

Hillingdon Gardens,
London Borough of Hillingdon.

Energy Statement



Cudd
Bentley
Consulting

Cudd Bentley Consulting Ltd.
Ashurst Manor, Church lane,
Sunninghill,
Berkshire,
SL5 7DD.
Tel: (01344) 628821
Fax: (01344) 623448
www.cuddbentley.co.uk

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1.0 Executive Summary

This preliminary report considers the predicted energy demand for the proposed development at the Hillingdon Gardens development.

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), The Draft London Plan (2019), GLA Energy Assessment Guidance (2018), and the London Borough of Hillingdon Local Plan (2018).

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 Collado Collins Architects.

This report includes annualised baseline calculations which predict the likely energy consumption and associated CO₂ emissions for the development. The total baseline energy and carbon emissions for the entire development, taking into account regulated energy demands are:

- **1,791,425.83 kWh/annum**
- **585.49 Tonnes CO₂/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:

- **814,753.72 kWh/annum**
- **427.88 Tonnes CO₂/annum**

The following energy hierarchy is to be 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 through installing a site wide Air Source Heat Pump (ASHP) district heating;
3. Be Green; Reduce energy and carbon emissions by installing Low or Zero Carbon (LZC) Technologies, such as Solar panels, Photovoltaics, Wind Turbines *etc.*

Be Lean

The reduced total baseline energy and carbon emissions for the development, taking into the following passive and energy efficiency measures, will be determined:

- The provision of energy efficient lighting and display lighting;
- Photoelectric and occupancy sensor lighting controls within relevant building areas;
- The provision of time and temperature zone control;
- The provision of metering on the HVAC system;
- Specific Fan Powers improved beyond Part L requirements.

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:

- **1,644,809.0 kWh/annum**
- **533.55 Tonnes CO₂/annum**

Be Clean

The use of Air Source Heat Pumps (ASHP) is proposed in a central block-by-block heat pump system for each building, which will provide heating and hot water for the residential units. The plant allocation space required by a building by building system is to be spread across each building. A route for pipework to connect all buildings will be indicated, and future connections to a district heating network shall be provided from one of the buildings to the site boundary (including indicative area for a heat interface unit within the plant room).

Connection to an existing district heating networks was investigated. However, there are currently no existing Heat distribution networks available locally. In order to economically justify installing a CHP unit on site, a minimum requirement of 4000 hours running time per year is necessary. Based on the number of proposed units and the resulting heating and the hot water demand, it is not recommended to install a central CHP plant.

Be Green

A range of low or zero carbon technologies have been considered for incorporation within the proposed development; it has been proposed that Air Source Heat Pumps (ASHP) and a 155.65 kWp Solar PV array (circa 556 panels; 929 sq.m) are incorporated into 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 PV at roof level and the ASHP into both the residential and commercial elements of the development, the total baseline energy and carbon emissions for the development, taking into account regulated energy demands have further reduced to:

- **1,498,700.00 kWh/annum**
- **361.65 Tonnes CO₂/annum**

Proposed Energy Strategy:

In summary the energy strategy comprises of:

- Passive Design and Energy Efficient Measures (Section 7.0);
- Air Source Heat Pumps (ASHP) (Section 9.0);
- Solar Photovoltaics (PV) (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.

This review has resulted in the formulation of an Energy Strategy to be adopted for the development involving the use of passive design and energy efficiency measures, and the installation of Air Source Heat Pumps, and a 155.65 kWp solar PV array. Tables 1.1 and 1.2 details the strategies for both the residential and commercial elements, respectfully. Tables 1.3 and 1.4 highlight the carbon and energy savings that are currently anticipated for the development from a base Part L 2013 compliant build:

Residential Element	
Heating	Individual Building ASHP system
Hot water (DHW)	Individual Building ASHP system
Cooling	N/A
Ventilation	Mechanical ventilation with heat recovery (MVHR) where required.
Lighting	Energy efficient LED lighting where applicable

Table 1.1: Proposed Energy Strategy for Residential Element

Commercial Element	
Heating	Stand-alone ASHP system
Hot water (DHW)	Class use A1 = Electric Point of Use Class Use A3 = Stand Alone ASHP
Cooling	Stand-alone ASHP system
Ventilation	Mechanical ventilation with heat recovery (MVHR)
Lighting	Energy efficient LED lighting

Table 1.2: Proposed Energy Strategy for Commercial Element

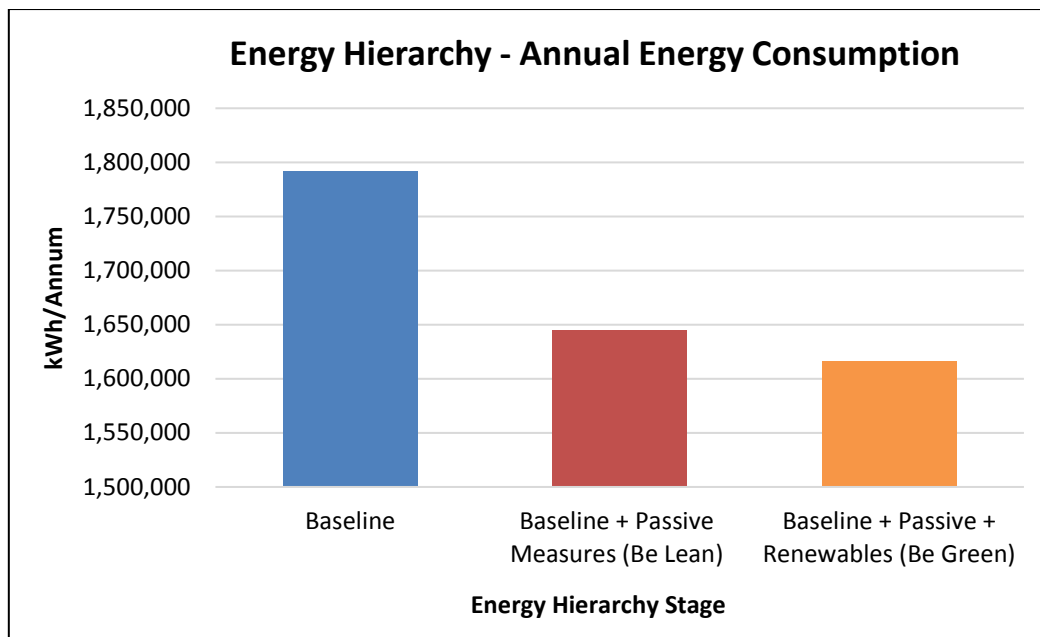
Development	Carbon Dioxide Emissions (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline : Part L 2013 of the Building Regulations Compliant Development	585.49	427.88
After Energy Demand Reduction	533.55	It is anticipated that a circa 3% saving can be achieved through the use of energy efficient fittings, for example A or A+ appliances. This would reduce the unregulated carbon emissions to: 415.04
After ASHP	422.56	-
After PV	361.65	-

Table 1.3: Carbon Dioxide Emissions of Development

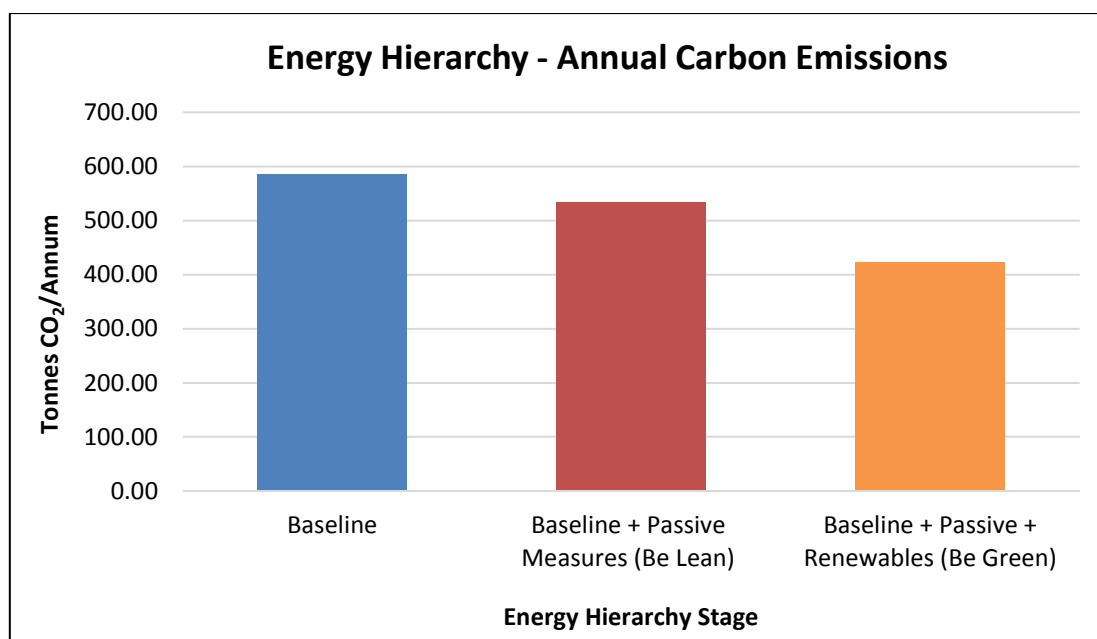
Development	Regulated Carbon Dioxide Savings	
	Tonnes CO ₂ per annum	%
Savings from energy demand reduction	51.64	8.87
Savings from ASHP	110.99	18.96
Savings from PV	60.91	10.40
Total Cumulative Savings	223.84	38.23

Table 1.4 Regulated Carbon Savings of Development

The development shall have an anticipated CO₂ improvement of 38.23 % beyond Part L 2013, complying with local policy requirements set out by The London Borough of Hillingdon's local plan and The Adopted London Plan. The energy and carbon savings achieved can be visually represented as per graphs 1.1 and 1.2 below:



Graph 1.1: Annual Energy Savings



Graph 1.2: Annual Carbon Savings

2.0 Introduction

This report has been prepared by Cudd Bentley Consulting to develop an energy strategy for the proposed Hillingdon Gardens development, within the London Borough of Hillingdon. The works involves the construction of a residential-led, mixed-use development comprising buildings of between 2 and 11 storeys containing 514 units (Use Class C3); flexible commercial units (Use Class B1/A1/A3/D1); associated car (164 spaces) and cycle parking spaces; refuse and bicycle stores; hard and soft landscaping including a new central space, greenspaces, new pedestrian links; biodiversity enhancement; associated highways infrastructure; plant; and other associated ancillary development. This document will be considered 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 communal ASHP Plants to provide the heating and hot water requirements for the residential element; (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.

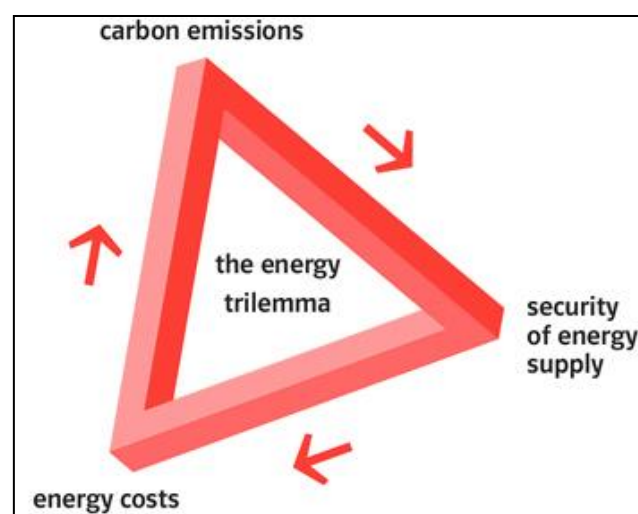


Figure 3.1: The Energy Trilemma

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.

Draft London Plan – Consolidated Changes Version (July 2019)

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.

- 3A. 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.
- a. 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.
 - b. 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.

LBH Local Plan Part 1 Strategic Policies (2012)

Policy EM1: Climate Change Adaptation and Mitigation

The Council will ensure that climate change mitigation is addressed at every stage of the development process by:

1. Prioritising higher density development in urban and town centres that are well served by sustainable forms of transport.
2. Promoting a modal shift away from private car use and requiring new development to include innovative initiatives to reduce car dependency.
3. Ensuring development meets the highest possible design standards whilst still retaining competitiveness within the market.
4. Working with developers of major schemes to identify the opportunities to help provide efficiency initiatives that can benefit the existing building stock.
5. Promoting the use of decentralised energy within large scale development whilst improving local air quality levels.
6. Targeting areas with high carbon emissions for additional reductions through low carbon strategies. These strategies will also have an objective to minimise other pollutants that impact on local air quality. Targeting areas of poor air quality for additional emissions reductions.
7. Encouraging sustainable techniques to land remediation to reduce the need to transport waste to landfill. In particular developers should consider bioremediation as part of their proposals.

8. Encouraging the installation of renewable energy for all new development in meeting the carbon reduction targets savings set out in the London Plan. Identify opportunities for new sources of electricity generation including anaerobic digestion, hydroelectricity and a greater use of waste as a resource.
9. Promoting new development to contribute to the upgrading of existing housing stock where appropriate.

The Borough will ensure that climate change adaptation is addressed at every stage of the development process by:

10. Locating and designing development to minimise the probability and impacts of flooding.
11. Requiring major development proposals to consider the whole water cycle impact which includes flood risk management, foul and surface water drainage and water consumption.
12. Giving preference to development of previously developed land to avoid the loss of further green areas.
13. Promoting the use of living walls and roofs, alongside sustainable forms of drainage to manage surface water run-off and increase the amount of carbon sinks.
14. Promoting the inclusion of passive design measures to reduce the impacts of urban heat effects.

LBH Local Plan Part 2 Development Management Policies (2019)

Policy DME2: Reducing Carbon Emissions

- A. All developments are required to make the fullest contribution to minimising carbon dioxide emissions in accordance with London Plan targets.
- B. All major development proposals must be accompanied by an energy assessment showing how these reductions will be achieved.
- C. Proposals that fail to take reasonable steps to achieve the required savings will be resisted. However, where it is clearly demonstrated that the targets for carbon emissions cannot be met onsite, the Council may approve the application and seek an offsite contribution to make up for the shortfall.

Policy DMEI 3: Decentralised Energy

- A. All major developments are required to be designed to be able to connect to a Decentralised Energy Network (DEN).
- B. Major developments located within 500 metres of an existing DEN, and minor new-build developments located within 100 metres, will be required to connect to that network, including provision of the means to connect to that network and a reasonable financial contribution to the connection charge, unless a feasibility assessment demonstrates that connection is not reasonably possible.
- C. Major developments located within 500 metres of a planned future DEN, which is considered by the Council likely to be operational within 3 years of a grant of planning permission, will be required to provide a means to connect to that network and developers shall provide a

reasonable financial contribution for the future cost of connection and a commitment to connect via a legal agreement or contract, unless a feasibility assessment demonstrates that connection is not reasonably possible.

- D. The Council will support the development of DENs and energy centres in principle, subject to meeting the wider policy requirements of this plan and in particular on design and air quality.

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 feasibility of connecting into an existing district heat network and where this is not available investigate the feasibility of providing a communal ASHP CHP Plant to serve the base heating and hot water requirements for the development;
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 development works involves the construction of a residential-led, mixed-use development comprising buildings of between 2 and 11 storeys containing 514 units (Use Class C3); flexible commercial units (Use Class B1/A1/A3/D1); associated car (164 spaces) and cycle parking spaces; refuse and bicycle stores; hard and soft landscaping including a new central space, greenspaces, new pedestrian links; biodiversity enhancement; associated highways infrastructure; plant; and other associated ancillary development. This document will be considered as part of the planning application.

The proposed site plan of the development can be seen below in Figures 5.1



Figure 5.1: Proposed Site Plan

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, computer calculations have been completed using approved SBEM software (Hevacomp V8i SS1 SP1) and SAP software (JPA Designer, Version 9.92) for the residential element. 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:

- **1,791,425.83 kWh/annum**
- **585.49 Tonnes CO₂/annum**

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

7.0 Passive Design and Energy Efficient Measures – Be Lean

Passive design measures will include targeting upgraded construction details above the minimum requirements as detailed in Part L1A (2013) for the residential element, as detailed below:

- External Walls - $U = 0.16 \text{ W/m}^2.\text{K};$
- Exposed Floors - $U = 0.11 \text{ W/m}^2.\text{K};$
- Exposed Roofs - $U = 0.11 \text{ W/m}^2.\text{K};$
- Glazing - $U = 1.2 \text{ W/m}^2.\text{K};$ G' value of 0.36;
- Air Permeability - $3 \text{ m}^3/\text{hr/m}^2 @ 50 \text{ Pa};$

Please note that the Accredited Construction Details are to achieve the details highlighted within Table K1 of Appendix K of Part L 2013.

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.

- External Walls - $U = 0.20 \text{ W/m}^2.\text{K};$
- Exposed Floors - $U = 0.20 \text{ W/m}^2.\text{K};$
- Exposed Roofs - $U = 0.16 \text{ W/m}^2.\text{K};$
- Glazing - $U = 1.4 \text{ W/m}^2.\text{K};$ G' value of 0.36;
- Air Permeability - $5 \text{ m}^3/\text{hr/m}^2 @ 50 \text{ Pa}.$

In conjunction with the GLAs Energy Assessment Guidance, the domestic element of the development will target a 10% carbon emission improvement beyond Part L from passive and energy efficiency measures. Similarly, the non-domestic development will target 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:

- High performance double glazing with low G values and shading co-efficient to limit the effects of solar gain;
- Mechanical Whole House Ventilation with Heat Recovery;
- The provision of energy efficient lighting;
- The provision of time and temperature zone control on HVAC systems;
- Improved specific fan powers.

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 passive measures the total energy and carbon emissions for the development (built to Part L 2013) are reduced to:

- **1,644,809 kWh/annum**
- **533.55 Tonnes CO₂/annum**

7.1 Fabric Energy Efficiency (FEE)

The developments 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 7.1.

Unit	Quantity	Baseline	Passive	% Improvement	MWh/Annum
		DFEE (kWh/m ² /annum)	DFEE (kWh/m ² /annum)		
Ground Floor 1 Bed	9	31.5	28.1	10.79	12.90
Mid Floor 1 Bed	189	23.2	21.2	8.62	204.35
Top Floor 1 Bed	23	30	27.3	9.00	32.02
Ground Floor 2 Bed	5	39.2	36.4	7.14	14.38
Mid Floor 2 Bed	183	31.4	29.1	7.32	420.70
Top Floor 2 Bed	28	37.8	35.2	6.88	77.86
Ground Floor 3 Bed	13	33.4	31.3	6.29	36.21
Mid Floor 3 Bed	57	26	24.4	6.15	123.78
Top Floor 3 Bed	7	32.3	30.2	6.50	18.81

Table 7.1: Fabric Energy Efficiency Performance

7.2 Overheating Assessment

An overheating assessment has been undertaken for a sample number of units of the residential element, corridor spaces, and the commercial elements in order to assess the overheating risk to occupants. This assessment followed CIBSE guidance TM59 for the residential element and TM52 for the commercial element. The overheating assessment is appended within Appendix D.

7.3 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 7.3. Please note that an overheating checklist as displayed within Appendix 5 of the GLAs Energy Assessment Guidance (2018) has been compiled and is displayed within Appendix G.

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 are to unable to be provided due to acoustic reasons.
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 ASHP's for cooling which are considered as low or zero carbon technology.

Table 7.3: Part L Building Regulations Applicable

The actual and notational cooling demand of the commercial units within building 1 and 2 has been calculated via the SBEM modelling software and is displayed below in Table 7.3. 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/m2)		
	Building 1	Building 2
Actual	196.1	204.7
Notational	204.7	218.2

Table 7.3: Non-Domestic Cooling Demand

8.0 Decentralised Energy – Be Clean

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 SI1 (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 Heat Networks

Existing District Heating Networks have been investigated through the London Heat Map from the GLA which confirms there is no district heating network to which a connection is technically feasible (As shown in Figure 8.1). The red line within Figure 1 displays available district heat networks, which is not in proximity to the development shown by the black dot.

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.

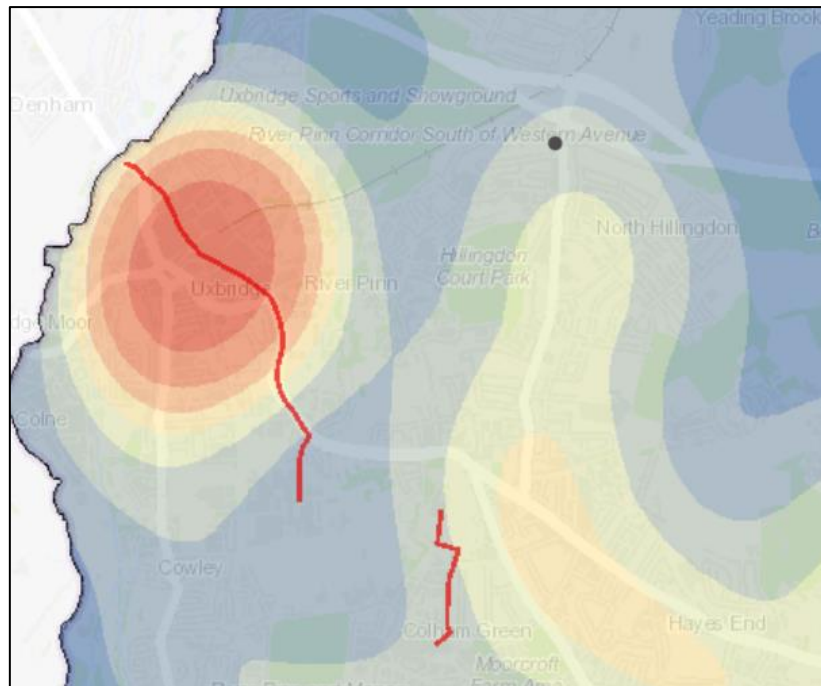


Figure 8.1: London Heat Map

8.2 Site-Wide Decentralised Heat Network

The use of Air Source Heat Pumps (ASHP) is proposed in a central block-by-block heat pump system for each building, which will provide heating and hot water for the residential units. Appendix C displays the additional ASHP details that is to be provided. The plant allocation space required by a building by building system is to be spread across each building, with indicative locations are shown in Appendix C. A route for pipework to connect all buildings will be indicated, and future connections to a district heating network shall be provided from one of the buildings to the site boundary (including indicative area for a heat interface unit within the plant room). The pipework to connect all buildings will not be installed at this time due to:-

- Contamination;
- Potential for mechanical damage;
- Deterioration of pipework;
- Future issues with pressure testing i.e. leaks.

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

- For the provision of a CHP system to be commercially viable, a base load (in this case heating and domestic hot water) must extend for a minimum operational period of 4,000 – 5,000 hours per annum, the anticipated individual CHP operation hours can be seen in Table 8.1 to be lower than the required minimum operation period.

- Within Appendix 3 of the GLA Energy Assessment Guidance (2018) it states that it is not generally considered economical feasible to install CHP in small to medium residential/mixed use developments.


Months	Load per Day (hrs)	Load per week (hrs)	Load per month (hrs)	Load for 6 months (hrs)	
April to Sept	8	56	224	1344	
October to March	12	84	336	2016	
		Total approximate Load for a year		3360	hours
		Minimum required hours		4000	hours


Table 8.1: Anticipated CHP Operation Hours



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 systems operate with low return temperatures, in line with the CIBSE Heat Networks: Code of Practice for the UK



9.0 Renewable Energy – Be Green

The feasibility of incorporating a range of renewable and low or zero carbon (LZC) technologies within the development has been addressed. Table 9.1 displays the feasibility assessment of on-site renewable / LZC energy, considering their suitability for use on the development.

Renewable Technology Feasibility Assessment		Feasible?
<div><div>Bio Fuel Boilers</div><div></div></div>	<p>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.</p> <p>Bio-fuel boilers are not proposed for use within the development for the following reasons</p> <ol style="list-style-type: none">1. Biomass boilers generate increased Oxides of Nitrogen (NOx) and particulates (PM10) which would affect air quality;2. The requirement of bio-fuel would involve a vehicular movement of articulated lorries fortnightly delivering to the site. As this is a city centre location, this would not be desirable;3. The storage requirements for the biofuel would require a large plant space, with an auxiliary storage facility to allow for a two-week period where delivery of fuel might not be available;	No
<p><u>Land Use</u></p> <p>Large volumes of storage are required for fuel at ground level or basement level with sufficient vehicular access for fuel delivered.</p> <p><u>Noise</u></p> <p>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.</p>		

Renewable Technology Feasibility Assessment		Feasible?
<div>Wind Turbines</div> <div></div>	<p>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</p> <p>Wind Turbines are not proposed for use within the development for the following reasons:</p> <ol style="list-style-type: none">1. Wind turbines are considered inappropriate on spatial, planning, aesthetic and noise grounds due to the urban location. Noise pollution from commercial wind turbines can be quite significant within a few hundred metres;2. The site is not ideal; an ideal site is a hill with a flat, clear exposure. It should be free from strong turbulence and obstructions like large trees, houses or other buildings. As the building is located in an urban area, other buildings will produce turbulence;3. The financial viability of a small-scale installation on the site would be compromised by the operational efficiency of the units (circa 30%);4. Wind turbines can cause electrical interference within a 2km radius;5. Wind speeds for the site can be seen in Appendix B, which shows that at 10m the site has a wind speed of circa 4.8mph, a minimum of 5.5mph is recommended.	No
<div>Land Use</div> <p>The site plans demonstrate that there is in-sufficient space for the allocation of a suitably sized wind turbine.</p> <div>Noise</div> <p>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.</p>		

Renewable Technology Feasibility Assessment		Feasible?
<div>Ground Source Heat Pumps</div> <div></div>	<p>Space heating & cooling can be provided by circulating water heated or cooled directly by the ground or via subterranean water. Ground water cooling 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.</p> <p>Ground Source Heat Pumps are not proposed for use within the development for the following reasons:</p> <ol style="list-style-type: none">1. The installation of ground source heat pumps for this development would involve extensive excavation works which is not appropriate as it is an existing building within an urban London Borough;	No
<div>Land Use</div> <p>This installation would require Environmental Agency approval (if an open loop system connecting to an aquifer is selected). Ground and Hydrology analysis would be required to investigate if favourable conditions exist.</p> <div>Noise</div> <p>There are no noise issues generated by this technology.</p>		
<div>Solar Water Heating</div> <div></div>	<p>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:</p> <ol style="list-style-type: none">1. Roof space best utilised with Solar PV	
<div>Land Use</div> <p>Roof space is required for the installation of solar panels; optimum installation is south facing at an angle of 30 degrees.</p> <div>Noise</div> <p>Noise levels are generated by pumps at roof level, these are insignificant so should pose no issues.</p>		No

Renewable Technology Feasibility Assessment		Feasible?
<div>Air Source Heat Pumps</div> <div></div>	<p>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.</p> <p>Air Source Heat Pumps (ASHP) are proposed for use within to provide the heating and hot water demands of the residential element, as well as the heating, hot water and cooling demand of the commercial element. The benefits of ASHP are as follows:</p> <ol style="list-style-type: none">1. Air Source Heat Pumps are to be utilised on this development, as it is the most efficient way to meet the heating and cooling demands of the development.2. They are ideally suited to serve the individual commercial tenant areas during periods when heating and cooling may be required;3. Air to Air or Air to Water applications can be used to suit the tenant’s bespoke environmental requirements; and4. The heat pump units can be configured to provide internal heat reclaim from dissimilar environmental zones, reducing energy consumption and carbon emissions.	Yes
<p><u>Land Use</u></p> <p>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.</p> <p><u>Noise</u></p> <p>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.</p>		
<div>Photovoltaics</div> <div></div>	<p>Photovoltaic (PV) modules convert sunlight directly to DC electricity. The solar cells consist of a thin piece of semiconductor material, in most cases silicon. A solar PV array (circa 155.65 kWp; 566 Panels; 929 sq.m) is to be implemented into the development due to the following advantages:</p> <ol style="list-style-type: none">1. Photovoltaic panels can be situated at roof level to provide a source of renewable energy.2. Panels can be grid connected to sell surplus electricity produced.3. Low maintenance issues.4. Visual use of renewable energy can be seen by public.	

Renewable Technology Feasibility Assessment	Feasible?
<u>Land Use</u> There are no land issues or adverse visual impacts as the photovoltaics are roof mounted.	
<u>Noise</u> There are no noise issues generated by this technology.	

Table 9.1: Renewable Technology Feasibility Assessment

9.1 Air Source Heat Pumps

Air Source Heat Pump (ASHP) have been specified to provide heating and hot water to the residential element of the development and heating and cooling for the commercial element of the development. The ASHP specification will be determined during detailed design stage however as minimum the following efficiencies shall be targeted.

ASHP Operational Details		
Anticipated Energy Contribution	Heating SEER	Cost to Occupants
1,237,312.33 kWh/annum	3.19	4.01 p/kWh

Table 9.2: ASHP Specification

Based on a 12.8 p/kWh electricity cost, and the seasonal efficiency as per Table 9.2, the expected average cost of cooling to the occupants is circa 4.01 p/kWh. In order to monitor system performance the system will be connected to heat meters and electric meters to determine consumption and operational COP. The heat pumps confirmation of inclusion to the Enhanced Capital Allowances (ECA) schemes in order to target the governments Renewable Heat Incentive (RHI).

Table 9.3, below, states the calculated contribution of the ASHP to the residential and commercial elements heating and cooling requirements, as well as the corresponding CO₂ savings.

