are insignificant so should pose no issues.		

<table>
<tr><th colspan="2">Renewable Technology Feasibility Assessment</th><th>Feasible?</th></tr>
<tr><td>Air Source Heat Pumps
</td><td>An Air Source Heat Pump extracts heat from the outside air in the same way that a fridge extracts heat from its inside. It can extract heat from the air even when the outside temperature is as low as minus 15°C.

Air Source Heat Pumps (ASHP) are proposed for use within the development to meet the heating and cooling demand in the commercial element of the development.</td><td rowspan="2">Yes</td></tr>
<tr><td colspan="2"><u>Land Use</u>
Air Source Heat Pumps can be installed on ground mounted, roof mounted or wall mounted frames. When installing Air Source Heat Pumps there are various factors to consider; Heat Pumps should be positioned to provide shelter from high winds which can reduce efficiency by causing defrost problems and be kept free from leaves and debris.

<u>Noise</u>
Noise levels are generated by fans, and compressors causing vibrations. The noise levels are dependent on manufacturer and vary accordingly, these will need to be in acceptable levels imposed by planning and Acoustician recommendations.</td></tr>
<tr><td>Photovoltaics
</td><td>Photovoltaic (PV) modules convert sunlight directly to DC electricity. The solar cells consist of a thin piece of semiconductor material, in most cases silicon.

Photovoltaics will not be used on this development due to there being no safe access available, as the 21st floor is where the BMU is situated for faced cleaning and maintenance. There is also not enough significant space left to offset energy in a meaningful way.</td><td rowspan="2">No</td></tr>
<tr><td colspan="2"><u>Land Use</u>
There are no land issues or adverse visual impacts as the solar panels are roof mounted.

<u>Noise</u>
There are no noise issues generated by this technology.</td></tr>
</table>

Table 9.1 Renewable Technology Feasibility Assessment

Following the inclusion of the CHP network and ASHP (Retail unit only), the total baseline energy and carbon emissions for the entire development, taking into account regulated energy demands, have further reduced to:

- **127,500.90 kWh/Annum**
- **39.49 Tonnes CO_2/Annum**

(A full set of calculations supporting these figures included in Appendix A of this document)

9.1 Be Seen

The 'be seen' reporting spreadsheet will be completed by developer during detailed design stage. Also, the be seen report will be completed by developer at in-use stage, the development will be designed to enable post construction monitoring. All relevant reports will be submitted to the GLA along with any other relevant material. The guidance from ''GLA_energy_assessment_guidance_april_2020'' will be utilised.

10.0 Summary of Proposed Scheme

Consideration has been given in Sections 8.0 and 9.0, of this document, to the options that are available for the development in relation to passive measures, Low Zero Carbon technologies and renewable energy technologies. The technologies considered are as follows:

- Biofuel Boilers
- Wind Turbines
- Ground Source Heat Pumps
- Solar Water Heating
- Air Source Heat Pumps
- Photovoltaics

This review has resulted in the formulation of the following energy strategy displayed in Tables 10.1.

Residential Element Energy Strategy	
Heating	On-Site Communal Heating Network via CHP (75% of the annual heating and hot water demand) and high efficiency boilers (25% of the annual heating and hot water demand)
Hot water (DHW)	On-Site Communal Heating Network via CHP (75% of the annual heating and hot water demand) and high efficiency boilers (25% of the annual heating and hot water demand)
Cooling	Central chilled water system (occupied areas only)
Ventilation	Natural Ventilation via openable windows, and MVHR where required
Lighting	Energy efficient LED lighting where applicable

Table 10.1 Proposed Energy Strategy for Residential Element

Commercial Element Energy Strategy	
Heating	On-Site Communal Heating Network via CHP (75% of the annual heating and hot water demand) and high efficiency boilers (25% of the annual heating and hot water demand)
Hot water (DHW)	On-Site Communal Heating Network via CHP (75% of the annual heating and hot water demand) and high efficiency boilers (25% of the annual heating and hot water demand)
Cooling	Split system Direct Expansion units with high efficiency
Ventilation	Mechanical ventilation to meet Approved Document Part F requirements
Lighting	Energy efficient LED lighting where applicable

Table 10.2 Proposed Energy Strategy for Commercial Element

The following Tables 10.3 to 10.8 highlight the carbon emissions and savings that are currently anticipated for the development from a base Part L 2013 compliant build. Based on the analysis within this report, it is confirmed that the development achieves Part L 2013 compliance and with the local planning requirements.

Commercial Element

For Commercial	Carbon Dioxide Emissions (Tonnes/Annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	11.14	2.35
After Energy Efficient and Passive Measures	10.8	2.27
After CHP + ASHP (Retail unit only)	8.00	-

Table 10.3 Carbon Dioxide Emissions of Commercial Element

For Commercial	Regulated Carbon Dioxide Emissions	
	Tonnes/Annum	%
Savings from Passive	0.34	3.06%
Savings from CHP + ASHP	2.8	25.13%
Total Cumulative Saving	**3.14**	**28.19%**
Total Target Savings	11.14	100%
Annual Surplus	-8.00	-71.81%

Table 10.4 Regulated Carbon Savings of Commercial Element

Residential Element

For Residential	Carbon Dioxide Emissions (Tonnes/Annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	79.59	80.21
After Energy Efficient and Passive Measures	75.78	77.8
After CHP + ASHP (Retail unit only)	31.49	-

Table 10.5 Carbon Dioxide Emissions of Residential Element

For Residential	Regulated Carbon Dioxide Emissions	
	Tonnes/Annum	%
Savings from Passive	3.81	4.79%
Savings from CHP + ASHP	44.29	55.65%
Total Cumulative Saving	**48.1**	**60.43%**
Total Target Savings	79.59	100%
Annual Surplus	-31.49	-39.57%

Table 10.6 Regulated Carbon Savings of Residential Element

Development

Development	Carbon Dioxide Emissions (Tonnes/Annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	90.73	82.56
After Energy Efficient and Passive Measures	86.57	80.08
After CHP + ASHP (Retail unit only)	39.49	-

Table 10.7 Carbon Dioxide Emissions of Development

Development	Regulated Carbon Dioxide Emissions	
	Tonnes/Annum	%
Savings from Passive	4.16	4.58%
Savings from CHP + ASHP	47.08	51.89%
Total Cumulative Saving	**51.24**	**56.47%**

Table 10.8 Regulated Carbon Savings of Development

The development shall have an anticipated CO_2 improvement of 56.47% beyond Part L 2013, complying with local policy requirements. The energy and carbon calculations for the development, as well as the building rating at each stage (baseline, passive measures, CHP and ASHP), are displayed in full within Appendix A. Furthermore, sample SAP calculations for the residential element are displayed in Appendix F and the SBEM/BRUKL documents for the commercial element are displayed in Appendix E. The energy and carbon savings achieved are visually represented in the figures 10.1 and 10.2 below:

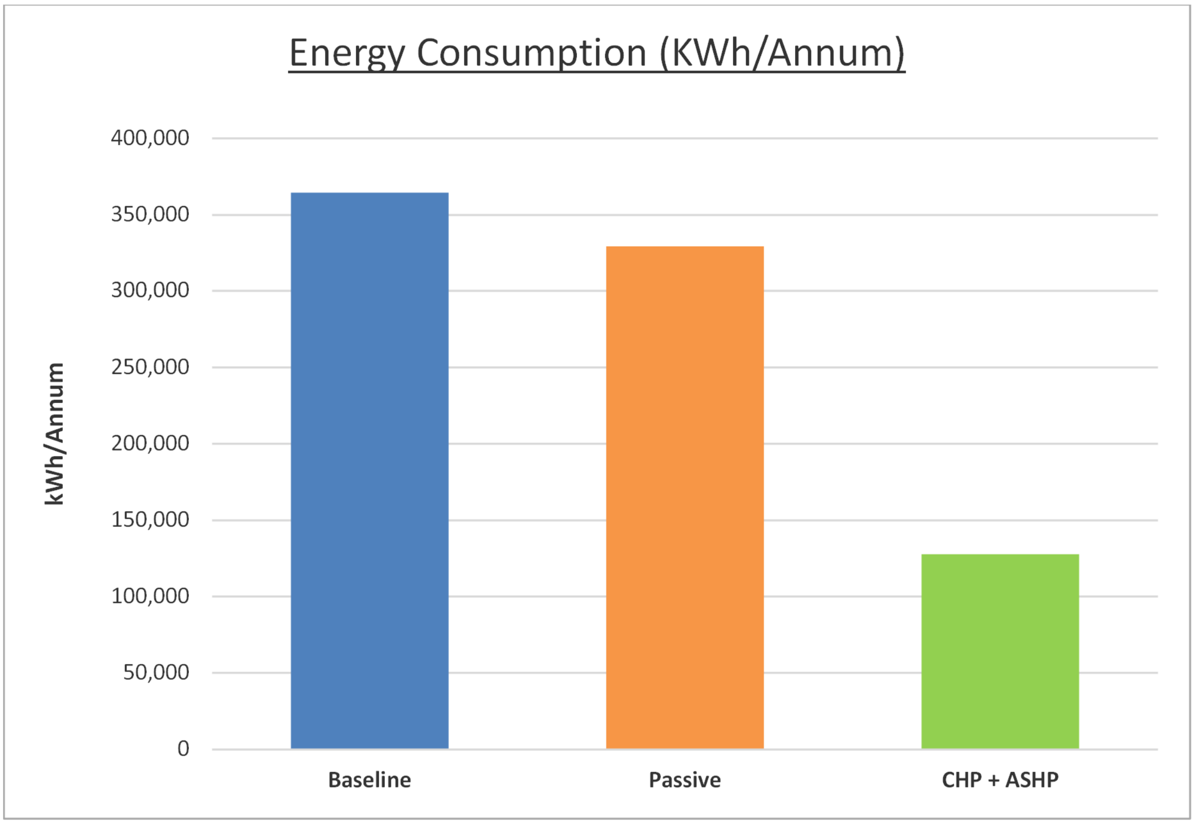


Figure 10.1 Annual Energy Consumption for the development

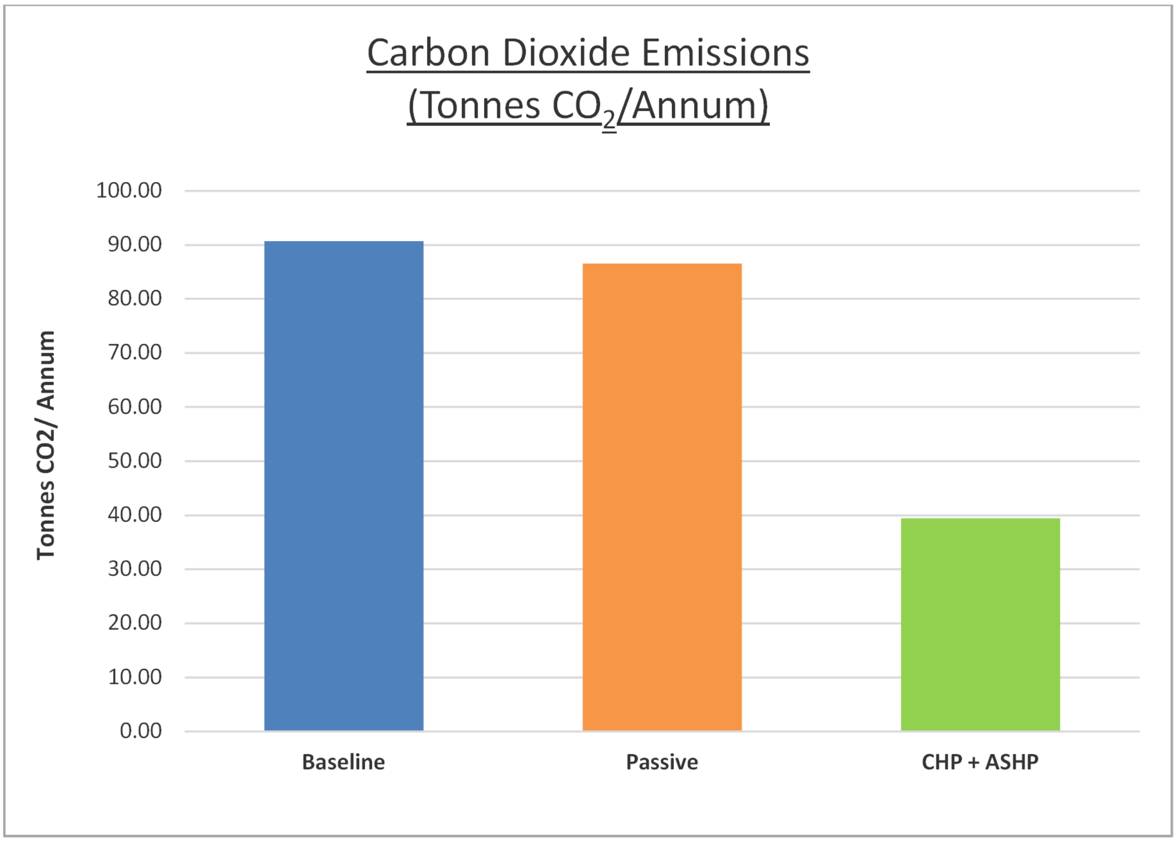


Figure 10.2 Annual Carbon Emissions for the development

10.1 SAP 10 Carbon Factor Consideration

The latest GLA guidance (April 2020) states that it is expected that SAP 10 emission factors will be used for referable applications unless the application:

- Is in a Heat Network Priority Area; and
- There is potential to connect to an existing network using gas-engine CHP or a new network using low-emission CHP.

