# Brill Place, Grand Central

# Energy Statement



**BRILL PLACE**

Cudd Bentley Consulting

| Record of revisions | | |
|---|---|---|
| **Date.** | **Revision.** | **Description of change.** |
| 13/01/2021 | 1 | Draft for comment |
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| | | |

# Brill Place, Grand Central

## Contents

# Brill Place, Grand Central

## 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 (2019), The London Plan (2016), Intend to Publish London Plan (2019), GLA Energy Assessment Guidance (2018) and the London Borough of Camden Local Plan (Adopted July 2017).

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**

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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.

## Energy Consumption (KWh/Annum)
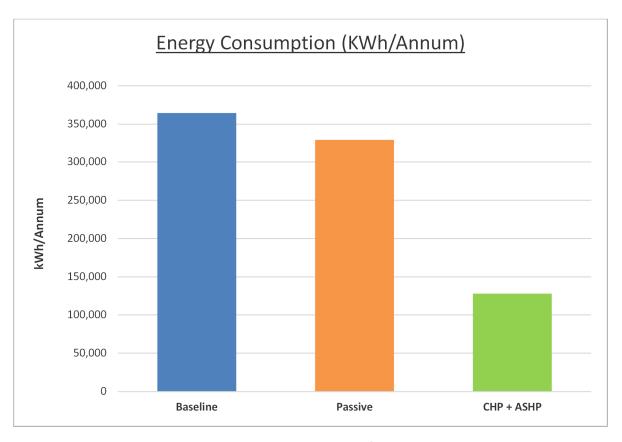


**Figure 1.1 Annual Energy Consumption for the development**

## Carbon Dioxide Emissions (Tonnes $CO_2$/Annum)
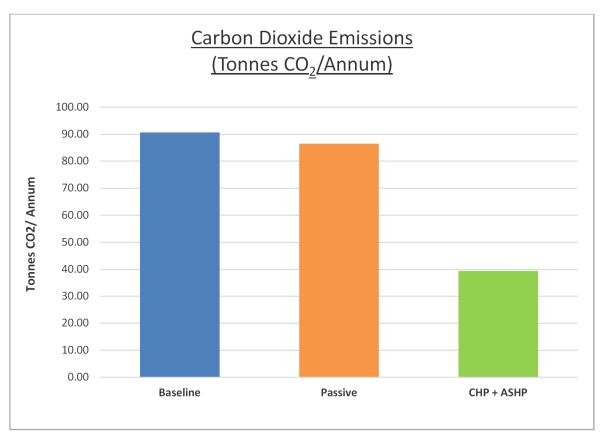


**Figure 1.2 Annual Carbon Emissions for the development**

## 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).

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), 2019, 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, 2019.
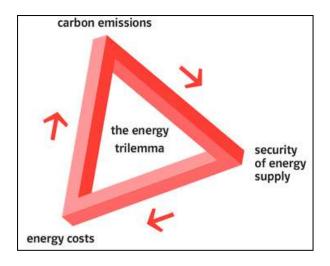


**Figure 3.1 The Energy Trilemma**

Guidance has been followed from the (NPPF) 2019, 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 149**

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 temperatures. 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 150**

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 151**

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 152**

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 153**

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 London Plan (March 2016)**

**Policy 5.2 Minimising Carbon Dioxide Emissions**

Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

- Be Lean: use less energy –This involves the use of passive and energy efficiency design measures to reduce the energy requirement and subsequent carbon footprint of the site. These provide a footprint which delivers compliance with Building Regulations Part L (2013) and the Baseline Energy and Carbon emission figures for the development.

- Be Clean: supply energy efficiently – The use of a central energy centre has been considered to serve the development, to provide the primary heating and cooling requirements for the development.

- Be Green: use renewable energy – The use of renewable energy has been investigated in the context of the site and the overall usage patterns of energy throughout the development.

The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Residential Buildings:

| Year | Improvement on 2010 Building Regulations |
|---|---|
| 2010 – 2013 | 25 per cent (Code for Sustainable Homes level 4)t |
| 2013 – 2016 | 40 per cent |
| 2016 – 2031 | Zero Carbon |

Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy.

As a minimum, energy assessments should include the following details:

- calculation of the energy demand and carbon dioxide emissions covered by Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations (see paragraph 5.22) at each stage of the energy hierarchy
- proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services c proposals to further reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP)
- proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.