Development Element		Contribution by ASHP (kWh/Annum)	CO ₂ Savings (Tonnes/CO ₂)
Commercial	Building 1	5,851.2	3.61
	Building 2	13,333.76	8.21
Residential		1,218,127.37	97.56
Total		1,237,312.33	109.38

Table 9.3: ASHP Contribution

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 Low Zero Carbon technologies and renewable energy. The technologies considered are as follows:

- Decentralised Gas fired CHP;
- Bio-fuel boilers;
- Wind Turbine;
- Ground Source Heat Pump;
- Solar Water Heating;
- Air Source Heat Pump;
- Solar PV

This review has resulted in the formulation of the following energy strategy displayed in Table 10.0 and 10.1.

Residential Element	
Heating	Individual Building ASHP system
Hot water (DHW)	Individual Building ASHP system
Cooling	N/A
Ventilation	Mechanical ventilation with heat recovery (MVHR) where required.
Lighting	Energy efficient LED lighting where applicable

Table 10.0: Proposed Energy Strategy for Residential Element

Commercial Element	
Heating	Stand-alone ASHP system
Hot water (DHW)	Class use A1 = Electric Point of Use Class Use A3 = Stand Alone ASHP
Cooling	Stand-alone ASHP system
Ventilation	Mechanical ventilation with heat recovery (MVHR)
Lighting	Energy efficient LED lighting

Table 10.1: Proposed Energy Strategy for Commercial Element

The following Tables 10.2 to 10.7 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	Carbon Dioxide Emissions (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline : Part L 2013 of the Building Regulations Compliant Development	56.84	12.83
After Energy Demand Reduction	47.68	It is anticipated that a circa 3% saving can be achieved through the use of energy efficient fittings, for example A or A+ appliances. This would reduce the unregulated carbon emissions to: 12.44
After ASHP	35.86	

Table 10.2: Carbon Dioxide Emissions of Commercial Element

Commercial Element	Regulated Carbon Dioxide Savings	
	Tonnes CO ₂ per annum	%
Savings from energy demand reduction	9.16	16.12
Savings from ASHP	11.81	20.79
Total Cumulative Savings	20.98	36.91
Total Target Savings	19.89	35 %
Annual Surplus	10.09	1.91

Table 10.3: Regulated Carbon Savings of Commercial Element

Residential Element	Carbon Dioxide Emissions (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline : Part L 2013 of the Building Regulations Compliant Development	528.65	415.0
After Energy Demand Reduction	485.87	It is anticipated that a circa 3% saving can be achieved through the use of energy efficient fittings, for example A or A+ appliances. This would reduce the unregulated carbon emissions to: 402.55
After ASHP	386.70	-
After PV Array (155.65 kWp)	325.79	-

Table 10.4: Carbon Dioxide Emissions of Residential Element

Residential Element	Regulated Carbon Dioxide Savings	
	Tonnes CO ₂ per annum	%
Savings from energy demand reduction	42.78	7.69
Savings from ASHP	99.17	18.76
Savings from PV	60.91	11.52
Total Cumulative Savings	202.86	38.37
Total Target Savings	528.65	100 %
Annual Surplus	- 325.79	- 61.63 %

Table 10.5: Regulated Carbon Savings of Residential Element

Development	Carbon Dioxide Emissions (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline : Part L 2013 of the Building Regulations Compliant Development	585.49	427.88
After Energy Demand Reduction	533.55	It is anticipated that a circa 3% saving can be achieved through the use of energy efficient fittings, for example A or A+ appliances. This would reduce the unregulated carbon emissions to: 415.04
After ASHP	422.56	-
After PV	361.65	-

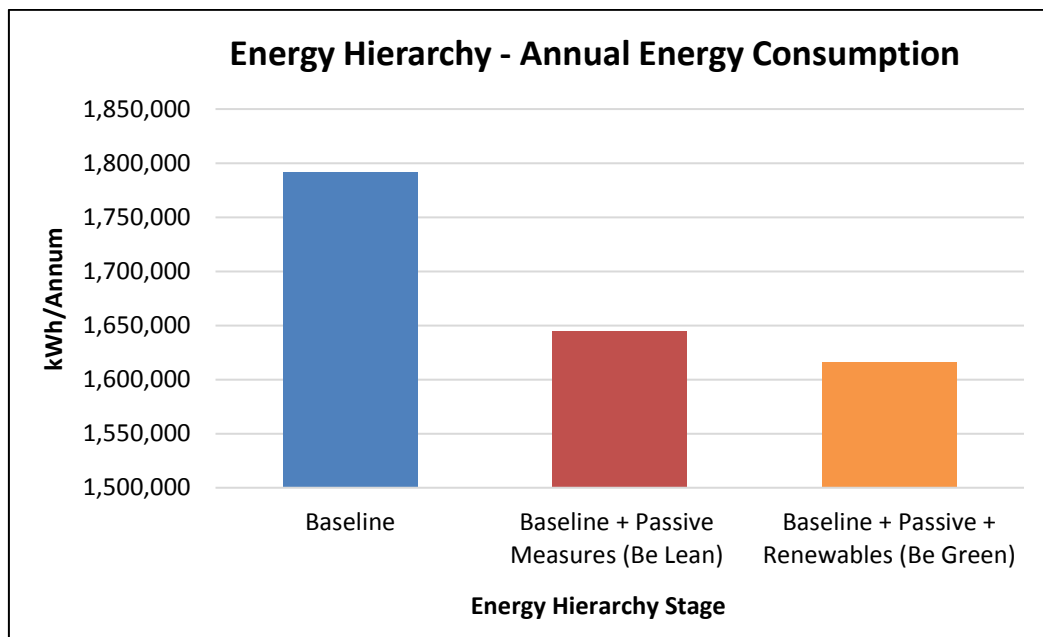
Table 10.6: Carbon Dioxide Emissions of Development

Development	Regulated Carbon Dioxide Savings	
	Tonnes CO ₂ per annum	%
Savings from energy demand reduction	51.64	8.87
Savings from ASHP	110.99	18.96
Savings from PV	60.91	10.40
Total Cumulative Savings	223.84	38.23

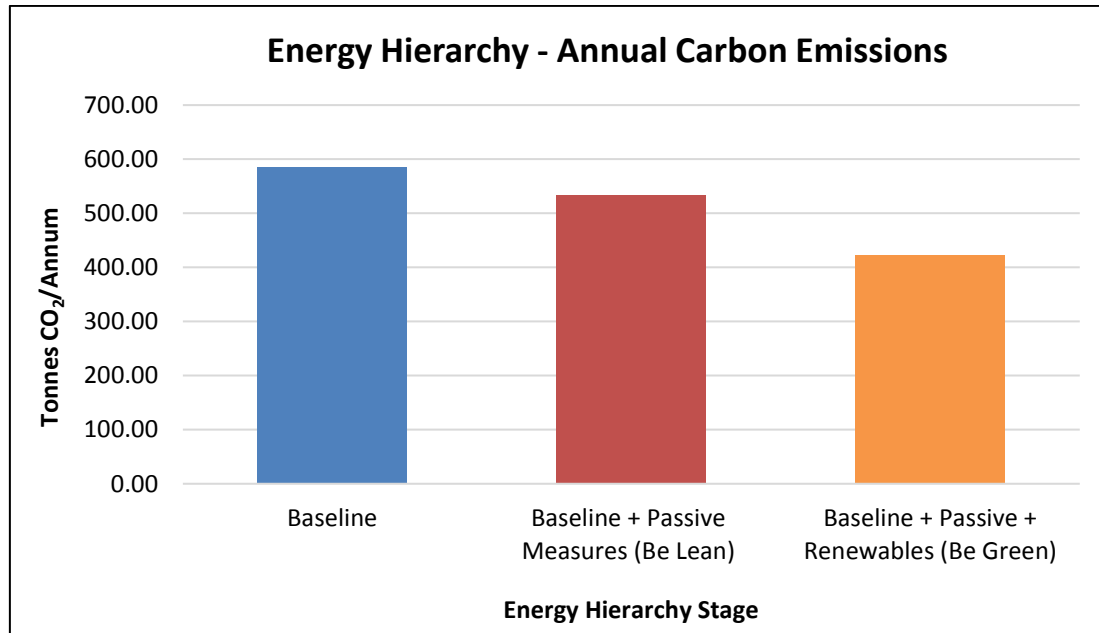
Table 10.7: Regulated Carbon Savings of Development

The development shall have an anticipated CO₂ improvement of 38.23 % 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, ASHP, and PV), 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 F. The energy and carbon savings achieved are visually represented as per graphs 10.1 and 10.2 below:



Graph 10.1: Annual Energy Savings



Graph 10.2: Annual Carbon Savings

10.1 SAP 10 Carbon Factors

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. The updated carbon factor reflects the decarbonisation of grid electricity through an increase in electricity generation from renewable and low carbon technologies. The updated SAP 10 carbon emission factor from the previous SAP 2012 factors are highlighted in Table 10.8 below.

Fuel type	Fuel Carbon Factor (kgCO ₂ /kWh)	
	SAP 2012	SAP 10
Natural Gas	0.216	0.210
Grid Electricity	0.519	0.233

Table 10.8: Carbon Factors

Below, in Table 10.9, is the calculated carbon performance improvement against the regulated carbon baseline using the updated SAP 10 carbon factors.

Development Carbon performance	Carbon performance SAP 2012 (Tonnes CO ₂ /Annum)	SAP 10 Carbon performance (Tonnes CO ₂ /Annum)
Regulated Carbon Baseline	585.49	452.71
Baseline + Passive Measures	533.55	405.76
Baseline + Passive Measures + ASHP	422.56	186.21
Baseline + Passive Measures + ASHP + Solar PV	361.65	147.05
Total Carbon Saving from Baseline (%)	38.23	67.52

Table 10.9: Carbon Improvement using SAP 10 Carbon Factor

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 require has been calculated and displayed below in Table 10.7. Assuming a carbon off-set price of £60 per tonne of carbon dioxide for a period of 30 years, the contribution for offsite renewable solutions is displayed below in Table 10.10.

Development Element	Annual Shortfall Tonnes CO ₂ per Annum	Carbon Off-set Contribution (£)
Residential	325.79	586,422
Total	325.79	586,422

Table 10.10: Calculated Carbon Shortfall and Cash in Lieu Contribution

Appendix A – Energy and Carbon Calculation

Commercial Calculations

Regulated Energy Demand											
kWh/m2/annum Baseline											
Typical Unit	Area m ²	Heating	Cooling	Auxillary	Lighting	Hot Water	Total	Total Kwh/Annum	Carbon kg CO2 / m2/Annum	Carbon kg CO2 / Annum	Tonnes
Building 1 - Commercial	368	9.9	34.31	6.57	40.68	1.7	93.16	34282.88	45.3	16670.40	16.67
Building 2 - Commercial	873.2	7.49	34.21	6.57	43.07	1.7	93.04	81242.528	46	40167.20	40.17
Total	1241.2							115525.41	91.3		56.84
kWh/m2/annum Baseline + Passive/Energy Efficiency Measures											
Typical Unit	Area m ²	Heating	Cooling	Auxillary	Lighting	Hot Water	Total	Total Kwh/Annum	Carbon kg Co2 / m2/Annum	Carbon kg CO2 / Annum	Tonnes
Building 1 - Commercial	368	9.95	30.69	5.63	31.52	1.70	79.48	29248.64	38.20	14057.60	14.06
Building 2 - Commercial	873.2	7.33	30.42	5.16	33.90	1.70	78.51	68554.93	38.50	33618.20	33.62
Total	1241.20							97803.57	76.70		47.68
kWh/m2/annum Baseline + Passive/Energy Efficiency Measures+ASHP											
Typical Unit	Area m ²	Heating	Cooling	Auxillary	Lighting	Hot Water	Total	Total Kwh/Annum	Carbon kg Co2 / m2/Annum	Carbon kg CO2 / Annum	Tonnes
Building 1 - Commercial	368	1.95	13.95	5.63	31.52	1.70	54.74	20144.32	28.40	10451.20	10.45
Building 2 - Commercial	873.2	1.44	13.83	5.16	33.90	1.70	56.02	48916.66	29.10	25410.12	25.41
Total	1241.20							69060.98	57.50	35861.32	35.86

<u>Unregulated Energy Demand</u>								
<u>Typical Unit</u>	<u>Area m²</u>	<u>Energy from Equipment kWh/m2/Annum</u>	<u>Total Energy kWh/annum</u>	<u>Gas %</u>	<u>Electricity %</u>	<u>KgCO2/m2</u>	<u>Total KgCO2</u>	<u>Total Tonnes</u>
Building 1 - Commercial	368	19.00	6992.00	0.00	100.00	10.34	3803.65	3.80
Building 2 - Commercial	873.2	19.00	16590.80	0.00	100.00	10.34	9025.40	9.03
Total	1241.20		23582.80					12.83
<u>Carbon Savings</u>								
<u>Typical Unit</u>	<u>Area m²</u>	<u>Baseline Emissions kgCO2/annum</u>	<u>Emissions after Incorporation of Passive Measures kgCO2 /annum</u>	<u>Emissions after Passive Measures + ASHP kgCO2 /annum</u>	<u>Total kgCO2/annum displaced</u>	<u>Total TonsCO2/annum displaced</u>	<u>Total % TonsCO2/annum displaced</u>	<u>Total % TonsCO2/annum displaced by Passive</u>
Building 1 - Commercial	368	16670.40	14057.60	10451.20	6219.20	6.22	37.31	15.67
Building 2 - Commercial	873.2	40167.20	33618.20	25410.12	14757.08	14.76	36.74	16.30
Total	1241.20	56837.60	47675.80	35861.32	20976.28	20.98	36.91	16.12

<u>Energy Savings</u>						
<u>Typical Unit</u>	<u>Area m²</u>	<u>BaselineTotal kWh/Annum</u>	<u>Baseline with Passive/Energy Efficiency Measures kWh/Annum</u>	<u>Baseline + Passive + ASHP kWh/Annum</u>	<u>Total kwh/annum displaced</u>	<u>Total % kwh/annum displaced</u>
Building 1 - Commercial	368	34282.88	29248.64	20144.32	14138.56	41.24
Building 2 - Commercial	873.2	81242.53	68554.93	48916.66	32325.86	39.79
Total	1241.20	115525.41	97803.57	69060.98	46464.42	40.22

Residential Calculations

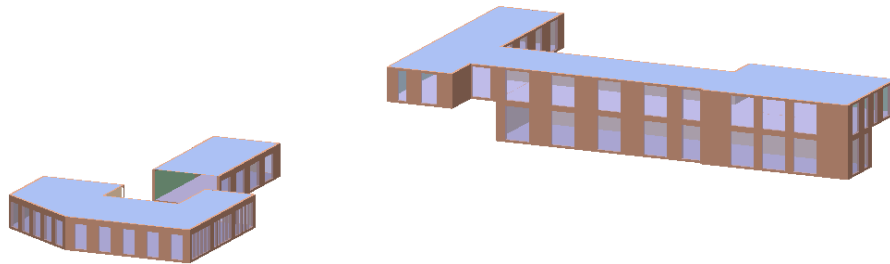
Regulated Energy Demand											
kWh/annum Baseline											
Typical Unit	Quantity	DER	TER	Heating	Cooling	Auxillary	Lighting	Hot Water	Total Kwh/Annum	Carbon kg Co2 / Annum	Tonnes
Ground Floor 1 Bed	9	17.98	17.98	419.87	0	220.33	243.45	2013.35	26073	8091	8.09
Mid Floor 1 Bed	189	15.82	15.82	104.34	0	217.17	243.45	2013.35	487300.59	149499	149.50
Top Floor 1 Bed	23	17.4	17.4	326.29	0	219.39	243.45	2013.95	64470.84	20010	20.01
Ground Floor 2 Bed	5	17.26	17.26	1266.61	0	340.78	335.46	2293.86	21183.55	6645.1	6.65
Mid Floor 2 Bed	183	15.13	15.13	705.66	0	334.79	335.46	2255.53	664553.52	213196.83	213.20
Top Floor 2 Bed	28	16.76	16.76	1157.18	0	339.31	335.46	2255.53	114449.44	36134.56	36.13
Ground Floor 3 Bed	13	15.44	15.44	1160.34	0	438.12	376.83	2337.26	56063.15	17864.08	17.86
Mid Floor 3 Bed	57	13.38	13.38	575.62	0	432.27	376.83	2337.26	212152.86	67876.74	67.88
Top Floor 3 Bed	7	14.98	14.98	1084.76	0	437.36	376.83	2337.26	29653.47	9332.54	9.33
Total	514								1,675,900.42	528,649.85	528.65

kWh/annum Baseline + Passive/Energy Efficiency Measures											
Typical Unit	Quantity	DER	TER	Heating	Cooling	Auxillary	Lighting	Hot Water	Total Kwh/Annum	Carbon kg Co2 / Annum	Tonnes
Ground Floor 1 Bed	9	16.01	17.98	126.23	0	217.39	243.45	2013.95	23409.18	7204.50	7.20
Mid Floor 1 Bed	189	14.84	15.82	17.35	0	216.3	243.45	2013.95	470808.45	140238.00	140.24
Top Floor 1 Bed	23	15.87	17.4	109.05	0	217.22	243.45	2013.95	59424.41	18250.50	18.25
Ground Floor 2 Bed	5	15.49	17.26	767.8	0	335.8	335.46	2293.86	18664.6	5963.65	5.96
Mid Floor 2 Bed	183	13.75	15.13	354.29	0	331.28	335.46	2255.53	599610.48	193751.25	193.75
Top Floor 2 Bed	28	15.13	16.76	701.76	0	334.75	335.46	2255.53	101570	32620.28	32.62
Ground Floor 3 Bed	13	14.08	15.44	727.34	0	433.79	376.83	2337.26	50377.86	16290.56	16.29
Mid Floor 3 Bed	57	12.43	13.38	304.35	0	429.56	376.83	2337.26	196536	63057.39	63.06
Top Floor 3 Bed	7	13.64	14.98	653.5	0	433.05	376.83	2337.26	26604.48	8497.72	8.50
Total	514								1547005.46	485873.85	485.87

kWh/annum Baseline + Passive/Energy Efficiency Measures + ASHP											
Typical Unit	Quantity	DER	TER	Heating	Cooling	Auxillary	Lighting	Hot Water	Total Kwh/Annum	Carbon kg Co2 / Annum	Tonnes
Ground Floor 1 Bed	9	12.57	26.05	126.23	0	217.22	243.45	2013.95	23407.65	5656.50	5.66
Mid Floor 1 Bed	189	11.75	22.71	17.35	0	216.3	243.45	2013.95	470808.45	111037.50	111.04
Top Floor 1 Bed	23	12.47	25.15	109.05	0	217.22	243.45	2013.95	59424.41	14340.50	14.34
Ground Floor 2 Bed	5	12.13	25.24	767.8	0	335.8	335.46	2293.86	18664.60	4670.05	4.67
Mid Floor 2 Bed	183	10.92	21.93	354.29	0	331.28	335.46	2255.53	599610.48	153873.72	153.87
Top Floor 2 Bed	28	11.88	24.46	701.76	0	334.75	335.46	2255.53	101570.00	25613.28	25.61
Ground Floor 3 Bed	13	11.22	22.49	727.34	0	433.79	376.83	2337.26	50377.86	12981.54	12.98
Mid Floor 3 Bed	57	10.18	19.29	304.35	0	429.56	376.83	2337.26	196536.00	51643.14	51.64
Top Floor 3 Bed	7	11.05	21.77	653.5	0	433.05	376.83	2337.26	26604.48	6884.15	6.88
Total	514								1547003.93	386700.38	386.70

kWh/annum Baseline + Passive/Energy Efficiency Measures + ASHP + PV											
Typical Unit	Quantity	DER	TER	Heating	Cooling	Auxillary	Lighting	Hot Water	Total Kwh/Annum	Carbon kg Co2 / Annum	Tonnes
Ground Floor 1 Bed	9	10.2	26.05	126.23	0	217.22	243.45	2013.95	21352.74	4590.00	4.59
Mid Floor 1 Bed	189	9.38	22.71	17.35	0	216.3	243.45	2013.95	427655.27	88641.00	88.64
Top Floor 1 Bed	23	10.1	25.15	109.05	0	217.22	243.45	2013.95	54172.96	11615.00	11.62
Ground Floor 2 Bed	5	10.6	25.24	767.8	0	335.8	335.46	2293.86	17529.63	4081.00	4.08
Mid Floor 2 Bed	183	9.38	21.93	354.29	0	331.28	335.46	2255.53	557799.03	132173.58	132.17
Top Floor 2 Bed	28	10.34	24.46	701.76	0	334.75	335.46	2255.53	95172.62	22293.04	22.29
Ground Floor 3 Bed	13	9.89	22.49	727.34	0	433.79	376.83	2337.26	47412.91	11442.73	11.44
Mid Floor 3 Bed	57	8.85	19.29	304.35	0	429.56	376.83	2337.26	183535.83	44896.05	44.90
Top Floor 3 Bed	7	9.72	21.77	653.5	0	433.05	376.83	2337.26	25007.97	6055.56	6.06
Total	514								1429638.96	325787.96	325.79

SBEM – Commercial Element



Building 1

Building Rating

	Heating	Cooling	Auxiliary	Lighting	Hot water	Total	
Actual	9.9	34.31	6.57	40.68	1.7	93.16	kWh/m ²
Notional	0.78	15.79	3.78	68.31	1.96	90.62	kWh/m ²

CO2 emissions mandatory requirement

BER	45.3	kgCO ₂ /m ²
Notional	45.3	kgCO ₂ /m ²
TER	45.3	kgCO ₂ /m ²
Pass CO ₂	Yes	

Baseline

Building Rating

	Heating	Cooling	Auxiliary	Lighting	Hot water	Total	
Actual	9.95	30.69	5.63	31.52	1.7	79.48	kWh/m ²
Notional	0.78	15.79	3.78	68.31	1.96	90.62	kWh/m ²

CO2 emissions mandatory requirement

BER	38.2	kgCO ₂ /m ²
Notional	45.3	kgCO ₂ /m ²
TER	45.3	kgCO ₂ /m ²
Pass CO ₂	Yes	

Baseline + Passive

Building Rating

	Heating	Cooling	Auxiliary	Lighting	Hot water	Total	
Actual	1.95	13.95	5.63	31.52	1.7	54.74	kWh/m ²
Notional	0.26	15.79	3.78	68.31	1.96	90.11	kWh/m ²

CO2 emissions mandatory requirement

BER	28.4	kgCO ₂ /m ²
Notional	45.2	kgCO ₂ /m ²
TER	45.2	kgCO ₂ /m ²
Pass CO ₂	Yes	

Baseline + Passive + ASHP

Building 2

Building Rating

	Heating	Cooling	Auxiliary	Lighting	Hot water	Total	
Actual	7.49	34.21	6.57	43.07	1.7	93.04	kWh/m ²
Notional	1.07	16.84	3.78	68.64	1.96	92.29	kWh/m ²

CO2 emissions mandatory requirement

BER	46.0	kgCO ₂ /m ²
Notional	46.0	kgCO ₂ /m ²
TER	46.0	kgCO ₂ /m ²
Pass CO2	Yes	

Baseline

Building Rating

	Heating	Cooling	Auxiliary	Lighting	Hot water	Total	
Actual	7.33	30.42	5.16	33.9	1.7	78.51	kWh/m ²
Notional	1.07	16.84	3.78	68.64	1.96	92.29	kWh/m ²

CO2 emissions mandatory requirement

BER	38.5	kgCO ₂ /m ²
Notional	46.0	kgCO ₂ /m ²
TER	46.0	kgCO ₂ /m ²
Pass CO2	Yes	

Baseline + Passive

Building Rating

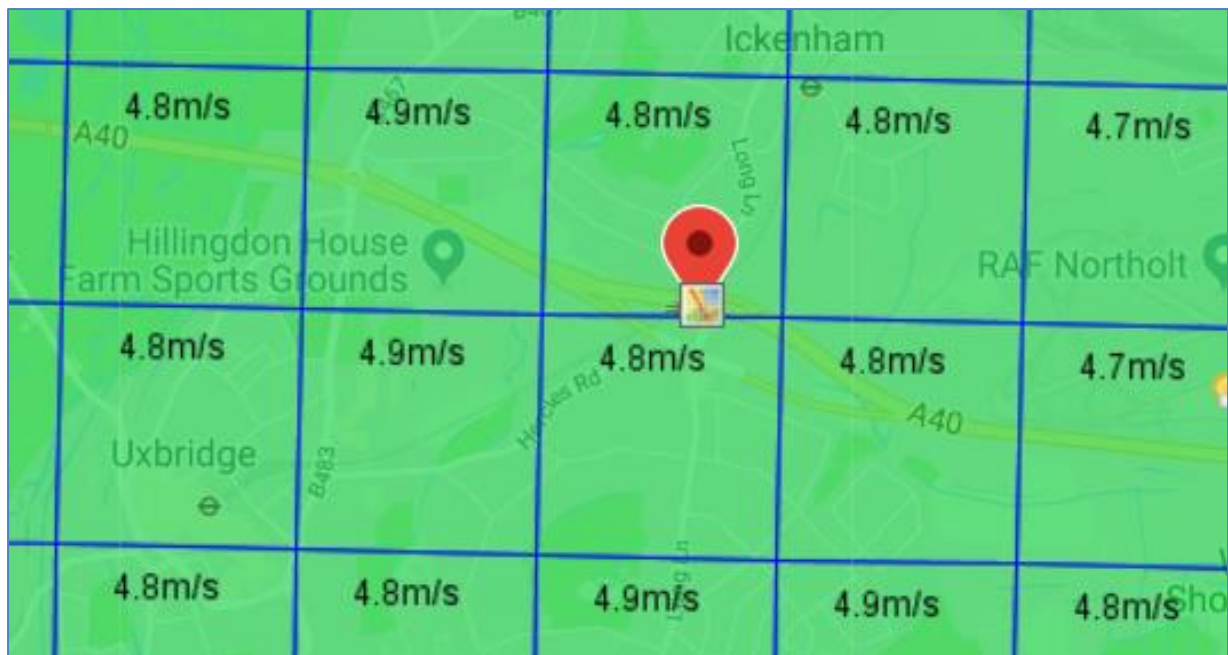
	Heating	Cooling	Auxiliary	Lighting	Hot water	Total	
Actual	1.44	13.83	5.16	33.9	1.7	56.02	kWh/m ²
Notional	0.36	16.84	3.78	68.64	1.96	91.58	kWh/m ²

CO2 emissions mandatory requirement

BER	29.1	kgCO ₂ /m ²
Notional	46.0	kgCO ₂ /m ²
TER	46.0	kgCO ₂ /m ²
Pass CO ₂	Yes	

Baseline + Passive+ ASHP

Appendix B – Wind Data



Wind Data Taken from RENSsmart Wind Map

Appendix C – ASHP Details

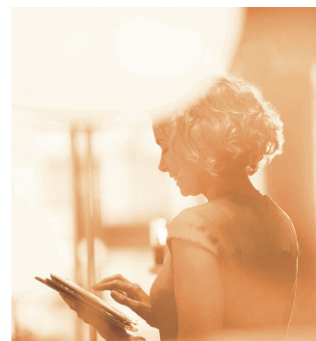
Heating

Product Information

CAHV-P500YA-HPB

Ecodan Air Source Heat Pump

Making a
World of
Difference



CAHV Monobloc Heat Pump System

The Ecodan CAHV air source heat pump monobloc system can operate singularly, or form part of a multiple unit system. The CAHV also comes equipped with a wide range of controller features as standard.

A multiple unit system has the ability to cascade available units on and off to meet the load from a building. As an example of this modulation, a 16 unit system allows 0.5kW increments of capacity, from 18kW all the way up to 688kW. This level of modulation is unprecedented within the heating industry and with cascade and rotation built in as standard, the Ecodan CAHV system is perfectly suited to a wide range of commercial applications.