As this development is connecting to a communal CHP heating network there is no requirement to convert the carbon emissions from SAP 2012 to SAP 10 in accordance with GLA guidance. Therefore the figures stated previously within this report remain unchanged from SAP 2012.

10.2 Carbon Cash-in-Lieu Contribution

As a result of the zero-carbon target having not been achieved in line with The London Plan Policy 5.2E, the cash in lieu contribution requirement has been calculated and displayed below in Table 10.11. Assuming a carbon off-set price of £95 per tonne of carbon dioxide for a period of 30 years, the contribution for offsite renewable solutions is displayed below in Table 10.9.

Development Element	Annual Shortfall Tonnes CO2 per Annum	Carbon Off-set Contribution (£)
Residential	31.49	89,746.50
Commercial	8.00	22,800.00
Total	**39.49**	**112,546.50**

Table 10.9 Calculated Carbon Shortfall and Cash in Lieu Contribution

Cudd Bentley Consulting

Appendix A – Energy Calculations

Residential - Baseline

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated TER 2012 (kgCO2 / m2)	VALIDATION CHECK: TER Worksheet TER 2012 (kgCO2 / m2)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - TER WORKSHEET: Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling	REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.): Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)	REGULATED CO2 EMISSIONS PER UNIT: Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated TER SAP10 (kgCO2 / m2)	Fabric Energy Efficiency: Target Fabric Energy Efficiency
	TER Worksheet (Row 4)				TER Worksheet (Row 273)	TER Worksheet (Row 211)		TER Worksheet (Row 219)		TER Worksheet (Row 232)	TER Worksheet (Row 231)	N / A														
1 Bed First I	55.14	2	110.28	21.3	21.3	2528.3095	Natural Gas	2109.3553	Natural Gas	252.769	75		546	456	131	39		1,172	531	443	59	17		1,050	19.0	59.54
2 Bed First I	71	2	142	19.3	19.3	3097.8595	Natural Gas	2295.6618	Natural Gas	314.2671	75		669	496	163	39		1,367	651	482	73	17		1,223	17.2	56.34
1 bed Midd I	55.1	31	1708.1	19.0	19.0	1959.7748	Natural Gas	2133.2	Natural Gas	252.769	75		419	459	131	39		1,048	407	446	59	17		930	16.9	48.09
2 Bed Midd	71	30	2130	17.1	17.1	2562.1645	Natural Gas	2509.3927	Natural Gas	314.2671	75		515	499	163	39		1,216	500	485	73	17		1,076	15.2	45.43
3 Bed Top F	135.6	3	406.8	13.8	13.8	4731.1259	Natural Gas	2573.4557	Natural Gas	479.3443	75		1,022	556	249	39		1,865	994	540	112	17		1,663	12.3	45.38
																										0
Sum	4,497	68	4,497	17.7	-	157,044	N/A	151,651	N/A	19,837	5,100	0	33,922	32,757	10,295	2,647	0	73,620	32,979	31,847	4,622	1,188	0	70,636	15.7	47.13

Brill Place, Grand Central

Residential – Be Lean

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK		GULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE LEAN' SAP DER WORKSHE							REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.)						REGULATED CO2 EMISSIONS PER UNIT							Fabric Energy	EGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh p.				
				Calculated DER 2012 (kgCO2 / m2)	DER Worksheet DER 2012 (kgCO2 /	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)	Space Heating CO2 emissions	Domestic Hot Water CO2 emissions	Lighting CO2 emissions (kgCO2	Auxiliary CO2 emissions (kgCO2	Cooling CO2 emissions (kgCO2	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)	Dwelling Fabric Energy Efficiency	Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
					DER Sheet (Row 384)	DER Sheet [(Row 307a) + (Row 367a	Select fuel type	DER Sheet [(Row 310a) + (Row 367a	Select fuel type	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315																			
1 Bed First F	55.14	2	110.28	21.0	21.0	1965.6477	Natural Gas	2268.9687	Natural Gas	252.769	160.9679	59.1331	425	490	131	84	31	1,160	413	476	59	38	14	939	18.1	50.32	1965.6477	2268.9687	252.769	160.9679	59
2 Bed First I	71	2	142	17.8	17.8	2005.0525	Natural Gas	2462.6107	Natural Gas	314.2871	198.3041	63.6489	433	532	163	103	33	1,264	421	517	73	46	15	1,072	15.1	44.31	2005.0525	2462.6107	314.2871	198.3041	64
1 bed Midd I	55.1	31	1708.1	18.9	18.9	1430.1095	Natural Gas	2268.9687	Natural Gas	252.769	156.0035	64.7971	307	490	131	81	34	1,043	298	476	59	36	15	885	16.1	42.66	1430.1095	2268.9687	252.769	156.0035	65
2 Bed Midd	71	30	2130	15.8	15.8	1341.0889	Natural Gas	2462.6107	Natural Gas	314.2871	192.2621	70.3904	290	532	163	100	37	1,121	282	517	73	45	16	933	13.1	36.33	1341.0889	2462.6107	314.2871	192.2621	70
3 Bed Top F	135.6	3	406.8	12.3	12.3	2561.3669	Natural Gas	2750.9011	Natural Gas	479.3443	312.5465	209.5965	553	594	249	162	109	1,667	538	578	112	73	49	1,349	9.9	34.67	2561.3669	2750.9011	479.3443	312.5465	210
Sum	4,497	68	4,497	16.9	-	39,882	N/A	161,932	N/A	19,837	12,260	4,995	21,574	34,977	10,295	6,363	2,592	75,882	20,975	34,006	4,622	2,857	1,164	63,623	14.1	39.19	39,882	161,932	19,837	12,260	4,995

Brill Place, Grand Central

Residential – Be Green

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated DER 2012 (kgCO2 / m2)	VALIDATION CHECK: DER Worksheet DER 2012 (kgCO2 / m2)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE GREEN' SAP DER WORKSHEET: Space Heating (Heat Source 1)	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water
					DER Sheet (Row 384)	DER Sheet (Row 307b + (Row 367b	Select fuel type	DER Sheet (Row 310b + (Row 367b x 0.01))	Select fuel type
1 Bed First I	55.10	2	110.20	8.1	8.1	[illegible]	Natural Gas	[illegible]	Natural Gas
2 Bed First I	71	2	142	7.2	7.2	[illegible]	Natural Gas	[illegible]	Natural Gas
1 bed Midd I	55.1	31	[illegible]	7.6	7.6	[illegible]	Natural Gas	[illegible]	Natural Gas
2 Bed Midd	71	30	2130	6.7	6.1	[illegible]	Natural Gas	[illegible]	Natural Gas
3 Bed Top F	135.6	3	406.8	5.3	5.7	[illegible]	Natural Gas	[illegible]	Natural Gas
Sum	4,437	68	4,437	7.0	-	25,461	N/A	33,229	N/A

Unit identifier	Space Heating (Heat Source 2) if applicable	Fuel type Space Heating	Domestic Hot Water (Heat Source 2) if applicable	Fuel type Domestic Hot Water	Space and Domestic Hot Water (CHP) if applicable	Fuel type CHP if applicable	Total Electricity generated by CHP if applicable	Electricity generated by ...	Lighting	Auxiliary	Cooling
	DER Sheet (Row 307c + (Row 367c	Select fuel type	DER Sheet (Row 310c + (Row 367c x 0.01))	Select fuel type	DER Sheet ((Row 307e + 310e) + (Row 362 x	Select fuel type	DER Sheet ((Row 307e + 310e) + (Row 361 +	DER Sheet Row 380	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315
1 Bed First I	0	Natural Gas	0	Natural Gas	[illegible]	Natural Gas	[illegible]	0	252.768	[illegible]	[illegible]
2 Bed First I	0	Natural Gas	0	Natural Gas	[illegible]	Natural Gas	[illegible]	0	[illegible]	[illegible]	[illegible]
1 bed Midd I	0	Natural Gas	0	Natural Gas	[illegible]	Natural Gas	[illegible]	0	252.768	[illegible]	[illegible]
2 Bed Midd	0	Natural Gas	0	Natural Gas	[illegible]	Natural Gas	[illegible]	0	[illegible]	[illegible]	[illegible]
3 Bed Top F	0	Natural Gas	0	Natural Gas	[illegible]	Natural Gas	[illegible]	0	[illegible]	[illegible]	[illegible]
Sum	0	N/A	0	N/A	356,035	N/A	-1,001,861	0	13,637	11,373	4,832

Unit identifier	REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.): Space Heating	Domestic Hot Water	Space Heating and DHW if applicable	Electricity generated by CHP if applicable	Electricity generated by ... if applicable	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)
1 Bed First I	107	100	1,255	-1,259	0	131	81	29	445
2 Bed First I	109	110	1,323	-1,333	0	163	101	32	511
1 bed Midd I	78	100	1,080	-1,083	0	131	79	32	417
2 Bed Midd	74	110	1,116	-1,119	0	163	98	35	477
3 Bed Top F	138	125	1,594	-1,598	0	243	160	107	774
Sum	5,300	7,177	76,316	-77,161	0	10,295	6,217	2,508	31,472

Unit identifier	REGULATED CO2 EMISSIONS PER UNIT: Space Heating	Domestic Hot Water	Space Heating and DHW if applicable	Electricity generated by CHP if applicable	Electricity generated by ... if applicable	Lighting	Auxiliary	Cooling	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)
1 Bed First I	104	97	1,220	-565	0	55	37	13	365	17.5
2 Bed First I	106	107	1,232	-599	0	73	45	14	1,040	14.6
1 bed Midd I	76	97	1,050	-486	0	55	35	15	846	15.3
2 Bed Midd	72	107	1,085	-503	0	73	44	16	834	12.6
3 Bed Top F	134	121	1,549	-718	0	112	72	48	1,319	3.7
Sum	5,341	6,978	74,180	-34,632	0	4,622	2,791	1,126	61,612	13.6

Brill Place, Grand Central

Cudd Bentley Consulting

Commercial - Baseline

Building Use	Area per unit (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated TER 2012 (kgCO2 / m2)	BRUKL TER 2012 (kgCO2 / m2)	REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) TER - SOURCE: BRUKL OUTPUT: Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) TER - SOURCE: BRUKL.INP: Natural Gas	Grid Electricity				2012 CO2 emissions (kgCO2 p.a.)	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) - TER BRUKL: Natural Gas	Grid Electricity				REGULATED CO2 EMISSIONS: SAP10 CO2 emissions (kgCO2 p.a.)	BRUKL TER SAP10 (kgCO2 / m2)
													#########	#########					#########	#########					
Retail Unit	76	1	76	79.7	79.7	28.81	Natural Gas	118.07	Natural Gas	38.91	17.97	26.57	132	99				6,054	132	99				3,849	50.6
Residential L	76.4	1	76.4	66.5	66.5	79.59	Natural Gas	0.69	Natural Gas	40.2	35.14	19.29	80	95				5,077	80	95				2,973	38.9
Sum	152	2	152	73.0	-	8,270	8,270	0	0	0	0	0	212	193	N/A	N/A	N/A	11,131	212	193	N/A	N/A	N/A	6,821	44.8

Commercial – Be Lean

Building Use	Area per unit (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL OUTPUT: Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)	CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL.INP: Natural Gas	Grid Electricity				2012 CO2 emissions (kgCO2 p.a.)	REGULATED CO2 EMISSIONS PER UNIT: Natural Gas	Grid Electricity				SAP10 CO2 emissions (kgCO2	BRUKL BER SAP10 (kgCO2 / m2)		REGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh p.a.): Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
													########	########					########	########											
Retail Unit	76	1	76	77.5	77.5	28.81	Grid Electricity	118.07	Natural Gas	26.97	17.97	26.57	135	93				5,892	135	93				3,800	50.1	N/A	2,190	1,973	2,010	1,366	2,019
Residential L	76.4	1	76.4	64.2	64.2	79.42	Natural Gas	0.69	Natural Gas	38.11	35.14	19.29	75	93				4,902	75	93				2,846	37.3		6,033	53	2,912	2,605	1,473
Sum	152	2	152	70.8	-	8,273	N/A	9,026	N/A	5,721	4,050	3,492	210	186	N/A	N/A	N/A	10,794	210	186				6,654	43.7		8,273	9,026	5,721	4,050	3,492

