ENERGY & OVERHEATING ASSESSMENT

FLAT 29 GAINSBOROUGH HOUSE

PROPERTY ADDRESS

FLAT 29 GAINSBOROUGH HOUSE,
FRONGNAL RISE,
LONDON,
NW3 6PZ,

DATE REV

January 23

PREPARED BY

EAL Consult

winner 2020 Home and Garden Awards

EAL Consult
Best Energy Compliance Consultancy - London

BUILD

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1. EXECUTIVE SUMMARY

This Sustainability statement has been prepared to support the installation of two new outdoor air condenser units within acoustic enclosures at Flat 29 Gainsborough House. The strategy highlights how the proposed development will promote sustainability throught both design and operation and summarises the relevant regulatory and planning policies applicable and how the relevant policy targets will be addressed and achieved. The report analyses also whether Flat 29 has comfort level in accordance with the criteria set out in CIBSE TM59 to assess the space against the cooling hierarchy presented in section 6 and confirm whether an active cooling system will be required.

The strategy reponds to the UK Planning and regulatory framework, the National Planning Policy Framework 2021, the New London Plan and Camden Local Plan 2021.

This statement outlines an overall commitment to reducing energy consumption under occupancy through the adoption of a 'Fabric First' principle, which will seek enhanced insulation standards and improved heating and lighting efficiencies in comparison to the standard requirements of Approved Document Part L1 2013.

Where an existing building is being assessed the dwelling emission rates (DER) of the notional flats and proposed flats are compared to determine the level of improvement. This is in line with Building Regulations L1B for Existing Buildings.

The report also demonstrates that the proposed flat, by incorporating the measures above, can achieve an average carbon emission reduction of **29.9%** on Notional Dewelling emission.

Table 1. Carbon Emission Rate

Dwelling	Notional DER	Lean DER (without active cooling)	Lean DER (with air con)
29 Gainsborough House	35.53	26.52	26.57

SAP methodology and Building regulations Part L 2013 have been used in the assessment

Table 2. Carbon Dioxide emissions after each stage of the Energy Hierarchy

	Carbon dioxide emissions (Tonnes CO2 per annum) – without Active cooling	Carbon dioxide emissions (Tonnes CO2 per annum) – with Active cooling
	Regulated	**Regulated**
Building Regs Notional Development	11.68	11.68
After Energy demand Reduction	7.99	8.00

Table 3. Carbon Dioxide Savings from each stage of the Energy Hierarchy

	With Active cooling		Without Active cooling	
	Regulated Carbon dioxide savings (Tonnes CO_2)	% Improvement	Regulated Carbon dioxide savings (Tonnes CO_2)	% Improvement
Savings from energy efficiency measures	3.68	**31.5%**	**3.70**	**31.6%**

The results below show that the carbon dioxide savings are similar for both options (with or without active cooling) and therefore we can conclude that the use of active cooling does not lead to the increase the carbon emission.

The reported improvements are also deemed to be at the limit of financial viability for a minor development such as the proposal exceeded Part L requirements.

2. INTRODUCTION

Site description

The development is located at flat 29 Gainsborough house near Hamsptead station.

Methodology

This energy assessment outlines the energy demand from the development together with the associated CO_2 emissions, using the present Building Regulations Part L as a baseline. It demonstrates how the emissions from energy use in the development will be reduced through energy efficiency measures.

The proposed scheme is required to achieve carbon emission reduction principles in accordance with the UK Planning and regulatory framework,

The methodology employed to determine the potential CO_2 savings is in accordance with the three-step Energy Hierarchy.

- **Be Lean -** Improve the energy efficiency of the scheme;
- **Be Clean -** Supply as much of the remaining energy requirement with low carbon; technologies such as district heating if available or combined heat and power (CHP); and
- **Be Green -** Offset a proportion of the remaining carbon dioxide emissions by using renewable technologies.

The government approved Standard Assessment Procedure (SAP) methodology software (2013) has been used to determine the CO_2 emissions and energy requirements. It compares CO_2 emissions from regulated energy use (DER) with those of an equivalent dwelling built to Part L1A 2013 (TER), a notional dwelling of the same size and shape. These calculations do not include emissions from cooking or appliances.

Opportunities for incorporating features into the development that contribute to the objectives of sustainable development were explored during the design process, to ensure that where possible, the proposals achieve best practice.

3. PLANNING POLICY CONTEXT

National Planning Policy Framework 2021 – emphasised the concept of sustainable development by encouraging local authorities to adopt proactive strategies to mitigate and adapt to climate change. It recommends the move to a low carbon future by:

- Avoiding 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
- Contributing 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.
- To help increase the use and supply of renewable and low carbon energy and heat, plans should:
    - 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);
    - consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and
    - identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for colocating potential heat customers and suppliers.

The London Plan 2021 provides the strategic framework for an integrated socio-economic, transportation and environmental development plan across the capital to 2050. The Plan seeks to ensure new developments are designed to enable the efficient use of energy and support the development of sustainable energy infrastructure to produce energy more efficiently. It sets out a range of policies that apply to new developments.

Policy SI 2 Minimising Greenhouse Gas Emissions:

A. Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy: a) Be lean: use less energy and manage demand during operation, b) Be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly, c) Be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site.

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

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

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

E. Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.
F. Development proposals referable to the Mayor should calculate whole lifecycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.

9.2.1 The Mayor is committed to London becoming a zero-carbon city. This will require reduction of all greenhouse gases, of which carbon dioxide is the most prominent. London's homes and workplaces are responsible for producing approximately 78 per cent of its greenhouse gas emissions. If London is to achieve its objective of becoming a zero-carbon city by 2050, new development needs to meet the requirements of this policy. Development involving major refurbishment should also aim to meet this policy.

9.2.2 The energy hierarchy should inform the design, construction, and operation of new buildings. The priority is to minimise energy demand, and then address how energy will be supplied and renewable technologies incorporated. An important aspect of managing demand will be to reduce peak energy loadings.

Policy SI 4 Managing heat risk

A. Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.
B. Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:
    1. reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure
    2. minimise internal heat generation through energy efficient design
    3. manage the heat within the building through exposed internal thermal mass and high ceilings
    4. provide passive ventilation
    5. provide mechanical ventilation
    6. provide active cooling systems.

Camden Planning Guidance 'Energy, Efficiency & Adaption', 2021

Policy CC1 Climate change mitigation

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

We will:

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

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

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

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

Policy CC2 Adapting to climate change

All new developments will be expected to submit a statement demonstrating how the London Plan's 'cooling hierarchy' has informed the building design. Any development that is likely to be at risk of overheating (for example due to large expanses of south or south west facing glazing) will be required to complete dynamic thermal modelling to demonstrate that any risk of overheating has been mitigated.