Certificate Number: MCS-HP0002
Product Reference: CAHV-P500YA-HPB

Key Features

- Multiple unit cascade control of up to 688kW capacity
- Split refrigerant circuits within each CAHV provide 50% back up
- Ability to rotate units based on accumulated run hours
- Provides from 25°C up to 70°C water flow temperatures without boost heaters
- Low maintenance, hermetically-sealed monobloc design
- Low on-site refrigerant volume
- HIC (Zubadan) technology delivers 43kW at -3°C with minimal drop off down to -20°C



Air Conditioning | Heating
Ventilation | Controls



ecodan[®]
Renewable Heating Technology

MODEL		CAHV-P500YA-HPB
HEAT PUMP SPACE HEATER - 55°C	ErP Rating	A++
	η_s	125%
	SCOP	3.19
HEAT PUMP SPACE HEATER - 35°C	ErP Rating	A+
	η_s	139%
	SCOP	3.54
HEATING ^{*1} (A-3/W35)	Capacity (kW)	42.6
	Power Input (kW)	15.2
	COP	2.80
OPERATING AMBIENT TEMPERATURE (°C DB)		-20~+40°C
SOUND PRESSURE LEVEL AT 1M (dBA) ^{*2,3}		59
LOW NOISE MODE (dBA) ^{*2}		Variable
FLOW RATE(l/min)		126
WATER PRESSURE DROP (kPa)		18
DIMENSIONS (mm)	Width	1978
	Depth	759
	Height	1710 (1650 without legs)
WEIGHT (kg)		526
ELECTRICAL SUPPLY		380-415v, 50Hz
PHASE		3
NOMINAL RUNNING CURRENT [MAX] (A)		17.6 [52.9]
FUSE RATING - MCB SIZES (A) ^{*4}		63

*1 Under normal heating conditions at outdoor temp: -3°CDB / -4°CWB, outlet water temp 35°C, inlet water temp 30°C

*2 Under normal heating conditions at outdoor temp: 7°CDB / 6°CWB, outlet water temp 35°C, inlet water temp 30°C as tested to BS EN14511

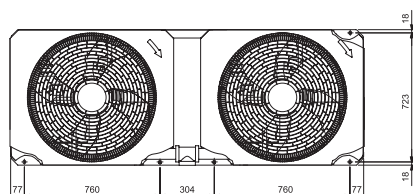
*3 Sound power level of the CAHV-P500YA-HPB is 70.7dBA. Tested to BS EN12102

*4 MCB Sizes BS EN60898-2 & BS EN60947-2

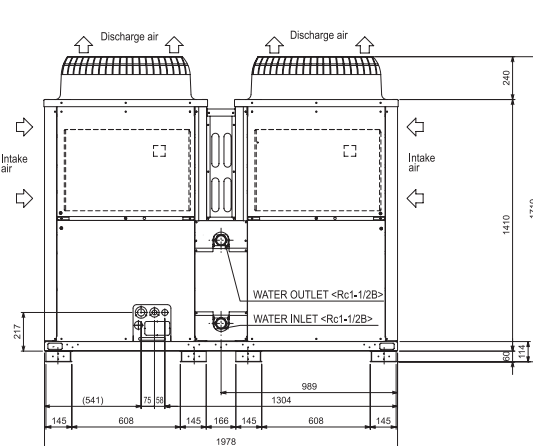
η_s is the seasonal space heating energy efficiency (SSHEE) η_{ws} is the water heating energy efficiency

DIMENSIONS

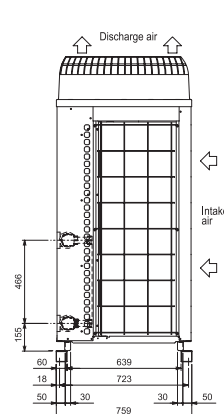
Upper View



Front View



Side View



Telephone: 01707 282880

email: heating@meuk.mee.com web: heating.mitsubishielectric.co.uk

UNITED KINGDOM Mitsubishi Electric Europe Living Environmental Systems Division
Travellers Lane, Hatfield, Hertfordshire, AL10 8XB, England General Enquiries Telephone: 01707 282880 Fax: 01707 278881

IRELAND Mitsubishi Electric Europe Westgate Business Park, Ballymount, Dublin 24, Ireland
Telephone: Dublin (01) 419 8800 Fax: Dublin (01) 419 8890 International code: (003531)

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Appendix D – Overheating Assessment

Hillingdon Gardens, Hillingdon, Overheating Study in Compliance with CIBSE Guidance TM52 & TM59 – October 2019

1.0 Introduction

Cudd Bentley Consulting has produced the following dynamic thermal model of a sample of residential units at the Hillingdon Gardens development in Hillingdon. The study has been undertaken using the datasets of CIBSE TM52 and TM59 in order to identify the overheating risk.

Thermal modelling has been undertaken by a Cudd Bentley CIBSE Low Carbon Energy Assessor, who is registered to carry Level 5 Energy Assessments. Level 5 energy assessments account for dynamic thermal modelling, which are preferred when a building has a more complex design and incorporating specialist building fabric design. The SBEM software used to carry out the modelling is Bentley, HEVACOMP, Version V8i, SS1 SP5 which is approved software.

The sample apartments and commercial elements that have been assessed for overheating are displayed within Appendix A.

2.0 Design Parameters

The following design parameters have been utilised to create the thermal model.

2.1 Construction Elements

The following U- values and construction details have been used within the thermal model:

The minimum requirements as detailed in Part L1A (2013) for the residential element, as detailed below:

- External Walls - $U = 0.16 \text{ W/m}^2.\text{K};$
- Exposed Floors - $U = 0.11 \text{ W/m}^2.\text{K};$
- Exposed Roofs - $U = 0.11 \text{ W/m}^2.\text{K};$
- Glazing - $U = 1.2 \text{ W/m}^2.\text{K}; G' \text{ value of } 0.36;$
- Air Permeability - $3 \text{ m}^3/\text{hr}/\text{m}^2 @ 50 \text{ Pa};$

Please note that the Accredited Construction Details are to achieve the details highlighted within Table K1 of Appendix K of Part L 2013.

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.

- External Walls - $U = 0.20 \text{ W/m}^2.\text{K};$
- Exposed Floors - $U = 0.20 \text{ W/m}^2.\text{K};$
- Exposed Roofs - $U = 0.16 \text{ W/m}^2.\text{K};$
- Glazing - $U = 1.4 \text{ W/m}^2.\text{K}; G' \text{ value of } 0.36;$
- Air Permeability - $5 \text{ m}^3/\text{hr}/\text{m}^2 @ 50 \text{ Pa}.$

Please note the glazing sections have been modelled with high performance opaque blinds.

2.2 Room Occupancy and Heat Gain

Table 1 below outlines the occupancy and heat gain profiles utilised within the thermal model.

Number of people	Description	Peak load (W)		Period																									
		Sensible	Latent	Hour-ending																									
				00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24		
				1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00		
1	Single bedroom occupancy	75	55	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.7		
2	Double bedroom occupancy	150	110	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.7	
2	Studio occupancy	150	110	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
1	1-bed: living/kitchen occupancy	75	55	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	
1	1-bed: living occupancy	75	55	0	0	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0	0	
1	1-bed: kitchen occupancy	75	55	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0	0	
2	2-bed: living/kitchen occupancy	150	110	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	
2	2-bed: living occupancy	150	110	0	0	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0	0	
2	2-bed: kitchen occupancy	150	110	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0	0	
3	3-bed: living/kitchen occupancy	225	165	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	
3	3-bed: living occupancy	225	165	0	0	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0	0	
3	3-bed: kitchen occupancy	225	165	0	0	0	0	0	0	0	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0	0	
	Single bedroom equipment	80		0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.13	
	Double bedroom equipment	80		0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.13	
	Studio equipment	450		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	
	Living/kitchen equipment	450		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	
	Living equipment	150		0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
	Kitchen equipment	300		0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	
	Lighting profile	2 (W/m2)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Table 1: Occupancy and Heat Gain Profiles

2.3 Heat Gains

The following heat gains have been implemented within the thermal model:

- People – 75 Watts Sensible/ 55 Watts Latent;
- Equipment – 80 Watts (Bedrooms) 450 Watts (Lounge / Kitchen).
- Lighting – 2 W/m²

2.4 Ventilation Rates

Room	Mechanical Ventilation Rate
Living Room/ Kitchen	MVHR and/or openable windows to allow 4.5 ACH
Bedroom	MVHR and/or openable windows to allow 4.5 ACH

Table 2: Ventilation Rates

2.5 Weather Data

The CIBSE Design Summer Year 2020s, high emissions, 50 percentile scenario (DSY1) has been imported within the calculations to represent a typical year for the geographical location of the development.

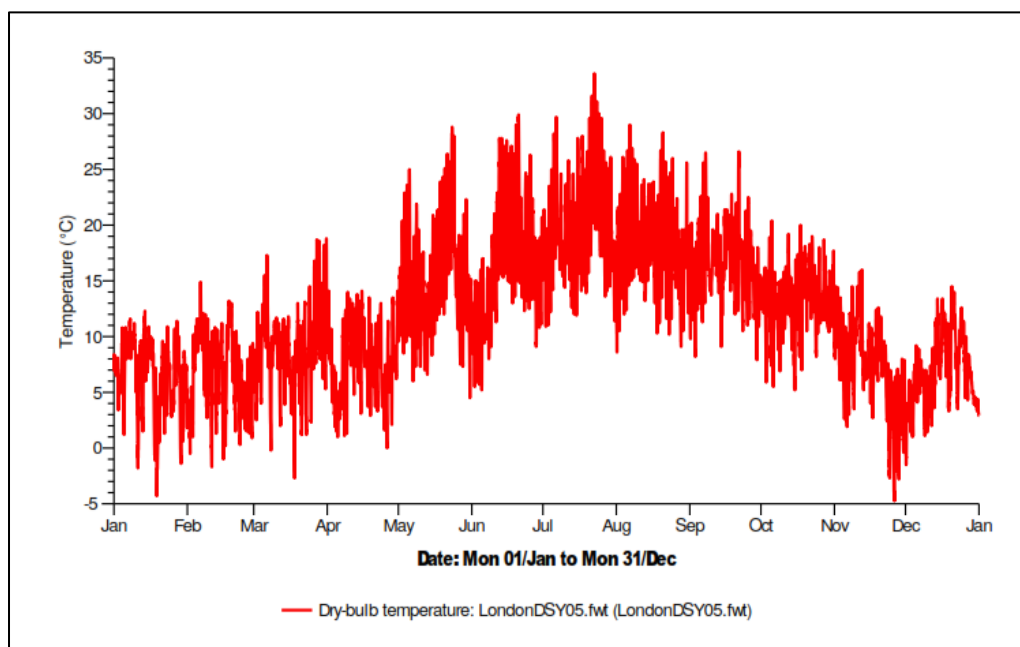


Figure 2: CIBSE Design Summer Year London

3.0 CIBSE TM52 Criteria

TM52 states that in hot periods people's perception of heat is better coped with during long periods exposed to warmth. In order to assess this, TM52 requires an analysis of the following:

- Hours of Exceedance (H_e);
- Daily Weighted Exceedance (We);
- Upper Limit Temperature (T_{upp}).

The above analysis should then be assessed against the following criteria within TM52 which states that should any two of the three criteria fail, a building or room is classed as overheating:

- The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1 K or more during the occupied hours of a typical non-heating season (1 May to 30 September). This is further detailed within TM52 as the H_e shall not exceed 3% of the total occupied hours.
- The second criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperature rise and its duration. This criterion sets a daily limit for acceptability. This is further detailed within TM52 as the We shall be less than or equal to 6 in any one day.
- The third criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable. This is further detailed within TM52 as the T_{upp} shall not exceed 4K.

3.1 CIBSE TM59 Criteria

TM59 states that homes that are predominantly mechanically ventilated due to having no or limited opportunities for opening windows (due to noise levels or air quality) should be assessed for overheating using the fixed temperature method based on CIBSE Guide A, as stated below.

The CIBSE fixed temperature test must be followed, i.e. all occupied rooms should not exceed operative temperature of 26 °C for more than 3% of the annual occupied annual hours.

4.0 Results

The occupied spaces have been assessed under the CIBSE TM52 and TM59 overheating criteria against the requirements identified in Section 3.0 and 3.1.

The results to the initial overheating assessment are summarised below and displayed in full in within Appendix B and C.

The following overheating mitigation measures were required, and modelled for, in order to achieve compliance with the TM52 and TM59 overheating criteria:

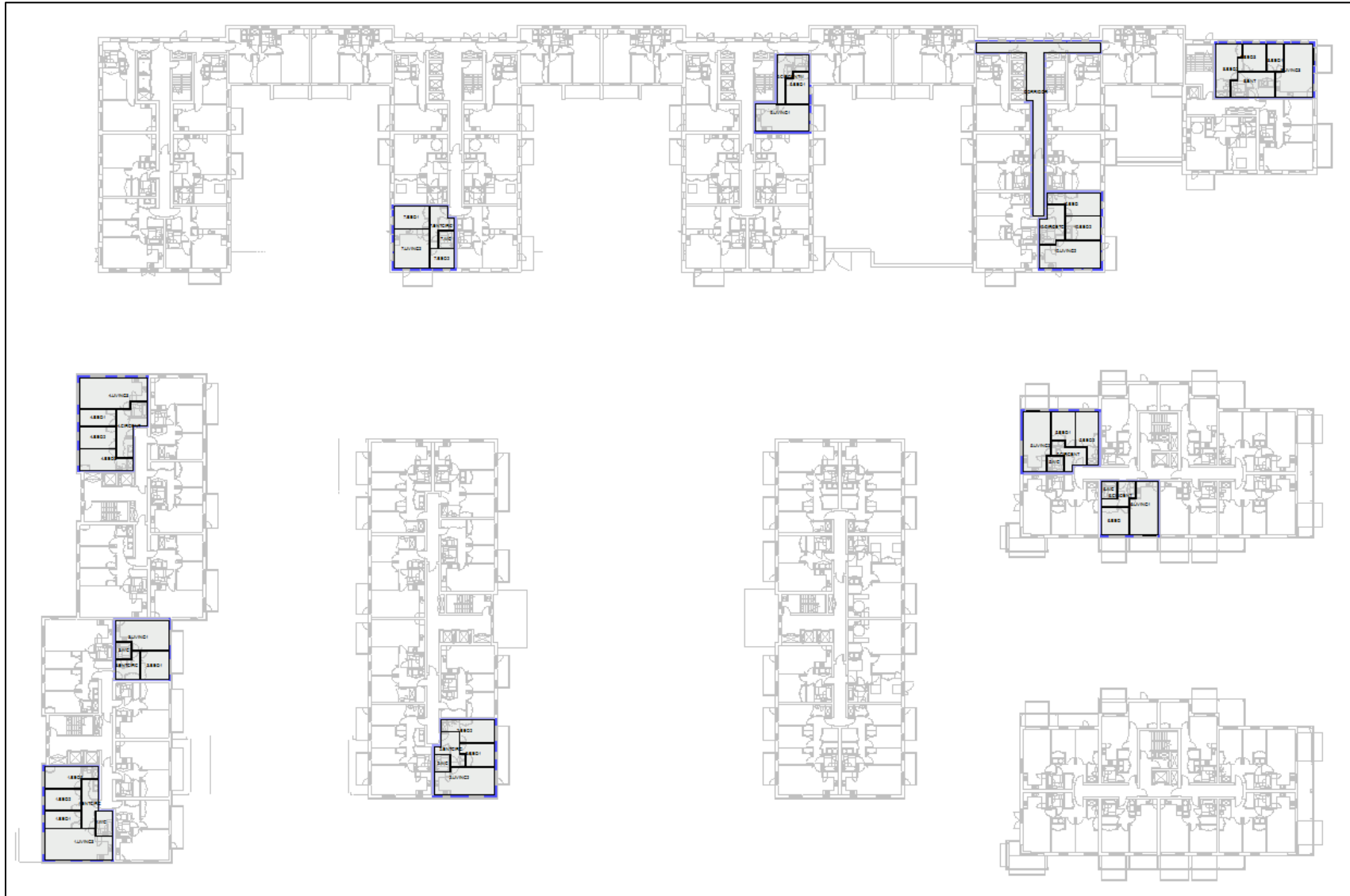
- Increased air change rate in the lounge/kitchen zones of each unit,
- The addition of insulated solid panels within some of the glazing panels within the lounge/kitchen areas.

5.0 Summary

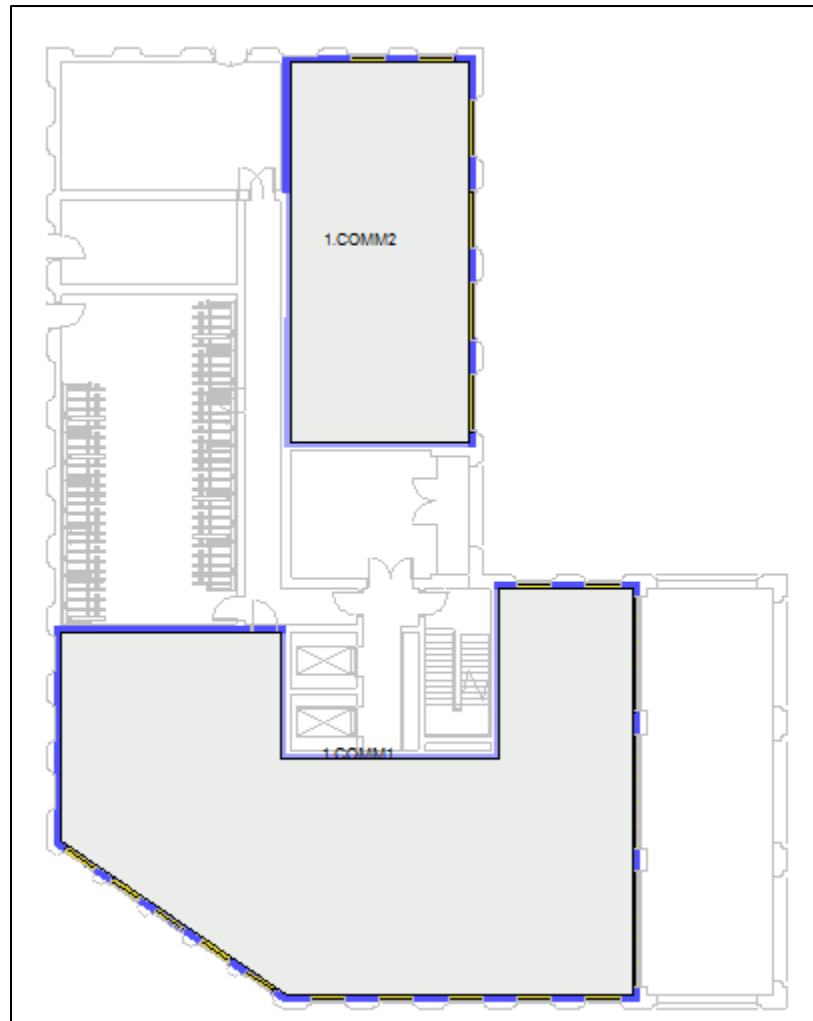
The thermal model demonstrates that the developments initial design and services strategy currently meet the thermal comfort requirements in all residential and commercial units in accordance with the requirements set out within TM52 and TM59.

Appendix A – Thermal Model

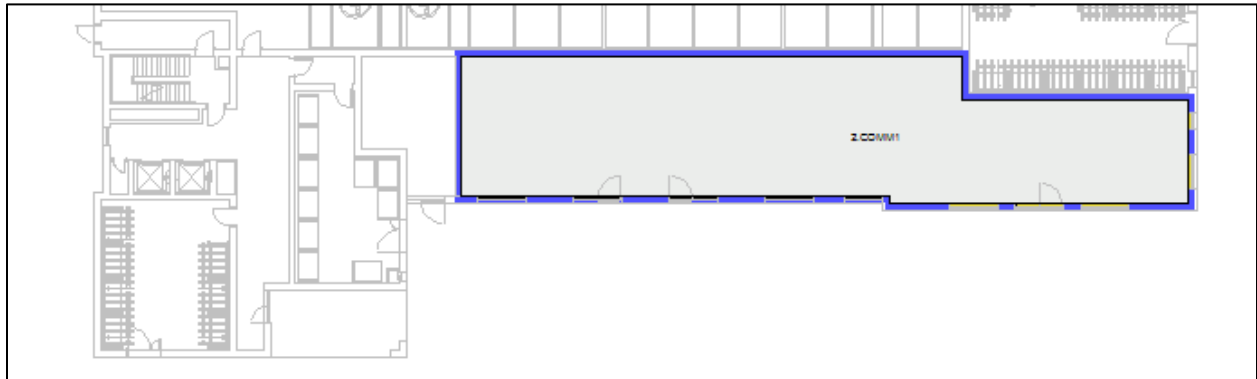
Sample of Residential Units and Corridor



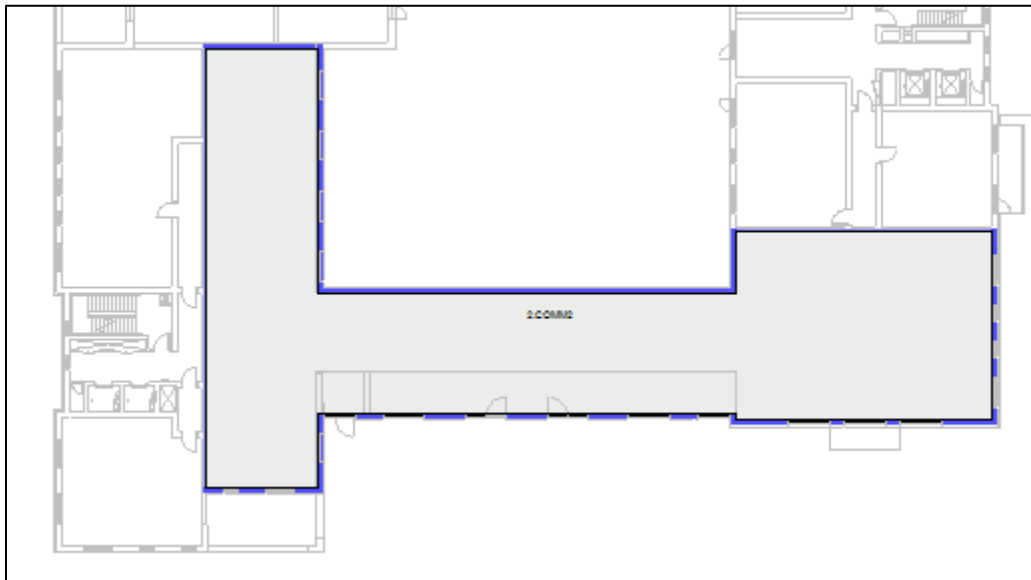
Commercial Building 1



Commercial Building 2 Ground Floor



Commercial Building 2 First Floor



Appendix B – TM52 Results

Month	He	Occupied Hours	We	Tupp	Pass/ Fail
Building 1 – Commercial Space 1					
May	0	278	0	0	Pass
June	0	288	0	0	
July	0	295	0	0	
August	0	288	0	0	
September	0	285	0	0	
Totals	0	1434	0	0	
Building 1 – Commercial Space 2					
May	0	278	0	0	Pass
June	0	288	0	0	
July	0	295	0	0	
August	0	288	0	0	
September	0	285	0	0	
Totals	0	1434	0	0	
Building 2 – Commercial Space 1 (GF)					
May	0	278	0	0	Pass
June	0	288	0	0	
July	0	295	0	0	
August	0	288	0	0	
September	0	285	0	0	
Totals	0	1434	0	0	
Building 2 – Commercial Space 2 (1F)					
May	0	278	0	0	Pass
June	0	288	0	0	
July	0	295	0	0	
August	0	288	0	0	
September	0	285	0	0	
Totals	0	1434	0	0	

Table 6 CIBSE TM52 Results

Appendix C – TM59 Results

Temperature frequency schedule			
Room	% of year above	Hours above	
1.BED1	2.2	79	
1.BED2	2.2	90	
1.BED3	2.3	92	
1.ENTCIRC	0.8	34	
1.LIVING3	2.7	127	
1.WC	Unoccupied	Unoccupied	
10.BED	1.5	60	
10.BED2	2.3	94	
10.CIRCETC	0.8	32	
10.LIVING2	2.8	134	
2.BED1	1.9	76	
2.BED2	1.6	65	
2.ENTCIRC	0.8	32	
2.LIVING2	2.3	109	
2.WC	Unoccupied	Unoccupied	
3.BED1	1.9	75	
3.ENTCIRC	0.7	26	
3.LIVING1	1.9	91	
3.WC	Unoccupied	Unoccupied	
4.BED1	2.6	95	
4.BED2	2.6	103	
4.BED3	2.8	113	



Temperature frequency schedule		
Room	% of year above	Hours above
4.LIVING3	2.6	121
5.BED1	1.4	58
5.BED2	1.2	50
5.CIRCENT	0.7	28
5.LIVING2	2.7	130
5.WC	Unoccupied	Unoccupied
6.BED	2.1	84
6.CIRCENT	0.8	29
6.LIVING1	2.3	108
6.WC	Unoccupied	Unoccupied
7.BED1	2.1	85
7.BED2	2.7	109
7.ENTCIRC	0.7	28
7.LIVING2	3.0	143
7.WC	Unoccupied	Unoccupied
8.BED1	2.4	88
8.BED2	1.3	52
8.BED3	1.9	78
8.ENT	0.8	31
8.LIVING3	1.3	54
9.BED1	1.4	57
9.CIRCENTW	0.6	26

9.LIVING1	2.9	137
CORRIDOR	0.7	24

Table 7 - TM 59 Results

Appendix E – Sample SAP Calculations

Project Information

Building type Ground-floor flat

Reference

Date 17 July 2019

Client 1 BED Ground Floor Baseline Project Hillingdon Gardens
UB10**SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings****1. Overall dwelling dimensions**

	Area (m ²)	Av. Storey height (m)	Volume (m ³)	
Ground floor (1)	50.00	2.55	127.50	(3a)
Total floor area	50.00			(4)
Dwelling volume (m ³)			127.50	(5)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

2. Ventilation rate

	main + secondary + other heating		m³ per hour										
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)									
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)									
Number of intermittent fans	0	x 10	0.00	(7a)									
Number of passive vents	0	x 10	0.00	(7b)									
Number of flueless gas fires	0	x 40	0.00	(7c)									
			Air changes per hour										
Infiltration due to chimneys, fans and flues			0.00	(8)									
Pressure test, result q50	7.06			(17)									
Air permeability			0.35	(18)									
Number of sides on which sheltered			3.00	(19)									
Shelter factor			0.78	(20)									
Infiltration rate incorporating shelter factor			0.27	(21)									
Infiltration rate modified for monthly wind speed													
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70		
												52.50	(22)
Wind Factor													
1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18		
												13.13	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed)													
0.35	0.34	0.34	0.30	0.29	0.26	0.26	0.25	0.27	0.29	0.31	0.32		
												3.59	(22b)
air change rate through system							0.50						(23a)
efficiency in % allowing for in-use factor							70.55						(23c)
Ventilation : balanced whole house mechanical with heat recovery													
Effective air change rate													
0.50	0.49	0.48	0.45	0.44	0.41	0.41	0.40	0.42	0.44	0.46	0.47	(25)	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	kappa-value kJ/m ² K	A x K kJ/K					
Window - Double-glazed, argon filled (West)			7.740	1.15 (1.20)	8.86			(27)				
Walls			10.76	0.16	1.72	190.00	2044.40	(29)				
West												
Ground floors			50.00	0.11	5.50	75.00	3750.00	(28)				
Party wall			53.56	0.00	0.00	180.00	9640.80					
Circ and Apartment												
Party ceiling			50.00	0.00	0.00	30.00	1500.00					
Internal wall			57.00	0.00	0.00	9.00	513.00					
All internal walls												
Total area of external elements Sigma A, m ²							68.50	(31)				
Fabric heat loss, W/K							16.08	(33)				
Heat capacity							17448.20	(34)				
Thermal mass parameter, kJ/m ² K							348.96	(35)				
Effect of thermal bridges							4.01	(36)				
Total fabric heat loss							20.09	(37)				
Ventilation heat loss calculated monthly												
20.87	20.58	20.30	18.86	18.57	17.13	17.13	16.84	17.71	18.57	19.15	19.72	(38)
Heat transfer coefficient, W/K												
40.96	40.68	40.39	38.95	38.66	37.22	37.22	36.94	37.80	38.66	39.24	39.81	
											38.88	(39)
Heat loss parameter (HLP), W/m ² K												
0.82	0.81	0.81	0.78	0.77	0.74	0.74	0.74	0.76	0.77	0.78	0.80	
HLP (average)											0.78	(40)
Number of days in month (Table 1a)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31	28	31	30	31	30	31	31	30	31	30	31	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

4. Water heating energy requirements

4. Water heating energy requirements												kWh/year
Assumed occupancy, N												1.69 (42)
Annual average hot water usage in litres per day Vd,average												74.34 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month												
81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	(44)
Energy content of hot water used												
121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	
Energy content (annual)												1169.66 (45)
Distribution loss												
18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)
Cylinder volume, l							110.00					(47)
Manufacturer's declared cylinder loss factor (kWh/day)							1.30					(48)
Temperature Factor							1.0000					(49)
Energy lost from hot water cylinder (kWh/day)												1.30 (55)
Total storage loss												
40.30	36.40	40.30	39.00	40.30	39.00	40.30	40.30	39.00	40.30	39.00	40.30	(56)
Net storage loss												
40.30	36.40	40.30	39.00	40.30	39.00	40.30	40.30	39.00	40.30	39.00	40.30	(57)
Primary loss												
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Total heat required for water heating calculated for each month												
184.83	163.47	173.01	156.93	155.12	140.52	136.77	147.57	146.53	162.64	169.66	181.00	(62)
Output from water heater for each month, kWh/month												
184.83	163.47	173.01	156.93	155.12	140.52	136.77	147.57	146.53	162.64	169.66	181.00	(64)
												1918.05 (64)
Heat gains from water heating, kWh/month												
91.17	81.19	87.24	80.94	81.29	75.48	75.19	78.78	77.48	83.79	85.17	89.90	(65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains												
34.46	30.61	24.89	18.85	14.09	11.89	12.85	16.70	22.42	28.47	33.23	35.42	(67)
Appliances gains												
219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains												
46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pumps and fans gains												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (negative values)												
-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains												
122.54	120.83	117.26	112.41	109.26	104.83	101.07	105.89	107.61	112.62	118.29	120.83	(72)
Total internal gains												
457.39	454.10	439.07	415.94	392.59	371.45	358.95	365.35	378.53	401.83	427.69	446.94	(73)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

6. Solar gains (calculation for January)

												Area & Flux	g & FF		Shading	Gains				
Window - Double-glazed, argon filled (West) walls												7.740	19.64	0.43		--	0.77	50.3324		
Total solar gains, January																		50.33	(83-1)	
Solar gains																				
50.33	98.46	162.15	236.49	289.82	296.69	282.46	242.63	188.59	116.83	62.76	41.39			(83)						
Total gains																				
507.72	552.56	601.22	652.43	682.42	668.14	641.41	607.98	567.11	518.66	490.45	488.33			(84)						

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, argon filled (West) walls	0.9 x 7.74	0.80	0.70 x 0.83	3.24
GL = 3.24 / 50.00 = 0.065				
C1 = 0.500				
C2 = 1.008				
EI = 243				