Cudd Bentley Consulting

Commercial – Be Green

Use	Area per unit (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated BER 2012 (kgCO2 / m2)	VALIDATION CHECK: BRUKL BER 2012 (kgCO2 / m2)
Retail Unit	76	1	76	53.9	53.9
Residential I	76.4	1	76.4	51.1	51.1
Sum	152	2	152	52.5	-

Use	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water							Electricity generated by CHP (-)	Electricity generated by renewable technology (-)	Lighting	Auxiliary	Cooling
REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE GREEN' BER - SOURCE: BRUKL OUTPUT											if applicable	if			
Retail Unit	[illegible]	Grid Electricity	[illegible]	Natural Gas	N/A	N/A	N/A	N/A	N/A	N/A	-84.04		36.37	17.37	24.16
Residential I	132.04	Natural Gas	1.25	Natural Gas							-47.26		38.11	25.14	19.28
Sum	12,786	N/A	16,256	N/A							-3,999	0	5,721	4,050	3,309

Use	Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-)	Electricity generated by renewable technology (-)	Enter Carbon Factor 1	Enter Carbon Factor 2	Enter Carbon Factor 3	2012 CO2 emissions (kgCO2 p.a.)
...TED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE GREEN' BER - SOURCE: BRUKL.INP or "SIM.C...	#######	#######	#######	#######	#######	#######	#######	#######	
Retail Unit	255	88			-84.04				4,899
Residential I	128	93			-47				3,907
Sum	367	181	0	0	-131	0	0	0	8,866

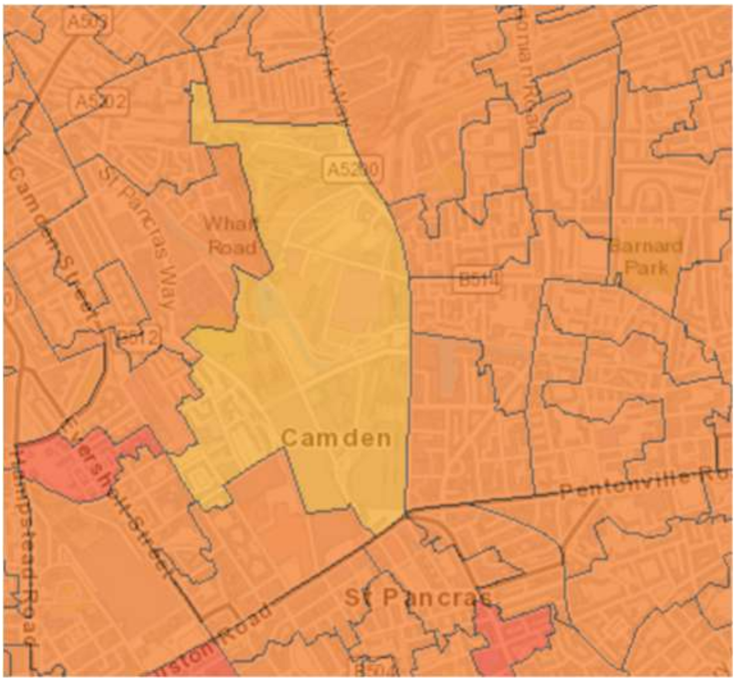
Use	Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-)	Electricity generated by renewable technology (-)	Enter Carbon Factor 1	Enter Carbon Factor 2	Enter Carbon Factor 3	SAP10 CO2 emissions	BRUKL BER SAP10 (kgCO2 / m2)
REGULATED CO2 EMISSIONS PER UNIT	#######	#######	#######	#######	#######	#######	#######	#######		
Retail Unit	255	88			-84				3,897	51.3
Residential I	128	93			-47				2,859	37.4
Sum	367	181	0	0	-131	0	0	0	6,756	44.3

Brill Place, Grand Central

Appendix B –Wind Data

Wind Data Taken from RENSmart Wind Map

Appendix C – CHP Availability



Sector Name	Share	Total MWh
Communications and Transport	0.86%	62 MWh
Commercial Offices	3.41%	245 MWh
Domestic	87.89%	6,332 MWh
Education	2.83%	204 MWh
Government Buildings	0%	0 MWh
Hotels	1.57%	113 MWh
Large Industrial	0%	0 MWh
Health	0%	0 MWh
Other	0.13%	9 MWh
Small Industrial	0.02%	1 MWh
Prisons	0%	0 MWh
Retail	3.3%	238 MWh
Sport and Leisure	0%	0 MWh
Warehouses	0.01%	1 MWh
District Heating	0%	0 MWh
Total heat load in Area		**7,205 MWh**

CHP Search Area for Development Site

Brill Place, Grand Central

Appendix D – BRUKL Reports

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Lobby - Baseline

As designed

Date: Tue Jan 12 15:53:12 2021

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.4.a.1

Interface to calculation engine: Design Database

Interface to calculation engine version: v26.06.00.06

BRUKL compliance check version: v5.4.a.1

Owner Details

Name: Information not provided by the user

Telephone number: Information not provided by the user

Address: Information not provided by the user, Information not provided by the user, Information not provided by the user

Certifier details

Name: Information not provided by the user

Telephone number: 01344 628821

Address: Cudd Bentley, Ashurst Manor, Sunninghill, SL5 7DD

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

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	66.5
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	66.5
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	66.5
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	0.26	0.26	0.LOBBY Wall 1
Floor	0.25	-	-	"No heat loss floors"
Roof	0.25	-	-	"No heat loss roofs"
Windows***, roof windows, and rooflights	2.2	1.4	1.4	0.LOBBY Window 1 (1)
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/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	4

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Lobby

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	4.5	-	1.5	0.73
Standard value	0.91*	3.9	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

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

1- Default DHW

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	0.91	-
Standard value	0.8	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**
0.LOBBY	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
0.LOBBY	-	231	27	262

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?**
0.LOBBY	NO (-2.6%)	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]	76.4	76.4
External area [m²]	123.1	123.1
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	4	5
Average conductance [W/K]	137.34	76.39
Average U-value [W/m²K]	1.12	0.62
Alpha value* [%]	23.55	19.11

* 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
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
100	**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	79.59	19.06
Cooling	19.29	26.88
Auxiliary	35.14	33.8
Lighting	40.2	62.2
Hot water	0.69	0.73
Equipment*	28.78	28.78
TOTAL**	**174.92**	**142.67**

* 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]	526.43	404.56
Primary energy* [kWh/m²]	388.49	391.97
Total emissions [kg/m²]	66.5	66.5

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	238.1	288.3	79.6	19.3	35.1	0.83	4.15	0.91	4.5
	Notional	56.2	348.4	19.1	26.9	33.8	0.82	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-Typ}	U_{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.26	0.LOBBY Wall 1
Floor	0.2	-	"No heat loss floors"
Roof	0.15	-	"No heat loss roofs"
Windows, roof windows, and rooflights	1.5	1.4	0.LOBBY Window 1 (1)
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-Typ} = Typical individual element U-values [W/(m²K)] U_{i-Min} = Minimum individual element U-values [W/(m²K)]

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

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	4

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Lobby - Baseline + Passive

As designed

Date: Tue Jan 12 15:55:57 2021

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.4.a.1

Interface to calculation engine: Design Database

Interface to calculation engine version: v26.06.00.06

BRUKL compliance check version: v5.4.a.1

Owner Details

Name: Information not provided by the user

Telephone number: Information not provided by the user

Address: Information not provided by the user, Information not provided by the user, Information not provided by the user

Certifier details

Name: Information not provided by the user

Telephone number: 01344 628821

Address: Cudd Bentley, Ashurst Manor, Sunninghill, SL5 7DD

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

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	66.5
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	66.5
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	64.2
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	0.26	0.26	0.LOBBY Wall 1
Floor	0.25	-	-	"No heat loss floors"
Roof	0.25	-	-	"No heat loss roofs"
Windows***, roof windows, and rooflights	2.2	1.4	1.4	0.LOBBY Window 1 (1)
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/(m²K)]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

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

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	4

Building services

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

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

1- Lobby

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	4.5	-	1.5	0.73
Standard value	0.91*	3.9	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

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

1- Default DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.91	-
Standard value	0.8	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**
0.LOBBY	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	**Lamp**	**Display lamp**	
Standard value	60	60	22	
0.LOBBY	-	231	27	262

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?
0.LOBBY	NO (-2.6%)	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]	76.4	76.4
External area [m²]	123.1	123.1
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	4	5
Average conductance [W/K]	137.34	76.39
Average U-value [W/m²K]	1.12	0.62
Alpha value* [%]	23.55	19.11

* 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
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
100	**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	79.62	19.06
Cooling	19.28	26.88
Auxiliary	35.14	33.8
Lighting	38.11	62.2
Hot water	0.69	0.73
Equipment*	28.78	28.78
TOTAL**	**172.84**	**142.67**

* 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]	526.33	404.56
Primary energy* [kWh/m²]	374.95	391.97
Total emissions [kg/m²]	64.2	66.5

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	238.2	288.1	79.6	19.3	35.1	0.83	4.15	0.91	4.5
	Notional	56.2	348.4	19.1	26.9	33.8	0.82	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-Typ}	U_{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.26	0.LOBBY Wall 1
Floor	0.2	-	"No heat loss floors"
Roof	0.15	-	"No heat loss roofs"
Windows, roof windows, and rooflights	1.5	1.4	0.LOBBY Window 1 (1)
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-Typ} = Typical individual element U-values [W/(m²K)] U_{i-Min} = Minimum individual element U-values [W/(m²K)]

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

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	4

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Lobby - Baseline + Passive + CHP

As designed

Date: Tue Jan 12 15:59:22 2021

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.4.a.1

Interface to calculation engine: Design Database

Interface to calculation engine version: v26.06.00.06

BRUKL compliance check version: v5.4.a.1

Owner Details

Name: Information not provided by the user

Telephone number: Information not provided by the user

Address: Information not provided by the user, Information not provided by the user, Information not provided by the user

Certifier details

Name: Information not provided by the user

Telephone number: 01344 628821

Address: Cudd Bentley, Ashurst Manor, Sunninghill, SL5 7DD

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

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	66.5
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	66.5
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	51.1
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and 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	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.26	0.26	0.LOBBY Wall 1
Floor	0.25	-	-	"No heat loss floors"
Roof	0.25	-	-	"No heat loss roofs"
Windows***, roof windows, and rooflights	2.2	1.4	1.4	0.LOBBY Window 1 (1)
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"

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	4

Building services

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

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

1- Lobby

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	4.5	-	1.5	0.73
Standard value	0.91*	3.9	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

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

1- Default DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	-
Standard value	N/A	N/A

1- CCHP-GENERATOR in NCM

	CHPQA quality index	CHP electrical efficiency
This building	-	0.42
Standard value	Not provided	N/A

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
0.LOBBY	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
0.LOBBY	-	231	27	262

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?
0.LOBBY	NO (-2.6%)	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?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	76.4	76.4
External area [m²]	123.1	123.1
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	4	5
Average conductance [W/K]	137.34	76.39
Average U-value [W/m²K]	1.12	0.62
Alpha value* [%]	23.55	19.11

* 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
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
100	**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	132.04	19.06
Cooling	19.28	26.88
Auxiliary	35.14	33.8
Lighting	38.11	62.2
Hot water	1.25	0.73
Equipment*	28.78	28.78
TOTAL**	**178.56**	**142.67**

* 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	47.26	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	526.33	404.56
Primary energy* [kWh/m²]	294.49	391.97
Total emissions [kg/m²]	51.1	66.5

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	59.5	288.1	19.9	19.3	35.1	0.83	4.15	0.91	4.5
	Notional	56.2	348.4	19.1	26.9	33.8	0.82	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	0.26	0.LOBBY Wall 1
Floor	0.2	-	"No heat loss floors"
Roof	0.15	-	"No heat loss roofs"
Windows, roof windows, and rooflights	1.5	1.4	0.LOBBY Window 1 (1)
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
$m^3/(h.m^2)$ at 50 Pa	5	4

Appendix E – Sample SAP Worksheets

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

Design SAP
elmhurst energy

Property Reference	Brill place-FF-F2	**Issued on Date**	13/01/2021
Assessment Reference	001-Baseline	**Prop Type Ref**	6024
Property	L1.03, Brill Place, London, NW1 1HG		