The carbon dioxide reduction targets should be met on-site. Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, any shortfall may be provided off-site or through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

The GLAs Energy Planning guidance requires carbon reduction for schemes received on or after the 1st October 2016 to be zero carbon for residential development and 35% below Part L 2013 for commercial development.

The carbon dioxide reduction targets should be met on-site. Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, any shortfall may be provided off-site or through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

Within LDFs boroughs should consider the need to develop more detailed policies and proposals based on the sustainable design principles outlined above and those which are outlined in the Mayor's supplementary planning guidance that are specific to their local circumstances

**Energy Assessment Guidance (October 2018)**

The report will adhere to the guidance as part of the document stated above.
Please note that 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.

**The London Plan (December 2019) – Intend to Publish**

**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.

**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)

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.
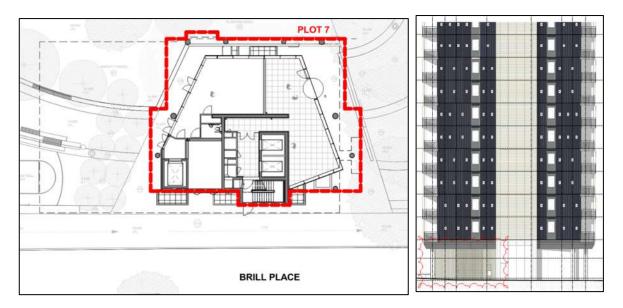


**Figure 5.1 Site Area and South Elevation (Lower levels)**

## 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.

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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 TFEE (kWh/m2 /annum) | Passive DFEE (kWh/m2 /annum) | % Improvement | MWh/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.

| Renewable Technology Feasibility Assessment | | Feasible? |
|---|---|---|
| **Bio Fuel Boilers**<br> | 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.<br><br>Bio-fuel boilers are not proposed for use within the development for the following reasons<br><br>1. Biomass boilers generate increased Oxides of Nitrogen (NOx) and particulates (PM10) which would affect air quality<br><br>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<br><br>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 | No |
| <span>Land Use</span><br><br>Large volumes of storage are required for fuel at ground level or basement level with sufficient vehicular access for fuel delivered.<br><br>Noise<br><br>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. | | |

| Renewable Technology Feasibility Assessment | | Feasible? |
|---|---|---|
| **Wind Turbines**<br> | 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.<br><br>Wind Turbines are not proposed for use within the development for the following reasons:<br><br>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<br><br>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<br><br>3. The financial viability of a small-scale installation on the site would be compromised by the operational efficiency of the units (circa 30%)<br><br>4. Wind turbines can cause electrical interference within a 2km radius<br><br>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. | No |
| Land Use<br><br>The site plans demonstrate that there is in-sufficient space for the allocation of a suitably sized wind turbine.<br><br>Noise<br><br>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. | | |

# Brill Place, Grand Central

| 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 – 14°C. The use of Ground Source Heat Pumps is not recommended for this development for the following reasons:<br>1. Cost of boreholes may be prohibitive (subject to site geological conditions).<br>2. Favourable ground conditions may not exist.<br>3. Problems can arise with boreholes silting up (open-loop).<br>Changes in local ground conditions could affect water quality and the amount that can be extracted (open-loop). | No |
| Land Use<br>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:<br>1. Heating and hot water demand to be provided via CHP | No |
| Land Use<br>Roof space is required for the installation of solar panels; optimum installation is south facing at an angle of 30 degrees.<br><br>Noise<br>Noise levels are generated by pumps at roof level, these are insignificant so should pose no issues. | | |

| Renewable Technology Feasibility Assessment | | Feasible? |
|---|---|---|
| **Air Source Heat Pumps**<br> | 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.<br><br>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. | Yes |
| <u>Land Use</u><br>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.<br><br><u>Noise</u><br>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. | | |
| **Photovoltaics**<br> | Photovoltaic (PV) modules convert sunlight directly to DC electricity. The solar cells consist of a thin piece of semiconductor material, in most cases silicon.<br><br>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. | No |
| <u>Land Use</u><br>There are no land issues or adverse visual impacts as the solar panels are roof mounted.<br><br><u>Noise</u><br>There are no noise issues generated by this technology. | | |

**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.

# Brill Place, Grand Central

## 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**

# Brill Place, Grand Central

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:

## Energy Consumption (KWh/Annum)
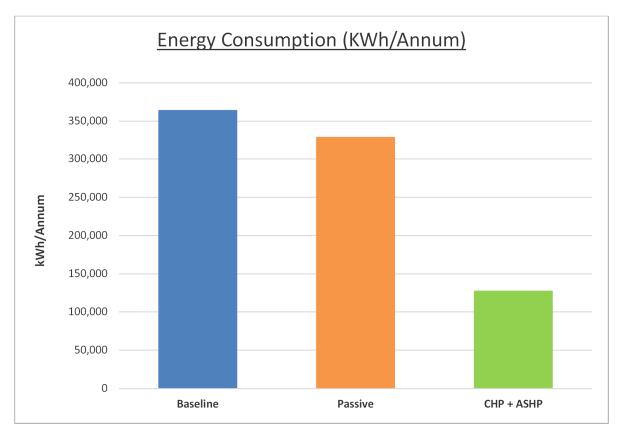


**Figure 10.1 Annual Energy Consumption for the development**

## Carbon Dioxide Emissions (Tonnes $CO_2$/Annum)
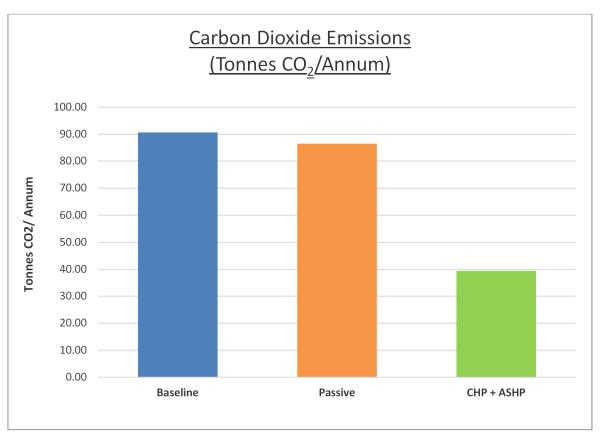


**Figure 10.2 Annual Carbon Emissions for the development**

## 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 $CO_2$ 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**

# Brill Place, Grand Central

## 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 | | REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - TER WORKSHEET | | | | | | | REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.) | | | | | | REGULATED CO2 EMISSIONS PER UNIT | | | | | | | Fabric Energy |
| | | | | Calculated TER 2012 (kgCO2 / m2) | TER Worksheet TER 2012 (kgCO2 / m²) | 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 | Domestic Hot Water | Lighting | Auxiliary | Cooling | SAP10 CO2 emissions (kgCO2 p.a.) | Calculated TER SAP10 (kgCO2 / m2) | Target Fabric Energy Efficiency |
| | | | | TER Workshe et (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 F | 55.14 | 2 | 110.28 | 21.3 | 21.3 | 2528.3095 | Natural Gas | 2103.9553 | Natural Gas | 252.769 | 15 | | 546 | 456 | 131 | 33 | | 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 | 15 | | 669 | 436 | 163 | 33 | | 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 | 1939.7748 | Natural Gas | 2123.2 | Natural Gas | 252.769 | 15 | | 419 | 459 | 131 | 33 | | 1,048 | 407 | 446 | 59 | 17 | | 930 | 16.9 | 48.09 |
| 2 Bed Midd | 71 | 30 | 2130 | 17.1 | 17.1 | 2362.1645 | Natural Gas | 2309.9927 | Natural Gas | 314.2671 | 15 | | 515 | 433 | 163 | 33 | | 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 | 2513.4557 | Natural Gas | 479.3443 | 15 | | 1,022 | 556 | 243 | 33 | | 1,865 | 994 | 540 | 112 | 17 | | 1,663 | 12.3 | 45.38 |
| Sum | 4,497 | 68 | 4,497 | 17.7 | - | 157,044 | N/A | 151,651 | N/A | 19,837 | 5,100 | 0 | 33,322 | 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
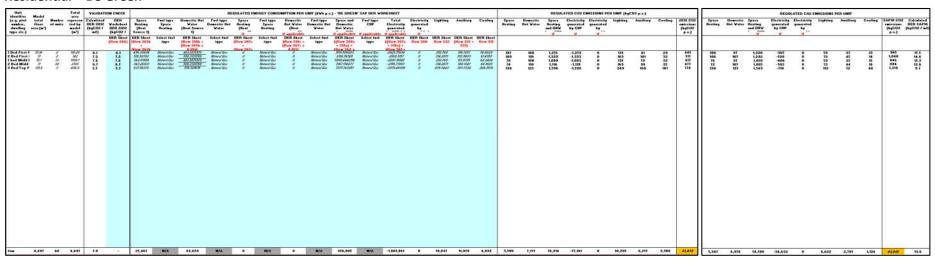
**Residential – Be Lean**