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C)											21.00	(85)
Heating system responsiveness											1.00	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau												
118.32	119.15	120.00	124.44	125.36	130.21	130.21	131.22	128.23	125.36	123.52	121.74	
alpha												
8.89	8.94	9.00	9.30	9.36	9.68	9.68	9.75	9.55	9.36	9.23	9.12	
Utilisation factor for gains for living area												
0.98	0.96	0.89	0.71	0.53	0.36	0.26	0.28	0.46	0.76	0.94	0.98	(86)
Mean internal temperature in living area T1												
20.72	20.81	20.92	20.99	21.00	21.00	21.00	21.00	21.00	20.99	20.88	20.72	(87)
Temperature during heating periods in rest of dwelling Th2												
20.24	20.24	20.25	20.27	20.28	20.30	20.30	20.31	20.29	20.28	20.27	20.26	(88)
Utilisation factor for gains for rest of dwelling												
0.97	0.95	0.86	0.67	0.49	0.32	0.21	0.24	0.41	0.71	0.92	0.98	(89)
Mean internal temperature in the rest of dwelling T2												
19.89	20.02	20.16	20.26	20.28	20.30	20.30	20.31	20.29	20.27	20.13	19.90	(90)
Living area fraction (22.70 / 50.00)											0.45	(91)
Mean internal temperature (for the whole dwelling)												
20.27	20.38	20.51	20.59	20.60	20.62	20.62	20.62	20.61	20.59	20.47	20.27	(92)
Apply adjustment to the mean internal temperature, where appropriate												
20.27	20.38	20.51	20.59	20.60	20.62	20.62	20.62	20.61	20.59	20.47	20.27	(93)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.97	0.95	0.87	0.69	0.50	0.34	0.23	0.26	0.43	0.73	0.93	0.98	(94)
Useful gains												
494.70	523.61	523.37	450.45	343.98	224.03	149.59	155.92	246.14	379.76	455.96	477.80	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
654.06	629.59	565.75	455.44	344.26	224.03	149.59	155.92	246.19	386.34	524.46	639.84	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
118.56	71.22	31.53	3.59	0.21	-	-	-	-	4.89	49.32	120.55	
Total space heating requirement per year (kWh/year) (October to May)											399.88	(98)
Space heating requirement per m ² (kWh/m ² /year)											8.00	(99)

8c. Space cooling requirement - not applicable

9b. Energy requirements

		kWh/year	
Fraction of space heat from secondary system	0.00		(301)
Fraction of space heat from community system	1.00		(302)
Fraction of community heat from Boilers	1.00		(303a)
Fraction of total space heat from Boilers	1.00		(304a)
Factor for control and charging method for community space heating	1.00		(305)
Factor for charging method for community water heating	1.00		(305a)
Distribution loss factor	1.05		(306)
<u>Space heating</u>			
Annual space heating requirement	399.88		(98)
Space heat from Boilers		419.87	(307a)
Efficiency of secondary heating system	0.00		(308)
Space heating fuel for secondary system		0.00	(309)
<u>Water heating</u>			
Annual water heating requirement	1918.05		(64)
Water heat from Boilers		2013.95	(310a)
<u>Other energy</u>			
Electrical energy for heat distribution		24.34	(313)
Electricity for pumps and fans within dwelling:			
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside (SFP=1.26)		195.99	(330a)
warm air heating system fans		0.00	(330b)
pump for solar water heating		0.00	(330g)
pump for waste water heat recovery		0.00	(330h)
Total electricity for the above, kWh/year		195.99	(331)
Electricity for lighting (100.00% fixed LEL)		243.45	(332)
Energy saving/generation technologies			
Appendix Q -			
Energy saved or generated ():		0.000	(336a)
Energy used ():		0.000	(337a)
Total delivered energy for all uses		2897.61	(338)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

10b. Fuel costs using Table 12 prices

	kWh/year	Fuel price p/kWh	£/year	
Space heating from Boilers	419.87	4.240	17.80	(340a)
Space heating (secondary)	0.00	0.000	0.00	(341)
Water heating from Boilers	2013.95	4.240	85.39	(342a)
Mech vent fans	195.99	13.190	25.85	(349)
Warm air heating system fans	0.00	0.000	0.00	(349)
Pump for solar water heating	0.00	0.000	0.00	(349)
Electricity for lighting	243.453	13.190	32.11	(350)
Additional standing charges			120.00	(351)
Electricity generated - PVs	0.000	0.000	0.00	(352)
Appendix Q -				
Energy saved or generated ():	0.000	0.000	0.00	(353)
Energy used ():	0.000	0.000	0.00	(354)
Total energy cost			281.16	(355)

11b. SAP rating

Energy cost deflator	0.42	(356)
Energy cost factor (ECF)	1.24	(357)
SAP value	82.66	(358)
SAP rating	83.00	(358)
SAP band	B	

12b. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of Boilers - 92.00%				(367a)
CO2 emissions from Boilers	2645.47	0.2160	571.42	(368)
Electrical energy for heat distribution	24.34	0.5190	12.63	(372)
Total CO2 associated with community systems			584.05	(373)
Total CO2 associated with space and water heating			584.05	(376)
Electricity for pumps and fans	195.99	0.519	101.72	(378)
Electricity for lighting	243.45	0.519	126.35	(379)
Electricity generated - PVs	0.00	0.519	0.00	(380)
Electricity generated - µCHP	0.00	0.000	0.00	(380)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(381)
Energy used ():	0.00	0.000	0.00	(382)
Total CO2, kg/year			812.12	(383)

CO2 emissions per m²	kg/m²/year	
EI value	16.24	(384)
EI rating	88.54	(384a)
EI band	89	(385)
	B	

Calculation of stars for heating and DHW

Main heating energy efficiency	, stars = 4
Main heating environmental impact	, stars = 4
Water heating energy efficiency	4.45 = 4.4520, stars = 4
Water heating environmental impact	0.25 = 0.2465, stars = 4

Project Information

Building type Ground-floor flat

Reference

Date 17 July 2019

Client 1 BED Ground Floor PASSIVE Project Hillingdon Gardens
UB10

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings**1. Overall dwelling dimensions**

	Area (m ²)	Av. Storey height (m)	Volume (m ³)	
Ground floor (1)	50.00	2.55	127.50	(3a)
Total floor area	50.00			(4)
Dwelling volume (m ³)			127.50	(5)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

2. Ventilation rate

	main + secondary + other heating		m³ per hour										
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)									
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)									
Number of intermittent fans	0	x 10	0.00	(7a)									
Number of passive vents	0	x 10	0.00	(7b)									
Number of flueless gas fires	0	x 40	0.00	(7c)									
			Air changes per hour										
Infiltration due to chimneys, fans and flues			0.00	(8)									
Pressure test, result q50	3.00			(17)									
Air permeability			0.15	(18)									
Number of sides on which sheltered			3.00	(19)									
Shelter factor			0.78	(20)									
Infiltration rate incorporating shelter factor			0.12	(21)									
Infiltration rate modified for monthly wind speed													
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70		
												52.50	(22)
Wind Factor													
1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18		
												13.13	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed)													
0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14		
												1.53	(22b)
air change rate through system							0.50						(23a)
efficiency in % allowing for in-use factor							70.55						(23c)
Ventilation : balanced whole house mechanical with heat recovery													
Effective air change rate													
0.30	0.29	0.29	0.28	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28	(25)	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	kappa-value kJ/m ² K	A x K kJ/K					
Window - Double-glazed, argon filled (West)			7.740	1.15 (1.20)	8.86			(27)				
Walls			10.76	0.16	1.72	190.00	2044.40	(29)				
West												
Ground floors			50.00	0.11	5.50	75.00	3750.00	(28)				
Party wall			53.56	0.00	0.00	180.00	9640.80					
Circ and Apartment												
Party ceiling			50.00	0.00	0.00	30.00	1500.00					
Internal wall			57.00	0.00	0.00	9.00	513.00					
All internal walls												
Total area of external elements Sigma A, m ²							68.50	(31)				
Fabric heat loss, W/K							16.08	(33)				
Heat capacity							17448.20	(34)				
Thermal mass parameter, kJ/m ² K							348.96	(35)				
Effect of thermal bridges							4.01	(36)				
Total fabric heat loss							20.09	(37)				
Ventilation heat loss calculated monthly												
12.43	12.31	12.19	11.58	11.45	10.84	10.84	10.72	11.09	11.45	11.70	11.94	(38)
Heat transfer coefficient, W/K												
32.52	32.40	32.28	31.67	31.55	30.93	30.93	30.81	31.18	31.55	31.79	32.03	
											31.64	(39)
Heat loss parameter (HLP), W/m ² K												
0.65	0.65	0.65	0.63	0.63	0.62	0.62	0.62	0.62	0.63	0.64	0.64	
HLP (average)											0.63	(40)
Number of days in month (Table 1a)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31	28	31	30	31	30	31	31	30	31	30	31	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

4. Water heating energy requirements

4. Water heating energy requirements												kWh/year
Assumed occupancy, N												1.69 (42)
Annual average hot water usage in litres per day Vd,average												74.34 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month												
81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	(44)
Energy content of hot water used												
121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	
Energy content (annual)												1169.66 (45)
Distribution loss												
18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)
Cylinder volume, l							110.00					(47)
Manufacturer's declared cylinder loss factor (kWh/day)							1.30					(48)
Temperature Factor							1.0000					(49)
Energy lost from hot water cylinder (kWh/day)												1.30 (55)
Total storage loss												
40.30	36.40	40.30	39.00	40.30	39.00	40.30	40.30	39.00	40.30	39.00	40.30	(56)
Net storage loss												
40.30	36.40	40.30	39.00	40.30	39.00	40.30	40.30	39.00	40.30	39.00	40.30	(57)
Primary loss												
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Total heat required for water heating calculated for each month												
184.83	163.47	173.01	156.93	155.12	140.52	136.77	147.57	146.53	162.64	169.66	181.00	(62)
Output from water heater for each month, kWh/month												
184.83	163.47	173.01	156.93	155.12	140.52	136.77	147.57	146.53	162.64	169.66	181.00	(64)
												1918.05 (64)
Heat gains from water heating, kWh/month												
91.17	81.19	87.24	80.94	81.29	75.48	75.19	78.78	77.48	83.79	85.17	89.90	(65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains												
34.46	30.61	24.89	18.85	14.09	11.89	12.85	16.70	22.42	28.47	33.23	35.42	(67)
Appliances gains												
219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains												
46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pumps and fans gains												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (negative values)												
-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains												
122.54	120.83	117.26	112.41	109.26	104.83	101.07	105.89	107.61	112.62	118.29	120.83	(72)
Total internal gains												
457.39	454.10	439.07	415.94	392.59	371.45	358.95	365.35	378.53	401.83	427.69	446.94	(73)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

6. Solar gains (calculation for January)

												Area & Flux	g & FF		Shading	Gains				
Window - Double-glazed, argon filled (West) walls												7.740	19.64	0.43		--	0.77	50.3324		
Total solar gains, January																		50.33	(83-1)	
Solar gains																				
50.33	98.46	162.15	236.49	289.82	296.69	282.46	242.63	188.59	116.83	62.76	41.39					(83)				
Total gains																				
507.72	552.56	601.22	652.43	682.42	668.14	641.41	607.98	567.11	518.66	490.45	488.33					(84)				

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, argon filled (West) walls	0.9 x 7.74	0.80	0.70 x 0.83	3.24
GL = 3.24 / 50.00 = 0.065				
C1 = 0.500				
C2 = 1.008				
EI = 243				

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C)												21.00 (85)
Heating system responsiveness												1.00
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau												
149.02	149.58	150.15	153.05	153.64	156.68	156.68	157.30	155.45	153.64	152.46	151.29	
alpha												
10.93	10.97	11.01	11.20	11.24	11.45	11.45	11.49	11.36	11.24	11.16	11.09	
Utilisation factor for gains for living area												
0.94	0.89	0.77	0.59	0.43	0.30	0.21	0.23	0.38	0.63	0.86	0.95	(86)
Mean internal temperature in living area T1												
20.90	20.95	20.99	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.97	20.89	(87)
Temperature during heating periods in rest of dwelling Th2												
20.38	20.39	20.39	20.40	20.40	20.41	20.41	20.42	20.41	20.40	20.40	20.39	(88)
Utilisation factor for gains for rest of dwelling												
0.93	0.87	0.74	0.56	0.40	0.27	0.18	0.20	0.35	0.60	0.83	0.94	(89)
Mean internal temperature in the rest of dwelling T2												
20.27	20.33	20.38	20.40	20.40	20.41	20.41	20.42	20.41	20.40	20.37	20.26	(90)
Living area fraction (22.70 / 50.00)												0.45 (91)
Mean internal temperature (for the whole dwelling)												
20.56	20.61	20.66	20.67	20.67	20.68	20.68	20.68	20.68	20.67	20.64	20.55	(92)
Apply adjustment to the mean internal temperature, where appropriate												
20.56	20.61	20.66	20.67	20.67	20.68	20.68	20.68	20.68	20.67	20.64	20.55	(93)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.93	0.87	0.75	0.57	0.41	0.28	0.20	0.22	0.36	0.61	0.85	0.95	(94)
Useful gains												
473.96	483.07	451.39	372.49	283.07	188.07	126.20	131.90	205.07	317.25	415.06	461.69	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
528.72	509.19	456.95	372.79	283.08	188.07	126.20	131.90	205.07	317.75	430.49	523.65	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
40.74	17.55	4.13	0.22	0.01	-	-	-	-	0.37	11.11	46.10	
Total space heating requirement per year (kWh/year) (October to May)										120.22		(98)
Space heating requirement per m ² (kWh/m ² /year)										2.40		(99)

8c. Space cooling requirement - not applicable

9b. Energy requirements

		kWh/year	
Fraction of space heat from secondary system	0.00		(301)
Fraction of space heat from community system	1.00		(302)
Fraction of community heat from Boilers	1.00		(303a)
Fraction of total space heat from Boilers	1.00		(304a)
Factor for control and charging method for community space heating	1.00		(305)
Factor for charging method for community water heating	1.00		(305a)
Distribution loss factor	1.05		(306)
<u>Space heating</u>			
Annual space heating requirement	120.22		(98)
Space heat from Boilers		126.23	(307a)
Efficiency of secondary heating system	0.00		(308)
Space heating fuel for secondary system		0.00	(309)
<u>Water heating</u>			
Annual water heating requirement	1918.05		(64)
Water heat from Boilers		2013.95	(310a)
<u>Other energy</u>			
Electrical energy for heat distribution		21.40	(313)
Electricity for pumps and fans within dwelling:			
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside (SFP=1.26)		195.99	(330a)
warm air heating system fans		0.00	(330b)
pump for solar water heating		0.00	(330g)
pump for waste water heat recovery		0.00	(330h)
Total electricity for the above, kWh/year		195.99	(331)
Electricity for lighting (100.00% fixed LEL)		243.45	(332)
Energy saving/generation technologies			
Appendix Q -			
Energy saved or generated ():		0.000	(336a)
Energy used ():		0.000	(337a)
Total delivered energy for all uses		2601.04	(338)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

10b. Fuel costs using Table 12 prices

	kWh/year	Fuel price p/kWh	£/year	
Space heating from Boilers	126.23	4.240	5.35	(340a)
Space heating (secondary)	0.00	0.000	0.00	(341)
Water heating from Boilers	2013.95	4.240	85.39	(342a)
Mech vent fans	195.99	13.190	25.85	(349)
Warm air heating system fans	0.00	0.000	0.00	(349)
Pump for solar water heating	0.00	0.000	0.00	(349)
Electricity for lighting	243.453	13.190	32.11	(350)
Additional standing charges			120.00	(351)
Electricity generated - PVs	0.000	0.000	0.00	(352)
Appendix Q -				
Energy saved or generated ():	0.000	0.000	0.00	(353)
Energy used ():	0.000	0.000	0.00	(354)
Total energy cost			268.71	(355)

11b. SAP rating

Energy cost deflator	0.42	(356)
Energy cost factor (ECF)	1.19	(357)
SAP value	83.43	(358)
SAP rating	83.00	(358)
SAP band	B	

12b. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of Boilers - 92.00%				(367a)
CO2 emissions from Boilers	2326.29	0.2160	502.48	(368)
Electrical energy for heat distribution	21.40	0.5190	11.11	(372)
Total CO2 associated with community systems			513.59	(373)
Total CO2 associated with space and water heating			513.59	(376)
Electricity for pumps and fans	195.99	0.519	101.72	(378)
Electricity for lighting	243.45	0.519	126.35	(379)
Electricity generated - PVs	0.00	0.519	0.00	(380)
Electricity generated - µCHP	0.00	0.000	0.00	(380)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(381)
Energy used ():	0.00	0.000	0.00	(382)
Total CO2, kg/year			741.66	(383)

CO2 emissions per m²	kg/m²/year	
EI value	14.83	(384)
EI rating	89.54	(384a)
EI band	90	(385)
	B	

Calculation of stars for heating and DHW

Main heating energy efficiency	, stars = 4
Main heating environmental impact	, stars = 4
Water heating energy efficiency	4.45 = 4.4520, stars = 4
Water heating environmental impact	0.25 = 0.2465, stars = 4

Project Information

Building type Ground-floor flat

Reference

Date 17 July 2019

Client 1 BED Ground Floor ASHP Project Hillingdon Gardens
UB10**SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings****1. Overall dwelling dimensions**

	Area (m ²)	Av. Storey height (m)	Volume (m ³)	
Ground floor (1)	50.00	2.55	127.50	(3a)
Total floor area	50.00			(4)
Dwelling volume (m ³)			127.50	(5)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

2. Ventilation rate

	main + secondary + other heating		m³ per hour										
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)									
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)									
Number of intermittent fans	0	x 10	0.00	(7a)									
Number of passive vents	0	x 10	0.00	(7b)									
Number of flueless gas fires	0	x 40	0.00	(7c)									
			Air changes per hour										
Infiltration due to chimneys, fans and flues			0.00	(8)									
Pressure test, result q50	3.00			(17)									
Air permeability			0.15	(18)									
Number of sides on which sheltered			3.00	(19)									
Shelter factor			0.78	(20)									
Infiltration rate incorporating shelter factor			0.12	(21)									
Infiltration rate modified for monthly wind speed													
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70		
												52.50	(22)
Wind Factor													
1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18		
												13.13	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed)													
0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14		
												1.53	(22b)
air change rate through system												0.50	(23a)
efficiency in % allowing for in-use factor												70.55	(23c)
Ventilation : balanced whole house mechanical with heat recovery													
Effective air change rate													
0.30	0.29	0.29	0.28	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28	(25)	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	kappa-value kJ/m ² K	A x K kJ/K					
Window - Double-glazed, argon filled (West)			7.740	1.15 (1.20)	8.86			(27)				
Walls			10.76	0.16	1.72	190.00	2044.40	(29)				
West												
Ground floors			50.00	0.11	5.50	75.00	3750.00	(28)				
Party wall			53.56	0.00	0.00	180.00	9640.80					
Circ and Apartment												
Party ceiling			50.00	0.00	0.00	30.00	1500.00					
Internal wall			57.00	0.00	0.00	9.00	513.00					
All internal walls												
Total area of external elements Sigma A, m ²							68.50	(31)				
Fabric heat loss, W/K							16.08	(33)				
Heat capacity							17448.20	(34)				
Thermal mass parameter, kJ/m ² K							348.96	(35)				
Effect of thermal bridges							4.01	(36)				
Total fabric heat loss							20.09	(37)				
Ventilation heat loss calculated monthly												
12.43	12.31	12.19	11.58	11.45	10.84	10.84	10.72	11.09	11.45	11.70	11.94	(38)
Heat transfer coefficient, W/K												
32.52	32.40	32.28	31.67	31.55	30.93	30.93	30.81	31.18	31.55	31.79	32.03	
											31.64	(39)
Heat loss parameter (HLP), W/m ² K												
0.65	0.65	0.65	0.63	0.63	0.62	0.62	0.62	0.62	0.63	0.64	0.64	
HLP (average)											0.63	(40)
Number of days in month (Table 1a)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31	28	31	30	31	30	31	31	30	31	30	31	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

4. Water heating energy requirements

4. Water heating energy requirements												kWh/year
Assumed occupancy, N												1.69 (42)
Annual average hot water usage in litres per day Vd,average												74.34 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month												
81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	(44)
Energy content of hot water used												
121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	
Energy content (annual)												1169.66 (45)
Distribution loss												
18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)
Cylinder volume, l							110.00					(47)
Manufacturer's declared cylinder loss factor (kWh/day)							1.30					(48)
Temperature Factor							1.0000					(49)
Energy lost from hot water cylinder (kWh/day)												1.30 (55)
Total storage loss												
40.30	36.40	40.30	39.00	40.30	39.00	40.30	40.30	39.00	40.30	39.00	40.30	(56)
Net storage loss												
40.30	36.40	40.30	39.00	40.30	39.00	40.30	40.30	39.00	40.30	39.00	40.30	(57)
Primary loss												
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Total heat required for water heating calculated for each month												
184.83	163.47	173.01	156.93	155.12	140.52	136.77	147.57	146.53	162.64	169.66	181.00	(62)
Output from water heater for each month, kWh/month												
184.83	163.47	173.01	156.93	155.12	140.52	136.77	147.57	146.53	162.64	169.66	181.00	(64)
												1918.05 (64)
Heat gains from water heating, kWh/month												
91.17	81.19	87.24	80.94	81.29	75.48	75.19	78.78	77.48	83.79	85.17	89.90	(65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains												
34.46	30.61	24.89	18.85	14.09	11.89	12.85	16.70	22.42	28.47	33.23	35.42	(67)
Appliances gains												
219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains												
46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pumps and fans gains												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (negative values)												
-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains												
122.54	120.83	117.26	112.41	109.26	104.83	101.07	105.89	107.61	112.62	118.29	120.83	(72)
Total internal gains												
457.39	454.10	439.07	415.94	392.59	371.45	358.95	365.35	378.53	401.83	427.69	446.94	(73)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

6. Solar gains (calculation for January)

												Area & Flux	g & FF		Shading	Gains					
Window - Double-glazed, argon filled (West) walls												7.740	19.64			0.43	--	0.77	50.3324		
Total solar gains, January																			50.33	(83-1)	
Solar gains																					
50.33	98.46	162.15	236.49	289.82	296.69	282.46	242.63	188.59	116.83	62.76	41.39					(83)					
Total gains																					
507.72	552.56	601.22	652.43	682.42	668.14	641.41	607.98	567.11	518.66	490.45	488.33					(84)					

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, argon filled (West) walls	0.9 x 7.74	0.80	0.70 x 0.83	3.24
GL = 3.24 / 50.00 = 0.065				
C1 = 0.500				
C2 = 1.008				
EI = 243				

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C)												21.00 (85)
Heating system responsiveness												1.00
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau												
149.02	149.58	150.15	153.05	153.64	156.68	156.68	157.30	155.45	153.64	152.46	151.29	
alpha												
10.93	10.97	11.01	11.20	11.24	11.45	11.45	11.49	11.36	11.24	11.16	11.09	
Utilisation factor for gains for living area												
0.94	0.89	0.77	0.59	0.43	0.30	0.21	0.23	0.38	0.63	0.86	0.95	(86)
Mean internal temperature in living area T1												
20.90	20.95	20.99	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.97	20.89	(87)
Temperature during heating periods in rest of dwelling Th2												
20.38	20.39	20.39	20.40	20.40	20.41	20.41	20.42	20.41	20.40	20.40	20.39	(88)
Utilisation factor for gains for rest of dwelling												
0.93	0.87	0.74	0.56	0.40	0.27	0.18	0.20	0.35	0.60	0.83	0.94	(89)
Mean internal temperature in the rest of dwelling T2												
20.27	20.33	20.38	20.40	20.40	20.41	20.41	20.42	20.41	20.40	20.37	20.26	(90)
Living area fraction (22.70 / 50.00)												0.45 (91)
Mean internal temperature (for the whole dwelling)												
20.56	20.61	20.66	20.67	20.67	20.68	20.68	20.68	20.68	20.67	20.64	20.55	(92)
Apply adjustment to the mean internal temperature, where appropriate												
20.56	20.61	20.66	20.67	20.67	20.68	20.68	20.68	20.68	20.67	20.64	20.55	(93)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.93	0.87	0.75	0.57	0.41	0.28	0.20	0.22	0.36	0.61	0.85	0.95	(94)
Useful gains												
473.96	483.07	451.39	372.49	283.07	188.07	126.20	131.90	205.07	317.25	415.06	461.69	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
528.72	509.19	456.95	372.79	283.08	188.07	126.20	131.90	205.07	317.75	430.49	523.65	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
40.74	17.55	4.13	0.22	0.01	-	-	-	-	0.37	11.11	46.10	
Total space heating requirement per year (kWh/year) (October to May)										120.22		(98)
Space heating requirement per m ² (kWh/m ² /year)										2.40		(99)

8c. Space cooling requirement - not applicable

9b. Energy requirements

		kWh/year	
Fraction of space heat from secondary system	0.00		(301)
Fraction of space heat from community system	1.00		(302)
Fraction of community heat from Heat pumps	1.00		(303a)
Fraction of total space heat from Heat pumps	1.00		(304a)
Factor for control and charging method for community space heating	1.00		(305)
Factor for charging method for community water heating	1.00		(305a)
Distribution loss factor	1.05		(306)
<u>Space heating</u>			
Annual space heating requirement	120.22		(98)
Space heat from Heat pumps		126.23	(307a)
Efficiency of secondary heating system	0.00		(308)
Space heating fuel for secondary system		0.00	(309)
<u>Water heating</u>			
Annual water heating requirement	1918.05		(64)
Water heat from Heat pumps		2013.95	(310a)
<u>Other energy</u>			
Electrical energy for heat distribution		21.40	(313)
Electricity for pumps and fans within dwelling:			
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside (SFP=1.26)		195.99	(330a)
warm air heating system fans		0.00	(330b)
pump for solar water heating		0.00	(330g)
pump for waste water heat recovery		0.00	(330h)
Total electricity for the above, kWh/year		195.99	(331)
Electricity for lighting (100.00% fixed LEL)		243.45	(332)
Energy saving/generation technologies			
Appendix Q -			
Energy saved or generated ():		0.000	(336a)
Energy used ():		0.000	(337a)
Total delivered energy for all uses		2601.04	(338)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

10b. Fuel costs using Table 12 prices

	kWh/year	Fuel price p/kWh	£/year	
Space heating from Heat pumps	126.23	4.240	5.35	(340a)
Space heating (secondary)	0.00	0.000	0.00	(341)
Water heating from Heat pumps	2013.95	4.240	85.39	(342a)
Mech vent fans	195.99	13.190	25.85	(349)
Warm air heating system fans	0.00	0.000	0.00	(349)
Pump for solar water heating	0.00	0.000	0.00	(349)
Electricity for lighting	243.453	13.190	32.11	(350)
Additional standing charges			120.00	(351)
Electricity generated - PVs	0.000	0.000	0.00	(352)
Appendix Q -				
Energy saved or generated ():	0.000	0.000	0.00	(353)
Energy used ():	0.000	0.000	0.00	(354)
Total energy cost			268.71	(355)

11b. SAP rating

Energy cost deflator	0.42	(356)
Energy cost factor (ECF)	1.19	(357)
SAP value	83.43	(358)
SAP rating	83.00	(358)
SAP band	B	

12b. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of Heat pumps - 319.00%				(367a)
CO2 emissions from Heat pumps	670.91	0.5190	348.20	(368)
Electrical energy for heat distribution	21.40	0.5190	11.11	(372)
Total CO2 associated with community systems			359.31	(373)
Total CO2 associated with space and water heating			359.31	(376)
Electricity for pumps and fans	195.99	0.519	101.72	(378)
Electricity for lighting	243.45	0.519	126.35	(379)
Electricity generated - PVs	0.00	0.519	0.00	(380)
Electricity generated - µCHP	0.00	0.000	0.00	(380)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(381)
Energy used ():	0.00	0.000	0.00	(382)
Total CO2, kg/year			587.38	(383)

CO2 emissions per m²	kg/m²/year	
EI value	11.75	(384)
EI rating	91.71	(384a)
EI band	92	(385)
	A	

Calculation of stars for heating and DHW

Main heating energy efficiency	, stars = 4
Main heating environmental impact	, stars = 5
Water heating energy efficiency	4.45 = 4.4520, stars = 4
Water heating environmental impact	0.17 = 0.1708, stars = 5

Project Information

Building type Ground-floor flat

Reference

Date 17 July 2019

Client 1 BED Ground Floor PV Project Hillingdon Gardens
UB10

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings**1. Overall dwelling dimensions**

	Area (m ²)	Av. Storey height (m)	Volume (m ³)	
Ground floor (1)	50.00	2.55	127.50	(3a)
Total floor area	50.00			(4)
Dwelling volume (m ³)			127.50	(5)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

2. Ventilation rate

	main + secondary + other heating		m³ per hour										
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)									
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)									
Number of intermittent fans	0	x 10	0.00	(7a)									
Number of passive vents	0	x 10	0.00	(7b)									
Number of flueless gas fires	0	x 40	0.00	(7c)									
			Air changes per hour										
Infiltration due to chimneys, fans and flues			0.00	(8)									
Pressure test, result q50	3.00			(17)									
Air permeability			0.15	(18)									
Number of sides on which sheltered			3.00	(19)									
Shelter factor			0.78	(20)									
Infiltration rate incorporating shelter factor			0.12	(21)									
Infiltration rate modified for monthly wind speed													
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70		
												52.50	(22)
Wind Factor													
1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18		
												13.13	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed)													
0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14		
												1.53	(22b)
air change rate through system							0.50						(23a)
efficiency in % allowing for in-use factor							70.55						(23c)
Ventilation : balanced whole house mechanical with heat recovery													
Effective air change rate													
0.30	0.29	0.29	0.28	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28	(25)	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	kappa-value kJ/m ² K	A x K kJ/K					
Window - Double-glazed, argon filled (West)			7.740	1.15 (1.20)	8.86			(27)				
Walls			10.76	0.16	1.72	190.00	2044.40	(29)				
West												
Ground floors			50.00	0.11	5.50	75.00	3750.00	(28)				
Party wall			53.56	0.00	0.00	180.00	9640.80					
Circ and Apartment												
Party ceiling			50.00	0.00	0.00	30.00	1500.00					
Internal wall			57.00	0.00	0.00	9.00	513.00					
All internal walls												
Total area of external elements Sigma A, m ²							68.50	(31)				
Fabric heat loss, W/K							16.08	(33)				
Heat capacity							17448.20	(34)				
Thermal mass parameter, kJ/m ² K							348.96	(35)				
Effect of thermal bridges							4.01	(36)				
Total fabric heat loss							20.09	(37)				
Ventilation heat loss calculated monthly												
12.43	12.31	12.19	11.58	11.45	10.84	10.84	10.72	11.09	11.45	11.70	11.94	(38)
Heat transfer coefficient, W/K												
32.52	32.40	32.28	31.67	31.55	30.93	30.93	30.81	31.18	31.55	31.79	32.03	
											31.64	(39)
Heat loss parameter (HLP), W/m ² K												
0.65	0.65	0.65	0.63	0.63	0.62	0.62	0.62	0.62	0.63	0.64	0.64	
HLP (average)											0.63	(40)
Number of days in month (Table 1a)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31	28	31	30	31	30	31	31	30	31	30	31	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