SAP Rating	82 B	**DER**	19.25	**TER**	19.25
Environmental	85 B	**% DER<TER**	0.02		
CO_2 Emissions (t/year)	1.16	**DFEE**	46.53	**TFEE**	56.34
General Requirements Compliance	Pass	**% DFEE<TFEE**	17.40		

Assessor Details	Mr. Seyedali Mirnajafizadeh, Seyedali Mirnajafizadeh, Tel: 07943 6388893, Ali.Mirnajafi@cuddbentley.co.uk	**Assessor ID**	W408-0001
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 71 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 (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.25 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 19.25 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.5 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
Party wall      0.00 (max. 0.20)         -                          OK
Floor           0.13 (max. 0.25)        0.13 (max. 0.70)            OK
Roof            (no roof)
Openings and
curtain wall    0.62 (max. 2.00)        0.70 (max. 3.30)            OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         5.82 (design value)
Maximum                                 10.0                                                 OK
----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Community heating scheme                             -

Secondary heating system:               None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       No cylinder
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Charging system linked to use of community heating, programmer and TRVsOK


Hot water controls:                     No cylinder


----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                                  OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.56
Maximum                                 1.5                                                  OK
MVHR efficiency:                        89%
Minimum:                                70%                                                  OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Medium                                               OK
Based on:
Overshading:                            Average
Windows facing North East:              16.97 m², No overhang
Windows facing North West:              9.99 m², No overhang
Air change rate:                        6.00 ach
Blinds/curtains:                        None
----------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Window U-value                          0.70 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	71.0000 (1b)	x	2.6000 (2b)	=	184.6000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 71.0000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	184.6000	(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							0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		5.8200	
Infiltration rate		0.2910	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2474	(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	0.3154	0.3092	0.3030	0.2721	0.2659	0.2350	0.2350	0.2288	0.2474	0.2659	0.2783	0.2906	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.6500 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.4371	0.4309	0.4248	0.3938	0.3877	0.3567	0.3567	0.3505	0.3691	0.3877	0.4000	0.4124	(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	
Windows (Uw = 0.70)			26.9600	0.6809	18.3580			(27)
Exposed floor			37.9100	0.1300	4.9283			(28a)
External Wall	53.1700	26.9600	26.2100	0.5400	14.1534			(29a)
Total net area of external elements Aum(A, m2)			91.0800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		37.4397			(33)
Party Wall			42.1400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.6547 (36)
Total fabric heat loss (33) + (36) = 49.0944 (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	26.6286	26.2519	25.8751	23.9916	23.6149	21.7314	21.7314	21.3547	22.4848	23.6149	24.3683	25.1217	(38)
Heat transfer coeff	75.7229	75.3462	74.9695	73.0860	72.7093	70.8258	70.8258	70.4491	71.5792	72.7093	73.4627	74.2161	(39)

Average = Sum(39)m / 12 = 72.9918 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0665	1.0612	1.0559	1.0294	1.0241	0.9975	0.9975	0.9922	1.0082	1.0241	1.0347	1.0453	(40)
HLP (average)												1.0281	(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 2.2702 (42)
Average daily hot water use (litres/day) 88.1162 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9278	93.4032	89.8785	86.3539	82.8292	79.3046	79.3046	82.8292	86.3539	89.8785	93.4032	96.9278	(44)
Energy conte	143.7412	125.7169	129.7286	113.1005	108.5227	93.6468	86.7775	99.5785	100.7678	117.4351	128.1896	139.2056	(45)
Energy content (annual)										Total = Sum(45)m =		1386.4109	(45)
Distribution loss (46)m = 0.15 x (45)m	21.5612	18.8575	19.4593	16.9651	16.2784	14.0470	13.0166	14.9368	15.1152	17.6153	19.2284	20.8808	(46)