| 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 Calculated DER 2012 (kgCO2 / m2) | DER Worksheet DER 2012 (kgCO2 / m²) DER Sheet (Row 384) | REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE LEAN' SAP DER WORKSHEET Space Heating DER Sheet [(Row 307s) + (Row 367s | Feel type Space Heating Select fuel type | Domestic Hot Water DER Sheet [(Row 310s) + (Row 367s | Feel type Domestic Hot Water Select fuel type | Lighting Row 332 | Auxiliary (Row 315 + 331) | Cooling Row 315 | 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 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) | Fabric Energy Efficiency Dwelling Fabric Energy Efficiency | REGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh Space Heating (kWh p.a.) | Domestic Hot Water (kWh p.a.) | Lighting (kWh p.a.) | Auxiliary (kWh p.a.) | Cooling (kWh p.a.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Bed First F | 55.14 | 2 | 110.28 | 21.0 | 21.0 | 1965.6477 | Natural Gas | 2268.9687 | Natural Gas | 252.769 | 160.3673 | 59.1551 | 425 | 490 | 131 | 84 | 31 | 1,160 | 413 | 476 | 53 | 38 | 14 | 939 | 18.1 | 50.92 | 1965.6477 | 2268.9687 | 252.769 | 160.3673 | 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 | 1706.1 | 18.9 | 18.9 | 1420.1095 | Natural Gas | 2268.9687 | Natural Gas | 252.769 | 156.0035 | 64.7971 | 307 | 490 | 131 | 81 | 34 | 1,043 | 298 | 476 | 53 | 36 | 15 | 885 | 16.1 | 42.66 | 1420.1095 | 2268.9687 | 252.769 | 156.0035 | 65 |
| 2 Bed Midd | 71 | 30 | 2130 | 15.8 | 15.8 | 1341.0689 | Natural Gas | 2462.6107 | Natural Gas | 314.2871 | 192.2621 | 70.5564 | 290 | 532 | 163 | 100 | 37 | 1,121 | 282 | 517 | 73 | 45 | 16 | 933 | 13.1 | 36.33 | 1341.0689 | 2462.6107 | 314.2871 | 192.2621 | 70 |
| 3 Bed Top F | 135.6 | 3 | 406.8 | 12.3 | 12.3 | 2561.5889 | Natural Gas | 2750.9011 | Natural Gas | 473.3443 | 312.5465 | 209.5365 | 553 | 594 | 243 | 162 | 103 | 1,667 | 538 | 578 | 112 | 73 | 49 | 1,349 | 9.9 | 34.67 | 2561.5889 | 2750.9011 | 473.3443 | 312.5465 | 210 |
| **Sum** | **4,497** | **68** | **4,497** | **16.9** | **-** | **39,882** | **N/A** | **161,932** | **N/A** | **19,837** | **12,260** | **4,395** | **21,574** | **34,977** | **10,295** | **6,363** | **2,592** | **75,802** | **20,975** | **34,006** | **4,622** | **2,857** | **1,164** | **63,625** | **14.1** | **33.19** | **39,882** | **161,932** | **19,837** | **12,260** | **4,395** |