4. Water heating energy requirements

4. Water heating energy requirements												kWh/year
Assumed occupancy, N												1.69 (42)
Annual average hot water usage in litres per day Vd,average												74.34 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month												
81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	(44)
Energy content of hot water used												
121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	
Energy content (annual)												1169.66 (45)
Distribution loss												
18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)
Cylinder volume, l							110.00					(47)
Manufacturer's declared cylinder loss factor (kWh/day)							1.30					(48)
Temperature Factor							1.0000					(49)
Energy lost from hot water cylinder (kWh/day)												1.30 (55)
Total storage loss												
40.30	36.40	40.30	39.00	40.30	39.00	40.30	40.30	39.00	40.30	39.00	40.30	(56)
Net storage loss												
40.30	36.40	40.30	39.00	40.30	39.00	40.30	40.30	39.00	40.30	39.00	40.30	(57)
Primary loss												
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Total heat required for water heating calculated for each month												
184.83	163.47	173.01	156.93	155.12	140.52	136.77	147.57	146.53	162.64	169.66	181.00	(62)
Output from water heater for each month, kWh/month												
184.83	163.47	173.01	156.93	155.12	140.52	136.77	147.57	146.53	162.64	169.66	181.00	(64)
												1918.05 (64)
Heat gains from water heating, kWh/month												
91.17	81.19	87.24	80.94	81.29	75.48	75.19	78.78	77.48	83.79	85.17	89.90	(65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains												
34.46	30.61	24.89	18.85	14.09	11.89	12.85	16.70	22.42	28.47	33.23	35.42	(67)
Appliances gains												
219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains												
46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pumps and fans gains												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (negative values)												
-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains												
122.54	120.83	117.26	112.41	109.26	104.83	101.07	105.89	107.61	112.62	118.29	120.83	(72)
Total internal gains												
457.39	454.10	439.07	415.94	392.59	371.45	358.95	365.35	378.53	401.83	427.69	446.94	(73)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

6. Solar gains (calculation for January)

												Area & Flux	g & FF		Shading	Gains			
Window - Double-glazed, argon filled (West) walls												7.740	19.64	0.43	--	0.77	50.3324		
Total solar gains, January																	50.33	(83-1)	
Solar gains																			
50.33	98.46	162.15	236.49	289.82	296.69	282.46	242.63	188.59	116.83	62.76	41.39			(83)					
Total gains																			
507.72	552.56	601.22	652.43	682.42	668.14	641.41	607.98	567.11	518.66	490.45	488.33			(84)					

Lighting calculations

Window - Double-glazed, argon filled (West) walls	Area 0.9 x 7.74	g 0.80	FF x Shading 0.70 x 0.83	3.24
GL = 3.24 / 50.00 = 0.065				
C1 = 0.500				
C2 = 1.008				
EI = 243				

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C)											21.00	(85)
Heating system responsiveness											1.00	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau												
149.02	149.58	150.15	153.05	153.64	156.68	156.68	157.30	155.45	153.64	152.46	151.29	
alpha												
10.93	10.97	11.01	11.20	11.24	11.45	11.45	11.49	11.36	11.24	11.16	11.09	
Utilisation factor for gains for living area												
0.94	0.89	0.77	0.59	0.43	0.30	0.21	0.23	0.38	0.63	0.86	0.95	(86)
Mean internal temperature in living area T1												
20.90	20.95	20.99	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.97	20.89	(87)
Temperature during heating periods in rest of dwelling Th2												
20.38	20.39	20.39	20.40	20.40	20.41	20.41	20.42	20.41	20.40	20.40	20.39	(88)
Utilisation factor for gains for rest of dwelling												
0.93	0.87	0.74	0.56	0.40	0.27	0.18	0.20	0.35	0.60	0.83	0.94	(89)
Mean internal temperature in the rest of dwelling T2												
20.27	20.33	20.38	20.40	20.40	20.41	20.41	20.42	20.41	20.40	20.37	20.26	(90)
Living area fraction (22.70 / 50.00)											0.45	(91)
Mean internal temperature (for the whole dwelling)												
20.56	20.61	20.66	20.67	20.67	20.68	20.68	20.68	20.68	20.67	20.64	20.55	(92)
Apply adjustment to the mean internal temperature, where appropriate												
20.56	20.61	20.66	20.67	20.67	20.68	20.68	20.68	20.68	20.67	20.64	20.55	(93)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.93	0.87	0.75	0.57	0.41	0.28	0.20	0.22	0.36	0.61	0.85	0.95	(94)
Useful gains												
473.96	483.07	451.39	372.49	283.07	188.07	126.20	131.90	205.07	317.25	415.06	461.69	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
528.72	509.19	456.95	372.79	283.08	188.07	126.20	131.90	205.07	317.75	430.49	523.65	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
40.74	17.55	4.13	0.22	0.01	-	-	-	-	0.37	11.11	46.10	
Total space heating requirement per year (kWh/year) (October to May)										120.22		(98)
Space heating requirement per m ² (kWh/m ² /year)										2.40		(99)

8c. Space cooling requirement - not applicable

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

9b. Energy requirements

		kWh/year	
Fraction of space heat from secondary system	0.00		(301)
Fraction of space heat from community system	1.00		(302)
Fraction of community heat from Heat pumps	1.00		(303a)
Fraction of total space heat from Heat pumps	1.00		(304a)
Factor for control and charging method for community space heating	1.00		(305)
Factor for charging method for community water heating	1.00		(305a)
Distribution loss factor	1.05		(306)
<u>Space heating</u>			
Annual space heating requirement	120.22		(98)
Space heat from Heat pumps		126.23	(307a)
Efficiency of secondary heating system	0.00		(308)
Space heating fuel for secondary system		0.00	(309)
<u>Water heating</u>			
Annual water heating requirement	1918.05		(64)
Water heat from Heat pumps		2013.95	(310a)
<u>Other energy</u>			
Electrical energy for heat distribution		21.40	(313)
Electricity for pumps and fans within dwelling:			
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside (SFP=1.26)		195.99	(330a)
warm air heating system fans		0.00	(330b)
pump for solar water heating		0.00	(330g)
pump for waste water heat recovery		0.00	(330h)
Total electricity for the above, kWh/year		195.99	(331)
Electricity for lighting (100.00% fixed LEL)		243.45	(332)
Energy saving/generation technologies			
PVs 0.80 x 0.300 x 950.616 x 0.800		182.518	
PVs 0.80 x 0.000 x 0.000 x 0.500		0.000	
PVs 0.80 x 0.000 x 0.000 x 0.500		0.000	
		182.518	(333)
Appendix Q -			
Energy saved or generated ():		0.000	(336a)
Energy used ():		0.000	(337a)
Total delivered energy for all uses		2418.52	(338)

10b. Fuel costs using Table 12 prices

	kWh/year	Fuel price p/kWh	£/year	
Space heating from Heat pumps	126.23	4.240	5.35	(340a)
Space heating (secondary)	0.00	0.000	0.00	(341)
Water heating from Heat pumps	2013.95	4.240	85.39	(342a)
Mech vent fans	195.99	13.190	25.85	(349)
Warm air heating system fans	0.00	0.000	0.00	(349)
Pump for solar water heating	0.00	0.000	0.00	(349)
Electricity for lighting	243.453	13.190	32.11	(350)
Additional standing charges			120.00	(351)
Electricity generated - PVs	182.518	13.190	-24.07	(352)
Appendix Q -				
Energy saved or generated ():	0.000	0.000	0.00	(353)
Energy used ():	0.000	0.000	0.00	(354)
Total energy cost			244.63	(355)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

11b. SAP rating

Energy cost deflator	0.42	(356)
Energy cost factor (ECF)	1.08	(357)
SAP value	84.91	(358)
SAP rating	85.00	(358)
SAP band	B	

12b. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of Heat pumps - 319.00%				(367a)
CO2 emissions from Heat pumps	670.91	0.5190	348.20	(368)
Electrical energy for heat distribution	21.40	0.5190	11.11	(372)
Total CO2 associated with community systems			359.31	(373)
Total CO2 associated with space and water heating			359.31	(376)
Electricity for pumps and fans	195.99	0.519	101.72	(378)
Electricity for lighting	243.45	0.519	126.35	(379)
Electricity generated - PVs	-182.52	0.519	-94.73	(380)
Electricity generated - μ CHP	0.00	0.000	0.00	(380)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(381)
Energy used ():	0.00	0.000	0.00	(382)
Total CO2, kg/year			492.65	(383)

CO2 emissions per m²

El value	9.85	(384)
El rating	93	(385)
El band	A	

Calculation of stars for heating and DHW

Main heating energy efficiency	, stars = 4
Main heating environmental impact	, stars = 5
Water heating energy efficiency	4.45 = 4.4520, stars = 4
Water heating environmental impact	0.17 = 0.1708, stars = 5

Project Information

Building type Mid-floor flat

Reference

Date 17 July 2019

Client 2 BED MID Floor Baseline Project Hillingdon Gardens
UB10

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings**1. Overall dwelling dimensions**

	Area (m ²)	Av. Storey height (m)	Volume (m ³)	
Ground floor (1)	77.00	2.55	196.35	(3a)
Total floor area	77.00			(4)
Dwelling volume (m ³)			196.35	(5)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

2. Ventilation rate

	main + secondary + other heating		m³ per hour										
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)									
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)									
Number of intermittent fans	0	x 10	0.00	(7a)									
Number of passive vents	0	x 10	0.00	(7b)									
Number of flueless gas fires	0	x 40	0.00	(7c)									
			Air changes per hour										
Infiltration due to chimneys, fans and flues			0.00	(8)									
Pressure test, result q50	5.58			(17)									
Air permeability			0.28	(18)									
Number of sides on which sheltered			2.00	(19)									
Shelter factor			0.85	(20)									
Infiltration rate incorporating shelter factor			0.24	(21)									
Infiltration rate modified for monthly wind speed													
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70		
52.50												(22)	
Wind Factor													
1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18		
13.13												(22a)	
Adjusted infiltration rate (allowing for shelter and wind speed)													
0.30	0.30	0.29	0.26	0.25	0.23	0.23	0.22	0.24	0.25	0.27	0.28		
3.11												(22b)	
air change rate through system							0.50						(23a)
efficiency in % allowing for in-use factor							72.25						(23c)
Ventilation : balanced whole house mechanical with heat recovery													
Effective air change rate													
0.44	0.44	0.43	0.40	0.39	0.36	0.36	0.36	0.38	0.39	0.41	0.42	(25)	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	kappa-value kJ/m ² K	A x K kJ/K						
Window - Double-glazed, argon filled (West)			11.280	1.15 (1.20)	12.92			(27)					
Window - Double-glazed, argon filled (North)			5.850	1.15 (1.20)	6.70			(27)					
Walls West			17.28	0.16	2.76	190.00	3283.20	(29)					
Walls North			11.75	0.16	1.88	190.00	2232.50	(29)					
Party wall Circ and Apartment			51.10	0.00	0.00	180.00	9198.00						
Party floor			77.00	0.00	0.00	75.00	5775.00						
Party ceiling			77.00	0.00	0.00	30.00	2310.00						
Internal wall All internal walls			124.00	0.00	0.00	9.00	1116.00						
Total area of external elements Sigma A, m ²							46.16	(31)					
Fabric heat loss, W/K							24.26	(33)					
Heat capacity							23914.70	(34)					
Thermal mass parameter, kJ/m ² K							310.58	(35)					
Effect of thermal bridges							6.67	(36)					
Total fabric heat loss							30.93	(37)					
Ventilation heat loss calculated monthly													
28.58	28.20	27.81	25.89	25.51	23.59	23.59	23.20	24.36	25.51	26.28	27.05	(38)	
Heat transfer coefficient, W/K													
59.51	59.13	58.74	56.82	56.44	54.52	54.52	54.13	55.29	56.44	57.21	57.98		
												56.73	(39)
Heat loss parameter (HLP), W/m ² K													
0.77	0.77	0.76	0.74	0.73	0.71	0.71	0.70	0.72	0.73	0.74	0.75		
HLP (average)												0.74	(40)
Number of days in month (Table 1a)													
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
31	28	31	30	31	30	31	31	30	31	30	31		

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

4. Water heating energy requirements

4. Water heating energy requirements												kWh/year	
Assumed occupancy, N												2.40 (42)	
Annual average hot water usage in litres per day Vd,average												91.28 (43)	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month													
100.41	96.76	93.11	89.46	85.81	82.15	82.15	85.81	89.46	93.11	96.76	100.41	(44)	
Energy content of hot water used													
148.91	130.23	134.39	117.16	112.42	97.01	89.90	103.16	104.39	121.65	132.80	144.21		
Energy content (annual)												1436.23 (45)	
Distribution loss													
22.34	19.54	20.16	17.57	16.86	14.55	13.48	15.47	15.66	18.25	19.92	21.63	(46)	
Cylinder volume, l							110.00 (47)						
Manufacturer's declared cylinder loss factor (kWh/day)							1.20 (48)						
Temperature Factor							1.0000 (49)						
Energy lost from hot water cylinder (kWh/day)												1.20 (55)	
Total storage loss													
37.20	33.60	37.20	36.00	37.20	36.00	37.20	37.20	36.00	37.20	36.00	37.20	(56)	
Net storage loss													
37.20	33.60	37.20	36.00	37.20	36.00	37.20	37.20	36.00	37.20	36.00	37.20	(57)	
Primary loss													
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)	
Total heat required for water heating calculated for each month													
209.37	184.85	194.85	175.68	172.88	155.52	150.36	163.62	162.90	182.12	191.31	204.67	(62)	
Output from water heater for each month, kWh/month													
209.37	184.85	194.85	175.68	172.88	155.52	150.36	163.62	162.90	182.12	191.31	204.67	(64)	
												2148.13 (64)	
Heat gains from water heating, kWh/month													
97.88	86.99	93.05	85.77	85.75	79.07	78.26	82.67	81.52	88.82	90.96	96.32	(65)	

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	(66)
Lighting gains												
47.49	42.18	34.30	25.97	19.41	16.39	17.71	23.02	30.89	39.23	45.78	48.81	(67)
Appliances gains												
317.99	321.29	312.98	295.28	272.93	251.93	237.90	234.60	242.91	260.62	282.96	303.96	(68)
Cooking gains												
51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	(69)
Pumps and fans gains												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (negative values)												
-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	(71)
Water heating gains												
131.56	129.45	125.07	119.12	115.26	109.81	105.19	111.11	113.22	119.38	126.34	129.46	(72)
Total internal gains												
596.94	592.82	572.25	540.26	507.49	478.02	460.69	468.62	486.92	519.12	554.98	582.13	(73)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

6. Solar gains (calculation for January)

Solar gains (continued from Sunday)															
Window - Double-glazed, argon filled (West) west				Area & Flux 11.280 19.64				g & FF 0.43 --		Shading 0.77		Gains 73.3526			
Window - Double-glazed, argon filled (North) North				5.850 10.63				0.43 --		0.77		20.5962			
Total solar gains, January												93.95		(83-1)	
Solar gains															
93.95	182.85	303.20	452.08	567.10	587.31	556.29	468.35	355.26	217.12	116.87	77.49	(83)			
Total gains															
690.89	775.67	875.44	992.34	1074.59	1065.33	1016.98	936.98	842.18	736.24	671.85	659.62	(84)			

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, argon filled (West) west	0.9 x 11.28	0.80	0.70 x 0.83	4.72
Window - Double-glazed, argon filled (North) North	0.9 x 5.85	0.80	0.70 x 0.83	2.45
GL = 7.17 / 77.00 = 0.093				
C1 = 0.500				
C2 = 0.960				
EI = 335				

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C)												21.00	(85)
Heating system responsiveness												1.00	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
tau													
111.62	112.35	113.08	116.91	117.70	121.85	121.85	122.71	120.15	117.70	116.12	114.58		
alpha													
8.44	8.49	8.54	8.79	8.85	9.12	9.12	9.18	9.01	8.85	8.74	8.64		
Utilisation factor for gains for living area													
0.99	0.96	0.88	0.68	0.49	0.33	0.24	0.27	0.45	0.77	0.96	0.99		(86)
Mean internal temperature in living area T1													
20.66	20.78	20.91	20.99	21.00	21.00	21.00	21.00	21.00	20.98	20.83	20.65		(87)
Temperature during heating periods in rest of dwelling Th2													
20.28	20.28	20.29	20.31	20.31	20.33	20.33	20.34	20.32	20.31	20.30	20.29		(88)
Utilisation factor for gains for rest of dwelling													
0.98	0.95	0.86	0.65	0.45	0.29	0.20	0.23	0.41	0.73	0.94	0.98		(89)
Mean internal temperature in the rest of dwelling T2													
19.84	20.01	20.19	20.30	20.31	20.33	20.33	20.34	20.32	20.29	20.11	19.84		(90)
Living area fraction (29.00 / 77.00)												0.38	(91)
Mean internal temperature (for the whole dwelling)													
20.15	20.30	20.46	20.56	20.57	20.58	20.58	20.59	20.58	20.55	20.38	20.15		(92)
Apply adjustment to the mean internal temperature, where appropriate													
20.15	20.30	20.46	20.56	20.57	20.58	20.58	20.59	20.58	20.55	20.38	20.15		(93)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.98	0.95	0.86	0.66	0.47	0.31	0.21	0.24	0.43	0.75	0.94	0.98	(94)
Useful gains												
676.80	737.95	756.16	656.09	500.34	326.27	217.24	226.68	358.11	548.66	633.84	648.98	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
943.28	910.42	820.25	662.52	500.65	326.28	217.24	226.68	358.21	561.73	759.74	924.48	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
198.26	115.90	47.69	4.63	0.23	-	-	-	-	9.72	90.65	204.98	
Total space heating requirement per year (kWh/year) (October to May)											672.06	(98)
Space heating requirement per m ² (kWh/m ² /year)											8.73	(99)

8c. Space cooling requirement - not applicable

9b. Energy requirements

		kWh/year	
Fraction of space heat from secondary system	0.00		(301)
Fraction of space heat from community system	1.00		(302)
Fraction of community heat from Boilers	1.00		(303a)
Fraction of total space heat from Boilers	1.00		(304a)
Factor for control and charging method for community space heating	1.00		(305)
Factor for charging method for community water heating	1.00		(305a)
Distribution loss factor	1.05		(306)
<u>Space heating</u>			
Annual space heating requirement	672.06		(98)
Space heat from Boilers		705.66	(307a)
Efficiency of secondary heating system	0.00		(308)
Space heating fuel for secondary system		0.00	(309)
<u>Water heating</u>			
Annual water heating requirement	2148.13		(64)
Water heat from Boilers		2255.53	(310a)
<u>Other energy</u>			
Electrical energy for heat distribution		29.61	(313)
Electricity for pumps and fans within dwelling:			
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside (SFP=1.27)		305.18	(330a)
warm air heating system fans		0.00	(330b)
pump for solar water heating		0.00	(330g)
pump for waste water heat recovery		0.00	(330h)
Total electricity for the above, kWh/year		305.18	(331)
Electricity for lighting (100.00% fixed LEL)		335.46	(332)
Energy saving/generation technologies			
Appendix Q -			
Energy saved or generated ():		0.000	(336a)
Energy used ():		0.000	(337a)
Total delivered energy for all uses		3631.44	(338)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

10b. Fuel costs using Table 12 prices

	kWh/year	Fuel price p/kWh	£/year	
Space heating from Boilers	705.66	4.240	29.92	(340a)
Space heating (secondary)	0.00	0.000	0.00	(341)
Water heating from Boilers	2255.53	4.240	95.63	(342a)
Mech vent fans	305.18	13.190	40.25	(349)
Warm air heating system fans	0.00	0.000	0.00	(349)
Pump for solar water heating	0.00	0.000	0.00	(349)
Electricity for lighting	335.458	13.190	44.25	(350)
Additional standing charges			120.00	(351)
Electricity generated - PVs	0.000	0.000	0.00	(352)
Appendix Q -				
Energy saved or generated ():	0.000	0.000	0.00	(353)
Energy used ():	0.000	0.000	0.00	(354)
Total energy cost			330.05	(355)

11b. SAP rating

Energy cost deflator	0.42	(356)
Energy cost factor (ECF)	1.14	(357)
SAP value	84.15	(358)
SAP rating	84.00	(358)
SAP band	B	

12b. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of Boilers - 92.00%				(367a)
CO2 emissions from Boilers	3218.68	0.2160	695.24	(368)
Electrical energy for heat distribution	29.61	0.5190	15.37	(372)
Total CO2 associated with community systems			710.60	(373)
Total CO2 associated with space and water heating			710.60	(376)
Electricity for pumps and fans	305.18	0.519	158.39	(378)
Electricity for lighting	335.46	0.519	174.10	(379)
Electricity generated - PVs	0.00	0.519	0.00	(380)
Electricity generated - µCHP	0.00	0.000	0.00	(380)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(381)
Energy used ():	0.00	0.000	0.00	(382)
Total CO2, kg/year			1043.10	(383)

CO2 emissions per m²	kg/m²/year	
El value	13.55	(384)
El rating	88.54	(384a)
El band	89	(385)
	B	

Calculation of stars for heating and DHW

Main heating energy efficiency	, stars = 4
Main heating environmental impact	, stars = 4
Water heating energy efficiency	4.45 = 4.4520, stars = 4
Water heating environmental impact	0.25 = 0.2465, stars = 4

Project Information

Building type Mid-floor flat

Reference

Date 17 July 2019

Client 2 BED MID Floor PASSIVE Project Hillingdon Gardens
UB10

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings**1. Overall dwelling dimensions**

	Area (m ²)	Av. Storey height (m)	Volume (m ³)	
Ground floor (1)	77.00	2.55	196.35	(3a)
Total floor area	77.00			(4)
Dwelling volume (m ³)			196.35	(5)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

2. Ventilation rate

	main + secondary + other heating		m³ per hour										
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)									
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)									
Number of intermittent fans	0	x 10	0.00	(7a)									
Number of passive vents	0	x 10	0.00	(7b)									
Number of flueless gas fires	0	x 40	0.00	(7c)									
			Air changes per hour										
Infiltration due to chimneys, fans and flues			0.00	(8)									
Pressure test, result q50	3.00			(17)									
Air permeability			0.15	(18)									
Number of sides on which sheltered			2.00	(19)									
Shelter factor			0.85	(20)									
Infiltration rate incorporating shelter factor			0.13	(21)									
Infiltration rate modified for monthly wind speed													
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70		
												52.50	(22)
Wind Factor													
1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18		
												13.13	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed)													
0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15		
												1.67	(22b)
air change rate through system							0.50						(23a)
efficiency in % allowing for in-use factor							72.25						(23c)
Ventilation : balanced whole house mechanical with heat recovery													
Effective air change rate													
0.30	0.30	0.29	0.28	0.28	0.26	0.26	0.26	0.27	0.28	0.28	0.29	(25)	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	kappa-value kJ/m ² K	A x K kJ/K					
Window - Double-glazed, argon filled (West)			11.280	1.15 (1.20)	12.92			(27)				
Window - Double-glazed, argon filled (North)			5.850	1.15 (1.20)	6.70			(27)				
Walls West			17.28	0.16	2.76	190.00	3283.20	(29)				
Walls North			11.75	0.16	1.88	190.00	2232.50	(29)				
Party wall Circ and Apartment			51.10	0.00	0.00	180.00	9198.00					
Party floor			77.00	0.00	0.00	75.00	5775.00					
Party ceiling			77.00	0.00	0.00	30.00	2310.00					
Internal wall All internal walls			124.00	0.00	0.00	9.00	1116.00					
Total area of external elements Sigma A, m ²							46.16	(31)				
Fabric heat loss, W/K							24.26	(33)				
Heat capacity							23914.70	(34)				
Thermal mass parameter, kJ/m ² K							310.58	(35)				
Effect of thermal bridges							6.67	(36)				
Total fabric heat loss							30.93	(37)				
Ventilation heat loss calculated monthly												
19.52	19.32	19.11	18.08	17.87	16.84	16.84	16.63	17.25	17.87	18.28	18.70	(38)
Heat transfer coefficient, W/K												
50.45	50.25	50.04	49.01	48.80	47.77	47.77	47.56	48.18	48.80	49.21	49.63	48.96 (39)
Heat loss parameter (HLP), W/m ² K												
0.66	0.65	0.65	0.64	0.63	0.62	0.62	0.62	0.63	0.63	0.64	0.64	0.64 (40)
HLP (average)												
Number of days in month (Table 1a)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31	28	31	30	31	30	31	31	30	31	30	31	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

4. Water heating energy requirements

4. Water heating energy requirements												kWh/year	
Assumed occupancy, N												2.40 (42)	
Annual average hot water usage in litres per day Vd,average												91.28 (43)	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month													
100.41	96.76	93.11	89.46	85.81	82.15	82.15	85.81	89.46	93.11	96.76	100.41	(44)	
Energy content of hot water used													
148.91	130.23	134.39	117.16	112.42	97.01	89.90	103.16	104.39	121.65	132.80	144.21		
Energy content (annual)												1436.23 (45)	
Distribution loss													
22.34	19.54	20.16	17.57	16.86	14.55	13.48	15.47	15.66	18.25	19.92	21.63	(46)	
Cylinder volume, l							110.00 (47)						
Manufacturer's declared cylinder loss factor (kWh/day)							1.20 (48)						
Temperature Factor							1.0000 (49)						
Energy lost from hot water cylinder (kWh/day)												1.20 (55)	
Total storage loss													
37.20	33.60	37.20	36.00	37.20	36.00	37.20	37.20	36.00	37.20	36.00	37.20	(56)	
Net storage loss													
37.20	33.60	37.20	36.00	37.20	36.00	37.20	37.20	36.00	37.20	36.00	37.20	(57)	
Primary loss													
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)	
Total heat required for water heating calculated for each month													
209.37	184.85	194.85	175.68	172.88	155.52	150.36	163.62	162.90	182.12	191.31	204.67	(62)	
Output from water heater for each month, kWh/month													
209.37	184.85	194.85	175.68	172.88	155.52	150.36	163.62	162.90	182.12	191.31	204.67	(64)	
												2148.13 (64)	
Heat gains from water heating, kWh/month													
97.88	86.99	93.05	85.77	85.75	79.07	78.26	82.67	81.52	88.82	90.96	96.32	(65)	

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	(66)
Lighting gains												
47.49	42.18	34.30	25.97	19.41	16.39	17.71	23.02	30.89	39.23	45.78	48.81	(67)
Appliances gains												
317.99	321.29	312.98	295.28	272.93	251.93	237.90	234.60	242.91	260.62	282.96	303.96	(68)
Cooking gains												
51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	(69)
Pumps and fans gains												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (negative values)												
-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	(71)
Water heating gains												
131.56	129.45	125.07	119.12	115.26	109.81	105.19	111.11	113.22	119.38	126.34	129.46	(72)
Total internal gains												
596.94	592.82	572.25	540.26	507.49	478.02	460.69	468.62	486.92	519.12	554.98	582.13	(73)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

6. Solar gains (calculation for January)

Solar gains (continued from Sunday)															
Window - Double-glazed, argon filled (West) west				Area & Flux 11.280 19.64				g & FF 0.43 --		Shading 0.77		Gains 73.3526			
Window - Double-glazed, argon filled (North) North				5.850 10.63				0.43 --		0.77		20.5962			
Total solar gains, January												93.95		(83-1)	
Solar gains															
93.95	182.85	303.20	452.08	567.10	587.31	556.29	468.35	355.26	217.12	116.87	77.49	(83)			
Total gains															
690.89	775.67	875.44	992.34	1074.59	1065.33	1016.98	936.98	842.18	736.24	671.85	659.62	(84)			

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, argon filled (West) west	0.9 x 11.28	0.80	0.70 x 0.83	4.72
Window - Double-glazed, argon filled (North) North	0.9 x 5.85	0.80	0.70 x 0.83	2.45
GL = 7.17 / 77.00 = 0.093				
C1 = 0.500				
C2 = 0.960				
EI = 335				