Water storage loss:
Store volume 110.0000 (47)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

```
   b) If manufacturer declared loss factor is not known :
     Hot water storage loss factor from Table 2 (kWh/litre/day)                                                                        0.0152 (51)
     Volume factor from Table 2a                                                                                                       1.0294 (52)
     Temperature factor from Table 2b                                                                                                  0.6000 (53)
  Enter (49) or (54) in (55)                                                                                                           1.0327 (55)
  Total storage loss
                   32.0144    28.9162    32.0144    30.9817    32.0144    30.9817    32.0144    32.0144    30.9817    32.0144    30.9817    32.0144 (56)
  If cylinder contains dedicated solar storage
                   32.0144    28.9162    32.0144    30.9817    32.0144    30.9817    32.0144    32.0144    30.9817    32.0144    30.9817    32.0144 (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
                  199.0180   175.6444   185.0054   166.5942   163.7995   147.1405   142.0543   154.8553   154.2615   172.7119   181.6833   194.4824 (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
                  199.0180   175.6444   185.0054   166.5942   163.7995   147.1405   142.0543   154.8553   154.2615   172.7119   181.6833   194.4824 (64)
                                                                                              Total per year (kWh/year) = Sum(64)m =  2037.2507 (64)
  Heat gains from water heating, kWh/month
                   92.0154    81.7428    87.3562    80.4009    80.3052    73.9325    73.0750    77.3313    76.3002    83.2686    85.4180    90.5073 (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           113.5078   113.5078   113.5078   113.5078   113.5078   113.5078   113.5078   113.5078   113.5078   113.5078   113.5078   113.5078 (66)
  Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                   17.7962    15.8065    12.8547     9.7318     7.2746     6.1416     6.6362     8.6260    11.5777    14.7006    17.1578    18.2908 (67)
  Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
                  199.6196   201.6911   196.4711   185.3585   171.3309   158.1468   149.3391   147.2676   152.4876   163.6002   177.6279   190.8119 (68)
  Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                   34.3508    34.3508    34.3508    34.3508    34.3508    34.3508    34.3508    34.3508    34.3508    34.3508    34.3508    34.3508 (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)
                  -90.8062   -90.8062   -90.8062   -90.8062   -90.8062   -90.8062   -90.8062   -90.8062   -90.8062   -90.8062   -90.8062   -90.8062 (71)
  Water heating gains (Table 5)
                  123.6766   121.6411   117.4143   111.6679   107.9371   102.6840    98.2190   103.9399   105.9725   111.9202   118.6361   121.6496 (72)
  Total internal gains
                  398.1448   396.1910   383.7924   363.8106   343.5950   324.0248   311.2466   316.8858   327.0902   347.2733   370.4741   387.8047 (73)


  ---------------------------------------------------------------------------------------------------
  6. Solar gains
  ---------------------------------------------------------------------------------------------------
  [Jan]                                        Area          Solar flux               g               FF              Access                Gains
                                                 m2            Table 6a    Specific data    Specific data              factor                    W
                                                                   W/m2      or Table 6b      or Table 6c            Table 6d
  ---------------------------------------------------------------------------------------------------
  Northeast                                 16.9700             11.2829           0.4000           0.0000              0.7700              58.9732 (75)
  Northwest                                  9.9900             11.2829           0.4000           0.0000              0.7700              34.7167 (81)
  ---------------------------------------------------------------------------------------------------

  Solar gains      93.6899   190.7086   343.5962   564.2836   758.5079   808.6497   756.4753   603.0708   418.6773   233.0610   117.8862    76.5119 (83)
  Total gains     491.8347   586.8996   727.3886   928.0942  1102.1029  1132.6745  1067.7219   919.9567   745.7675   580.3343   488.3602   464.3166 (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              26.0452    26.1755    26.3070    26.9849    27.1248    27.8461    27.8461    27.9950    27.5530    27.1248    26.8466    26.5740
  alpha             2.7363     2.7450     2.7538     2.7990     2.8083     2.8564     2.8564     2.8663     2.8369     2.8083     2.7898     2.7716
  util living area
                    0.9525     0.9247     0.8595     0.7187     0.5423     0.3821     0.2857     0.3406     0.5748     0.8259     0.9290     0.9584 (86)

  MIT              18.9371    19.2596    19.7986    20.4294    20.7935    20.9456    20.9825    20.9714    20.8273    20.2714    19.5127    18.9064 (87)
  Th 2             20.0283    20.0326    20.0370    20.0589    20.0633    20.0854    20.0854    20.0898    20.0765    20.0633    20.0545    20.0458 (88)
  util rest of house
                    0.9458     0.9145     0.8413     0.6875     0.4998     0.3322     0.2285     0.2771     0.5163     0.7966     0.9177     0.9525 (89)
  MIT 2            17.2736    17.7380    18.5022    19.3763    19.8427    20.0379    20.0741    20.0702    19.9108    19.1932    18.1217    17.2398 (90)
  Living area fraction                                                                                  fLA = Living area / (4) =     0.3762 (91)
  MIT              17.8994    18.3104    18.9899    19.7724    20.2004    20.3794    20.4158    20.4093    20.2556    19.5989    18.6450    17.8667 (92)
  Temperature adjustment                                                                                                               0.0000
  adjusted MIT     17.8994    18.3104    18.9899    19.7724    20.2004    20.3794    20.4158    20.4093    20.2556    19.5989    18.6450    17.8667 (93)


  ---------------------------------------------------------------------------------------------------
  8. Space heating requirement
  ---------------------------------------------------------------------------------------------------
                     Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
  Utilisation       0.9262     0.8915     0.8182     0.6773     0.5062     0.3485     0.2494     0.2997     0.5282     0.7799     0.8962     0.9344 (94)
  Useful gains    455.5262   523.2015   595.1695   628.5570   557.9218   394.7620   266.2502   275.7456   393.8944   452.6082   437.6891   433.8466 (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
                 1029.7880  1010.4229   936.3593   794.6235   618.0547   409.3281   270.2575   282.4486   440.6121   654.3009   848.1279  1014.2927 (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
                  427.2508   327.4128   253.8452   119.5678    44.7389     0.0000     0.0000     0.0000     0.0000   150.0594   295.5159   431.8518 (98)
  Space heating                                                                                                                     2050.2426 (98)
  Space heating per m2                                                                                           (98) / (4) =      28.8767 (99)


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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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	665.7626	524.1110	535.4132	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9330	0.9555	0.9366	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	621.1543	500.7908	501.4455	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1395.5472	1318.1897	1146.4894	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	557.5629	608.1448	479.9127	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1645.6204	(104)
Cooled fraction									fC = cooled area / (4) =			0.7413	(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	103.3258	112.6995	88.9359	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												304.9613	(107)
Space cooling per m2												4.2952	(108)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Boilers	1.0000	(303a)
Fraction of total space heat from community Boilers	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.1000	(306)
Space heating:		
Annual space heating requirement	2050.2426	(98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10	2255.2668	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	2037.2507	(64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10	2240.9757	(310a)
Electricity used for heat distribution	44.9624	(313)
Cooling System Energy Efficiency Ratio	5.0625	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	60.2393	(315)
Annual totals kWh/year		
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7000)		
mechanical ventilation fans (SFP = 0.7000)	157.6484	(330a)
Total electricity for the above, kWh/year	157.6484	(331)
Electricity for lighting (calculated in Appendix L)	314.2871	(332)
Total delivered energy for all uses	5028.4174	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			91.0000	(367a)
Space heating from Boilers	4940.9259	0.2160	1067.2400	(367)
Electrical energy for heat distribution	44.9624	0.5190	23.3355	(372)
Total CO2 associated with community systems			1090.5755	(373)
(negative value allowed since DFEE <= TFEE)				
Space and water heating			1090.5755	(376)
Space cooling	60.2393	0.5190	31.2642	(377)
Pumps and fans	157.6484	0.5190	81.8195	(378)
Energy for lighting	314.2871	0.5190	163.1150	(379)
Total CO2, kg/year			1366.7742	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			19.2500	(384)

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

DER		19.2500	ZC1
Total Floor Area	TFA	71.0000	
Assumed number of occupants	N	2.2702	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.6606	ZC2
CO2 emissions from cooking, equation (L16)		2.4434	ZC3
Total CO2 emissions		38.3541	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		38.3541	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		71.0000 (1b)	x	2.6000 (2b)	=	184.6000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	184.6000	(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) =	0.1625	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4125	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3506	(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	0.4471	0.4383	0.4295	0.3857	0.3769	0.3331	0.3331	0.3243	0.3506	0.3769	0.3945	0.4120	(22b)
Effective ac	0.5999	0.5961	0.5922	0.5744	0.5710	0.5555	0.5555	0.5526	0.5615	0.5710	0.5778	0.5849	(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	
TER Opening Type Curtain (Uw = 1.50)			17.7400	1.4151	25.1038			(27)
Exposed floor			37.9100	0.1300	4.9283			(28a)
External Wall	53.1700	17.7400	35.4300	0.1800	6.3774			(29a)
Total net area of external elements Aum(A, m2)			91.0800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		36.4095			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.3633	(36)
Total fabric heat loss	(33) + (36) =	48.7728	(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	36.5467	36.3103	36.0786	34.9902	34.7866	33.8387	33.8387	33.6632	34.2038	34.7866	35.1985	35.6292	(38)
Heat transfer coeff	85.3194	85.0830	84.8513	83.7630	83.5594	82.6115	82.6115	82.4359	82.9766	83.5594	83.9713	84.4020	(39)
Average = Sum(39)m / 12 =												83.7620	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2017	1.1984	1.1951	1.1798	1.1769	1.1635	1.1635	1.1611	1.1687	1.1769	1.1827	1.1888	(40)
HLP (average)												1.1797	(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	2.2702	(42)
Average daily hot water use (litres/day)	88.1162	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9278	93.4032	89.8785	86.3539	82.8292	79.3046	79.3046	82.8292	86.3539	89.8785	93.4032	96.9278	(44)
Energy conte	143.7412	125.7169	129.7286	113.1005	108.5227	93.6468	86.7775	99.5785	100.7678	117.4351	128.1896	139.2056	(45)
Energy content (annual)										Total = Sum(45)m =		1386.4109	(45)
Distribution loss (46)m = 0.15 x (45)m	21.5612	18.8575	19.4593	16.9651	16.2784	14.0470	13.0166	14.9368	15.1152	17.6153	19.2284	20.8808	(46)

Water storage loss:

Store volume	150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.3938	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.7527	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(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	190.3361	167.8026	176.3235	158.1924	155.1176	138.7387	133.3724	146.1734	145.8596	164.0300	173.2815	185.8005	(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	190.3361	167.8026	176.3235	158.1924	155.1176	138.7387	133.3724	146.1734	145.8596	164.0300	173.2815	185.8005	(64)
Total per year (kWh/year) = Sum(64)m =												1935.0283	(64)
Heat gains from water heating, kWh/month	85.0699	75.4695	80.4107	73.6794	73.3597	67.2110	66.1295	70.3858	69.5788	76.3231	78.6965	83.5618	(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	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.7962	15.8065	12.8547	9.7318	7.2746	6.1416	6.6362	8.6260	11.5777	14.7006	17.1578	18.2908	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	199.6196	201.6911	196.4711	185.3585	171.3309	158.1468	149.3391	147.2676	152.4876	163.6002	177.6279	190.8119	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	(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)	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	(71)
Water heating gains (Table 5)	114.3412	112.3057	108.0789	102.3325	98.6018	93.3487	88.8837	94.6045	96.6372	102.5848	109.3007	112.3142	(72)
Total internal gains	391.8094	389.8556	377.4570	357.4752	337.2596	317.6894	304.9113	310.5505	320.7548	340.9379	364.1387	381.4693	(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	11.1600	11.2829	0.6300	0.7000	0.7700	38.4821	(75)
Northwest	6.5800	11.2829	0.6300	0.7000	0.7700	22.6892	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	61.1713	124.5160	224.3382	368.4277	495.2391	527.9773	493.9120	393.7524	273.3596	152.1684	76.9693	49.9556	(83)
Total gains	452.9807	514.3716	601.7952	725.9029	832.4987	845.6667	798.8232	704.3028	594.1144	493.1063	441.1080	431.4249	(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	57.7894	57.9499	58.1082	58.8632	59.0066	59.6837	59.6837	59.8108	59.4210	59.0066	58.7172	58.4176	
alpha	4.8526	4.8633	4.8739	4.9242	4.9338	4.9789	4.9789	4.9874	4.9614	4.9338	4.9145	4.8945	
util living area	0.9974	0.9947	0.9841	0.9363	0.8016	0.6011	0.4501	0.5268	0.8165	0.9726	0.9948	0.9979	(86)
MIT	19.7249	19.8747	20.1628	20.5608	20.8555	20.9732	20.9948	20.9892	20.8847	20.4874	20.0422	19.7030	(87)
Th 2	19.9187	19.9213	19.9239	19.9362	19.9385	19.9493	19.9493	19.9513	19.9451	19.9385	19.9339	19.9290	(88)
util rest of house	0.9965	0.9928	0.9784	0.9142	0.7440	0.5125	0.3452	0.4126	0.7383	0.9591	0.9926	0.9972	(89)
MIT 2	18.2274	18.4476	18.8666	19.4337	19.8055	19.9328	19.9475	19.9471	19.8556	19.3459	18.7016	18.2027	(90)
Living area fraction									fLA = Living area / (4) =			0.3762	(91)
MIT	18.7907	18.9845	19.3543	19.8577	20.2005	20.3242	20.3415	20.3391	20.2427	19.7753	19.2060	18.7671	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7907	18.9845	19.3543	19.8577	20.2005	20.3242	20.3415	20.3391	20.2427	19.7753	19.2060	18.7671	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9951	0.9906	0.9745	0.9123	0.7594	0.5451	0.3848	0.4558	0.7628	0.9564	0.9906	0.9961	(94)
Useful gains	450.7773	509.5358	586.4608	662.2293	632.2164	460.9783	307.4063	321.0081	453.1707	471.5991	436.9525	429.7576	(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	1236.3420	1198.3490	1090.7007	917.8497	710.2990	472.8844	309.0887	324.7262	509.7031	766.6851	1016.5531	1229.4956	(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	584.4601	462.8825	375.1545	184.0467	58.0934	0.0000	0.0000	0.0000	0.0000	219.5439	417.3124	595.0050	(98)
Space heating												2896.4987	(98)
Space heating per m2											(98) / (4) =	40.7958	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 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 %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3097.8595	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	584.4601	462.8825	375.1545	184.0467	58.0934	0.0000	0.0000	0.0000	0.0000	219.5439	417.3124	595.0050	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	625.0911	495.0615	401.2348	196.8414	62.1320	0.0000	0.0000	0.0000	0.0000	234.8064	446.3234	636.3690	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	190.3361	167.8026	176.3235	158.1924	155.1176	138.7387	133.3724	146.1734	145.8596	164.0300	173.2815	185.8005	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.6141	87.3826	86.7797	85.2183	82.4563	79.8000	79.8000	79.8000	79.8000	85.5922	87.0744	87.7017	(217)