# Brill Place, Grand Central

**Residential – Be Green**

**Cudd Bentley** Consulting

## Commercial - Baseline
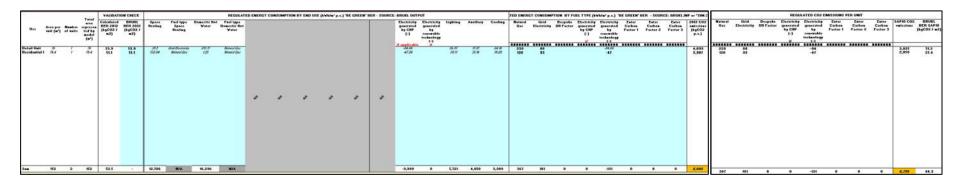
| Building Use | Area per unit (m²) | Number of units | Total area represented by model (m²) | VALIDATION CHECK | | REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) TER - SOURCE: BRUKL OUTPUT | | | | | | | ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) TER - SOURCE: BRUKL.INP | | | | | 2012 CO2 emissions (kgCO2 p.a.) | REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) - TER BRUKL | | | | | REGULATED CO2 EMISSIONS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Calculated TER 2012 (kgCO2/m2) | BRUKL TER 2012 (kgCO2/m2) | Space Heating | Fuel type Space Heating | Domestic Hot Water | Fuel type Domestic Hot Water | Lighting | Auxiliary | Cooling | Natural Gas | Grid Electricity | | | | | Natural Gas | Grid Electricity | | | | 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 | | REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL OUTPUT | | | | | | | CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL.IN | | | | | 2012 CO2 emissions (kgCO2 p.a.) | REGULATED CO2 EMISSIONS PER UNIT | | | | | SAP10 CO2 emissions /kgCO2 | BRUKL BER SAP10 (kgCO2/m2) | REGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh p.a.) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Calculated BER 2012 (kgCO2/m2) | BRUKL BER 2012 (kgCO2/m2) | Space Heating (kWh/m²) | Fuel type Space Heating | Domestic Hot Water (kWh/m²) | Fuel type Domestic Hot Water | Lighting (kWh/m² p.a.) | Auxiliary (kWh/m² p.a.) | Cooling (kWh/m² p.a.) | Natural Gas | Grid Electricity | | | | | Natural Gas | Grid Electricity | | | | | | 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 | 26.81 | Grid Electricity | 118.07 | Natural Gas | 26.57 | 17.97 | 26.57 | 135 | 93 | | | | 5,492 | 135 | 93 | | | | 3,800 | 50.1 | 2,190 | 1,073 | 2,010 | 1,344 | 2,019 |
| Residential L | 76.4 | 1 | 76.4 | 64.2 | 64.2 | 79.12 | Natural Gas | 0.69 | Natural Gas | 26.11 | 35.14 | 18.29 | 75 | 93 | | | | 4,992 | 75 | 93 | | | | 2,846 | 37.3 | 6,013 | 93 | 2,412 | 2,615 | 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 | 10,790 | 210 | 186 | | | | 6,654 | 43.7 | 8,273 | 9,026 | 5,721 | 4,050 | 3,492 |

# Brill Place, Grand Central

**Commercial – Be Green**

# Brill Place, Grand Central
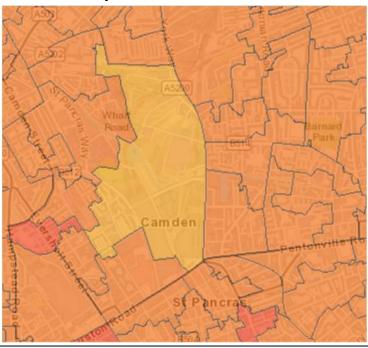
**Appendix B –Wind Data**



**Wind Data Taken from RENSmart Wind Map**

# Brill Place, Grand Central

**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**

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$_2$/m².annum | 66.5 |
| Target $CO_2$ emission rate (TER), kgCO$_2$/m².annum | 66.5 |
| Building $CO_2$ emission rate (BER), kgCO$_2$/m².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 |
|---|---|---|
| m³/(h.m²) 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 | $U_{i\text{-}Typ}$ | $U_{i\text{-}Min}$ | 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 |
|---|---|---|
| m³/(h.m²) 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 [$W/(m^2K)$]

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

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

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

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

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

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

| Air Permeability | Worst acceptable standard | This building |
|---|---|---|
| $m^3/(h.m^2)$ at 50 Pa | 10 | 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 | Zone | Standard |
| Standard value | 0.3 | 1.1 | 0.5 | 1.9 | 1.6 | 0.5 | 1.1 | 0.5 | 1 | | |
| 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 | 79.62 | 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