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C)												21.00	(85)
Heating system responsiveness												1.00	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
tau													
131.66	132.21	132.75	135.55	136.12	139.06	139.06	139.67	137.87	136.12	134.98	133.86		
alpha													
9.78	9.81	9.85	10.04	10.07	10.27	10.27	10.31	10.19	10.07	10.00	9.92		
Utilisation factor for gains for living area													
0.97	0.93	0.80	0.60	0.42	0.29	0.21	0.23	0.39	0.68	0.92	0.98		(86)
Mean internal temperature in living area T1													
20.81	20.90	20.98	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.92	20.79		(87)
Temperature during heating periods in rest of dwelling Th2													
20.38	20.38	20.39	20.40	20.40	20.41	20.41	20.41	20.41	20.40	20.39	20.39		(88)
Utilisation factor for gains for rest of dwelling													
0.96	0.91	0.78	0.57	0.40	0.26	0.18	0.20	0.36	0.65	0.90	0.97		(89)
Mean internal temperature in the rest of dwelling T2													
20.14	20.26	20.36	20.40	20.40	20.41	20.41	20.41	20.41	20.40	20.31	20.13		(90)
Living area fraction (29.00 / 77.00)												0.38	(91)
Mean internal temperature (for the whole dwelling)													
20.39	20.50	20.59	20.62	20.63	20.63	20.63	20.63	20.63	20.62	20.54	20.38		(92)
Apply adjustment to the mean internal temperature, where appropriate													
20.39	20.50	20.59	20.62	20.63	20.63	20.63	20.63	20.63	20.62	20.54	20.38		(93)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.96	0.91	0.78	0.58	0.41	0.27	0.19	0.21	0.37	0.66	0.90	0.97	(94)
Useful gains												
665.13	707.66	687.13	573.51	435.56	288.20	192.67	201.42	314.63	486.40	605.93	640.65	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
812.02	784.03	705.14	574.52	435.59	288.20	192.67	201.42	314.64	489.09	661.53	802.79	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
109.28	51.33	13.40	0.72	0.02	-	-	-	-	2.00	40.03	120.63	
Total space heating requirement per year (kWh/year) (October to May)										337.42		(98)
Space heating requirement per m ² (kWh/m ² /year)										4.38		(99)

8c. Space cooling requirement - not applicable

9b. Energy requirements

		kWh/year	
Fraction of space heat from secondary system	0.00		(301)
Fraction of space heat from community system	1.00		(302)
Fraction of community heat from Boilers	1.00		(303a)
Fraction of total space heat from Boilers	1.00		(304a)
Factor for control and charging method for community space heating	1.00		(305)
Factor for charging method for community water heating	1.00		(305a)
Distribution loss factor	1.05		(306)
<u>Space heating</u>			
Annual space heating requirement	337.42		(98)
Space heat from Boilers		354.29	(307a)
Efficiency of secondary heating system	0.00		(308)
Space heating fuel for secondary system		0.00	(309)
<u>Water heating</u>			
Annual water heating requirement	2148.13		(64)
Water heat from Boilers		2255.53	(310a)
<u>Other energy</u>			
Electrical energy for heat distribution		26.10	(313)
Electricity for pumps and fans within dwelling:			
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside (SFP=1.27)		305.18	(330a)
warm air heating system fans		0.00	(330b)
pump for solar water heating		0.00	(330g)
pump for waste water heat recovery		0.00	(330h)
Total electricity for the above, kWh/year		305.18	(331)
Electricity for lighting (100.00% fixed LEL)		335.46	(332)
Energy saving/generation technologies			
Appendix Q -			
Energy saved or generated ():		0.000	(336a)
Energy used ():		0.000	(337a)
Total delivered energy for all uses		3276.56	(338)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

10b. Fuel costs using Table 12 prices

	kWh/year	Fuel price p/kWh	£/year	
Space heating from Boilers	354.29	4.240	15.02	(340a)
Space heating (secondary)	0.00	0.000	0.00	(341)
Water heating from Boilers	2255.53	4.240	95.63	(342a)
Mech vent fans	305.18	13.190	40.25	(349)
Warm air heating system fans	0.00	0.000	0.00	(349)
Pump for solar water heating	0.00	0.000	0.00	(349)
Electricity for lighting	335.458	13.190	44.25	(350)
Additional standing charges			120.00	(351)
Electricity generated - PVs	0.000	0.000	0.00	(352)
Appendix Q -				
Energy saved or generated ():	0.000	0.000	0.00	(353)
Energy used ():	0.000	0.000	0.00	(354)
Total energy cost			315.16	(355)

11b. SAP rating

Energy cost deflator	0.42	(356)
Energy cost factor (ECF)	1.08	(357)
SAP value	84.86	(358)
SAP rating	85.00	(358)
SAP band	B	

12b. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of Boilers - 92.00%				(367a)
CO2 emissions from Boilers	2836.76	0.2160	612.74	(368)
Electrical energy for heat distribution	26.10	0.5190	13.54	(372)
Total CO2 associated with community systems			626.29	(373)
Total CO2 associated with space and water heating			626.29	(376)
Electricity for pumps and fans	305.18	0.519	158.39	(378)
Electricity for lighting	335.46	0.519	174.10	(379)
Electricity generated - PVs	0.00	0.519	0.00	(380)
Electricity generated - µCHP	0.00	0.000	0.00	(380)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(381)
Energy used ():	0.00	0.000	0.00	(382)
Total CO2, kg/year			958.78	(383)

CO2 emissions per m²	kg/m²/year	
EI value	12.45	(384)
EI rating	89.47	(384a)
EI band	89	(385)
	B	

Calculation of stars for heating and DHW

Main heating energy efficiency	, stars = 4
Main heating environmental impact	, stars = 4
Water heating energy efficiency	4.45 = 4.4520, stars = 4
Water heating environmental impact	0.25 = 0.2465, stars = 4

Project Information

Building type Mid-floor flat

Reference

Date 17 July 2019

Client 2 BED MID Floor ASHP Project Hillingdon Gardens
UB10

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings**1. Overall dwelling dimensions**

	Area (m ²)	Av. Storey height (m)	Volume (m ³)	
Ground floor (1)	77.00	2.55	196.35	(3a)
Total floor area	77.00			(4)
Dwelling volume (m ³)			196.35	(5)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

2. Ventilation rate

	main + secondary + other heating		m³ per hour										
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)									
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)									
Number of intermittent fans	0	x 10	0.00	(7a)									
Number of passive vents	0	x 10	0.00	(7b)									
Number of flueless gas fires	0	x 40	0.00	(7c)									
			Air changes per hour										
Infiltration due to chimneys, fans and flues			0.00	(8)									
Pressure test, result q50	3.00			(17)									
Air permeability			0.15	(18)									
Number of sides on which sheltered			2.00	(19)									
Shelter factor			0.85	(20)									
Infiltration rate incorporating shelter factor			0.13	(21)									
Infiltration rate modified for monthly wind speed													
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70		
52.50												(22)	
Wind Factor													
1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18		
13.13												(22a)	
Adjusted infiltration rate (allowing for shelter and wind speed)													
0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15		
1.67												(22b)	
air change rate through system							0.50						(23a)
efficiency in % allowing for in-use factor							72.25						(23c)
Ventilation : balanced whole house mechanical with heat recovery													
Effective air change rate													
0.30	0.30	0.29	0.28	0.28	0.26	0.26	0.26	0.27	0.28	0.28	0.29	(25)	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	kappa-value kJ/m ² K	A x K kJ/K					
Window - Double-glazed, argon filled (West)			11.280	1.15 (1.20)	12.92			(27)				
Window - Double-glazed, argon filled (North)			5.850	1.15 (1.20)	6.70			(27)				
Walls West			17.28	0.16	2.76	190.00	3283.20	(29)				
Walls North			11.75	0.16	1.88	190.00	2232.50	(29)				
Party wall Circ and Apartment			51.10	0.00	0.00	180.00	9198.00					
Party floor			77.00	0.00	0.00	75.00	5775.00					
Party ceiling			77.00	0.00	0.00	30.00	2310.00					
Internal wall All internal walls			124.00	0.00	0.00	9.00	1116.00					
Total area of external elements Sigma A, m ²							46.16	(31)				
Fabric heat loss, W/K							24.26	(33)				
Heat capacity							23914.70	(34)				
Thermal mass parameter, kJ/m ² K							310.58	(35)				
Effect of thermal bridges							6.67	(36)				
Total fabric heat loss							30.93	(37)				
Ventilation heat loss calculated monthly												
19.52	19.32	19.11	18.08	17.87	16.84	16.84	16.63	17.25	17.87	18.28	18.70	(38)
Heat transfer coefficient, W/K												
50.45	50.25	50.04	49.01	48.80	47.77	47.77	47.56	48.18	48.80	49.21	49.63	48.96 (39)
Heat loss parameter (HLP), W/m ² K												
0.66	0.65	0.65	0.64	0.63	0.62	0.62	0.62	0.63	0.63	0.64	0.64	0.64 (40)
HLP (average)												
Number of days in month (Table 1a)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31	28	31	30	31	30	31	31	30	31	30	31	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

4. Water heating energy requirements

4. Water heating energy requirements												kWh/year	
Assumed occupancy, N												2.40 (42)	
Annual average hot water usage in litres per day Vd,average												91.28 (43)	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month													
100.41	96.76	93.11	89.46	85.81	82.15	82.15	85.81	89.46	93.11	96.76	100.41	(44)	
Energy content of hot water used													
148.91	130.23	134.39	117.16	112.42	97.01	89.90	103.16	104.39	121.65	132.80	144.21		
Energy content (annual)												1436.23 (45)	
Distribution loss													
22.34	19.54	20.16	17.57	16.86	14.55	13.48	15.47	15.66	18.25	19.92	21.63	(46)	
Cylinder volume, l							110.00 (47)						
Manufacturer's declared cylinder loss factor (kWh/day)							1.20 (48)						
Temperature Factor							1.0000 (49)						
Energy lost from hot water cylinder (kWh/day)												1.20 (55)	
Total storage loss													
37.20	33.60	37.20	36.00	37.20	36.00	37.20	37.20	36.00	37.20	36.00	37.20	(56)	
Net storage loss													
37.20	33.60	37.20	36.00	37.20	36.00	37.20	37.20	36.00	37.20	36.00	37.20	(57)	
Primary loss													
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)	
Total heat required for water heating calculated for each month													
209.37	184.85	194.85	175.68	172.88	155.52	150.36	163.62	162.90	182.12	191.31	204.67	(62)	
Output from water heater for each month, kWh/month													
209.37	184.85	194.85	175.68	172.88	155.52	150.36	163.62	162.90	182.12	191.31	204.67	(64)	
												2148.13 (64)	
Heat gains from water heating, kWh/month													
97.88	86.99	93.05	85.77	85.75	79.07	78.26	82.67	81.52	88.82	90.96	96.32	(65)	

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	(66)
Lighting gains												
47.49	42.18	34.30	25.97	19.41	16.39	17.71	23.02	30.89	39.23	45.78	48.81	(67)
Appliances gains												
317.99	321.29	312.98	295.28	272.93	251.93	237.90	234.60	242.91	260.62	282.96	303.96	(68)
Cooking gains												
51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	(69)
Pumps and fans gains												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (negative values)												
-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	(71)
Water heating gains												
131.56	129.45	125.07	119.12	115.26	109.81	105.19	111.11	113.22	119.38	126.34	129.46	(72)
Total internal gains												
596.94	592.82	572.25	540.26	507.49	478.02	460.69	468.62	486.92	519.12	554.98	582.13	(73)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

6. Solar gains (calculation for January)

Solar gains (continued from Sunday)															
Window - Double-glazed, argon filled (West) west				Area & Flux 11.280 19.64				g & FF 0.43 --		Shading 0.77		Gains 73.3526			
Window - Double-glazed, argon filled (North) North				5.850 10.63				0.43 --		0.77		20.5962			
Total solar gains, January												93.95		(83-1)	
Solar gains															
93.95	182.85	303.20	452.08	567.10	587.31	556.29	468.35	355.26	217.12	116.87	77.49	(83)			
Total gains															
690.89	775.67	875.44	992.34	1074.59	1065.33	1016.98	936.98	842.18	736.24	671.85	659.62	(84)			

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, argon filled (West) west	0.9 x 11.28	0.80	0.70 x 0.83	4.72
Window - Double-glazed, argon filled (North) North	0.9 x 5.85	0.80	0.70 x 0.83	2.45
GL = 7.17 / 77.00 = 0.093				
C1 = 0.500				
C2 = 0.960				
EI = 335				

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C)												21.00	(85)
Heating system responsiveness												1.00	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
tau													
131.66	132.21	132.75	135.55	136.12	139.06	139.06	139.67	137.87	136.12	134.98	133.86		
alpha													
9.78	9.81	9.85	10.04	10.07	10.27	10.27	10.31	10.19	10.07	10.00	9.92		
Utilisation factor for gains for living area													
0.97	0.93	0.80	0.60	0.42	0.29	0.21	0.23	0.39	0.68	0.92	0.98		(86)
Mean internal temperature in living area T1													
20.81	20.90	20.98	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.92	20.79		(87)
Temperature during heating periods in rest of dwelling Th2													
20.38	20.38	20.39	20.40	20.40	20.41	20.41	20.41	20.41	20.40	20.39	20.39		(88)
Utilisation factor for gains for rest of dwelling													
0.96	0.91	0.78	0.57	0.40	0.26	0.18	0.20	0.36	0.65	0.90	0.97		(89)
Mean internal temperature in the rest of dwelling T2													
20.14	20.26	20.36	20.40	20.40	20.41	20.41	20.41	20.41	20.40	20.31	20.13		(90)
Living area fraction (29.00 / 77.00)												0.38	(91)
Mean internal temperature (for the whole dwelling)													
20.39	20.50	20.59	20.62	20.63	20.63	20.63	20.63	20.63	20.62	20.54	20.38		(92)
Apply adjustment to the mean internal temperature, where appropriate													
20.39	20.50	20.59	20.62	20.63	20.63	20.63	20.63	20.63	20.62	20.54	20.38		(93)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.96	0.91	0.78	0.58	0.41	0.27	0.19	0.21	0.37	0.66	0.90	0.97	(94)
Useful gains												
665.13	707.66	687.13	573.51	435.56	288.20	192.67	201.42	314.63	486.40	605.93	640.65	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
812.02	784.03	705.14	574.52	435.59	288.20	192.67	201.42	314.64	489.09	661.53	802.79	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
109.28	51.33	13.40	0.72	0.02	-	-	-	-	2.00	40.03	120.63	
Total space heating requirement per year (kWh/year) (October to May)										337.42		(98)
Space heating requirement per m ² (kWh/m ² /year)										4.38		(99)

8c. Space cooling requirement - not applicable

9b. Energy requirements

		kWh/year	
Fraction of space heat from secondary system	0.00		(301)
Fraction of space heat from community system	1.00		(302)
Fraction of community heat from Heat pumps	1.00		(303a)
Fraction of total space heat from Heat pumps	1.00		(304a)
Factor for control and charging method for community space heating	1.00		(305)
Factor for charging method for community water heating	1.00		(305a)
Distribution loss factor	1.05		(306)
<u>Space heating</u>			
Annual space heating requirement	337.42		(98)
Space heat from Heat pumps		354.29	(307a)
Efficiency of secondary heating system	0.00		(308)
Space heating fuel for secondary system		0.00	(309)
<u>Water heating</u>			
Annual water heating requirement	2148.13		(64)
Water heat from Heat pumps		2255.53	(310a)
<u>Other energy</u>			
Electrical energy for heat distribution		26.10	(313)
Electricity for pumps and fans within dwelling:			
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside (SFP=1.27)		305.18	(330a)
warm air heating system fans		0.00	(330b)
pump for solar water heating		0.00	(330g)
pump for waste water heat recovery		0.00	(330h)
Total electricity for the above, kWh/year		305.18	(331)
Electricity for lighting (100.00% fixed LEL)		335.46	(332)
Energy saving/generation technologies			
Appendix Q -			
Energy saved or generated ():		0.000	(336a)
Energy used ():		0.000	(337a)
Total delivered energy for all uses		3276.56	(338)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

10b. Fuel costs using Table 12 prices

	kWh/year	Fuel price p/kWh	£/year	
Space heating from Heat pumps	354.29	4.240	15.02	(340a)
Space heating (secondary)	0.00	0.000	0.00	(341)
Water heating from Heat pumps	2255.53	4.240	95.63	(342a)
Mech vent fans	305.18	13.190	40.25	(349)
Warm air heating system fans	0.00	0.000	0.00	(349)
Pump for solar water heating	0.00	0.000	0.00	(349)
Electricity for lighting	335.458	13.190	44.25	(350)
Additional standing charges			120.00	(351)
Electricity generated - PVs	0.000	0.000	0.00	(352)
Appendix Q -				
Energy saved or generated ():	0.000	0.000	0.00	(353)
Energy used ():	0.000	0.000	0.00	(354)
Total energy cost			315.16	(355)

11b. SAP rating

Energy cost deflator	0.42	(356)
Energy cost factor (ECF)	1.08	(357)
SAP value	84.86	(358)
SAP rating	85.00	(358)
SAP band	B	

12b. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of Heat pumps - 319.00%				(367a)
CO2 emissions from Heat pumps	818.13	0.5190	424.61	(368)
Electrical energy for heat distribution	26.10	0.5190	13.54	(372)
Total CO2 associated with community systems			438.15	(373)
Total CO2 associated with space and water heating			438.15	(376)
Electricity for pumps and fans	305.18	0.519	158.39	(378)
Electricity for lighting	335.46	0.519	174.10	(379)
Electricity generated - PVs	0.00	0.519	0.00	(380)
Electricity generated - µCHP	0.00	0.000	0.00	(380)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(381)
Energy used ():	0.00	0.000	0.00	(382)
Total CO2, kg/year			770.64	(383)

CO2 emissions per m²	kg/m²/year	
EI value	10.01	(384)
EI rating	91.54	(384a)
EI band	92	(385)
	A	

Calculation of stars for heating and DHW

Main heating energy efficiency	, stars = 4
Main heating environmental impact	, stars = 5
Water heating energy efficiency	4.45 = 4.4520, stars = 4
Water heating environmental impact	0.17 = 0.1708, stars = 5

Project Information

Building type Mid-floor flat

Reference

Date 17 July 2019

Client 2 BED MID Floor PV

Project

Hillingdon Gardens
UB10**SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings****1. Overall dwelling dimensions**

	Area (m²)	Av. Storey height (m)	Volume (m³)	
Ground floor (1)	77.00	2.55	196.35	(3a)
Total floor area	77.00			(4)
Dwelling volume (m ³)			196.35	(5)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

2. Ventilation rate

	main + secondary + other heating		m³ per hour										
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)									
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)									
Number of intermittent fans	0	x 10	0.00	(7a)									
Number of passive vents	0	x 10	0.00	(7b)									
Number of flueless gas fires	0	x 40	0.00	(7c)									
			Air changes per hour										
Infiltration due to chimneys, fans and flues			0.00	(8)									
Pressure test, result q50	3.00			(17)									
Air permeability			0.15	(18)									
Number of sides on which sheltered			2.00	(19)									
Shelter factor			0.85	(20)									
Infiltration rate incorporating shelter factor			0.13	(21)									
Infiltration rate modified for monthly wind speed													
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70		
52.50												(22)	
Wind Factor													
1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18		
13.13												(22a)	
Adjusted infiltration rate (allowing for shelter and wind speed)													
0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15		
1.67												(22b)	
air change rate through system							0.50						(23a)
efficiency in % allowing for in-use factor							72.25						(23c)
Ventilation : balanced whole house mechanical with heat recovery													
Effective air change rate													
0.30	0.30	0.29	0.28	0.28	0.26	0.26	0.26	0.27	0.28	0.28	0.29	(25)	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	kappa-value kJ/m ² K	A x K kJ/K					
Window - Double-glazed, argon filled (West)			11.280	1.15 (1.20)	12.92			(27)				
Window - Double-glazed, argon filled (North)			5.850	1.15 (1.20)	6.70			(27)				
Walls West			17.28	0.16	2.76	190.00	3283.20	(29)				
Walls North			11.75	0.16	1.88	190.00	2232.50	(29)				
Party wall Circ and Apartment			51.10	0.00	0.00	180.00	9198.00					
Party floor			77.00	0.00	0.00	75.00	5775.00					
Party ceiling			77.00	0.00	0.00	30.00	2310.00					
Internal wall All internal walls			124.00	0.00	0.00	9.00	1116.00					
Total area of external elements Sigma A, m ²							46.16	(31)				
Fabric heat loss, W/K							24.26	(33)				
Heat capacity							23914.70	(34)				
Thermal mass parameter, kJ/m ² K							310.58	(35)				
Effect of thermal bridges							6.67	(36)				
Total fabric heat loss							30.93	(37)				
Ventilation heat loss calculated monthly												
19.52	19.32	19.11	18.08	17.87	16.84	16.84	16.63	17.25	17.87	18.28	18.70	(38)
Heat transfer coefficient, W/K												
50.45	50.25	50.04	49.01	48.80	47.77	47.77	47.56	48.18	48.80	49.21	49.63	48.96 (39)
Heat loss parameter (HLP), W/m ² K												
0.66	0.65	0.65	0.64	0.63	0.62	0.62	0.62	0.63	0.63	0.64	0.64	0.64 (40)
HLP (average)												
Number of days in month (Table 1a)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31	28	31	30	31	30	31	31	30	31	30	31	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

4. Water heating energy requirements

4. Water heating energy requirements												kWh/year	
Assumed occupancy, N												2.40 (42)	
Annual average hot water usage in litres per day Vd,average												91.28 (43)	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month													
100.41	96.76	93.11	89.46	85.81	82.15	82.15	85.81	89.46	93.11	96.76	100.41	(44)	
Energy content of hot water used													
148.91	130.23	134.39	117.16	112.42	97.01	89.90	103.16	104.39	121.65	132.80	144.21		
Energy content (annual)												1436.23 (45)	
Distribution loss													
22.34	19.54	20.16	17.57	16.86	14.55	13.48	15.47	15.66	18.25	19.92	21.63	(46)	
Cylinder volume, l							110.00 (47)						
Manufacturer's declared cylinder loss factor (kWh/day)							1.20 (48)						
Temperature Factor							1.0000 (49)						
Energy lost from hot water cylinder (kWh/day)												1.20 (55)	
Total storage loss													
37.20	33.60	37.20	36.00	37.20	36.00	37.20	37.20	36.00	37.20	36.00	37.20	(56)	
Net storage loss													
37.20	33.60	37.20	36.00	37.20	36.00	37.20	37.20	36.00	37.20	36.00	37.20	(57)	
Primary loss													
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)	
Total heat required for water heating calculated for each month													
209.37	184.85	194.85	175.68	172.88	155.52	150.36	163.62	162.90	182.12	191.31	204.67	(62)	
Output from water heater for each month, kWh/month													
209.37	184.85	194.85	175.68	172.88	155.52	150.36	163.62	162.90	182.12	191.31	204.67	(64)	
												2148.13 (64)	
Heat gains from water heating, kWh/month													
97.88	86.99	93.05	85.77	85.75	79.07	78.26	82.67	81.52	88.82	90.96	96.32	(65)	

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	144.21	(66)
Lighting gains												
47.49	42.18	34.30	25.97	19.41	16.39	17.71	23.02	30.89	39.23	45.78	48.81	(67)
Appliances gains												
317.99	321.29	312.98	295.28	272.93	251.93	237.90	234.60	242.91	260.62	282.96	303.96	(68)
Cooking gains												
51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	51.82	(69)
Pumps and fans gains												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (negative values)												
-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	(71)
Water heating gains												
131.56	129.45	125.07	119.12	115.26	109.81	105.19	111.11	113.22	119.38	126.34	129.46	(72)
Total internal gains												
596.94	592.82	572.25	540.26	507.49	478.02	460.69	468.62	486.92	519.12	554.98	582.13	(73)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

6. Solar gains (calculation for January)

Solar gains (continued from Sunday)															
Window - Double-glazed, argon filled (West) west				Area & Flux 11.280 19.64				g & FF 0.43 --		Shading 0.77		Gains 73.3526			
Window - Double-glazed, argon filled (North) North				5.850 10.63				0.43 --		0.77		20.5962			
Total solar gains, January												93.95		(83-1)	
Solar gains															
93.95	182.85	303.20	452.08	567.10	587.31	556.29	468.35	355.26	217.12	116.87	77.49	(83)			
Total gains															
690.89	775.67	875.44	992.34	1074.59	1065.33	1016.98	936.98	842.18	736.24	671.85	659.62	(84)			

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, argon filled (West) west	0.9 x 11.28	0.80	0.70 x 0.83	4.72
Window - Double-glazed, argon filled (North) North	0.9 x 5.85	0.80	0.70 x 0.83	2.45
GL = 7.17 / 77.00 = 0.093				
C1 = 0.500				
C2 = 0.960				
EI = 335				

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C)

21.00

(85)

Heating system responsiveness

1.00

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

131.66	132.21	132.75	135.55	136.12	139.06	139.06	139.67	137.87	136.12	134.98	133.86
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alpha

9.78	9.81	9.85	10.04	10.07	10.27	10.27	10.31	10.19	10.07	10.00	9.92
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Utilisation factor for gains for living area

0.97	0.93	0.80	0.60	0.42	0.29	0.21	0.23	0.39	0.68	0.92	0.98
------	------	------	------	------	------	------	------	------	------	------	------

(86)

Mean internal temperature in living area T1

20.81	20.90	20.98	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.92	20.79
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(87)

Temperature during heating periods in rest of dwelling Th2

20.38	20.38	20.39	20.40	20.40	20.41	20.41	20.41	20.41	20.40	20.39	20.39
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(88)

Utilisation factor for gains for rest of dwelling

0.96	0.91	0.78	0.57	0.40	0.26	0.18	0.20	0.36	0.65	0.90	0.97
------	------	------	------	------	------	------	------	------	------	------	------

(89)

Mean internal temperature in the rest of dwelling T2

20.14	20.26	20.36	20.40	20.40	20.41	20.41	20.41	20.41	20.40	20.31	20.13
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(90)

Living area fraction (29.00 / 77.00)

0.38

(91)

Mean internal temperature (for the whole dwelling)

20.39	20.50	20.59	20.62	20.63	20.63	20.63	20.63	20.63	20.62	20.54	20.38
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(92)

Apply adjustment to the mean internal temperature, where appropriate

20.39	20.50	20.59	20.62	20.63	20.63	20.63	20.63	20.63	20.62	20.54	20.38
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(93)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.96	0.91	0.78	0.58	0.41	0.27	0.19	0.21	0.37	0.66	0.90	0.97	(94)
Useful gains												
665.13	707.66	687.13	573.51	435.56	288.20	192.67	201.42	314.63	486.40	605.93	640.65	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
812.02	784.03	705.14	574.52	435.59	288.20	192.67	201.42	314.64	489.09	661.53	802.79	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
109.28	51.33	13.40	0.72	0.02	-	-	-	-	2.00	40.03	120.63	
Total space heating requirement per year (kWh/year) (October to May)										337.42		(98)
Space heating requirement per m ² (kWh/m ² /year)										4.38		(99)

8c. Space cooling requirement - not applicable

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

9b. Energy requirements

		kWh/year	
Fraction of space heat from secondary system	0.00		(301)
Fraction of space heat from community system	1.00		(302)
Fraction of community heat from Heat pumps	1.00		(303a)
Fraction of total space heat from Heat pumps	1.00		(304a)
Factor for control and charging method for community space heating	1.00		(305)
Factor for charging method for community water heating	1.00		(305a)
Distribution loss factor	1.05		(306)
<u>Space heating</u>			
Annual space heating requirement	337.42		(98)
Space heat from Heat pumps		354.29	(307a)
Efficiency of secondary heating system	0.00		(308)
Space heating fuel for secondary system		0.00	(309)
<u>Water heating</u>			
Annual water heating requirement	2148.13		(64)
Water heat from Heat pumps		2255.53	(310a)
<u>Other energy</u>			
Electrical energy for heat distribution		26.10	(313)
Electricity for pumps and fans within dwelling:			
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside (SFP=1.27)		305.18	(330a)
warm air heating system fans		0.00	(330b)
pump for solar water heating		0.00	(330g)
pump for waste water heat recovery		0.00	(330h)
Total electricity for the above, kWh/year		305.18	(331)
Electricity for lighting (100.00% fixed LEL)		335.46	(332)
Energy saving/generation technologies			
PVs 0.80 x 0.300 x 950.616 x 0.800		182.518	
PVs 0.80 x 0.000 x 0.000 x 0.500		0.000	
PVs 0.80 x 0.000 x 0.000 x 0.500		0.000	
		182.518	(333)
Appendix Q -			
Energy saved or generated ():		0.000	(336a)
Energy used ():		0.000	(337a)
Total delivered energy for all uses		3094.04	(338)

10b. Fuel costs using Table 12 prices

	kWh/year	Fuel price p/kWh	£/year	
Space heating from Heat pumps	354.29	4.240	15.02	(340a)
Space heating (secondary)	0.00	0.000	0.00	(341)
Water heating from Heat pumps	2255.53	4.240	95.63	(342a)
Mech vent fans	305.18	13.190	40.25	(349)
Warm air heating system fans	0.00	0.000	0.00	(349)
Pump for solar water heating	0.00	0.000	0.00	(349)
Electricity for lighting	335.458	13.190	44.25	(350)
Additional standing charges			120.00	(351)
Electricity generated - PVs	182.518	13.190	-24.07	(352)
Appendix Q -				
Energy saved or generated ():	0.000	0.000	0.00	(353)
Energy used ():	0.000	0.000	0.00	(354)
Total energy cost			291.08	(355)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

11b. SAP rating

Energy cost deflator	0.42	(356)
Energy cost factor (ECF)	1.00	(357)
SAP value	86.02	(358)
SAP rating	86.00	(358)
SAP band	B	

12b. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of Heat pumps - 319.00%				(367a)
CO2 emissions from Heat pumps	818.13	0.5190	424.61	(368)
Electrical energy for heat distribution	26.10	0.5190	13.54	(372)
Total CO2 associated with community systems			438.15	(373)
Total CO2 associated with space and water heating			438.15	(376)
Electricity for pumps and fans	305.18	0.519	158.39	(378)
Electricity for lighting	335.46	0.519	174.10	(379)
Electricity generated - PVs	-182.52	0.519	-94.73	(380)
Electricity generated - μ CHP	0.00	0.000	0.00	(380)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(381)
Energy used ():	0.00	0.000	0.00	(382)
Total CO2, kg/year			675.92	(383)