Active cooling (air conditioning) will only be permitted where dynamic thermal modelling demonstrates there is a clear need for it after all the preferred measures are incorporated in line with the cooling hierarchy.

The cooling hierarchy includes:

- Minimise internal heat generation through energy efficient design;
- Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls;
- Manage the heat within the building through exposed internal thermal mass and high ceilings;
- Passive ventilation;
- Mechanical ventilation; and
- Active cooling

4. ENERGY STRATEGY

The Energy strategy for the proposed development is based on the Building Regulations Part L1A; it adopts a set of principles to guide design and decisions regarding energy, balanced with the need to optimise environmental and economic benefits. It seeks to incorporate energy efficiency through the approach detailed below.

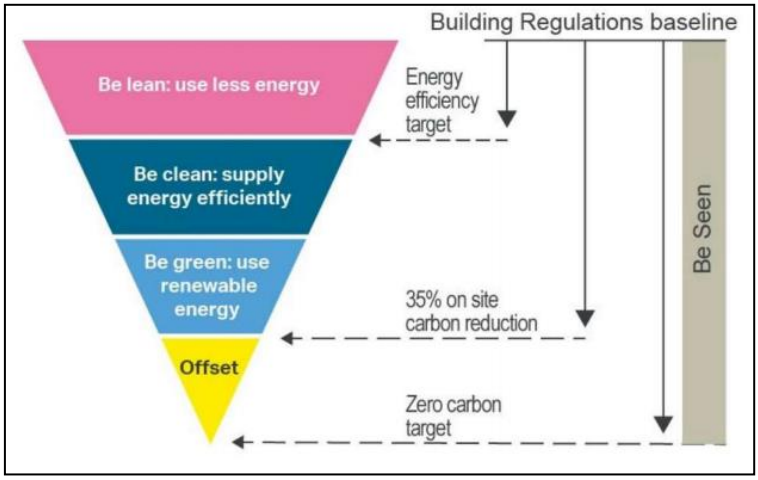

Figure 1. Energy Hierarchy

Be 'Lean' - Demand Reduction

The building fabric performance and engineering systems have been optimised in order to use less energy prior to the inclusion or consideration of Low and Zero Carbon (LZC) Technology.

Passive Design Measures:

Fabric Performance - The fabric performance values aim to reduce unwanted heat loss and heat gains, whilst maintaining a comfortable internal environment.

Under the strict terms of the lease, it is not feasible to alter or improve any external element of this existing building except for the roof. The table below outlined the u values assumed for the walls and reflecting the roof upgrade. Please note: whilst an 'External Wall' thermal element is shown within the Fabric Values, this property is wholly contained within the roof-space and there are NO external walls. The roof fabric element is being thermally upgraded (room-side) to meet current requirements.

Table 3. Fabric energy Efficiency Standard

Thermal element	Part L1A Minimum Standard
Wall	0.30W/m^2k
Roof	0.20 W/m^2k
Floor	0.25 W/m^2k
Glazing	1.2 W/m^2k
Doors	1.2 W/m^2k

Table 4. Fabric energy Efficiency specified

Thermal element	specification
Wall	1.55/m^2k
Roof	0.17 W/m^2k
Glazing	2.4 W/m^2k

Space Heating & Cooling - Space heating could be provided by radiators.

Efficient Lighting and Controls - Throughout the development natural lighting will be optimised. The development will also incorporate low energy light fittings throughout. All light fittings will be specified as low energy lighting and will accommodate LED luminaries only.

Ventilation - The use of natural ventilation is proposed for the building.

Domestic hot water (DHW) system – domestic hot water will be provided by the combi-boiler & cylinder.

Be 'Clean' – Supply Energy Efficiently

The Be Clean step of the energy hierarchy refers to the use of 'Clean energy supply'. This includes, but is not limited to, the use of Combined Heat and Power (CHP) and District Heat Networks. Policy TP1 seeks for new development to promote the use of CHP and district heating.

In light of the small-scale nature of the proposed development, it is apparent that the use of CHP is also technically and financially unviable in this instance.

Be 'Green' - Renewable Energy

Once energy demand reduction measures have been applied, methods for generating low and zero carbon energy can be assessed. The following renewable technologies to be considered for the project: Biomass, Water source heat pump, air source heat pump, Wind energy and solar photovoltaic panels.

In the light of the nature of the project, renewable technologies have been considered not feasible for this project.

5. SUSTAINABLE DESIGN

The proposed project incorporates sustainable design and construction measures capable of mitigating and adapting to climate change to meet future needs. This section details site-specific initiatives which demonstrate how the conversion helps to meet the sustainability objectives set out in the National Planning Framework 2021.

Energy Use and Pollution
The design of the development has taken into consideration day lighting to habitable spaces to improve the wellbeing of occupants. Good levels of daylight will offer occupants a pleasant and highly valued connection to the outdoors and plenty of natural light. It will also reduce the use of artificial lighting and therefore energy use. All light fittings will be specified as low energy lighting.
No external lighting is required.

Pollution: Air, Noise and Light
The layout of the development and the use of openable windows will create horizontal airflow. However, it is not sufficient to eliminate the overheating and therefore the need for air conditioning. Refer to section 6 for more details.

The development will not increase the air pollution of the area by reducing as a start, its energy consumption, which in turn will reduce emissions that lead to air pollution.
Other measures will include:

a. Use of eco-friendly building materials
b. Non-toxic paints
c. Installation of energy efficient appliances and devices
d. Use of renewable technologies

Light pollution can best be described as artificial light that is allowed to illuminate or intrude upon areas not intended to be lit. Light in the wrong place at the wrong time can be intrusive.
Intrusive light is over bright or poorly directed lights shining onto neighbouring property which affect the neighbours' right to enjoy their property. Therefore, the proposal will incorporate lighting measures in order to avoid causing a nuisance.

Water: Water Efficiency
In domestic and non-domestic buildings, the demand for water can be reduced as much as 50% using a variety of simple and innovative strategies that are integrated into the plumbing and mechanical systems. In order to reduce water consumption the proposed development will include efficient fixtures with low flow rates. Total internal water consumption will not exceed 105 litres/person/day.

Pollution
All contractors would be required to sign up to the nationally recognised Considerate Constructors Scheme which requires, amongst other things that dust emissions, potential noise pollution, impacts on water quality and the potential for ground contamination are minimised during demolition and construction. The Contractor would also be obliged to adhere to a site specific Code of Construction Practice to reduce potential nuisance effects.

Flood Risk
The development site is located in a Low Flood Risk Area on the Environment Agency Flood Risk Map.

6. COOLING STRATEGY

A dynamic overheating analysis has been carried out to identify the overheating risk of Flat 29 Gainsborough House, using dynamic thermal modelling via TM59 TM49 and The principles set in Building regulations Part O - Overheating.