Fuel for water heating, kWh/month	217.2437	192.0321	203.1853	185.6318	188.1210	173.8580	167.1334	183.1747	182.7815	191.6414	199.0039	211.8551	(219)
Water heating fuel used												2295.6618	(219)

Annual totals kWh/year		
Space heating fuel - main system	3097.8595	(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)	314.2871	(232)
Total delivered energy for all uses	5782.8084	(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	3097.8595	0.2160	669.1377	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2295.6618	0.2160	495.8629	(264)
Space and water heating			1165.0006	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	314.2871	0.5190	163.1150	(268)
Total CO2, kg/m2/year			1367.0406	(272)
Emissions per m2 for space and water heating			16.4085	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2974	(272b)
Emissions per m2 for pumps and fans			0.5482	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.4085 * 1.00) + 2.2974 + 0.5482, rounded to 2 d.p.			19.2500	(273)

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

Design SAP
elmhurst energy

Property Reference	Brill place-Top F-F5	**Issued on Date**	13/01/2021
Assessment Reference	002-Passive	**Prop Type Ref**	6024
Property	L16.03, Brill Place, London, NW1 1HG		

SAP Rating	86 B	**DER**	12.29	**TER**	13.75
Environmental	88 B	**% DER<TER**	10.61		
CO_2 Emissions (t/year)	1.45	**DFEE**	34.67	**TFEE**	45.38
General Requirements Compliance	Pass	**% DFEE<TFEE**	23.60		

Assessor Details	Mr. Seyedali Mirnajafizadeh, Seyedali Mirnajafizadeh, Tel: 07943 6388893, Ali.Mirnajafi@cuddbentley.co.uk	**Assessor ID**	W408-0001
Client			

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 136 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 (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 13.75 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.29 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)45.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)34.7 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                Highest
External wall   0.09 (max. 0.30)       0.09 (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 and
curtain wall    0.63 (max. 2.00)       0.70 (max. 3.30)          OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:        3.00 (design value)
Maximum                                10.0                                                OK
----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                   Community heating scheme                            -

Secondary heating system:              None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                      No cylinder
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                Charging system linked to use of community heating, programmer and TRVsOK


Hot water controls:                    No cylinder


----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                75%                                                 OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                    0.56
Maximum                                1.5                                                 OK
MVHR efficiency:                       89%
Minimum:                               70%                                                 OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):      Medium                                              OK
Based on:
Overshading:                           Average
Windows facing North East:             17.86 m², No overhang
Windows facing North West:             16.44 m², No overhang
Air change rate:                       6.00 ach
Blinds/curtains:                       Dark-coloured curtain or roller blind, closed 70% of daylight hours
----------------------------------------------------------------------------------------------------
10 Key features
External wall U-value                  0.09 W/m²K
Party wall U-value                     0.00 W/m²K
Window U-value                         0.70 W/m²K
Roof window U-value                    0.70 W/m²K
Air permeability                       3.0 m³/m²h



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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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         Storey height                 Volume
                                                                                   (m2)              (m)                       (m3)
Ground floor                                                                   135.6900 (1b)    x      2.2800 (2b)     =     309.3732 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)             135.6900                                                        (4)
Dwelling volume                                                                       (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =     309.3732 (5)


----------------------------------------------------------------------------------------------------
2. Ventilation rate
----------------------------------------------------------------------------------------------------
                                                              main          secondary             other              total       m3 per hour
                                                           heating           heating
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                                                                                            0 * 10 =       0.0000 (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) =                                      0.0000 / (5) =       0.0000 (8)
Pressure test                                                                                                                             Yes
Measured/design AP50                                                                                                                   3.0000
Infiltration rate                                                                                                                      0.1500 (18)
Number of sides sheltered                                                                                                                   2 (19)

Shelter factor                                                                                  (20) = 1 - [0.075 x (19)] =       0.8500 (20)
Infiltration rate adjusted to include shelter factor                                                     (21) = (18) x (20) =       0.1275 (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
                 0.1626     0.1594     0.1562     0.1403     0.1371     0.1211     0.1211     0.1179     0.1275     0.1371     0.1434     0.1498 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                             0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                                         75.6500 (23c)

Effective ac     0.2843     0.2811     0.2779     0.2620     0.2588     0.2429     0.2429     0.2397     0.2493     0.2588     0.2652     0.2716 (25)


----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
----------------------------------------------------------------------------------------------------
Element                                         Gross       Openings        NetArea       U-value         A x U        K-value          A x K
                                                   m2             m2             m2        W/m2K           W/K         kJ/m2K           kJ/K
Windows (Uw = 0.70)                                                         34.3000        0.6809       23.3560                                (27)
Roof light (Uw = 0.70)                                                      18.4800        0.6809       12.5837                                (27a)
External Wall                                 71.3700        34.3000        37.0700        0.5400       20.0178                                (29a)
Stud wall*0.72                                 5.5800                        5.5800        0.0900        0.5022                                (29a)
Roof @ rafter                                 56.2600        18.4800        37.7800        0.1300        4.9114                                (30)
Roof @ Joists                                 47.8000                       47.8000        0.1300        6.2140                                (30)
Total net area of external elements Aum(A, m2)                             181.0100                                                        (31)
Fabric heat loss, W/K = Sum (A x U)                                   (26)...(30) + (32) =      67.5851                                (33)
Party Wall                                                                  42.0400        0.0000        0.0000                                (32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                  100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                          10.8709 (36)
Total fabric heat loss                                                                                           (33) + (36) =      78.4560 (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          29.0264    28.7009    28.3755    26.7484    26.4230    24.7959    24.7959    24.4705    25.4467    26.4230    27.0738    27.7247 (38)
Heat transfer coeff
              107.4823   107.1569   106.8315   105.2044   104.8790   103.2519   103.2519   102.9264   103.9027   104.8790   105.5298   106.1807 (39)
Average = Sum(39)m / 12 =                                                                                                          105.1230 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              0.7921     0.7897     0.7873     0.7753     0.7729     0.7609     0.7609     0.7585     0.7657     0.7729     0.7777     0.7825 (40)
HLP (average)                                                                                                                       0.7747 (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                                                                                                                   2.9084 (42)
Average daily hot water use (litres/day)                                                                                          103.2742 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
              113.6016   109.4707   105.3397   101.2087    97.0778    92.9468    92.9468    97.0778   101.2087   105.3397   109.4707   113.6016 (44)
Energy conte  168.4680   147.3432   152.0449   132.5565   127.1911   109.7562   101.7053   116.7083   118.1022   137.6367   150.2412   163.1522 (45)
Energy content (annual)                                                                                       Total = Sum(45)m =   1624.9057 (45)
Distribution loss  (46)m = 0.15 x (45)m
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	25.2702	22.1015	22.8067	19.8835	19.0787	16.4634	15.2558	17.5062	17.7153	20.6455	22.5362	24.4728	(46)

Water storage loss:

Store volume	110.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0152	(51)
Volume factor from Table 2a	1.0294	(52)
Temperature factor from Table 2b	0.6000	(53)
Enter (49) or (54) in (55)	1.0327	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(56)
If cylinder contains dedicated solar storage	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(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	223.7448	197.2706	207.3217	186.0501	182.4679	163.2499	156.9821	171.9851	171.5958	192.9135	203.7349	218.4290	(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	223.7448	197.2706	207.3217	186.0501	182.4679	163.2499	156.9821	171.9851	171.5958	192.9135	203.7349	218.4290	(64)
Total per year (kWh/year) = Sum(64)m =												2275.7455	(64)
Heat gains from water heating, kWh/month	100.2370	88.9335	94.7764	86.8700	86.5125	79.2889	78.0384	83.0270	82.0639	89.9856	92.7501	98.4696	(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	145.4194	145.4194	145.4194	145.4194	145.4194	145.4194	145.4194	145.4194	145.4194	145.4194	145.4194	145.4194	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.1425	24.1077	19.6057	14.8428	11.0951	9.3670	10.1214	13.1561	17.6581	22.4210	26.1687	27.8968	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	304.4558	307.6151	299.6538	282.7051	261.3103	241.2023	227.7689	224.6096	232.5709	249.5197	270.9144	291.0224	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5419	37.5419	37.5419	37.5419	37.5419	37.5419	37.5419	37.5419	37.5419	37.5419	37.5419	37.5419	(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)	-116.3355	-116.3355	-116.3355	-116.3355	-116.3355	-116.3355	-116.3355	-116.3355	-116.3355	-116.3355	-116.3355	-116.3355	(71)
Water heating gains (Table 5)	134.7272	132.3416	127.3876	120.6527	116.2802	110.1235	104.8904	111.5954	113.9777	120.9484	128.8196	132.3516	(72)
Total internal gains	532.9513	530.6902	513.2729	484.8264	455.3115	427.3186	409.4065	415.9869	430.8325	459.5150	492.5285	517.8966	(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	17.8600	11.2829	0.4000	0.0000	0.7700	62.0661	(75)
Northwest	16.4400	11.2829	0.4000	0.0000	0.7700	57.1314	(81)
Southwest	18.4800	37.0308	0.4000	0.0000	1.0000	273.7317	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	392.9292	762.1666	1264.0906	1895.6444	2393.8858	2487.5855	2352.6912	1969.3139	1483.7502	904.4676	488.1655	324.5911	(83)
Total gains	925.8805	1292.8568	1777.3635	2380.4708	2849.1973	2914.9041	2762.0976	2385.3008	1914.5828	1363.9826	980.6940	842.4877	(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	35.0678	35.1743	35.2814	35.8271	35.9382	36.5046	36.5046	36.6200	36.2759	35.9382	35.7166	35.4977	
alpha	3.3379	3.3450	3.3521	3.3885	3.3959	3.4336	3.4336	3.4413	3.4184	3.3959	3.3811	3.3665	
util living area	0.9437	0.8664	0.7147	0.5029	0.3364	0.2256	0.1642	0.1979	0.3662	0.6798	0.8975	0.9561	(86)
MIT	19.6154	20.0896	20.5803	20.8852	20.9743	20.9952	20.9988	20.9978	20.9760	20.7524	20.1131	19.5239	(87)
Th 2	20.2602	20.2623	20.2643	20.2748	20.2769	20.2873	20.2873	20.2894	20.2831	20.2769	20.2727	20.2685	(88)
util rest of house	0.9369	0.8528	0.6926	0.4771	0.3114	0.2008	0.1377	0.1675	0.3302	0.6481	0.8844	0.9507	(89)
MIT 2	18.3934	19.0645	19.7362	20.1399	20.2495	20.2830	20.2865	20.2878	20.2602	19.9866	19.1152	18.2681	(90)
Living area fraction									fLA = Living area / (4) =			0.5261	(91)
MIT	19.0362	19.6037	20.1802	20.5320	20.6307	20.6577	20.6612	20.6613	20.6367	20.3895	19.6401	18.9287	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0362	19.6037	20.1802	20.5320	20.6307	20.6577	20.6612	20.6613	20.6367	20.3895	19.6401	18.9287	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9233	0.8394	0.6900	0.4864	0.3237	0.2137	0.1516	0.1834	0.3481	0.6532	0.8714	0.9384	(94)
Useful gains	854.8766	1085.2082	1226.3519	1157.7936	922.1588	622.9753	418.7789	437.5452	666.3731	891.0197	854.5684	790.5699	(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	1583.8834	1575.6070	1461.4809	1223.7336	936.6477	625.4680	419.3286	438.5997	679.1855	1026.7081	1323.3594	1563.9084	(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	542.3811	329.5480	174.9360	47.4768	10.7798	0.0000	0.0000	0.0000	0.0000	100.9522	337.5295	575.3638	(98)
Space heating												2118.9671	(98)
Space heating per m2											(98) / (4) =	15.6162	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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	970.5675	764.0638	782.2410	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9891	0.9938	0.9899	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	959.9643	759.3523	774.3176	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3268.3513	3098.8531	2692.1017	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	1662.0387	1740.5886	1426.8314	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												4829.4586	(104)
Cooled fraction									fC = cooled area / (4) =			0.8788	(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	365.1671	382.4254	313.4896	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												1061.0821	(107)
Space cooling per m2												7.8199	(108)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Boilers	1.0000	(303a)
Fraction of total space heat from community Boilers	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.1000	(306)
Space heating:		
Annual space heating requirement	2118.9671	(98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10	2330.8639	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	2275.7455	(64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10	2503.3200	(310a)
Electricity used for heat distribution	48.3418	(313)
Cooling System Energy Efficiency Ratio	5.0625	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	209.5965	(315)
Annual totals kWh/year		
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7000)		
mechanical ventilation fans (SFP = 0.7000)	264.2047	(330a)
Total electricity for the above, kWh/year	264.2047	(331)
Electricity for lighting (calculated in Appendix L)	479.3443	(332)
Total delivered energy for all uses	5787.3294	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			91.0000	(367a)
Space heating from Boilers	5312.2900	0.2160	1147.4546	(367)
Electrical energy for heat distribution	48.3418	0.5190	25.0894	(372)
Total CO2 associated with community systems			1172.5441	(373)
(negative value allowed since DFEE <= TFEE)				