CO2 emissions per m²

	kg/m²/year	
CO2 emissions per m²	8.78	(384)
El value	92.58	(384a)
El rating	93	(385)
El band	A	

Calculation of stars for heating and DHW

Main heating energy efficiency	, stars = 4
Main heating environmental impact	, stars = 5
Water heating energy efficiency	4.45 = 4.4520, stars = 4
Water heating environmental impact	0.17 = 0.1708, stars = 5

Project Information

Building type Top-floor maisonette

Reference

Date 17 July 2019

Client 3 BED TOP Floor Baseline Project Hillingdon Gardens
UB10

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings**1. Overall dwelling dimensions**

	Area (m ²)	Av. Storey height (m)	Volume (m ³)	
Ground floor (1)	89.00	2.55	226.95	(3a)
Total floor area	89.00			(4)
Dwelling volume (m ³)			226.95	(5)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

2. Ventilation rate

	main + secondary + other heating		m³ per hour										
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)									
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)									
Number of intermittent fans	0	x 10	0.00	(7a)									
Number of passive vents	0	x 10	0.00	(7b)									
Number of flueless gas fires	0	x 40	0.00	(7c)									
			Air changes per hour										
Infiltration due to chimneys, fans and flues			0.00	(8)									
Pressure test, result q50	5.57			(17)									
Air permeability			0.28	(18)									
Number of sides on which sheltered			2.00	(19)									
Shelter factor			0.85	(20)									
Infiltration rate incorporating shelter factor			0.24	(21)									
Infiltration rate modified for monthly wind speed													
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70		
												52.50	(22)
Wind Factor													
1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18		
												13.13	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed)													
0.30	0.30	0.29	0.26	0.25	0.22	0.22	0.22	0.24	0.25	0.27	0.28		
												3.11	(22b)
air change rate through system							0.50						(23a)
efficiency in % allowing for in-use factor							73.10						(23c)
Ventilation : balanced whole house mechanical with heat recovery													
Effective air change rate													
0.44	0.43	0.42	0.39	0.39	0.36	0.36	0.35	0.37	0.39	0.40	0.41	(25)	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	kappa-value kJ/m ² K	A x K kJ/K					
Window - Double-glazed, argon filled (West) west			11.650	1.15 (1.20)	13.34			(27)				
Window - Double-glazed, argon filled (South) south			5.850	1.15 (1.20)	6.70			(27)				
Walls West			18.45	0.16	2.95	190.00	3505.50	(29)				
Walls South			14.05	0.16	2.25	190.00	2669.50	(29)				
Flat roofs			89.00	0.11	9.79	30.00	2670.00	(30)				
Party wall Circ and Apartment			46.00	0.00	0.00	180.00	8280.00					
Party floor			89.00	0.00	0.00	20.00	1780.00					
Internal wall All internal walls			165.00	0.00	0.00	9.00	1485.00					
Total area of external elements Sigma A, m ²							139.00	(31)				
Fabric heat loss, W/K							35.03	(33)				
Heat capacity							20390.00	(34)				
Thermal mass parameter, kJ/m ² K							229.10	(35)				
Effect of thermal bridges							6.88	(36)				
Total fabric heat loss							41.91	(37)				
Ventilation heat loss calculated monthly												
32.68	32.23	31.79	29.58	29.13	26.92	26.92	26.47	27.80	29.13	30.02	30.90	(38)
Heat transfer coefficient, W/K												
74.59	74.14	73.70	71.48	71.04	68.82	68.82	68.38	69.71	71.04	71.93	72.81	71.37 (39)
Heat loss parameter (HLP), W/m ² K												
0.84	0.83	0.83	0.80	0.80	0.77	0.77	0.77	0.78	0.80	0.81	0.82	0.80 (40)
HLP (average)												
Number of days in month (Table 1a)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31	28	31	30	31	30	31	31	30	31	30	31	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

4. Water heating energy requirements

4. Water heating energy requirements											kWh/year	
Assumed occupancy, N											2.61 (42)	
Annual average hot water usage in litres per day Vd,average											96.23 (43)	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month												
105.85	102.00	98.15	94.31	90.46	86.61	86.61	90.46	94.31	98.15	102.00	105.85	(44)
Energy content of hot water used												
156.98	137.29	141.67	123.51	118.52	102.27	94.77	108.75	110.05	128.25	139.99	152.02	
Energy content (annual)											1514.07 (45)	
Distribution loss												
23.55	20.59	21.25	18.53	17.78	15.34	14.22	16.31	16.51	19.24	21.00	22.80	(46)
Cylinder volume, l							110.00 (47)					
Manufacturer's declared cylinder loss factor (kWh/day)							1.20 (48)					
Temperature Factor							1.0000 (49)					
Energy lost from hot water cylinder (kWh/day)											1.20 (55)	
Total storage loss												
37.20	33.60	37.20	36.00	37.20	36.00	37.20	37.20	36.00	37.20	36.00	37.20	(56)
Net storage loss												
37.20	33.60	37.20	36.00	37.20	36.00	37.20	37.20	36.00	37.20	36.00	37.20	(57)
Primary loss												
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Total heat required for water heating calculated for each month												
217.44	191.90	202.14	182.03	178.98	160.78	155.23	169.21	168.56	188.71	198.51	212.49	(62)
Output from water heater for each month, kWh/month												
217.44	191.90	202.14	182.03	178.98	160.78	155.23	169.21	168.56	188.71	198.51	212.49	(64)
											2225.97 (64)	
Heat gains from water heating, kWh/month												
100.56	89.34	95.48	87.88	87.78	80.81	79.88	84.53	83.40	91.01	93.36	98.92	(65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	(66)
Lighting gains												
53.34	47.38	38.53	29.17	21.81	18.41	19.89	25.86	34.70	44.06	51.43	54.83	(67)
Appliances gains												
354.07	357.74	348.48	328.77	303.89	280.51	264.89	261.21	270.47	290.18	315.06	338.45	(68)
Cooking gains												
53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	(69)
Pumps and fans gains												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (negative values)												
-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	(71)
Water heating gains												
135.17	132.94	128.33	122.05	117.98	112.24	107.37	113.61	115.83	122.33	129.66	132.95	(72)
Total internal gains												
648.10	643.59	620.86	585.52	549.19	516.68	497.66	506.20	526.53	562.09	601.67	631.74	(73)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

6. Solar gains (calculation for January)

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, argon filled (West) west	0.9 x 11.65	0.80	0.70 x 0.83	4.87
Window - Double-glazed, argon filled (South) south	0.9 x 5.85	0.80	0.70 x 0.83	2.45
GL = 7.32 / 89.00 = 0.082				
C1 = 0.500				
C2 = 0.969				
EI = 377				

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C)

21.00

(85)

Heating system responsiveness

1.00

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

75.94	76.39	76.85	79.23	79.73	82.30	82.30	82.83	81.25	79.73	78.75	77.79
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alpha

6.06	6.09	6.12	6.28	6.32	6.49	6.49	6.52	6.42	6.32	6.25	6.19
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Utilisation factor for gains for living area

0.97	0.94	0.87	0.71	0.54	0.37	0.27	0.29	0.48	0.77	0.94	0.98
------	------	------	------	------	------	------	------	------	------	------	------

(86)

Mean internal temperature in living area T1

20.45	20.63	20.81	20.95	20.99	21.00	21.00	21.00	21.00	20.94	20.70	20.43
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(87)

Temperature during heating periods in rest of dwelling Th2

20.22	20.22	20.23	20.25	20.25	20.28	20.28	20.28	20.27	20.25	20.25	20.24
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(88)

Utilisation factor for gains for rest of dwelling

0.97	0.93	0.84	0.68	0.50	0.33	0.22	0.25	0.43	0.73	0.92	0.97
------	------	------	------	------	------	------	------	------	------	------	------

(89)

Mean internal temperature in the rest of dwelling T2

19.51	19.76	20.01	20.20	20.25	20.28	20.28	20.28	20.27	20.19	19.88	19.50
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(90)

Living area fraction (30.00 / 89.00)

0.34

(91)

Mean internal temperature (for the whole dwelling)

19.83	20.05	20.28	20.45	20.50	20.52	20.52	20.52	20.51	20.45	20.16	19.82
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(92)

Apply adjustment to the mean internal temperature, where appropriate

19.83	20.05	20.28	20.45	20.50	20.52	20.52	20.52	20.51	20.45	20.16	19.82
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(93)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.96	0.92	0.84	0.69	0.51	0.35	0.24	0.26	0.44	0.74	0.92	0.97	(94)
Useful gains												
783.26	867.82	888.60	794.53	620.31	407.16	269.80	281.92	445.67	661.36	738.87	748.15	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
1158.38	1123.24	1015.51	825.87	625.06	407.44	269.82	281.95	447.02	699.39	939.26	1136.98	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
279.09	171.64	94.42	22.56	3.53	-	-	-	-	28.30	144.28	289.29	
Total space heating requirement per year (kWh/year) (October to May)										1033.11		(98)
Space heating requirement per m ² (kWh/m ² /year)										11.61		(99)

8c. Space cooling requirement - not applicable

9b. Energy requirements

		kWh/year	
Fraction of space heat from secondary system	0.00		(301)
Fraction of space heat from community system	1.00		(302)
Fraction of community heat from Boilers	1.00		(303a)
Fraction of total space heat from Boilers	1.00		(304a)
Factor for control and charging method for community space heating	1.00		(305)
Factor for charging method for community water heating	1.00		(305a)
Distribution loss factor	1.05		(306)
<u>Space heating</u>			
Annual space heating requirement	1033.11		(98)
Space heat from Boilers		1084.76	(307a)
Efficiency of secondary heating system	0.00		(308)
Space heating fuel for secondary system		0.00	(309)
<u>Water heating</u>			
Annual water heating requirement	2225.97		(64)
Water heat from Boilers		2337.26	(310a)
<u>Other energy</u>			
Electrical energy for heat distribution		34.22	(313)
Electricity for pumps and fans within dwelling:			
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside (SFP=1.46)		403.14	(330a)
warm air heating system fans		0.00	(330b)
pump for solar water heating		0.00	(330g)
pump for waste water heat recovery		0.00	(330h)
Total electricity for the above, kWh/year		403.14	(331)
Electricity for lighting (100.00% fixed LEL)		376.83	(332)
Energy saving/generation technologies			
Appendix Q -			
Energy saved or generated ():		0.000	(336a)
Energy used ():		0.000	(337a)
Total delivered energy for all uses		4236.21	(338)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

10b. Fuel costs using Table 12 prices

	kWh/year	Fuel price p/kWh	£/year	
Space heating from Boilers	1084.76	4.240	45.99	(340a)
Space heating (secondary)	0.00	0.000	0.00	(341)
Water heating from Boilers	2337.26	4.240	99.10	(342a)
Mech vent fans	403.14	13.190	53.17	(349)
Warm air heating system fans	0.00	0.000	0.00	(349)
Pump for solar water heating	0.00	0.000	0.00	(349)
Electricity for lighting	376.828	13.190	49.70	(350)
Additional standing charges			120.00	(351)
Electricity generated - PVs	0.000	0.000	0.00	(352)
Appendix Q -				
Energy saved or generated ():	0.000	0.000	0.00	(353)
Energy used ():	0.000	0.000	0.00	(354)
Total energy cost			367.97	(355)

11b. SAP rating

Energy cost deflator	0.42	(356)
Energy cost factor (ECF)	1.15	(357)
SAP value	83.91	(358)
SAP rating	84.00	(358)
SAP band	B	

12b. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of Boilers - 94.00%				(367a)
CO2 emissions from Boilers	3640.46	0.2160	786.34	(368)
Electrical energy for heat distribution	34.22	0.5190	17.76	(372)
Total CO2 associated with community systems			804.10	(373)
Total CO2 associated with space and water heating			804.10	(376)
Electricity for pumps and fans	403.14	0.519	209.23	(378)
Electricity for lighting	376.83	0.519	195.57	(379)
Electricity generated - PVs	0.00	0.519	0.00	(380)
Electricity generated - µCHP	0.00	0.000	0.00	(380)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(381)
Energy used ():	0.00	0.000	0.00	(382)
Total CO2, kg/year			1208.90	(383)

CO2 emissions per m²	kg/m²/year	
EI value	13.58	(384)
EI rating	87.91	(384a)
EI band	88	(385)
	B	

Calculation of stars for heating and DHW

Main heating energy efficiency	, stars = 4
Main heating environmental impact	, stars = 4
Water heating energy efficiency	4.45 = 4.4520, stars = 4
Water heating environmental impact	0.24 = 0.2413, stars = 4

Project Information

Building type Top-floor flat

Reference

Date 17 July 2019

Client 3 BED TOP Floor PASSIVE Project Hillingdon Gardens
UB10

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings**1. Overall dwelling dimensions**

	Area (m ²)	Av. Storey height (m)	Volume (m ³)	
Ground floor (1)	89.00	2.55	226.95	(3a)
Total floor area	89.00			(4)
Dwelling volume (m ³)			226.95	(5)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

2. Ventilation rate

	main + secondary + other heating		m³ per hour										
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)									
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)									
Number of intermittent fans	0	x 10	0.00	(7a)									
Number of passive vents	0	x 10	0.00	(7b)									
Number of flueless gas fires	0	x 40	0.00	(7c)									
			Air changes per hour										
Infiltration due to chimneys, fans and flues			0.00	(8)									
Pressure test, result q50	3.00			(17)									
Air permeability			0.15	(18)									
Number of sides on which sheltered			2.00	(19)									
Shelter factor			0.85	(20)									
Infiltration rate incorporating shelter factor			0.13	(21)									
Infiltration rate modified for monthly wind speed													
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70		
												52.50	(22)
Wind Factor													
1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18		
												13.13	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed)													
0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15		
												1.67	(22b)
air change rate through system							0.50						(23a)
efficiency in % allowing for in-use factor							73.10						(23c)
Ventilation : balanced whole house mechanical with heat recovery													
Effective air change rate													
0.30	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28	(25)	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	kappa-value kJ/m ² K	A x K kJ/K					
Window - Double-glazed, argon filled (West) west			11.650	1.15 (1.20)	13.34			(27)				
Window - Double-glazed, argon filled (South) south			5.850	1.15 (1.20)	6.70			(27)				
Walls West			18.45	0.16	2.95	190.00	3505.50	(29)				
Walls South			14.05	0.16	2.25	190.00	2669.50	(29)				
Flat roofs			89.00	0.11	9.79	30.00	2670.00	(30)				
Party wall Circ and Apartment			46.00	0.00	0.00	180.00	8280.00					
Party floor			89.00	0.00	0.00	20.00	1780.00					
Internal wall All internal walls			165.00	0.00	0.00	9.00	1485.00					
Total area of external elements Sigma A, m ²							139.00	(31)				
Fabric heat loss, W/K							35.03	(33)				
Heat capacity							20390.00	(34)				
Thermal mass parameter, kJ/m ² K							229.10	(35)				
Effect of thermal bridges							6.88	(36)				
Total fabric heat loss							41.91	(37)				
Ventilation heat loss calculated monthly												
22.25	22.01	21.77	20.58	20.34	19.14	19.14	18.91	19.62	20.34	20.82	21.29	(38)
Heat transfer coefficient, W/K												
64.16	63.92	63.68	62.49	62.25	61.05	61.05	60.81	61.53	62.25	62.72	63.20	62.43 (39)
Heat loss parameter (HLP), W/m ² K												
0.72	0.72	0.72	0.70	0.70	0.69	0.69	0.68	0.69	0.70	0.70	0.71	0.70 (40)
HLP (average)												
Number of days in month (Table 1a)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31	28	31	30	31	30	31	31	30	31	30	31	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

4. Water heating energy requirements

												kWh/year
Assumed occupancy, N												2.61 (42)
Annual average hot water usage in litres per day Vd,average												96.23 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month												
105.85	102.00	98.15	94.31	90.46	86.61	86.61	90.46	94.31	98.15	102.00	105.85	(44)
Energy content of hot water used												
156.98	137.29	141.67	123.51	118.52	102.27	94.77	108.75	110.05	128.25	139.99	152.02	
Energy content (annual)											1514.07	(45)
Distribution loss												
23.55	20.59	21.25	18.53	17.78	15.34	14.22	16.31	16.51	19.24	21.00	22.80	(46)
Cylinder volume, l							110.00					(47)
Manufacturer's declared cylinder loss factor (kWh/day)							1.20					(48)
Temperature Factor							1.0000					(49)
Energy lost from hot water cylinder (kWh/day)											1.20	(55)
Total storage loss												
37.20	33.60	37.20	36.00	37.20	36.00	37.20	37.20	36.00	37.20	36.00	37.20	(56)
Net storage loss												
37.20	33.60	37.20	36.00	37.20	36.00	37.20	37.20	36.00	37.20	36.00	37.20	(57)
Primary loss												
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Total heat required for water heating calculated for each month												
217.44	191.90	202.14	182.03	178.98	160.78	155.23	169.21	168.56	188.71	198.51	212.49	(62)
Output from water heater for each month, kWh/month												
217.44	191.90	202.14	182.03	178.98	160.78	155.23	169.21	168.56	188.71	198.51	212.49	(64)
											2225.97	(64)
Heat gains from water heating, kWh/month												
100.56	89.34	95.48	87.88	87.78	80.81	79.88	84.53	83.40	91.01	93.36	98.92	(65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	(66)
Lighting gains												
53.34	47.38	38.53	29.17	21.81	18.41	19.89	25.86	34.70	44.06	51.43	54.83	(67)
Appliances gains												
354.07	357.74	348.48	328.77	303.89	280.51	264.89	261.21	270.47	290.18	315.06	338.45	(68)
Cooking gains												
53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	(69)
Pumps and fans gains												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (negative values)												
-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	(71)
Water heating gains												
135.17	132.94	128.33	122.05	117.98	112.24	107.37	113.61	115.83	122.33	129.66	132.95	(72)
Total internal gains												
648.10	643.59	620.86	585.52	549.19	516.68	497.66	506.20	526.53	562.09	601.67	631.74	(73)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

6. Solar gains (calculation for January)

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, argon filled (West) west	0.9 x 11.65	0.80	0.70 x 0.83	4.87
Window - Double-glazed, argon filled (South) south	0.9 x 5.85	0.80	0.70 x 0.83	2.45
GL = 7.32 / 89.00 = 0.082				
C1 = 0.500				
C2 = 0.969				
EI = 377				

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C)

21.00

(85)

Heating system responsiveness

1.00

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

88.28	88.61	88.94	90.64	90.99	92.77	92.77	93.13	92.05	90.99	90.30	89.62
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alpha

6.89	6.91	6.93	7.04	7.07	7.18	7.18	7.21	7.14	7.07	7.02	6.97
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Utilisation factor for gains for living area

0.96	0.91	0.81	0.64	0.48	0.33	0.24	0.26	0.42	0.70	0.91	0.97
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(86)

Mean internal temperature in living area T1

20.64	20.79	20.91	20.98	21.00	21.00	21.00	21.00	21.00	20.98	20.82	20.61
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(87)

Temperature during heating periods in rest of dwelling Th2

20.32	20.32	20.33	20.34	20.34	20.35	20.35	20.36	20.35	20.34	20.34	20.33
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(88)

Utilisation factor for gains for rest of dwelling

0.95	0.89	0.78	0.61	0.44	0.30	0.20	0.22	0.38	0.66	0.89	0.96
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(89)

Mean internal temperature in the rest of dwelling T2

19.86	20.06	20.23	20.32	20.34	20.35	20.35	20.36	20.35	20.32	20.13	19.83
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(90)

Living area fraction (30.00 / 89.00)

0.34

(91)

Mean internal temperature (for the whole dwelling)

20.13	20.30	20.46	20.54	20.56	20.57	20.57	20.57	20.57	20.54	20.36	20.09
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(92)

Apply adjustment to the mean internal temperature, where appropriate

20.13	20.30	20.46	20.54	20.56	20.57	20.57	20.57	20.57	20.54	20.36	20.09
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(93)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.95	0.89	0.79	0.62	0.46	0.31	0.21	0.24	0.39	0.67	0.89	0.96	(94)
Useful gains												
771.58	839.33	831.14	716.97	550.42	364.50	242.45	253.76	397.63	604.15	715.05	739.75	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
1015.34	984.64	888.88	727.62	551.60	364.56	242.46	253.77	397.95	618.72	831.83	1004.46	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
181.36	97.65	42.96	7.67	0.88	-	-	-	-	10.84	84.08	196.95	
Total space heating requirement per year (kWh/year) (October to May)											622.38	(98)
Space heating requirement per m ² (kWh/m ² /year)											6.99	(99)

8c. Space cooling requirement - not applicable

9b. Energy requirements

		kWh/year	
Fraction of space heat from secondary system	0.00		(301)
Fraction of space heat from community system	1.00		(302)
Fraction of community heat from Boilers	1.00		(303a)
Fraction of total space heat from Boilers	1.00		(304a)
Factor for control and charging method for community space heating	1.00		(305)
Factor for charging method for community water heating	1.00		(305a)
Distribution loss factor	1.05		(306)
<u>Space heating</u>			
Annual space heating requirement	622.38		(98)
Space heat from Boilers		653.50	(307a)
Efficiency of secondary heating system	0.00		(308)
Space heating fuel for secondary system		0.00	(309)
<u>Water heating</u>			
Annual water heating requirement	2225.97		(64)
Water heat from Boilers		2337.26	(310a)
<u>Other energy</u>			
Electrical energy for heat distribution		29.91	(313)
Electricity for pumps and fans within dwelling:			
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside (SFP=1.46)		403.14	(330a)
warm air heating system fans		0.00	(330b)
pump for solar water heating		0.00	(330g)
pump for waste water heat recovery		0.00	(330h)
Total electricity for the above, kWh/year		403.14	(331)
Electricity for lighting (100.00% fixed LEL)		376.83	(332)
Energy saving/generation technologies			
Appendix Q -			
Energy saved or generated ():		0.000	(336a)
Energy used ():		0.000	(337a)
Total delivered energy for all uses		3800.63	(338)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

10b. Fuel costs using Table 12 prices

	kWh/year	Fuel price p/kWh	£/year	
Space heating from Boilers	653.50	4.240	27.71	(340a)
Space heating (secondary)	0.00	0.000	0.00	(341)
Water heating from Boilers	2337.26	4.240	99.10	(342a)
Mech vent fans	403.14	13.190	53.17	(349)
Warm air heating system fans	0.00	0.000	0.00	(349)
Pump for solar water heating	0.00	0.000	0.00	(349)
Electricity for lighting	376.828	13.190	49.70	(350)
Additional standing charges			120.00	(351)
Electricity generated - PVs	0.000	0.000	0.00	(352)
Appendix Q -				
Energy saved or generated ():	0.000	0.000	0.00	(353)
Energy used ():	0.000	0.000	0.00	(354)
Total energy cost			349.69	(355)

11b. SAP rating

Energy cost deflator	0.42	(356)
Energy cost factor (ECF)	1.10	(357)
SAP value	84.71	(358)
SAP rating	85.00	(358)
SAP band	B	

12b. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of Boilers - 94.00%				(367a)
CO2 emissions from Boilers	3181.66	0.2160	687.24	(368)
Electrical energy for heat distribution	29.91	0.5190	15.52	(372)
Total CO2 associated with community systems			702.76	(373)
Total CO2 associated with space and water heating			702.76	(376)
Electricity for pumps and fans	403.14	0.519	209.23	(378)
Electricity for lighting	376.83	0.519	195.57	(379)
Electricity generated - PVs	0.00	0.519	0.00	(380)
Electricity generated - µCHP	0.00	0.000	0.00	(380)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(381)
Energy used ():	0.00	0.000	0.00	(382)
Total CO2, kg/year			1107.56	(383)

CO2 emissions per m²	kg/m²/year	
El value	12.44	(384)
El rating	88.92	(384a)
El band	89	(385)
	B	

Calculation of stars for heating and DHW

Main heating energy efficiency	, stars = 4
Main heating environmental impact	, stars = 4
Water heating energy efficiency	4.45 = 4.4520, stars = 4
Water heating environmental impact	0.24 = 0.2413, stars = 4

Project Information

Building type Top-floor flat

Reference

Date 17 July 2019

Client 3 BED TOP Floor ASHP Project Hillingdon Gardens
UB10**SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings****1. Overall dwelling dimensions**

	Area (m ²)	Av. Storey height (m)	Volume (m ³)	
Ground floor (1)	89.00	2.55	226.95	(3a)
Total floor area	89.00			(4)
Dwelling volume (m ³)			226.95	(5)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

2. Ventilation rate

	main + secondary + other heating		m³ per hour										
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)									
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)									
Number of intermittent fans	0	x 10	0.00	(7a)									
Number of passive vents	0	x 10	0.00	(7b)									
Number of flueless gas fires	0	x 40	0.00	(7c)									
			Air changes per hour										
Infiltration due to chimneys, fans and flues			0.00	(8)									
Pressure test, result q50	3.00			(17)									
Air permeability			0.15	(18)									
Number of sides on which sheltered			2.00	(19)									
Shelter factor			0.85	(20)									
Infiltration rate incorporating shelter factor			0.13	(21)									
Infiltration rate modified for monthly wind speed													
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70		
												52.50	(22)
Wind Factor													
1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18		
												13.13	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed)													
0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15		
												1.67	(22b)
air change rate through system							0.50						(23a)
efficiency in % allowing for in-use factor							73.10						(23c)
Ventilation : balanced whole house mechanical with heat recovery													
Effective air change rate													
0.30	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28	(25)	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	kappa-value kJ/m ² K	A x K kJ/K					
Window - Double-glazed, argon filled (West) west			11.650	1.15 (1.20)	13.34			(27)				
Window - Double-glazed, argon filled (South) south			5.850	1.15 (1.20)	6.70			(27)				
Walls West			18.45	0.16	2.95	190.00	3505.50	(29)				
Walls South			14.05	0.16	2.25	190.00	2669.50	(29)				
Flat roofs			89.00	0.11	9.79	30.00	2670.00	(30)				
Party wall Circ and Apartment			46.00	0.00	0.00	180.00	8280.00					
Party floor			89.00	0.00	0.00	20.00	1780.00					
Internal wall All internal walls			165.00	0.00	0.00	9.00	1485.00					
Total area of external elements Sigma A, m ²							139.00	(31)				
Fabric heat loss, W/K							35.03	(33)				
Heat capacity							20390.00	(34)				
Thermal mass parameter, kJ/m ² K							229.10	(35)				
Effect of thermal bridges							6.88	(36)				
Total fabric heat loss							41.91	(37)				
Ventilation heat loss calculated monthly												
22.25	22.01	21.77	20.58	20.34	19.14	19.14	18.91	19.62	20.34	20.82	21.29	(38)
Heat transfer coefficient, W/K												
64.16	63.92	63.68	62.49	62.25	61.05	61.05	60.81	61.53	62.25	62.72	63.20	
											62.43	(39)
Heat loss parameter (HLP), W/m ² K												
0.72	0.72	0.72	0.70	0.70	0.69	0.69	0.68	0.69	0.70	0.70	0.71	
HLP (average)											0.70	(40)
Number of days in month (Table 1a)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31	28	31	30	31	30	31	31	30	31	30	31	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

4. Water heating energy requirements

4. Water heating energy requirements											kWh/year	
Assumed occupancy, N											2.61 (42)	
Annual average hot water usage in litres per day Vd,average											96.23 (43)	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month												
105.85	102.00	98.15	94.31	90.46	86.61	86.61	90.46	94.31	98.15	102.00	105.85	(44)
Energy content of hot water used												
156.98	137.29	141.67	123.51	118.52	102.27	94.77	108.75	110.05	128.25	139.99	152.02	
Energy content (annual)											1514.07 (45)	
Distribution loss												
23.55	20.59	21.25	18.53	17.78	15.34	14.22	16.31	16.51	19.24	21.00	22.80	(46)
Cylinder volume, l							110.00 (47)					
Manufacturer's declared cylinder loss factor (kWh/day)							1.20 (48)					
Temperature Factor							1.0000 (49)					
Energy lost from hot water cylinder (kWh/day)											1.20 (55)	
Total storage loss												
37.20	33.60	37.20	36.00	37.20	36.00	37.20	37.20	36.00	37.20	36.00	37.20	(56)
Net storage loss												
37.20	33.60	37.20	36.00	37.20	36.00	37.20	37.20	36.00	37.20	36.00	37.20	(57)
Primary loss												
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Total heat required for water heating calculated for each month												
217.44	191.90	202.14	182.03	178.98	160.78	155.23	169.21	168.56	188.71	198.51	212.49	(62)
Output from water heater for each month, kWh/month												
217.44	191.90	202.14	182.03	178.98	160.78	155.23	169.21	168.56	188.71	198.51	212.49	(64)
											2225.97 (64)	
Heat gains from water heating, kWh/month												
100.56	89.34	95.48	87.88	87.78	80.81	79.88	84.53	83.40	91.01	93.36	98.92	(65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	(66)
Lighting gains												
53.34	47.38	38.53	29.17	21.81	18.41	19.89	25.86	34.70	44.06	51.43	54.83	(67)
Appliances gains												
354.07	357.74	348.48	328.77	303.89	280.51	264.89	261.21	270.47	290.18	315.06	338.45	(68)
Cooking gains												
53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	(69)
Pumps and fans gains												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (negative values)												
-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	(71)
Water heating gains												
135.17	132.94	128.33	122.05	117.98	112.24	107.37	113.61	115.83	122.33	129.66	132.95	(72)
Total internal gains												
648.10	643.59	620.86	585.52	549.19	516.68	497.66	506.20	526.53	562.09	601.67	631.74	(73)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