6.1 Assessment Criteria

CIBSE TM59:2017 (Design methodology for the assessment of overheating risk in homes) defines overheating criteria for residential buildings. The buildings will be predominantly naturally ventilated and hence the relevant TM59 criteria will be used for the assessment.

Naturally Ventilated Buildings: The criteria below can be applied to homes which are naturally ventilated building. The compliance is based on passing both of the following two criteria.

A. **Living rooms, Kitchens and Bedrooms:** The number of hours () during which Δ is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 per cent of occupied hours. Please refer to CIBSE TM59.
B. **Bedrooms only:** The operative temperature in the bedroom between 10:00pm to 7:00am shall not exceed 26°C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26°C will be recorded as a fail).

CIBSE TM49:2014 - In line with guidance from the Greater London Authority, 3 weather files from the CIBSE TM49 document have been used

5.2 Modelling Input

Weather File & Description

- London_GTW_DSY1_2020High50.epw - London Gatwick Weather data: 2020 (high emission) DSY 1 - Moderately warm summer
- London_GTW_DSY2_2020High50.epw - London Gatwick Weather data: featuring short intense warm spell
- London_GTW_DSY3_2020High50.epw - London Gatwick Weather data: featuring long, less intense warm spell

Building Category

- Category II - all units: Normal expectation

Window[1]

- Glazed full height doors/windows are modelled as 100% openable. Operating on a 24hour time schedule if internal operative temperature is over 22°c - this has been rephrased to 24hours not from 8am to 10pm.
- Internal blinds installed

Lighting Gain

[1] Whilst 100% openable windows & doors are modelled as requested, in fact window openings are sliding-sash type (not casement) and therefore only ever 50% openable, doors to terraces are 100% openable, and 4No oval windows to eighth floor are pivot casement type with restricted opening (less than 30%) to provide protection from falling at this floor level – refer to Architects drawings.

The internal gains from the lighting are based on CIBSE TM59 5.2

Small Power Gains
The house is modelled to include small power gains that are representative of typical equipment use in an everyday occurrence. There are associated with an assumed usage profile to represent which times of the day such appliances would result in a heat gain into the space. Small power gains include appliances such as TV's, fridge/freezers, toasters, kettles, hairdryers etc.

A list of anticipated heat gains in the dwellings are:

- Kitchen and Living spaces: 250W maximum power consumption
- Bedroom spaces: 150W maximum power consumption

5. 3. Summary of Results – Rev I

As proposed – Including latest U-Values for walls – 1.55 and windows – 2.4

Table 04: Summary of Results for Bedrooms

Room Name	Criteria B (Sleeping hours between 10pm to 7am, per year) % of hours	TM59 Criteria met ?
Bedrooms		
Bedroom 1	1.8%	**Fail**
Bedroom 2	1.4%	**Fail**
Bedroom 3	1.8%	**Fail**
Bedroom 4	1.4%	**Fail**

Table 05: Summary of Results for Dining/living rooms and kitchens

Room Name	Criteria A (During The Period May to September)	TM59 Criteria met ?
Dining/Living Room and Kitchen		
Sixth Floor		
Sitting Room	2.9%	**Fail**
Seventh Floor		
Kitchen	3.4%	**Fail**
Reception	3.2%	**Fail**
Dining	3.3%	**Fail**

The tables below demonstrate a sample that has been assessed on by CIBSE TM59 Criteria using weather file Gatwick DSY 2:

Table 06: Summary of Results for Bedrooms

Room Name	Criteria B (Sleeping hours between 10pm to 7am, per year) % of hours	TM59 Criteria met ?
Bedroom 1	2.0%	**Fail**
Bedroom 2	1.7%	**Fail**
Bedroom 3	**2.0%**	**Fail**
Bedroom 4	1.7%	**Fail**

Table 07: Summary of Results for Dining/living rooms and kitchens

Room Name	Criteria A (During The Period May to September)	TM59 Criteria met ?
Dining/Living Room and Kitchen		
Ground floor Sitting Room	3.4%	**Fail**
Kitchen	3.5%	**Fail**
Reception	3.3%	**Fail**
Dining	3.3%	**Fail**

The tables below demonstrate a sample that has been assessed on by CIBSE TM59 Criteria using weather file Gatwick DSY 3:

Table 08: Summary of Results for Bedrooms

Room Name	Criteria B (Sleeping hours between 10pm to 7am, per year) % of hours	TM59 Criteria met ?
Bedroom 1	2.3%	**Fail**
Bedroom 2	1.8%	**Fail**
Bedroom 3	**2.3%**	**Fail**
Bedroom 4	1.8%	**Fail**

Table 09: Summary of Results for Dining/living rooms and kitchens

Room Name	Criteria A (During The Period May to September)	TM59 Criteria met ?
Dining/Living Room and Kitchen		
Ground floor Sitting Room	3.4%	**Fail**
Kitchen	3.7%	**Fail**
Reception	3.5%	**Fail**
Dining	3.5%	**Fail**

5.4. Additional Results

CIBSE TM49: 2014 Compliance

DYS1 (1989) Weather Data Results

Room Name	Criteria 1 ≤3.0%	Criteria 2 We≤6	Criteria 3 ΔT ≤4	TM59 Compliance
% of spaces pass	**0**	**0**	**0**	**Fail**
% of spaces fail	**100**	**100**	**100**	

DYS2 (2003) Weather Data Results

Room Name	Criteria 1 ≤3.0%	Criteria 2 We≤6	Criteria 3 ΔT ≤4	
% of spaces pass	**0**	**0**	**0**	**Fail**
% of spaces fail	**100**	**100**	**100**	

DYS2 (1976) Weather Data Results

Room Name	Criteria 1 ≤3.0%	Criteria 2 We≤6	Criteria 3 ΔT ≤4	
% of spaces pass	**0**	**0**	**0**	**Fail**
% of spaces fail	**100**	**100**	**100**	

5.5. Proposed Ventilation Strategy

Mechanical cooling - to maintain comfortable internal temperatures

CIBSE TM49: 2014 Compliance

DYS1 (1989) Weather Data Results

Room Name	Criteria 1 ≤3.0%	Criteria 2 We≤6	Criteria 3 ΔT ≤4	TM59 Compliance
% of spaces pass	100	100	100	Pass
% of spaces fail	0	0	0	

DYS2 (2003) Weather Data Results

Room Name	Criteria 1 ≤3.0%	Criteria 2 We≤6	Criteria 3 ΔT ≤4	
% of spaces pass	100	100	100	Pass
% of spaces fail	0	0	0	

DYS2 (1976) Weather Data Results

Room Name	Criteria 1 ≤3.0%	Criteria 2 We≤6	Criteria 3 ΔT ≤4	
% of spaces pass	100	100	100	Pass
% of spaces fail	0	0	0	