Space and water heating			1172.5441	(376)
Space cooling	209.5965	0.5190	108.7806	(377)
Pumps and fans	264.2047	0.5190	137.1222	(378)
Energy for lighting	479.3443	0.5190	248.7797	(379)
Total CO2, kg/year			1667.2265	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			12.2900	(384)

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

DER		12.2900	ZC1
Total Floor Area	TFA	135.6900	
Assumed number of occupants	N	2.9084	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.2961	ZC2
CO2 emissions from cooking, equation (L16)		1.3914	ZC3
Total CO2 emissions		26.9775	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		26.9775	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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



----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
----------------------------------------------------------------------------------------------------
                                                                                Area        Storey height             Volume
                                                                                (m2)             (m)                   (m3)
Ground floor                                                               135.6900 (1b)    x      2.2800 (2b)    =    309.3732 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)            135.6900                                                     (4)
Dwelling volume                                                                (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    309.3732 (5)



----------------------------------------------------------------------------------------------------
2. Ventilation rate
----------------------------------------------------------------------------------------------------
                                                            main          secondary             other              total        m3 per hour
                                                         heating            heating
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) =      0.1293 (8)
Pressure test                                                                                                                     Yes
Measured/design AP50                                                                                                           5.0000
Infiltration rate                                                                                                              0.3793 (18)
Number of sides sheltered                                                                                                           2 (19)

Shelter factor                                                                            (20) = 1 - [0.075 x (19)] =      0.8500 (20)
Infiltration rate adjusted to include shelter factor                                             (21) = (18) x (20) =      0.3224 (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
                0.4111     0.4030     0.3949     0.3546     0.3466     0.3063     0.3063     0.2982     0.3224     0.3466     0.3627     0.3788 (22b)
Effective ac    0.5845     0.5812     0.5780     0.5629     0.5601     0.5469     0.5469     0.5445     0.5520     0.5601     0.5658     0.5718 (25)



----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
----------------------------------------------------------------------------------------------------
Element                                            Gross      Openings        NetArea      U-value          A x U        K-value          A x K
                                                      m2            m2             m2        W/m2K            W/K        kJ/m2K           kJ/K
TER Opening Type Curtain (Uw = 1.50)                                          22.0500       1.4151        31.2028                              (27)
TER Room Window (Uw = 1.70)                                                   11.8800       1.5918        18.9101                              (27a)
External Wall                                    71.3700       22.0500        49.3200       0.1800         8.8776                              (29a)
Stud wall*0.72                                    5.5800                       5.5800       0.1800         1.0044                              (29a)
Roof @ rafter                                    56.2600       11.8800        44.3800       0.1300         5.7694                              (30)
Roof @ Joists                                    47.8000                      47.8000       0.1300         6.2140                              (30)
Total net area of external elements Aum(A, m2)                               181.0100                                                      (31)
Fabric heat loss, W/K = Sum (A x U)                                  (26)...(30) + (32) =     71.9783                                      (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                            250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                    10.9289 (36)
Total fabric heat loss                                                                                      (33) + (36) =     82.9072 (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          59.6719    59.3370    59.0087    57.4667    57.1782    55.8351    55.8351    55.5864    56.3524    57.1782    57.7618    58.3720 (38)
Heat transfer coeff
              142.5792   142.2442   141.9159   140.3739   140.0854   138.7424   138.7424   138.4936   139.2597   140.0854   140.6690   141.2792 (39)
Average = Sum(39)m / 12 =                                                                                                     140.3725 (39)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP             1.0508     1.0483     1.0459     1.0345     1.0324     1.0225     1.0225     1.0207     1.0263     1.0324     1.0367     1.0412 (40)
HLP (average)                                                                                                                  1.0345 (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                                                                                                              2.9084 (42)
Average daily hot water use (litres/day)                                                                                     103.2742 (43)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
              113.6016   109.4707   105.3397   101.2087    97.0778    92.9468    92.9468    97.0778   101.2087   105.3397   109.4707   113.6016 (44)
Energy conte  168.4680   147.3432   152.0449   132.5565   127.1911   109.7562   101.7053   116.7083   118.1022   137.6367   150.2412   163.1522 (45)
Energy content (annual)                                                                                 Total = Sum(45)m =   1624.9057 (45)
Distribution loss  (46)m = 0.15 x (45)m
               25.2702    22.1015    22.8067    19.8835    19.0787    16.4634    15.2558    17.5062    17.7153    20.6455    22.5362    24.4728 (46)
Water storage loss:
Store volume                                                                                                                 150.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                  1.3938 (48)
  Temperature factor from Table 2b                                                                                             0.5400 (49)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Enter (49) or (54) in (55) 0.7527 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(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	215.0629	189.4289	198.6398	177.6483	173.7860	154.8481	148.3002	163.3032	163.1940	184.2316	195.3331	209.7471	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Output from w/h	215.0629	189.4289	198.6398	177.6483	173.7860	154.8481	148.3002	163.3032	163.1940	184.2316	195.3331	209.7471	(64)

Total per year (kWh/year) = Sum(64)m = 2173.5231 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	93.2915	82.6602	87.8309	80.1485	79.5670	72.5674	71.0929	76.0814	75.3424	83.0401	86.0287	91.5240	(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	145.4194	145.4194	145.4194	145.4194	145.4194	145.4194	145.4194	145.4194	145.4194	145.4194	145.4194	145.4194	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.1425	24.1077	19.6057	14.8428	11.0951	9.3670	10.1214	13.1561	17.6581	22.4210	26.1687	27.8968	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	304.4558	307.6151	299.6538	282.7051	261.3103	241.2023	227.7689	224.6096	232.5709	249.5197	270.9144	291.0224	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5419	37.5419	37.5419	37.5419	37.5419	37.5419	37.5419	37.5419	37.5419	37.5419	37.5419	37.5419	(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)	-116.3355	-116.3355	-116.3355	-116.3355	-116.3355	-116.3355	-116.3355	-116.3355	-116.3355	-116.3355	-116.3355	-116.3355	(71)
Water heating gains (Table 5)	125.3918	123.0062	118.0522	111.3174	106.9448	100.7881	95.5550	102.2600	104.6423	111.6131	119.4843	123.0162	(72)
Total internal gains	526.6159	524.3548	506.9375	478.4910	448.9761	420.9832	403.0711	409.6515	424.4972	453.1796	486.1932	511.5613	(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	11.4800	11.2829	0.6300	0.7000	0.7700	39.5855	(75)
Northwest	10.5700	11.2829	0.6300	0.7000	0.7700	36.4476	(81)
Southwest	11.8800	37.0308	0.6300	0.7000	1.0000	174.6066	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	250.6397	486.1670	806.3318	1209.1842	1526.9999	1586.7686	1500.7229	1256.1761	946.4472	576.9373	311.3886	207.0485	(83)
Total gains	777.2556	1010.5219	1313.2693	1687.6752	1975.9760	2007.7518	1903.7940	1665.8277	1370.9444	1030.1169	797.5817	718.6098	(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	66.0890	66.2446	66.3979	67.1273	67.2655	67.9167	67.9167	68.0386	67.6644	67.2655	66.9864	66.6971	
alpha	5.4059	5.4163	5.4265	5.4752	5.4844	5.5278	5.5278	5.5359	5.5110	5.4844	5.4658	5.4465	
util living area	0.9984	0.9933	0.9665	0.8483	0.6348	0.4395	0.3203	0.3813	0.6681	0.9511	0.9956	0.9990	(86)
MIT	19.8686	20.0929	20.4437	20.8113	20.9657	20.9961	20.9995	20.9986	20.9681	20.6625	20.1793	19.8309	(87)
Th 2	20.0412	20.0433	20.0453	20.0547	20.0564	20.0646	20.0646	20.0662	20.0615	20.0564	20.0529	20.0491	(88)
util rest of house	0.9979	0.9911	0.9561	0.8122	0.5783	0.3765	0.2524	0.3045	0.5899	0.9304	0.9938	0.9986	(89)
MIT 2	18.5249	18.8529	19.3564	19.8526	20.0275	20.0624	20.0644	20.0656	20.0392	19.6770	18.9873	18.4755	(90)

Living area fraction fLA = Living area / (4) = 0.5261 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	19.2318	19.5052	19.9284	20.3569	20.5210	20.5536	20.5563	20.5564	20.5279	20.1954	19.6144	19.1885	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2318	19.5052	19.9284	20.3569	20.5210	20.5536	20.5563	20.5564	20.5279	20.1954	19.6144	19.1885	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9895	0.9546	0.8245	0.6066	0.4096	0.2881	0.3449	0.6299	0.9339	0.9927	0.9982	(94)
Useful gains	775.1260	999.9498	1253.6925	1391.4457	1198.6626	822.4161	548.5036	574.5897	863.5203	962.0741	791.7874	717.2897	(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	2128.9598	2077.5035	1905.7018	1608.2544	1235.6996	826.0130	548.9075	575.6410	895.1445	1344.1770	1760.3857	2117.5669	(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	1007.2523	724.1161	485.0949	156.1023	27.5556	0.0000	0.0000	0.0000	0.0000	284.2846	697.3908	1041.8062	(98)

Space heating 4423.6027 (98)

Space heating per m2 (98) / (4) = 32.6008 (99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 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 %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4731.1259	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1007.2523	724.1161	485.0949	156.1023	27.5556	0.0000	0.0000	0.0000	0.0000	284.2846	697.3908	1041.8062	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	1077.2752	774.4557	518.8181	166.9543	29.4712	0.0000	0.0000	0.0000	0.0000	304.0477	745.8725	1114.2313	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	215.0629	189.4289	198.6398	177.6483	173.7860	154.8481	148.3002	163.3032	163.1940	184.2316	195.3331	209.7471	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.4141	88.0519	87.1068	84.4712	81.1125	79.8000	79.8000	79.8000	79.8000	85.9673	87.9205	88.5110	(217)
Fuel for water heating, kWh/month	243.2449	215.1333	228.0418	210.3063	214.2530	194.0452	185.8398	204.6406	204.5038	214.3042	222.1700	236.9728	(219)

Water heating fuel used	2573.4557	(219)
Annual totals kWh/year		
Space heating fuel - main system	4731.1259	(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)	479.3443	(232)
Total delivered energy for all uses	7858.9259	(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	4731.1259	0.2160	1021.9232	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2573.4557	0.2160	555.8664	(264)
Space and water heating			1577.7896	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	479.3443	0.5190	248.7797	(268)
Total CO2, kg/m2/year			1865.4943	(272)
Emissions per m2 for space and water heating			11.6279	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.8334	(272b)
Emissions per m2 for pumps and fans			0.2869	(272c)
Target Carbon Dioxide Emission Rate (TER) = (11.6279 * 1.00) + 1.8334 + 0.2869, rounded to 2 d.p.			13.7500	(273)

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

Design SAP
elmhurst energy

Property Reference	Brill place-Midd F-F4	**Issued on Date**	13/01/2021
Assessment Reference	003-CHP	**Prop Type Ref**	6024
Property	L4.03, Brill Place, London, NW1 1HG		

SAP Rating	86 B	**DER**	6.71	**TER**	16.53
Environmental	95 A	**% DER<TER**	59.40		
CO_2 Emissions (t/year)	0.45	**DFEE**	36.33	**TFEE**	45.43
General Requirements Compliance	Pass	**% DFEE<TFEE**	20.02		

Assessor Details	Mr. Seyedali Mirnajafizadeh, Seyedali Mirnajafizadeh, Tel: 07943 6388893, Ali.Mirnajafi@cuddbentley.co.uk	**Assessor ID**	W408-0001
Client			

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 71 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 (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.53 kgCO2/m²
Dwelling Carbon Dioxide Emission Rate (DER)  6.71 kgCO2/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)45.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)36.3 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            (no roof)
Openings and
curtain wall    0.62 (max. 2.00)        0.70 (max. 3.30)          OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                                OK
----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Community heating scheme                            -

Secondary heating system:               None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Measured cylinder loss: 0.20 kWh/day
Permitted by DBSCG 0.29                           OK
Primary pipework insulated:             No primary pipework
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Charging system linked to use of community heating, programmer and TRVsOK


Hot water controls:                     No cylinderstat


----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                                 OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.56
Maximum                                 1.5                                                 OK
MVHR efficiency:                        89%
Minimum:                                70%                                                 OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Medium                                              OK
Based on:
Overshading:                            Average
Windows facing North East:              16.97 m², No overhang
Windows facing North West:              9.99 m², No overhang
Air change rate:                        6.00 ach
Blinds/curtains:                        None
----------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Window U-value                          0.70 W/m²K
Air permeability                        3.0 m³/m²h
Community CHP, Mains gas



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

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	71.0000 (1b)	x	2.6000 (2b)	=	184.6000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 71.0000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	184.6000	(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							0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 75.6500 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2843	0.2811	0.2779	0.2620	0.2588	0.2429	0.2429	0.2397	0.2493	0.2588	0.2652	0.2716	(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	
Windows (Uw = 0.70)			26.9600	0.6809	18.3580			(27)
External Wall	53.1700	26.9600	26.2100	0.5400	14.1534			(29a)
Total net area of external elements Aum(A, m2)			53.1700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	32.5114			(33)
Party Wall			42.1400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.5123 (36)
Total fabric heat loss (33) + (36) = 37.0237 (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	17.3197	17.1256	16.9314	15.9605	15.7663	14.7955	14.7955	14.6013	15.1838	15.7663	16.1547	16.5430	(38)
Heat transfer coeff	54.3434	54.1492	53.9551	52.9842	52.7900	51.8191	51.8191	51.6250	52.2075	52.7900	53.1784	53.5667	(39)