6. Solar gains (calculation for January)

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, argon filled (West) west	0.9 x 11.65	0.80	0.70 x 0.83	4.87
Window - Double-glazed, argon filled (South) south	0.9 x 5.85	0.80	0.70 x 0.83	2.45
GL = 7.32 / 89.00 = 0.082				
C1 = 0.500				
C2 = 0.969				
EI = 377				

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C)												21.00	(85)
Heating system responsiveness												1.00	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
tau													
88.28	88.61	88.94	90.64	90.99	92.77	92.77	93.13	92.05	90.99	90.30	89.62		
alpha													
6.89	6.91	6.93	7.04	7.07	7.18	7.18	7.21	7.14	7.07	7.02	6.97		
Utilisation factor for gains for living area													
0.96	0.91	0.81	0.64	0.48	0.33	0.24	0.26	0.42	0.70	0.91	0.97		(86)
Mean internal temperature in living area T1													
20.64	20.79	20.91	20.98	21.00	21.00	21.00	21.00	21.00	20.98	20.82	20.61		(87)
Temperature during heating periods in rest of dwelling Th2													
20.32	20.32	20.33	20.34	20.34	20.35	20.35	20.36	20.35	20.34	20.34	20.33		(88)
Utilisation factor for gains for rest of dwelling													
0.95	0.89	0.78	0.61	0.44	0.30	0.20	0.22	0.38	0.66	0.89	0.96		(89)
Mean internal temperature in the rest of dwelling T2													
19.86	20.06	20.23	20.32	20.34	20.35	20.35	20.36	20.35	20.32	20.13	19.83		(90)
Living area fraction (30.00 / 89.00)												0.34	(91)
Mean internal temperature (for the whole dwelling)													
20.13	20.30	20.46	20.54	20.56	20.57	20.57	20.57	20.57	20.54	20.36	20.09		(92)
Apply adjustment to the mean internal temperature, where appropriate													
20.13	20.30	20.46	20.54	20.56	20.57	20.57	20.57	20.57	20.54	20.36	20.09		(93)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.95	0.89	0.79	0.62	0.46	0.31	0.21	0.24	0.39	0.67	0.89	0.96	(94)
Useful gains												
771.58	839.33	831.14	716.97	550.42	364.50	242.45	253.76	397.63	604.15	715.05	739.75	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
1015.34	984.64	888.88	727.62	551.60	364.56	242.46	253.77	397.95	618.72	831.83	1004.46	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
181.36	97.65	42.96	7.67	0.88	-	-	-	-	10.84	84.08	196.95	
Total space heating requirement per year (kWh/year) (October to May)											622.38	(98)
Space heating requirement per m ² (kWh/m ² /year)											6.99	(99)

8c. Space cooling requirement - not applicable

9b. Energy requirements

		kWh/year	
Fraction of space heat from secondary system	0.00		(301)
Fraction of space heat from community system	1.00		(302)
Fraction of community heat from Heat pumps	1.00		(303a)
Fraction of total space heat from Heat pumps	1.00		(304a)
Factor for control and charging method for community space heating	1.00		(305)
Factor for charging method for community water heating	1.00		(305a)
Distribution loss factor	1.05		(306)
<u>Space heating</u>			
Annual space heating requirement	622.38		(98)
Space heat from Heat pumps		653.50	(307a)
Efficiency of secondary heating system	0.00		(308)
Space heating fuel for secondary system		0.00	(309)
<u>Water heating</u>			
Annual water heating requirement	2225.97		(64)
Water heat from Heat pumps		2337.26	(310a)
<u>Other energy</u>			
Electrical energy for heat distribution		29.91	(313)
Electricity for pumps and fans within dwelling:			
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside (SFP=1.46)		403.14	(330a)
warm air heating system fans		0.00	(330b)
pump for solar water heating		0.00	(330g)
pump for waste water heat recovery		0.00	(330h)
Total electricity for the above, kWh/year		403.14	(331)
Electricity for lighting (100.00% fixed LEL)		376.83	(332)
Energy saving/generation technologies			
Appendix Q -			
Energy saved or generated ():		0.000	(336a)
Energy used ():		0.000	(337a)
Total delivered energy for all uses		3800.63	(338)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

10b. Fuel costs using Table 12 prices

	kWh/year	Fuel price p/kWh	£/year	
Space heating from Heat pumps	653.50	4.240	27.71	(340a)
Space heating (secondary)	0.00	0.000	0.00	(341)
Water heating from Heat pumps	2337.26	4.240	99.10	(342a)
Mech vent fans	403.14	13.190	53.17	(349)
Warm air heating system fans	0.00	0.000	0.00	(349)
Pump for solar water heating	0.00	0.000	0.00	(349)
Electricity for lighting	376.828	13.190	49.70	(350)
Additional standing charges			120.00	(351)
Electricity generated - PVs	0.000	0.000	0.00	(352)
Appendix Q -				
Energy saved or generated ():	0.000	0.000	0.00	(353)
Energy used ():	0.000	0.000	0.00	(354)
Total energy cost			349.69	(355)

11b. SAP rating

Energy cost deflator	0.42	(356)
Energy cost factor (ECF)	1.10	(357)
SAP value	84.71	(358)
SAP rating	85.00	(358)
SAP band	B	

12b. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of Heat pumps - 319.00%				(367a)
CO2 emissions from Heat pumps	937.54	0.5190	486.58	(368)
Electrical energy for heat distribution	29.91	0.5190	15.52	(372)
Total CO2 associated with community systems			502.11	(373)
Total CO2 associated with space and water heating			502.11	(376)
Electricity for pumps and fans	403.14	0.519	209.23	(378)
Electricity for lighting	376.83	0.519	195.57	(379)
Electricity generated - PVs	0.00	0.519	0.00	(380)
Electricity generated - µCHP	0.00	0.000	0.00	(380)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(381)
Energy used ():	0.00	0.000	0.00	(382)
Total CO2, kg/year			906.91	(383)

CO2 emissions per m²	kg/m²/year	
EI value	10.19	(384)
EI rating	90.93	(384a)
EI band	91	(385)
	B	

Calculation of stars for heating and DHW

Main heating energy efficiency	, stars = 4
Main heating environmental impact	, stars = 5
Water heating energy efficiency	4.45 = 4.4520, stars = 4
Water heating environmental impact	0.17 = 0.1708, stars = 5

Project Information

Building type Top-floor flat

Reference

Date 17 July 2019

Client 3 BED TOP Floor PV Project Hillingdon Gardens
UB10**SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings****1. Overall dwelling dimensions**

	Area (m ²)	Av. Storey height (m)	Volume (m ³)	
Ground floor (1)	89.00	2.55	226.95	(3a)
Total floor area	89.00			(4)
Dwelling volume (m ³)			226.95	(5)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

2. Ventilation rate

	main + secondary + other heating		m³ per hour											
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)										
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)										
Number of intermittent fans	0	x 10	0.00	(7a)										
Number of passive vents	0	x 10	0.00	(7b)										
Number of flueless gas fires	0	x 40	0.00	(7c)										
			Air changes per hour											
Infiltration due to chimneys, fans and flues			0.00	(8)										
Pressure test, result q50	3.00			(17)										
Air permeability			0.15	(18)										
Number of sides on which sheltered			2.00	(19)										
Shelter factor			0.85	(20)										
Infiltration rate incorporating shelter factor			0.13	(21)										
Infiltration rate modified for monthly wind speed														
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70			
												52.50	(22)	
Wind Factor														
1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18			
												13.13	(22a)	
Adjusted infiltration rate (allowing for shelter and wind speed)														
0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15			
												1.67	(22b)	
air change rate through system													0.50	(23a)
efficiency in % allowing for in-use factor													73.10	(23c)
Ventilation : balanced whole house mechanical with heat recovery														
Effective air change rate														
0.30	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28		(25)	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	kappa-value kJ/m ² K	A x K kJ/K					
Window - Double-glazed, argon filled (West) west			11.650	1.15 (1.20)	13.34			(27)				
Window - Double-glazed, argon filled (South) south			5.850	1.15 (1.20)	6.70			(27)				
Walls West			18.45	0.16	2.95	190.00	3505.50	(29)				
Walls South			14.05	0.16	2.25	190.00	2669.50	(29)				
Flat roofs			89.00	0.11	9.79	30.00	2670.00	(30)				
Party wall Circ and Apartment			46.00	0.00	0.00	180.00	8280.00					
Party floor			89.00	0.00	0.00	20.00	1780.00					
Internal wall All internal walls			165.00	0.00	0.00	9.00	1485.00					
Total area of external elements Sigma A, m ²							139.00	(31)				
Fabric heat loss, W/K							35.03	(33)				
Heat capacity							20390.00	(34)				
Thermal mass parameter, kJ/m ² K							229.10	(35)				
Effect of thermal bridges							6.88	(36)				
Total fabric heat loss							41.91	(37)				
Ventilation heat loss calculated monthly												
22.25	22.01	21.77	20.58	20.34	19.14	19.14	18.91	19.62	20.34	20.82	21.29	(38)
Heat transfer coefficient, W/K												
64.16	63.92	63.68	62.49	62.25	61.05	61.05	60.81	61.53	62.25	62.72	63.20	
											62.43	(39)
Heat loss parameter (HLP), W/m ² K												
0.72	0.72	0.72	0.70	0.70	0.69	0.69	0.68	0.69	0.70	0.70	0.71	
HLP (average)											0.70	(40)
Number of days in month (Table 1a)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31	28	31	30	31	30	31	31	30	31	30	31	

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

4. Water heating energy requirements

												kWh/year
Assumed occupancy, N												2.61 (42)
Annual average hot water usage in litres per day Vd,average												96.23 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month												
105.85	102.00	98.15	94.31	90.46	86.61	86.61	90.46	94.31	98.15	102.00	105.85	(44)
Energy content of hot water used												
156.98	137.29	141.67	123.51	118.52	102.27	94.77	108.75	110.05	128.25	139.99	152.02	
Energy content (annual)												1514.07 (45)
Distribution loss												
23.55	20.59	21.25	18.53	17.78	15.34	14.22	16.31	16.51	19.24	21.00	22.80	(46)
Cylinder volume, l												110.00 (47)
Manufacturer's declared cylinder loss factor (kWh/day)												1.20 (48)
Temperature Factor												1.0000 (49)
Energy lost from hot water cylinder (kWh/day)												1.20 (55)
Total storage loss												
37.20	33.60	37.20	36.00	37.20	36.00	37.20	37.20	36.00	37.20	36.00	37.20	(56)
Net storage loss												
37.20	33.60	37.20	36.00	37.20	36.00	37.20	37.20	36.00	37.20	36.00	37.20	(57)
Primary loss												
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Total heat required for water heating calculated for each month												
217.44	191.90	202.14	182.03	178.98	160.78	155.23	169.21	168.56	188.71	198.51	212.49	(62)
Output from water heater for each month, kWh/month												
217.44	191.90	202.14	182.03	178.98	160.78	155.23	169.21	168.56	188.71	198.51	212.49	(64)
												2225.97 (64)
Heat gains from water heating, kWh/month												
100.56	89.34	95.48	87.88	87.78	80.81	79.88	84.53	83.40	91.01	93.36	98.92	(65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	156.71	(66)
Lighting gains												
53.34	47.38	38.53	29.17	21.81	18.41	19.89	25.86	34.70	44.06	51.43	54.83	(67)
Appliances gains												
354.07	357.74	348.48	328.77	303.89	280.51	264.89	261.21	270.47	290.18	315.06	338.45	(68)
Cooking gains												
53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	53.28	(69)
Pumps and fans gains												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (negative values)												
-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	-104.47	(71)
Water heating gains												
135.17	132.94	128.33	122.05	117.98	112.24	107.37	113.61	115.83	122.33	129.66	132.95	(72)
Total internal gains												
648.10	643.59	620.86	585.52	549.19	516.68	497.66	506.20	526.53	562.09	601.67	631.74	(73)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

6. Solar gains (calculation for January)

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, argon filled (West) west	0.9 x 11.65	0.80	0.70 x 0.83	4.87
Window - Double-glazed, argon filled (South) south	0.9 x 5.85	0.80	0.70 x 0.83	2.45
GL = 7.32 / 89.00 = 0.082				
C1 = 0.500				
C2 = 0.969				
EI = 377				

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C)

21.00 (85)

Heating system responsiveness

1.00

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

tau

88.28	88.61	88.94	90.64	90.99	92.77	92.77	93.13	92.05	90.99	90.30	89.62
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

alpha

6.89	6.91	6.93	7.04	7.07	7.18	7.18	7.21	7.14	7.07	7.02	6.97
------	------	------	------	------	------	------	------	------	------	------	------

Utilisation factor for gains for living area

0.96	0.91	0.81	0.64	0.48	0.33	0.24	0.26	0.42	0.70	0.91	0.97
------	------	------	------	------	------	------	------	------	------	------	------

(86)

Mean internal temperature in living area T1

20.64	20.79	20.91	20.98	21.00	21.00	21.00	21.00	21.00	20.98	20.82	20.61
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(87)

Temperature during heating periods in rest of dwelling Th2

20.32	20.32	20.33	20.34	20.34	20.35	20.35	20.36	20.35	20.34	20.34	20.33
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(88)

Utilisation factor for gains for rest of dwelling

0.95	0.89	0.78	0.61	0.44	0.30	0.20	0.22	0.38	0.66	0.89	0.96
------	------	------	------	------	------	------	------	------	------	------	------

(89)

Mean internal temperature in the rest of dwelling T2

19.86	20.06	20.23	20.32	20.34	20.35	20.35	20.36	20.35	20.32	20.13	19.83
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(90)

Living area fraction (30.00 / 89.00)

0.34 (91)

Mean internal temperature (for the whole dwelling)

20.13	20.30	20.46	20.54	20.56	20.57	20.57	20.57	20.57	20.54	20.36	20.09
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(92)

Apply adjustment to the mean internal temperature, where appropriate

20.13	20.30	20.46	20.54	20.56	20.57	20.57	20.57	20.57	20.54	20.36	20.09
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(93)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains												
0.95	0.89	0.79	0.62	0.46	0.31	0.21	0.24	0.39	0.67	0.89	0.96	(94)
Useful gains												
771.58	839.33	831.14	716.97	550.42	364.50	242.45	253.76	397.63	604.15	715.05	739.75	(95)
Monthly average external temperature												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature												
1015.34	984.64	888.88	727.62	551.60	364.56	242.46	253.77	397.95	618.72	831.83	1004.46	(97)
Fraction of month for heating												
1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month												
181.36	97.65	42.96	7.67	0.88	-	-	-	-	10.84	84.08	196.95	
Total space heating requirement per year (kWh/year) (October to May)										622.38		(98)
Space heating requirement per m ² (kWh/m ² /year)										6.99		(99)

8c. Space cooling requirement - not applicable

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

9b. Energy requirements

		kWh/year	
Fraction of space heat from secondary system	0.00		(301)
Fraction of space heat from community system	1.00		(302)
Fraction of community heat from Heat pumps	1.00		(303a)
Fraction of total space heat from Heat pumps	1.00		(304a)
Factor for control and charging method for community space heating	1.00		(305)
Factor for charging method for community water heating	1.00		(305a)
Distribution loss factor	1.05		(306)
<u>Space heating</u>			
Annual space heating requirement	622.38		(98)
Space heat from Heat pumps		653.50	(307a)
Efficiency of secondary heating system	0.00		(308)
Space heating fuel for secondary system		0.00	(309)
<u>Water heating</u>			
Annual water heating requirement	2225.97		(64)
Water heat from Heat pumps		2337.26	(310a)
<u>Other energy</u>			
Electrical energy for heat distribution		29.91	(313)
Electricity for pumps and fans within dwelling:			
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside (SFP=1.46)		403.14	(330a)
warm air heating system fans		0.00	(330b)
pump for solar water heating		0.00	(330g)
pump for waste water heat recovery		0.00	(330h)
Total electricity for the above, kWh/year		403.14	(331)
Electricity for lighting (100.00% fixed LEL)		376.83	(332)
Energy saving/generation technologies			
PVs 0.80 x 0.300 x 950.616 x 0.800		182.518	
PVs 0.80 x 0.000 x 0.000 x 0.500		0.000	
PVs 0.80 x 0.000 x 0.000 x 0.500		0.000	
		182.518	(333)
Appendix Q -			
Energy saved or generated ():		0.000	(336a)
Energy used ():		0.000	(337a)
Total delivered energy for all uses		3618.12	(338)

10b. Fuel costs using Table 12 prices

	kWh/year	Fuel price p/kWh	£/year	
Space heating from Heat pumps	653.50	4.240	27.71	(340a)
Space heating (secondary)	0.00	0.000	0.00	(341)
Water heating from Heat pumps	2337.26	4.240	99.10	(342a)
Mech vent fans	403.14	13.190	53.17	(349)
Warm air heating system fans	0.00	0.000	0.00	(349)
Pump for solar water heating	0.00	0.000	0.00	(349)
Electricity for lighting	376.828	13.190	49.70	(350)
Additional standing charges			120.00	(351)
Electricity generated - PVs	182.518	13.190	-24.07	(352)
Appendix Q -				
Energy saved or generated ():	0.000	0.000	0.00	(353)
Energy used ():	0.000	0.000	0.00	(354)
Total energy cost			325.61	(355)

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

11b. SAP rating

Energy cost deflator	0.42	(356)
Energy cost factor (ECF)	1.02	(357)
SAP value	85.76	(358)
SAP rating	86.00	(358)
SAP band	B	

12b. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of Heat pumps - 319.00%				(367a)
CO2 emissions from Heat pumps	937.54	0.5190	486.58	(368)
Electrical energy for heat distribution	29.91	0.5190	15.52	(372)
Total CO2 associated with community systems			502.11	(373)
Total CO2 associated with space and water heating			502.11	(376)
Electricity for pumps and fans	403.14	0.519	209.23	(378)
Electricity for lighting	376.83	0.519	195.57	(379)
Electricity generated - PVs	-182.52	0.519	-94.73	(380)
Electricity generated - μ CHP	0.00	0.000	0.00	(380)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(381)
Energy used ():	0.00	0.000	0.00	(382)
Total CO2, kg/year			812.18	(383)

CO2 emissions per m²

El value	9.13	(384)
El rating	91.88	(384a)
El band	92	(385)
	A	

Calculation of stars for heating and DHW

Main heating energy efficiency	, stars = 4
Main heating environmental impact	, stars = 5
Water heating energy efficiency	4.45 = 4.4520, stars = 4
Water heating environmental impact	0.17 = 0.1708, stars = 5

Appendix F – Sample BRUKL Calculations

Project name

Building 2 Baseline**As designed**

Date: Thu Sep 26 15:43:42 2019

Administrative information

Building Details

Address: Hillingdon Gardens, Uxbridge, LONDON,

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: Ashurst Manor, Church Lane, Sunninghill, SL5 7DD

Criterion 1: The calculated CO₂ emission rate for the building must not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	46
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	46
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	46
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	2.COMM1 Wall 1
Floor	0.25	0.2	0.2	2.COMM1 Exposed Floor 1
Roof	0.25	-	-	"No heat loss roofs"
Windows***, roof windows, and rooflights	2.2	1.4	1.4	2.COMM1 Window 1 (1)
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

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

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

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

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

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	5

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- commercial

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	2.5	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

1- Default DHW

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

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		Zone	Standard
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1			
2.COMM1	-	-	-	1.4	-	-	-	-	-		0.7	0.5
2.COMM2	-	-	-	1.4	-	-	-	-	-		0.7	0.5

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
Standard value	60	60	22	
2.COMM1	-	154	30	3276
2.COMM2	-	151	30	6956

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?
2.COMM1	NO (-55.8%)	NO
2.COMM2	NO (-48.7%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m ²]	854.9	854.9
External area [m ²]	1308.6	1308.6
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	5	3
Average conductance [W/K]	499.68	320.78
Average U-value [W/m ² K]	0.38	0.25
Alpha value* [%]	22.02	12.68

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
100	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
	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	7.49	1.07
Cooling	34.21	16.84
Auxiliary	6.57	3.78
Lighting	43.07	68.64
Hot water	1.7	1.96
Equipment*	20.26	20.26
TOTAL**	93.04	92.29

* 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 & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	241.45	221.39
Primary energy* [kWh/m ²]	271.77	270.62
Total emissions [kg/m ²]	46	46

* 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 SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	22.9	218.6	7.5	34.2	6.6	0.85	1.78	0.91	2.5
Notional	3.2	218.2	1.1	16.8	3.8	0.82	3.6	----	----

Key to terms	
Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.2	2.COMM1 Wall 1
Floor	0.2	0.2	2.COMM1 Exposed Floor 1
Roof	0.15	-	"No heat loss roofs"
Windows, roof windows, and rooflights	1.5	1.4	2.COMM1 Window 1 (1)
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"
U _{i-Typ} = Typical individual element U-values [W/(m²K)] U _{i-Min} = Minimum individual element U-values [W/(m²K)]			
* There might be more than one surface where the minimum U-value occurs.			

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

Project name

Building 1 Baseline + Passive**As designed**

Date: Thu Sep 26 15:46:22 2019

Administrative information

Building Details

Address: Hillingdon Gardens, Uxbridge, LONDON,

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: Ashurst Manor, Church Lane, Sunninghill, SL5 7DD

Criterion 1: The calculated CO₂ emission rate for the building must not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	45.3
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	45.3
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	38.2
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 -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	1.COMM1 Wall 1
Floor	0.25	0.2	0.2	1.COMM1 Exposed Floor 1
Roof	0.25	-	-	"No heat loss roofs"
Windows***, roof windows, and rooflights	2.2	1.4	1.4	1.COMM1 Window 2 (1)
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

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

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

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

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

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	5

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- commercial

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.94	2.5	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

1- Default DHW

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

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		Zone	Standard
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1			
1.COMM1	-	-	-	1.2	-	-	-	-	-		0.75	0.5
1.COMM2	-	-	-	1.2	-	-	-	-	-		0.75	0.5

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
Standard value	60	60	22	
1.COMM1	-	168	40	2803
1.COMM2	-	174	40	1127

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?
1.COMM1	NO (-37.8%)	NO
1.COMM2	NO (-42.3%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m ²]	369.4	369.4
External area [m ²]	640.9	640.9
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	5	3
Average conductance [W/K]	255.62	152.08
Average U-value [W/m ² K]	0.4	0.24
Alpha value* [%]	24.44	11.14

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
100	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
	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	9.95	0.78
Cooling	30.69	15.79
Auxiliary	5.63	3.78
Lighting	31.52	68.31
Hot water	1.7	1.96
Equipment*	20.26	20.26
TOTAL**	79.48	90.62

* 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 & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	227.49	206.98
Primary energy* [kWh/m ²]	225.6	266.16
Total emissions [kg/m ²]	38.2	45.3

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

HVAC Systems Performance										
System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	31.4	196.1	10	30.7	5.6	0.88	1.78	0.94	2.5
	Notional	2.3	204.7	0.8	15.8	3.8	0.82	3.6	----	----

Key to terms	
Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.2	1.COMM1 Wall 1
Floor	0.2	0.2	1.COMM1 Exposed Floor 1
Roof	0.15	-	"No heat loss roofs"
Windows, roof windows, and rooflights	1.5	1.4	1.COMM1 Window 2 (1)
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"
U _{i-Typ} = Typical individual element U-values [W/(m²K)] U _{i-Min} = Minimum individual element U-values [W/(m²K)]			
* There might be more than one surface where the minimum U-value occurs.			

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

Project name

Building 2 Baseline + passive + ASHP

As designed

Date: Wed Sep 04 11:21:54 2019

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: Ashurst Manor, Church Lane, Sunninghill, SL5 7DD

Criterion 1: The calculated CO₂ emission rate for the building must not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	46
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	46
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	29.1
Are emissions from the building less than or equal to the target?	BER ≤ TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	2.COMM1 Wall 1
Floor	0.25	0.2	0.2	2.COMM1 Exposed Floor 1
Roof	0.25	-	-	"No heat loss roofs"
Windows***, roof windows, and rooflights	2.2	1.4	1.4	2.COMM1 Window 1 (1)
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

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

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

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

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

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	5

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- commercial

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.8	5.5	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types ≤12 kW output, refer to EN 14825 for limiting standards.					

1- Default DHW

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

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		Zone	Standard
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1			
2.COMM1	-	-	-	1.1	-	-	-	-	-		0.75	0.5
2.COMM2	-	-	-	1.1	-	-	-	-	-		0.75	0.5

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
Standard value	60	60	22	
2.COMM1	-	172	40	2933
2.COMM2	-	169	40	6229

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?
2.COMM1	NO (-55.8%)	NO
2.COMM2	NO (-48.7%)	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?	NO
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m ²]	854.9	854.9
External area [m ²]	1308.6	1308.6
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	5	3
Average conductance [W/K]	499.68	320.78
Average U-value [W/m ² K]	0.38	0.25
Alpha value* [%]	22.02	12.68

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
100	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
	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	1.44	0.36
Cooling	13.83	16.84
Auxiliary	5.16	3.78
Lighting	33.9	68.64
Hot water	1.7	1.96
Equipment*	20.26	20.26
TOTAL**	56.02	91.58

* Energy used by equipment does not count towards the total for consumption or calculating emissions.

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

Energy Production by Technology [kWh/m²]

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

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	217.48	221.39
Primary energy* [kWh/m ²]	171.98	270.4
Total emissions [kg/m ²]	29.1	46

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

HVAC Systems Performance										
System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	23.1	194.4	1.4	13.8	5.2	4.47	3.91	4.8	5.5
	Notional	3.2	218.2	0.4	16.8	3.8	2.43	3.6	----	----

Key to terms	
Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.2	2.COMM1 Wall 1
Floor	0.2	0.2	2.COMM1 Exposed Floor 1
Roof	0.15	-	"No heat loss roofs"
Windows, roof windows, and rooflights	1.5	1.4	2.COMM1 Window 1 (1)
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"
U _{i-Typ} = Typical individual element U-values [W/(m²K)] U _{i-Min} = Minimum individual element U-values [W/(m²K)]			
* There might be more than one surface where the minimum U-value occurs.			

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

Appendix G – Overheating Checklist

Section 1 - Site features affecting vulnerability to overheating		
Site location	Urban – within central London or in a high density conurbation	No
	Peri-urban – on the suburban fringes of London	Yes
Air quality and/or Noise sensitivity – are any of the following in the vicinity of buildings?	Busy roads / A roads	Yes (A40)
	Railways / Overground / DLR	Yes (Underground + Railway)
	Airport / Flight path	Yes (Circa 9km from Heathrow and circa 1km from RAF Northolt)
	Industrial uses / waste facility	Several industrial estates nearby area
Proposed building use	Will any buildings be occupied by vulnerable people (e.g. elderly, disabled, young children)?	The residential development is likely to have a mixed demographic of occupants (e.g. elderly, disabled, young children)
	Are residents likely to be at home during the day (e.g. students)?	The residential development is likely to have a mixed demographic of occupants (e.g. students)
Dwelling aspect	Are there any single aspect units?	Yes
Glazing ratio	Is the glazing ratio (glazing: internal floor area) greater than 25%?	No
	If yes, is this to allow acceptable levels of daylighting?	N/A
Security - Are there any security issues that could limit opening of windows for ventilation?	Single storey ground floor units	Yes
	Vulnerable areas identified by the Police Architectural Liaison Officer	n/a
	Other	Single storey ground floor dwellings facing the site boundary.
Section 2 - Design features implemented to mitigate overheating risk		
Landscaping	Will deciduous trees be provided for summer shading (to windows and pedestrian routes)?	Yes
	Will green roofs be provided?	Yes
	Will other green or blue infrastructure be provided around buildings for evaporative cooling?	Yes

Materials	Have high albedo (light colour) materials been specified?	Buildings 5, 6, 7, 8, and 9 will have light-coloured buff brick facades.
Dwelling aspect	% of total units that are single aspect	TBC
	% single aspect with N / NE / NW orientation	TBC
	% single aspect with E orientation	TBC
	% single aspect with S / SE / SW orientation	TBC
	% single aspect with W orientation	TBC
Glazing ratio - What is the glazing ratio (glazing; internal floor area) on each facade?	N / NE / NW	TBC
	E	TBC
	S / SE / SW	TBC
	W	TBC
Daylighting	What is the average daylight factor range?	TBC
Window opening	Are windows openable?	Yes, except on facades facing Long Lane and the A40.
Window opening	What is the average percentage of openable area for the windows?	TBC at detailed design stage.
Window opening - What is the extent of the opening?	Fully openable	No windows.
	Limited (e.g. for security, safety, wind loading reasons)	All windows.
Security	Where there are security issues (e.g. ground floor flats) has an alternative night time natural ventilation method been provided (e.g. ventilation grates)?	TBC at detailed design stage.
Shading	Details of any external shading?	See planting plans.
	Details of any internal shading?	TBC at detailed design stage.
Glazing specification	Is there any solar control glazing?	Residential Glazing: 1.2 W/m ² .K; G' value of 0.36

		Commercial glazing: 1.4 W/m ² .K; G' value of 0.36
Ventilation - What is the ventilation strategy?	Natural – background	No
	Natural – purge	Yes – Residential
	Mechanical – background (e.g. MVHR)	Yes – Residential and Commercial
	Mechanical – purge	Yes – Commercial
	What is the average design air change rate	2.3 ach
Heating system	Is communal heating present?	Yes – ASHP block by Block
	What is the flow/return temperature?	55/50 Deg
	Have horizontal pipe runs been minimised?	Yes
	Do the specifications include insulation levels in line with the London Heat Network Manual	Yes