### 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 |
|---|---|---|
| m³/(h.m²) 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, kgCO₂/m².annum | 66.5 |
| Target $CO_2$ emission rate (TER), kgCO₂/m².annum | 66.5 |
| Building $CO_2$ emission rate (BER), kgCO₂/m².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 | $U_{a\text{-Limit}}$ | $U_{a\text{-Calc}}$ | $U_{i\text{-Calc}}$ | 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 |
|---|---|---|
| m³/(h.m²) 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 | Zone | Standard |
| Standard value | 0.3 | 1.1 | 0.5 | 1.9 | 1.6 | 0.5 | 1.1 | 0.5 | 1 | | |
| 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

### 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 |
|---|---|---|
| m³/(h.m²) at 50 Pa | 5 | 4 |

# Brill Place, Grand Central

**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 | | |
| **CO₂ 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** | | | |

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

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

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      Storey height        Volume
                                                    (m2)           (m)              (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         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                                                                  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)

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   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)                                 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)
```

elmhurst energy

## 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, ni1,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   654.3309   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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-----------------------------------------------------------------------------------------------------
```

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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        Emission factor      Emissions
                                                  kWh/year          kg CO2/kWh         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      Storey height       Volume
                                              (m2)          (m)              (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      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                                                   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    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)                 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)
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)
```

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System) version 4.14r16

## CALCULATION OF TARGET EMISSIONS    09 Jan 2014

```
If cylinder contains dedicated solar storage
           23.3325    21.0745    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       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                        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   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, ni1,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
----------------------------------------------------------------------------------------------
```

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## 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
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          Emission factor        Emissions
                                          kWh/year          kg CO2/kWh           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)
```

elmhurst energy

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Regs Region: England
Elmhurst Energy Systems
SAP2012 Calculator (Design
System) version 4.14r16

# 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 | | |
| **CO₂ 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** | | | |

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

Design SAP
elmhurst energy

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

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



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

elmhurst energy

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Regs Region: England
Elmhurst Energy Systems
SAP2012 Calculator (Design
System) version 4.14r16

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

*Design SAP*
*elmhurst energy*

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**CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE    09 Jan 2014**

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


-------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-------------------------------------------------------------------------------------
                                                    Area          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
```

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## CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE    09 Jan 2014

```
          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)
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)
-------------------------------------------------------------------------------------
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  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        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                   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)
-------------------------------------------------------------------------------------

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, ni1,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       Emission factor       Emissions
                                                    kWh/year        kg CO2/kWh          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


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Regs Region: England
Elmhurst Energy Systems
SAP2012 Calculator (Design
System) version 4.14r16

## 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        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)
```

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## CALCULATION OF TARGET EMISSIONS    09 Jan 2014

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


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, ni1,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 (90)
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)
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
```

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Regs Region: England
Elmhurst Energy Systems
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System) version 4.14r16

**CALCULATION OF TARGET EMISSIONS     09 Jan 2014**

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---------------------------------------------------------------------------------------
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
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
(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      Emission factor        Emissions
                                                    kWh/year       kg CO2/kWh           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 | | |
| **CO₂ 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
------------------------------------------------------------------------------------------

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 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER)  6.71 kgCO□/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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Regs Region: England
Elmhurst Energy Systems
SAP2012 Calculator (Design
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elmhurst energy

## 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      Storey height        Volume
                                                 (m2)            (m)             (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       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)                                  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)
```

Regs Region: England
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## 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  Solar input (sum of months) = Sum(63)m =   0.0000 (63)
                                                                                              0.0000      0.0000      0.0000      0.0000      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)
```
---

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)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>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, ni1,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
```

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## 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       Emission factor      Emissions
                                             kWh/year        kg CO2/kWh        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
```

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## 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      Storey height       Volume
                                              (m2)           (m)            (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        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                                               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    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)                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)
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
```

## CALCULATION OF TARGET EMISSIONS    09 Jan 2014

```
                  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, ni1,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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elmhurst energy

Regs Region: England
Elmhurst Energy Systems
SAP2012 Calculator (Design
System) version 4.14r16

## CALCULATION OF TARGET EMISSIONS     09 Jan 2014

```
-------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                    0.0000 (201)
Fraction of space heat from main system(s)                                               1.0000 (202)
Efficiency of main space heating system 1 (in %)                                        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
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
(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      Emission factor        Emissions
                                                   kWh/year       kg CO2/kWh           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 m³/h.m² @ 50Pa<br>Windows G-value : 0.40 (BFRC Approve)<br>Low Thermal Mass | |

**Mechanical and Electrical services;**

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