CIBSE TM59: 2014 Compliance

Table 10: Summary of Results for Bedrooms

Room Name	Criteria B (Sleeping hours between 10pm to 7am, per year) % of hours	TM59 Criteria met ?
Bedrooms		
Bedroom 1	0%	Pass
Bedroom 2	0%	Pass
Bedroom 3	0%	Pass
Bedroom 4	0%	Pass

Table 11: Summary of Results for Dining/living rooms and kitchens

Room Name	Criteria A (During The Period May to September)	TM59 Criteria met ?
Dining/Living Room and Kitchen		
Sixth Floor		
Sitting Room	2.5%	Pass
Seventh Floor		
Kitchen	2.8%	Pass
Reception	2.6%	Pass
Dining	2.5%	Pass

The tables below demonstrate a sample that has been assessed on by CIBSE TM59 Criteria using weather file Gatwick DSY 2:

Table 12: Summary of Results for Bedrooms

Room Name	Criteria B (Sleeping hours between 10pm to 7am, per year)	TM59 Criteria met ?
	% of hours	
Bedroom 1	0%	**Pass**
Bedroom 2	0%	**Pass**
Bedroom 3	0%	**Pass**
Bedroom 4	0%	**Pass**

Table 13: Summary of Results for Dining/living rooms and kitchens

Room Name	Criteria A (During The Period May to September)	TM59 Criteria met ?
Dining/Living Room and Kitchen		
Ground floor Sitting Room	2.5%	**Pass**
Kitchen	2.3%	**Pass**
Reception	2.0%	**Pass**
Dining	2.0%	**Pass**

The tables below demonstrate a sample that has been assessed on by CIBSE TM59 Criteria using weather file Gatwick DSY 3:

Table 14: Summary of Results for Bedrooms

Room Name	Criteria B (Sleeping hours between 10pm to 7am, per year)	TM59 Criteria met ?
	% of hours	
Bedroom 1	0.5%	**Pass**
Bedroom 2	0.6%	**Pass**
Bedroom 3	**0.6%**	**Pass**
Bedroom 4	0.3%	**Pass**

Table 15: Summary of Results for Dining/living rooms and kitchens

Room Name	Criteria A (During The Period May to September)	TM59 Criteria met ?
Dining/Living Room and Kitchen		
Ground floor Sitting Room	2.6%	**Pass**
Kitchen	2.7%	**Pass**
Reception	2.6%	**Pass**
Dining	2.7%	**Pass**

5.6 Cooling strategy:

The following strategy has been defined according the cooling hierarchy in Policy SI4 of the London Plan.

Table 16. cooling hierarchy

Cooling Hierarchy category	Flat 29 Gainsborough House
1. Reduce the amount of heat entering the building through orientation, shading, high albedo material, fenestration, insulation and the provision of green infrastructure.	The flat was originally converted from a hospital in 1997. Also under the strict terms of the lease, it is not permitted to proceed with alterations in the infrastructure. Only the roofs will be upgraded
2. Minimise internal heat generation through energy efficient design	As above.
3. Manage the heat within the building through exposed internal thermal mass and high ceilings.	As above.
4. Provide passive ventilation	The natural ventilation is not enough to recover the heat generated. This has been demonstrated in the results provided in section 5.4. Also, the tenant has a documented medical condition that affects her ability to regulate body temperature, hence the strong desire for cooling throughout the apartment.
5. Provide mechanical ventilation	Mechanical ventilation can be used but it won't be enough to recover the heat generated. Also, the tenant has a documented medical condition that affects her ability to regulate body temperature, hence the strong desire for cooling throughout the apartment.
6. Provide active cooling system	The use of air conditioning is proposed for the development. Refer to section 5.5 for results.

7. CONCLUSION

The development has been designed to exceed Part L1A building regulations requirements. In line with the national and local policies, regulated CO_2 emissions from the development will be improved by **25.4%** from the notional emissions once energy efficiency measures, lean measures and active cooling are taken into account.

The development is constrained and doesn't provide opportunities for implementing passive measures to improve the performance of the flat. The health conditions of the tenant urge the need to use active cooling to regulate her thermal comfort.

In order to achieve the required carbon emissions reduction, the report concludes and proposes the use of energy efficient measures outlined in the section 4 of this report. The overheating analysis outlined in section 6 supports the use of air conditioning to provide a comfortable space for the tenant.

An appraisal of the proposed development has been undertaken against key sustainability objectives identified from relevant policy guidance. The framework for the appraisal was guided by the National Plan. This process has ensured that the development responds to the sustainable development objectives that are relevant to the area. Key sustainability initiatives in ecology, waste management, water, health and wellbeing, materials, pollution and Surface water management have been incorporated in the design of the proposed Development.

8. APPENDIX

I. SAP Calculation

EAL CONSULT
Assessor : Mark Simons
17 Dobree Avenue
LONDON
NW10 2AD
0208 930 5668

Project Information
Building type Top-floor flat

Reference
Date 4 October 2022
Email: NONE Project Flat 29
Gainsborough House
Frognal Rise
LONDON
NW3 6PZ

SAP 2012 worksheet for Existing dwelling - calculation of energy ratings

1. Overall dwelling dimensions

	Area (m^2)	Av. Storey height (m)	Volume (m^3)	
Second floor	157.93	2.84	448.52	(3a)
Third floor	111.23	3.45	383.74	(3b)
Fourth and other floors	32.02	2.20	70.44	(3c)
	301.18			**(4)**
			902.71	**(5)**

2. Ventilation rate

	main + seondary + other heating		m^3 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	5	x 10	50.00	(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	
			0.06	**(8)**
(ns)	3			(9)
			0.20	**(10)**
			0.35	**(11)**
			0.00	**(13)**
		100.00		**(14)**
			0.05	**(15)**
Infiltration rate			0.66	(16)
Air permeability			0.66	(18)
			2.00	**(19)**
			0.85	**(20)**
Infiltration rate incorporating shelter factor			0.56	(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)

0.71	0.70	0.68	0.61	0.60	0.53	0.53	0.52	0.56	0.60	0.63	0.65	
												7.31 (22b)