Average = Sum(39)m / 12 = 52.9356 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7654	0.7627	0.7599	0.7463	0.7435	0.7298	0.7298	0.7271	0.7353	0.7435	0.7490	0.7545	(40)
HLP (average)												0.7456	(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 2.2702 (42)
Average daily hot water use (litres/day) 88.1162 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9278	93.4032	89.8785	86.3539	82.8292	79.3046	79.3046	82.8292	86.3539	89.8785	93.4032	96.9278	(44)
Energy conte	143.7412	125.7169	129.7286	113.1005	108.5227	93.6468	86.7775	99.5785	100.7678	117.4351	128.1896	139.2056	(45)
Energy content (annual)										Total = Sum(45)m =		1386.4109	(45)
Distribution loss (46)m = 0.15 x (45)m	21.5612	18.8575	19.4593	16.9651	16.2784	14.0470	13.0166	14.9368	15.1152	17.6153	19.2284	20.8808	(46)

Water storage loss:
Store volume 1.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 0.2000 (48)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Temperature factor from Table 2b												1.0000	(49)
Enter (49) or (54) in (55)												0.2000	(55)
Total storage loss	6.2000	5.6000	6.2000	6.0000	6.2000	6.0000	6.2000	6.2000	6.0000	6.2000	6.0000	6.2000	(56)
If cylinder contains dedicated solar storage	6.2000	5.6000	6.2000	6.0000	6.2000	6.0000	6.2000	6.2000	6.0000	6.2000	6.0000	6.2000	(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	173.2036	152.3281	159.1910	141.6125	137.9851	122.1588	116.2399	129.0409	129.2798	146.8975	156.7016	168.6680	(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	173.2036	152.3281	159.1910	141.6125	137.9851	122.1588	116.2399	129.0409	129.2798	146.8975	156.7016	168.6680	(64)
Total per year (kWh/year) = Sum(64)m =												1733.3069	(64)
Heat gains from water heating, kWh/month	71.3639	63.0898	66.7047	60.4155	59.6537	53.9472	52.4235	56.6798	56.3149	62.6171	65.4326	69.8558	(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	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.7962	15.8065	12.8547	9.7318	7.2746	6.1416	6.6362	8.6260	11.5777	14.7006	17.1578	18.2908	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	199.6196	201.6911	196.4711	185.3585	171.3309	158.1468	149.3391	147.2676	152.4876	163.6002	177.6279	190.8119	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	(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)	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	(71)
Water heating gains (Table 5)	95.9192	93.8837	89.6568	83.9105	80.1797	74.9266	70.4616	76.1825	78.2151	84.1628	90.8787	93.8922	(72)
Total internal gains	370.3874	368.4336	356.0350	336.0531	315.8376	296.2673	283.4892	289.1284	299.3328	319.5159	342.7166	360.0473	(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	16.9700	11.2829	0.4000	0.0000	0.7700	58.9732	(75)
Northwest	9.9900	11.2829	0.4000	0.0000	0.7700	34.7167	(81)

Solar gains	93.6899	190.7086	343.5962	564.2836	758.5079	808.6497	756.4753	603.0708	418.6773	233.0610	117.8862	76.5119	(83)
Total gains	464.0773	559.1421	699.6312	900.3368	1074.3455	1104.9171	1039.9645	892.1993	718.0101	552.5769	460.6028	436.5592	(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	36.2918	36.4220	36.5530	37.2228	37.3598	38.0597	38.0597	38.2029	37.7766	37.3598	37.0869	36.8181	
alpha	3.4195	3.4281	3.4369	3.4815	3.4907	3.5373	3.5373	3.5469	3.5184	3.4907	3.4725	3.4545	
util living area	0.9480	0.9090	0.8158	0.6317	0.4404	0.2972	0.2184	0.2644	0.4786	0.7748	0.9171	0.9559	(86)
MIT	19.6425	19.9435	20.3844	20.7882	20.9477	20.9903	20.9976	20.9953	20.9513	20.6460	20.0743	19.5928	(87)
Th 2	20.2834	20.2858	20.2882	20.3002	20.3025	20.3145	20.3145	20.3169	20.3097	20.3025	20.2978	20.2930	(88)
util rest of house	0.9417	0.8989	0.7978	0.6048	0.4104	0.2661	0.1847	0.2257	0.4360	0.7469	0.9061	0.9506	(89)
MIT 2	18.4484	18.8789	19.4965	20.0453	20.2457	20.3056	20.3128	20.3135	20.2618	19.8759	19.0801	18.3836	(90)
Living area fraction									fLA = Living area / (4) =			0.3762	(91)
MIT	18.8976	19.2794	19.8305	20.3248	20.5098	20.5632	20.5704	20.5700	20.5212	20.1656	19.4541	18.8385	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8976	19.2794	19.8305	20.3248	20.5098	20.5632	20.5704	20.5700	20.5212	20.1656	19.4541	18.8385	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9268	0.8822	0.7852	0.6058	0.4194	0.2774	0.1973	0.2401	0.4493	0.7411	0.8905	0.9367	(94)
Useful gains	430.1071	493.2928	549.3526	545.4293	450.5434	306.5452	205.2077	214.2178	322.5719	409.5020	410.1858	408.9371	(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	793.2848	778.6321	719.2473	605.3327	465.0687	309.0081	205.7431	215.2738	335.2323	504.9690	656.9717	784.1365	(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	270.2042	191.7481	126.4017	43.1305	10.8068	0.0000	0.0000	0.0000	0.0000	71.0274	177.6858	279.1484	(98)
Space heating												1170.1529	(98)
Space heating per m2											(98) / (4) =	16.4810	(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	487.0999	383.4616	392.3497	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9831	0.9904	0.9841	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	478.8904	379.7622	386.1005	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1367.7898	1290.4323	1118.7320	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	640.0075	677.5385	545.0779	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1862.6239	(104)
Cooled fraction										fC = cooled area / (4) =		0.7413	(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	118.6042	125.5593	101.0121	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												345.1757	(107)
Space cooling per m2												4.8616	(108)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Combined Heat and Power	0.7500	(303a)
Fraction of heat from community Boilers	0.2500	(303b)
Fraction of total space heat from community Combined Heat and Power	0.7500	(304a)
Fraction of total space heat from community Boilers	0.2500	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	1170.1529	(98)
Space heat from Combined Heat and Power = (98) x 0.75 x 1.00 x 1.05	921.4954	(307a)
Space heat from Boilers = (98) x 0.25 x 1.00 x 1.05	307.1651	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	1733.3069	(64)
Water heat from Combined Heat and Power = (64) x 0.75 x 1.00 x 1.05	1364.9792	(310a)
Water heat from Boilers = (64) x 0.25 x 1.00 x 1.05	454.9931	(310b)
Electricity used for heat distribution	30.4863	(313)
Cooling System Energy Efficiency Ratio	5.0625	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	68.1829	(315)
Annual totals kWh/year		
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7000)		
mechanical ventilation fans (SFP = 0.7000)	157.6484	(330a)
Total electricity for the above, kWh/year	157.6484	(331)
Electricity for lighting (calculated in Appendix L)	314.2871	(332)
Total delivered energy for all uses	3588.7512	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			41.7500	(361)
Heat efficiency of CHP unit			44.2500	(362)
Space heating from Combined Heat and Power	2082.4756	0.2160	449.8147	(363)
less credit emissions for electricity	-869.4336	0.5190	-451.2360	(364)
Water heating from Combined Heat and Power	3084.6987	0.2160	666.2949	(365)
less credit emissions for electricity	-1287.8617	0.5190	-668.4002	(366)
Efficiency of heat source Boilers			89.5000	(367b)
Space heating from Boilers	851.5734	0.2160	183.9399	(368)
Electrical energy for heat distribution	30.4863	0.5190	15.8224	(372)
Total CO2 associated with community systems			196.2357	(373)
(negative value allowed since DFEE <= TFEE)				
Space and water heating			196.2357	(376)
Space cooling	68.1829	0.5190	35.3869	(377)
Pumps and fans	157.6484	0.5190	81.8195	(378)
Energy for lighting	314.2871	0.5190	163.1150	(379)
Total CO2, kg/year			476.5571	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			6.7100	(384)

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

DER		6.7100	ZC1
Total Floor Area	TFA	71.0000	
Assumed number of occupants	N	2.2702	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.6606	ZC2
CO2 emissions from cooking, equation (L16)		2.4434	ZC3
Total CO2 emissions		25.8141	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		25.8141	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

		Area (m2)			Storey height (m)			Volume (m3)	
Ground floor		71.0000	(1b)	x	2.6000	(2b)	=	184.6000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0000								(4)
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	184.6000	(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) =	0.1625	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4125	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3506	(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	0.4471	0.4383	0.4295	0.3857	0.3769	0.3331	0.3331	0.3243	0.3506	0.3769	0.3945	0.4120	(22b)
Effective ac	0.5999	0.5961	0.5922	0.5744	0.5710	0.5555	0.5555	0.5526	0.5615	0.5710	0.5778	0.5849	(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	
TER Opening Type Curtain (Uw = 1.50)			17.7400	1.4151	25.1038			(27)
External Wall	53.1700	17.7400	35.4300	0.1800	6.3774			(29a)
Total net area of external elements Aum(A, m2)			53.1700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	31.4812			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		5.2209	(36)
Total fabric heat loss	(33) + (36) =	36.7021	(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	36.5467	36.3103	36.0786	34.9902	34.7866	33.8387	33.8387	33.6632	34.2038	34.7866	35.1985	35.6292	(38)
Heat transfer coeff	73.2487	73.0123	72.7806	71.6923	71.4887	70.5408	70.5408	70.3652	70.9059	71.4887	71.9006	72.3313	(39)
Average = Sum(39)m / 12 =												71.6913	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0317	1.0283	1.0251	1.0098	1.0069	0.9935	0.9935	0.9911	0.9987	1.0069	1.0127	1.0188	(40)
HLP (average)												1.0097	(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	2.2702	(42)
Average daily hot water use (litres/day)	88.1162	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9278	93.4032	89.8785	86.3539	82.8292	79.3046	79.3046	82.8292	86.3539	89.8785	93.4032	96.9278	(44)
Energy conte	143.7412	125.7169	129.7286	113.1005	108.5227	93.6468	86.7775	99.5785	100.7678	117.4351	128.1896	139.2056	(45)
Energy content (annual)										Total = Sum(45)m =		1386.4109	(45)
Distribution loss (46)m = 0.15 x (45)m	21.5612	18.8575	19.4593	16.9651	16.2784	14.0470	13.0166	14.9368	15.1152	17.6153	19.2284	20.8808	(46)

Water storage loss:		
Store volume	1.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	0.2134	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.1152	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	3.5715	3.2259	3.5715	3.4563	3.5715	3.4563	3.5715	3.5715	3.4563	3.5715	3.4563	3.5715	(56)

If cylinder contains dedicated solar storage

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	3.5715	3.2259	3.5715	3.4563	3.5715	3.4563	3.5715	3.5715	3.4563	3.5715	3.4563	3.5715	(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	170.5750	149.9540	156.5625	139.0688	135.3565	119.6151	113.6114	126.4124	126.7360	144.2690	154.1579	166.0395	(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	170.5750	149.9540	156.5625	139.0688	135.3565	119.6151	113.6114	126.4124	126.7360	144.2690	154.1579	166.0395	(64)
Total per year (kWh/year) = Sum(64)m =												1702.3582	(64)
Heat gains from water heating, kWh/month	69.2610	61.1905	64.6019	58.3805	57.5509	51.9122	50.3206	54.5770	54.2799	60.5143	63.3977	67.7530	(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	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.7962	15.8065	12.8547	9.7318	7.2746	6.1416	6.6362	8.6260	11.5777	14.7006	17.1578	18.2908	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	199.6196	201.6911	196.4711	185.3585	171.3309	158.1468	149.3391	147.2676	152.4876	163.6002	177.6279	190.8119	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	(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)	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	(71)
Water heating gains (Table 5)	93.0928	91.0573	86.8305	81.0841	77.3533	72.1003	67.6353	73.3561	75.3888	81.3364	88.0523	91.0658	(72)
Total internal gains	370.5610	368.6072	356.2086	336.2268	316.0112	296.4410	283.6628	289.3020	299.5064	319.6895	342.8903	360.2209	(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	11.1600	11.2829	0.6300	0.7000	0.7700	38.4821	(75)
Northwest	6.5800	11.2829	0.6300	0.7000	0.7700	22.6892	(81)

Solar gains	61.1713	124.5160	224.3382	368.4277	495.2391	527.9773	493.9120	393.7524	273.3596	152.1684	76.9693	49.9556	(83)
Total gains	431.7323	493.1232	580.5468	704.6545	811.2503	824.4183	777.5748	683.0544	572.8660	471.8579	419.8596	410.1765	(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	67.3125	67.5304	67.7454	68.7739	68.9697	69.8965	69.8965	70.0709	69.5366	68.9697	68.5746	68.1663	
alpha	5.4875	5.5020	5.5164	5.5849	5.5980	5.6598	5.6598	5.6714	5.6358	5.5980	5.5716	5.5444	
util living area	0.9979	0.9951	0.9830	0.9212	0.7531	0.5393	0.3978	0.4702	0.7751	0.9698	0.9954	0.9984	(86)
MIT	19.9287	20.0737	20.3440	20.7036	20.9268	20.9906	20.9986	20.9966	20.9385	20.6118	20.2111	19.9082	(87)
Th 2	20.0570	20.0598	20.0625	20.0752	20.0776	20.0887	20.0887	20.0908	20.0844	20.0776	20.0728	20.0677	(88)
util rest of house	0.9972	0.9935	0.9772	0.8969	0.6974	0.4662	0.3162	0.3792	0.6997	0.9559	0.9935	0.9979	(89)
MIT 2	18.6241	18.8374	19.2303	19.7389	20.0117	20.0830	20.0882	20.0895	20.0377	19.6270	19.0482	18.6021	(90)
Living area fraction									fLA = Living area / (4) =			0.3762	(91)
MIT	19.1149	19.3025	19.6493	20.1018	20.3560	20.4245	20.4307	20.4307	20.3766	19.9975	19.4857	19.0934	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1149	19.3025	19.6493	20.1018	20.3560	20.4245	20.4307	20.4307	20.3766	19.9975	19.4857	19.0934	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9917	0.9740	0.8977	0.7150	0.4935	0.3469	0.4136	0.7255	0.9544	0.9919	0.9971	(94)
Useful gains	430.0748	489.0328	565.4739	632.5711	580.0770	406.8202	269.7755	282.4852	415.5984	450.3322	416.4721	408.9727	(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	1085.1719	1051.5607	957.0146	803.0828	618.8024	410.8612	270.2208	283.6231	445.0447	671.8142	890.5382	1077.2613	(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	487.3922	378.0188	291.3062	122.7684	28.8117	0.0000	0.0000	0.0000	0.0000	164.7826	341.3276	497.2067	(98)
Space heating												2311.6143	(98)
Space heating per m2											(98) / (4) =	32.5579	(99)

8c. Space cooling requirement

Not applicable

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

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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 %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2472.3147	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	487.3922	378.0188	291.3062	122.7684	28.8117	0.0000	0.0000	0.0000	0.0000	164.7826	341.3276	497.2067	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	521.2751	404.2982	311.5575	131.3031	30.8147	0.0000	0.0000	0.0000	0.0000	176.2381	365.0562	531.7719	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	170.5750	149.9540	156.5625	139.0688	135.3565	119.6151	113.6114	126.4124	126.7360	144.2690	154.1579	166.0395	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.4598	87.1800	86.4480	84.4834	81.4909	79.8000	79.8000	79.8000	79.8000	85.1690	86.8758	87.5608	(217)
Fuel for water heating, kWh/month	195.0325	172.0051	181.1060	164.6108	166.1001	149.8936	142.3702	158.4115	158.8171	169.3914	177.4463	189.6276	(219)

Water heating fuel used	2024.8123	(219)
Annual totals kWh/year		
Space heating fuel - main system	2472.3147	(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)	314.2871	(232)
Total delivered energy for all uses	4886.4141	(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	2472.3147	0.2160	534.0200	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2024.8123	0.2160	437.3595	(264)
Space and water heating			971.3794	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	314.2871	0.5190	163.1150	(268)
Total CO2, kg/m2/year			1173.4194	(272)
Emissions per m2 for space and water heating			13.6814	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2974	(272b)
Emissions per m2 for pumps and fans			0.5482	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.6814 * 1.00) + 2.2974 + 0.5482, rounded to 2 d.p.			16.5300	(273)

Brill Place, Grand Central

Appendix F – SAP Specification

Residential Unit Specification (Coombe Road Development)

Fabric Specification:

Fabric	U-Value(W/m²K)
External wall	0.54 - Curtain wall (Low thermal mass)
Corridor area	Heated
Exposed floor	0.13
Exposed Roof	0.13 (Low thermal mass)
Windows	0.70
Roof light	0.70
Door	1.40
Air permeability : 3.00 $m^3/h.m^2$ @ 50Pa Windows G-value : 0.40 (BFRC Approve) Low Thermal Mass	

Mechanical and Electrical services;

System	Description
Space Heating	Heat Source: Community network with CHP and Gas boiler Boiler efficiency : 89.50% CHP Efficiency : 86.00% CHP heat: 44.25 CHP electrical: 41.75 CHP heat to power ratio 1.06 Distribution loss factor: 1.05 Control: Room thermostat and TRV
Domestic Hot Water	Heat source: same as heating system Type: Heat Interface Unit (HIU) Declared loss factor: 1 liter: 0.2 kWh/day Water use <125 litres/person/day No Cylinder
Background ventilation	MVHR, (WHHR-Maxi Plus BY) Ductwork to be rigid and insulated
Cooling	All occupied area SEER 4.05
Lighting	All fixed lighting installed in apartments to be low energy lamps.