Ventilation : natural ventilation, intermittent extract fans

Effective air change rate

0.75	0.74	0.73	0.69	0.68	0.64	0.64	0.63	0.66	0.68	0.70	0.71	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	kappa-value kJ/m²K	A x K kJ/K	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR			**1.369**	**2.19 (2.40)**	3.00			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR			**12.080**	**2.19 (2.40)**	26.45			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) FRONT			**3.020**	**2.19 (2.40)**	6.61			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) SIDE			**12.080**	**2.19 (2.40)**	26.45			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) SIDE			**1.230**	**2.19 (2.40)**	2.69			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast) SIDE			**1.230**	**2.19 (2.40)**	2.69			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) FRONT			**1.230**	**2.19 (2.40)**	2.69			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR			**1.230**	**2.19 (2.40)**	2.69			(27)
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR			**4.040**	**2.40**	9.70			(26)
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) SIDE			**4.040**	**2.40**	9.70			(26)
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) FRONT			**4.040**	**2.40**	9.70			(26)
Walls EXTERNAL			93.44	1.55	144.83	18.00	1681.94	(29)
Walls ROOF VOID WALL			64.42	0.65 (Ru=0.90)	41.69	18.00	1159.56	(29)

4. Water heating energy requirements **kWh/year**

Assumed occupancy, N 3.13 (42)

Annual average hot water usage in litres per day Vd,average 108.62 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month												
119.48	115.14	110.79	106.45	102.10	97.76	97.76	102.10	106.45	110.79	115.14	119.48	(44)
Energy content of hot water used												
177.19	154.97	159.91	139.42	133.77	115.44	106.97	122.75	124.22	144.76	158.02	171.60	

Energy content (annual) 1709.01 (45)

Distribution loss												
26.58	23.25	23.99	20.91	20.07	17.32	16.05	18.41	18.63	21.71	23.70	25.74	(46)

Cylinder volume, l 300.00 (47)

Manufacturer's declared cylinder loss factor (kWh/day) 2.32 (48)

Temperature Factor 0.5400 (49)

Energy lost from hot water cylinder (kWh/day) 1.25 (55)

Total storage loss												
38.84	35.08	38.84	37.58	38.84	37.58	38.84	38.84	37.58	38.84	37.58	38.84	(56)
Net storage loss												
38.84	35.08	38.84	37.58	38.84	37.58	38.84	38.84	37.58	38.84	37.58	38.84	(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												
239.29	211.06	222.01	199.51	195.87	175.53	169.07	184.85	184.31	206.86	218.11	233.70	(62)
Output from water heater for each month, kWh/month												
239.29	211.06	222.01	199.51	195.87	175.53	169.07	184.85	184.31	206.86	218.11	233.70	(64)

2440.18 (64)

Heat gains from water heating, kWh/month												
108.59	96.40	102.85	94.43	94.16	86.46	85.25	90.49	89.38	97.81	100.62	106.74	(65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	(66)
Lighting gains												
115.54	102.62	83.46	63.18	47.23	39.87	43.08	56.00	75.17	95.44	111.40	118.75	(67)
Appliances gains												
685.40	692.51	674.59	636.44	588.27	543.00	512.76	505.65	523.57	561.73	609.89	655.16	(68)
Cooking gains												
56.93	56.93	56.93	56.93	56.93	56.93	56.93	56.93	56.93	56.93	56.93	56.93	(69)
Pumps and fans gains												
3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (negative values)												
-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	(71)
Water heating gains												
145.96	143.45	138.24	131.16	126.56	120.08	114.58	121.63	124.14	131.47	139.75	143.46	(72)
Total internal gains												
1069.51	1061.19	1018.89	953.38	884.66	825.56	793.03	805.89	845.48	911.24	983.64	1039.98	(73)

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR	0.9 x 1.369 36.79	0.63 x 0.70	0.77	15.3940
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR	0.9 x 12.080 36.79	0.63 x 0.70	0.77	135.8357
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) FRONT	0.9 x 3.020 11.28	0.63 x 0.70	0.77	10.4136
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) SIDE	0.9 x 12.080 11.28	0.63 x 0.70	0.77	41.6544
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) SIDE	0.9 x 1.230 11.28	0.63 x 0.70	0.77	4.2413
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast) SIDE	0.9 x 1.230 36.79	0.63 x 0.70	0.77	13.8309
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) FRONT	0.9 x 1.230 11.28	0.63 x 0.70	0.77	4.2413
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR	0.9 x 1.230 36.79	0.63 x 0.70	0.77	13.8309
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR	0.9 x 4.040 36.79	0.63 x 0.70	0.77	45.4285

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains	
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) SIDE	0.9 x 4.040	11.28	0.63 x 0.70	0.77	13.9308
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) FRONT	0.9 x 4.040	11.28	0.63 x 0.70	0.77	13.9308
Total solar gains, January				312.73	(83-1)

Solar gains

312.73	562.07	847.05	1180.28	1441.35	1483.42	1408.33	1205.53	961.18	642.23	379.93	264.17	(83)

Total gains

1382.24	1623.26	1865.94	2133.7	2326.0	2309.0	2201.4	2011.4	1806.66	1553.48	1363.57	1304.15	(84)

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR	0.9 x 1.37	0.80	0.70 x 0.83	0.57
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR	0.9 x 12.08	0.80	0.70 x 0.83	5.05
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) FRONT	0.9 x 3.02	0.80	0.70 x 0.83	1.26
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) SIDE	0.9 x 12.08	0.80	0.70 x 0.83	5.05
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) SIDE	0.9 x 1.23	0.80	0.70 x 0.83	0.51
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast) SIDE	0.9 x 1.23	0.80	0.70 x 0.83	0.51
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) FRONT	0.9 x 1.23	0.80	0.70 x 0.83	0.51
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR	0.9 x 1.23	0.80	0.70 x 0.83	0.51

GL = 14.00 / 301.18 = 0.046
C1 = 0.500
C2 = 1.084
El = 816

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C) 21.00 (85)

Heating system responsiveness 0.75

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau											
15.72	15.79	15.86	16.19	16.26	16.56	16.56	16.62	16.44	16.26	16.13	16.00
alpha											
2.05	2.05	2.06	2.08	2.08	2.10	2.10	2.11	2.10	2.08	2.08	2.07
Utilisation factor for gains for living area											
0.99	0.98	0.97	0.95	0.91	0.84	0.75	0.79	0.90	0.96	0.98	0.99 (86)
Mean internal temperature in living area T1											
18.02	18.21	18.59	19.16	19.72	20.25	20.54	20.48	20.05	19.33	18.60	18.01 (87)
Temperature during heating periods in rest of dwelling Th2											
19.21	19.22	19.22	19.25	19.26	19.28	19.28	19.29	19.27	19.26	19.25	19.24 (88)
Utilisation factor for gains for rest of dwelling											
0.98	0.98	0.96	0.93	0.87	0.75	0.58	0.64	0.85	0.95	0.98	0.99 (89)
Mean internal temperature in the rest of dwelling T2											
15.38	15.66	16.22	17.04	17.85	18.57	18.92	18.88	18.33	17.30	16.24	15.38 (90)

Living area fraction (97.09 / 301.18) 0.32 (91)

Mean internal temperature (for the whole dwelling)

16.23	16.48	16.99	17.72	18.46	19.11	19.44	19.39	18.88	17.95	17.00	16.23 (92)

Apply adjustment to the mean internal temperature, where appropriate

16.23	16.48	16.99	17.72	18.46	19.11	19.44	19.39	18.88	17.95	17.00	16.23 (93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains											
0.98	0.97	0.95	0.91	0.85	0.74	0.60	0.65	0.83	0.93	0.97	0.98 (94)
Useful gains											
1349.65	1569.02	1770.52	1948.71	1976.96	1714.93	1327.89	1312.16	1494.73	1445.73	1319.24	1276.96 (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											
7856.8	7594.5	6844.3	5640.4	4301.7	2820.4	1777.95	1865.35	3010.1	4682.5	6353.4	7782.7 (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											
4841.3	4049.1	3774.9	2658.0	1729.62	-	-	-	-	2408.1	3624.6	4840.2

Total space heating requirement per year (kWh/year) (October to May) 27925.94 (98)

Space heating requirement per m² (kWh/m²/year) 92.72 (99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
External temperaturers													
	-	-	-	-	-	14.60	16.60	16.40	-	-	-	-	
Heat loss rate W													
	-	-	-	-	-	5875.5	4625.4	4734.0	-	-	-	-	(100)
Utilisation factor for loss													
	-	-	-	-	-	0.39	0.45	0.41	-	-	-	-	(101)
Useful loss W													
	-	-	-	-	-	2285.3	2089.6	1950.40	-	-	-	-	(102)
Internal gains W													
	0.00	0.00	0.00	0.00	0.00	822.56	790.03	802.89	0.00	0.00	0.00	0.00	
Solar gains W													
	0.00	0.00	0.00	0.00	0.00	1733.87	1646.10	1409.06	0.00	0.00	0.00	0.00	
Gains W													
	-	-	-	-	-	2556.4	2436.1	2212.0	-	-	-	-	(103)
Fraction of month for cooling													
	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	(103a)
Space heating kWh													
	-	-	-	-	-	597.01	96.79	63.29	-	-	-	-	(98)
Space cooling kWh													
	-	-	-	-	-	195.24	257.83	194.60	-	-	-	-	(104)
Total												647.68	(104)
Cooled fraction												0.80	(105)
Intermittency factor													
	-	-	-	-	-	0.25	0.25	0.25	-	-	-	-	(106)
Space cooling requirement for month													
	-	-	-	-	-	39.05	51.57	38.92	-	-	-	-	
Space cooling (June to August)												129.54	(107)
Space cooling requirement per m² (kWh/m²/year)												0.43	(108)

9a. Energy requirements

kWh/year

No secondary heating system selected

Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main heating system	90.90%	(206)
Cooling system energy efficiency ratio	4.38%	(209)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement												
4841.3	4049.1	3774.9	2658.0	1729.62	-	-	-	-	2408.1	3624.6	4840.2	(98)
Appendix Q - monthly energy saved (main heating system 1)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(210)
Space heating fuel (main heating system 1)												
5326.0	4454.5	4152.8	2924.1	1902.77	-	-	-	-	2649.2	3987.4	5324.8	(211)
Appendix Q - monthly energy saved (main heating system 2)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(212)
Space heating fuel (main heating system 2)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(213)
Appendix Q - monthly energy saved (secondary heating system)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(214)
Space heating fuel (secondary)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(215)
Water heating												
Water heating requirement												
239.29	211.06	222.01	199.51	195.87	175.53	169.07	184.85	184.31	206.86	218.11	233.70	(64)
Efficiency of water heater												80.20 (216)
90.33	90.30	90.23	90.06	89.68	80.20	80.20	80.20	80.20	89.95	90.22	90.34	(217)
Water heating fuel												
264.90	233.72	246.05	221.53	218.41	218.87	210.81	230.48	229.81	229.97	241.77	258.67	(219)

Annual totals	kWh/year	
Space heating fuel used, main system 1	30721.60	(211)
Space heating fuel (secondary)	0.00	(215)
Water heating fuel	2804.99	(219)
Space cooling fuel used	29.61	(221)

-	-	-	-	-	8.93	11.79	8.90	-	-	-	-	(221)

Electricity for pumps, fans and electric keep-hot		
central heating pump	30.00	(230c)
boiler with a fan-assisted flue	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (100.00% fixed LEL)	816.19	(232)
Energy saving/generation technologies		
Appendix Q -		
Energy saved or generated ():	0.000	(236a)
Energy used ():	0.000	(237a)
Total delivered energy for all uses	34447.40	(238)

10a. Fuel costs using Table 12 prices

	kWh/year	Fuel price p/kWh	£/year	
Space heating - main system 1	30721.603	3.480	1069.11	(240)
Space heating - main system 2	0.000	0.000	0.00	(241)
Water heating cost	2804.99	3.480	97.61	(247)
Space cooling	29.608	13.190	3.91	(248)
Mech vent fans cost	0.000	13.190	0.00	(249)
Pump/fan energy cost	75.000	13.190	9.89	(249)
Energy for lighting	816.193	13.190	107.66	(250)
Additional standing charges			120.00	(251)
Electricity generated - PVs	0.000	0.000	0.00	(252)
Appendix Q -				
Energy saved or generated ():	0.000	0.000	0.00	(253)
Energy used ():	0.000	0.000	0.00	(254)
Total energy cost			1408.18	(255)

11a. SAP rating

	0.42	**(256)**
	1.71	**(257)**
SAP value	76.17	
	76	(258)
SAP band	**C**	

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating, main system 1	30721.60	0.216	6635.87	(261)
Space heating, main system 2	0.00	0.000	0.00	(262)
Space heating, secondary	0.00	0.519	0.00	(263)
Water heating	2804.99	0.216	605.88	(264)
Space and water heating			7241.74	(265)
Space cooling	29.61	0.519	15.37	(266)
Electricity for pumps and fans	75.00	0.519	38.93	(267)
Electricity for lighting	816.19	0.519	423.60	(268)
Electricity generated - PVs	0.00	0.519	0.00	(269)
Electricity generated - µCHP	0.00	0.000	0.00	(269)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(270)
Energy used ():	0.00	0.000	0.00	(271)
Total CO2, kg/year			7719.64	(272)

	kg/m²/year	
CO2 emissions per m²	**25.63**	(273)
EI value	70.12	(273a)
EI rating	**70**	(274)
EI band	**C**	

Calculation of stars for heating and DHW

Main heating energy efficiency	(3.48 / 0.9090) x (1 + (0.29 x 0.25)) = 4.1059, stars = 4
Main heating environmental impact	(0.2160 / 0.9090) x (1 + (0.29 x 0.25)) = 0.2549, stars = 4
Water heating energy efficiency	3.48 / 0.8683 = 4.0080, stars = 4
Water heating environmental impact	0.2160 / 0.8683 = 0.2488, stars = 4

EAL CONSULT
Assessor : Mark Simons
17 Dobree Avenue
LONDON
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0208 930 5668

Project Information
Building type Top-floor flat

Reference
Date 4 October 2022
Email: NONE Project Flat 29
Gainsborough House
Frognal Rise
LONDON
NW3 6PZ

REGULATION COMPLIANCE REPORT - Approved Document L1A, 2012 Edition, England
assessed by program JPA Designer version 6.05.069, printed on 31/10/2022 at 10:19:43

Existing dwelling

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1 TER and DER
Fuel for main heating system: Gas (mains) (fuel factor = 1.00)

Target Carbon Dioxide Emission Rate	TER = 13.89	
Dwelling Carbon Dioxide Emission Rate	DER = 38.79	Fail

Excess emissions = 24.90kg/m² (179.3%)

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	TFEE = 55.7	
Dwelling Fabric Energy Efficiency (DFEE)	DFEE = 101.4	Fail

2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15

2b Fabric U-values

Element	Average	Highest	
Wall	1.04 (max. 0.30)	1.55 (max. 0.70)	Fail
Floor	0.00 (max. 0.25)	0.00 (max. 0.70)	OK
Roof	0.24 (max. 0.20)	0.30 (max. 0.35)	Fail
Openings	2.40 (max. 2.00)	2.40 (max. 3.30)	Fail

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3 Air permeability

Air permeability at 50 pascals:	10.00	OK
Maximum :	10.00	

4 Heating efficiency

Main heating system:

Boiler and underfloor heating, mains gas
Vaillant Thermocompact

Source of efficiency: from boiler database
Vaillant Thermocompact vc240h
Efficiency: 65.0% SEDBUK2009
Minimum: 88.0% Fail

Secondary heating system:

Room heater systems - Electric (direct acting)
Panel, convector or radiant heaters

5 Cylinder insulation

Hot water storage

Calculated cylinder loss factor (kWh/day)		3.36	
Permitted by DBSCG		2.86	Fail
Primary pipework insulated	Yes		OK

6 Controls

(Also refer to "Domestic Building Services Compliance Guide" by the DCLG)

Space heating controls	Time and temperature zone control	OK
	Cylinderstat - Yes	OK
	Independent timer for DHW - Yes	OK
Boiler Interlock	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100.0%
Minimum: 75.0% OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames Valley): OK
Not significant OK

Based on:

Thermal mass parameter :	123.74
Overshading :	Average or unknown (20-60 % sky blocked)

Orientation : NorthEast

Ventilation rate :	8.00
Blinds/curtains :	

None with blinds/shutters closed 0.00% of daylight hours

10 Key features

Fixed cooling system

EAL CONSULT
Assessor : Mark Simons
17 Dobree Avenue
LONDON
NW10 2AD
0208 930 5668

Project Information
Building type Top-floor flat

Reference
Date 4 October 2022
Email: NONE Project Flat 29
Gainsborough House
Frognal Rise
LONDON
NW3 6PZ

SAP 2012 worksheet for Existing dwelling - calculation of energy ratings

1. Overall dwelling dimensions

	Area (m^2)	Av. Storey height (m)	Volume (m^3)	
Second floor	157.93	2.84	448.52	(3a)
Third floor	111.23	3.45	383.74	(3b)
Fourth and other floors	32.02	2.20	70.44	(3c)
	301.18			**(4)**
			902.71	**(5)**

2. Ventilation rate

	main + seondary + other heating		m^3 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	5	x 10	50.00	(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	
			0.06	**(8)**
(ns)	3			(9)
			0.20	**(10)**
			0.35	**(11)**
			0.00	**(13)**
		100.00		**(14)**
			0.05	**(15)**
Infiltration rate			0.66	(16)
Air permeability			0.66	(18)
			2.00	**(19)**
			0.85	**(20)**
Infiltration rate incorporating shelter factor			0.56	(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)

0.71	0.70	0.68	0.61	0.60	0.53	0.53	0.52	0.56	0.60	0.63	0.65	
												7.31 (22b)

Ventilation : natural ventilation, intermittent extract fans

Effective air change rate

0.75	0.74	0.73	0.69	0.68	0.64	0.64	0.63	0.66	0.68	0.70	0.71	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	kappa-value kJ/m²K	A x K kJ/K	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR			**1.230**	**2.19 (2.40)**	2.69			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) FRONT			**1.230**	**2.19 (2.40)**	2.69			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast) SIDE			**1.230**	**2.19 (2.40)**	2.69			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) SIDE			**1.230**	**2.19 (2.40)**	2.69			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) SIDE			**12.080**	**2.19 (2.40)**	26.45			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) FRONT			**3.020**	**2.19 (2.40)**	6.61			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR			**12.080**	**2.19 (2.40)**	26.45			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR			**1.369**	**2.19 (2.40)**	3.00			(27)
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) FRONT			**4.040**	**2.40**	9.70			(26)
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) SIDE			**4.040**	**2.40**	9.70			(26)
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR			**4.040**	**2.40**	9.70			(26)
Walls EXTERNAL			93.44	1.55	144.83	18.00	1681.94	(29)
Walls ROOF VOID WALL			64.42	0.65 (Ru=0.90)	41.69	18.00	1159.56	(29)

4. Water heating energy requirements **kWh/year**

Assumed occupancy, N 3.13 (42)

Annual average hot water usage in litres per day Vd,average 108.62 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month												
119.48	115.14	110.79	106.45	102.10	97.76	97.76	102.10	106.45	110.79	115.14	119.48	(44)
Energy content of hot water used												
177.19	154.97	159.91	139.42	133.77	115.44	106.97	122.75	124.22	144.76	158.02	171.60	

Energy content (annual) 1709.01 (45)

Distribution loss												
26.58	23.25	23.99	20.91	20.07	17.32	16.05	18.41	18.63	21.71	23.70	25.74	(46)

300.00 (50)

Hot water cylinder loss factor (kWh/day) 0.0152 (51)

Volume factor 0.7368 (52)

Temperature factor 0.5400 (53)

Energy lost from hot water cylinder (kWh/day) 1.81 (55)

Total storage loss												
56.19	50.75	56.19	54.38	56.19	54.38	56.19	56.19	54.38	56.19	54.38	56.19	(56)
Net storage loss												
56.19	50.75	56.19	54.38	56.19	54.38	56.19	56.19	54.38	56.19	54.38	56.19	(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												
256.64	226.73	239.37	216.31	213.23	192.33	186.42	202.20	201.10	224.21	234.91	251.05	(62)
Output from water heater for each month, kWh/month												
256.64	226.73	239.37	216.31	213.23	192.33	186.42	202.20	201.10	224.21	234.91	251.05	(64)

2644.49 (64)

Heat gains from water heating, kWh/month												
122.48	108.94	116.73	107.87	108.04	99.89	99.13	104.38	102.81	111.69	114.05	120.62	(65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	(66)
Lighting gains												
115.54	102.62	83.46	63.18	47.23	39.87	43.08	56.00	75.17	95.44	111.40	118.75	(67)
Appliances gains												
685.40	692.51	674.59	636.44	588.27	543.00	512.76	505.65	523.57	561.73	609.89	655.16	(68)
Cooking gains												
56.93	56.93	56.93	56.93	56.93	56.93	56.93	56.93	56.93	56.93	56.93	56.93	(69)
Pumps and fans gains												
3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (negative values)												
-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	(71)
Water heating gains												
164.62	162.11	156.90	149.82	145.22	138.74	133.24	140.29	142.79	150.13	158.40	162.12	(72)
Total internal gains												
1088.16	1079.85	1037.55	972.04	903.32	844.22	811.69	824.55	864.14	929.90	1002.30	1058.64	(73)

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR	0.9 x 1.230 36.79	0.63 x 0.70	0.77	13.8309
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) FRONT	0.9 x 1.230 11.28	0.63 x 0.70	0.77	4.2413
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast) SIDE	0.9 x 1.230 36.79	0.63 x 0.70	0.77	13.8309
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) SIDE	0.9 x 1.230 11.28	0.63 x 0.70	0.77	4.2413
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) SIDE	0.9 x 12.080 11.28	0.63 x 0.70	0.77	41.6544
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) FRONT	0.9 x 3.020 11.28	0.63 x 0.70	0.77	10.4136
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR	0.9 x 12.080 36.79	0.63 x 0.70	0.77	135.8357
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR	0.9 x 1.369 36.79	0.63 x 0.70	0.77	15.3940
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) FRONT	0.9 x 4.040 11.28	0.63 x 0.70	0.77	13.9308

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains	
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest)	0.9 x 4.040	11.28	0.63 x 0.70	0.77	13.9308	
SIDE						
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest)	0.9 x 4.040	36.79	0.63 x 0.70	0.77	45.4285	
REAR						
Total solar gains, January					312.73	(83-1)

Solar gains

312.73	562.07	847.05	1180.28	1441.35	1483.42	1408.33	1205.53	961.18	642.23	379.93	264.17	(83)

Total gains

1400.90	1641.91	1884.60	2152.3	2344.7	2327.6	2220.0	2030.1	1825.32	1572.13	1382.23	1322.81	(84)

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest)	0.9 x 1.23	0.80	0.70 x 0.83	0.51
REAR				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast)	0.9 x 1.23	0.80	0.70 x 0.83	0.51
FRONT				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast)	0.9 x 1.23	0.80	0.70 x 0.83	0.51
SIDE				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest)	0.9 x 1.23	0.80	0.70 x 0.83	0.51
SIDE				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest)	0.9 x 12.08	0.80	0.70 x 0.83	5.05
SIDE				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast)	0.9 x 3.02	0.80	0.70 x 0.83	1.26
FRONT				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest)	0.9 x 12.08	0.80	0.70 x 0.83	5.05
REAR				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest)	0.9 x 1.37	0.80	0.70 x 0.83	0.57
REAR				

GL = 14.00 / 301.18 = 0.046
C1 = 0.500
C2 = 1.084
EI = 816

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C) 21.00 (85)

Heating system responsiveness 0.75

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau											
15.33	15.39	15.46	15.78	15.84	16.13	16.13	16.18	16.01	15.84	15.71	15.59
alpha											
2.02	2.03	2.03	2.05	2.06	2.08	2.08	2.08	2.07	2.06	2.05	2.04
Utilisation factor for gains for living area											
0.99	0.98	0.97	0.95	0.91	0.84	0.75	0.79	0.90	0.96	0.98	0.99 (86)
Mean internal temperature in living area T1											
17.98	18.17	18.55	19.12	19.70	20.22	20.52	20.47	20.03	19.30	18.56	17.96 (87)
Temperature during heating periods in rest of dwelling Th2											
19.18	19.18	19.19	19.22	19.22	19.25	19.25	19.25	19.24	19.22	19.21	19.20 (88)
Utilisation factor for gains for rest of dwelling											
0.98	0.98	0.96	0.93	0.87	0.75	0.58	0.64	0.84	0.95	0.98	0.99 (89)
Mean internal temperature in the rest of dwelling T2											
15.31	15.59	16.15	16.97	17.79	18.52	18.88	18.83	18.28	17.24	16.17	15.30 (90)

Living area fraction (97.09 / 301.18) 0.32 (91)

Mean internal temperature (for the whole dwelling)

16.17	16.42	16.93	17.67	18.41	19.07	19.41	19.36	18.84	17.90	16.94	16.16 (92)

Apply adjustment to the mean internal temperature, where appropriate

16.17	16.42	16.93	17.67	18.41	19.07	19.41	19.36	18.84	17.90	16.94	16.16 (93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains											
0.98	0.97	0.95	0.91	0.85	0.74	0.60	0.65	0.83	0.93	0.97	0.98 (94)
Useful gains											
1366.73	1585.61	1786.42	1963.71	1991.17	1728.12	1338.49	1322.80	1507.73	1460.96	1335.88	1294.18 (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											
8015.7	7747.7	6981.0	5752.4	4383.9	2871.1	1804.97	1894.60	3065.1	4774.8	6482.8	7942.9 (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											
4946.8	4140.9	3864.8	2727.9	1780.22	-	-	-	-	2465.5	3705.8	4946.6

Total space heating requirement per year (kWh/year) (October to May) 28578.56 (98)

Space heating requirement per m² (kWh/m²/year) 94.89 (99)

8c. Space cooling requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
External temperaturers												
-	-	-	-	-	14.60	16.60	16.40	-	-	-	-	
Heat loss rate W												
-	-	-	-	-	6034.7	4750.7	4862.7	-	-	-	-	(100)
Utilisation factor for loss												
-	-	-	-	-	0.38	0.44	0.40	-	-	-	-	(101)
Useful loss W												
-	-	-	-	-	2303.1	2107.8	1967.80	-	-	-	-	(102)
Internal gains W												
0.00	0.00	0.00	0.00	0.00	841.22	808.69	821.55	0.00	0.00	0.00	0.00	
Solar gains W												
0.00	0.00	0.00	0.00	0.00	1733.87	1646.10	1409.06	0.00	0.00	0.00	0.00	
Gains W												
-	-	-	-	-	2575.1	2454.8	2230.6	-	-	-	-	(103)
Fraction of month for cooling												
0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	(103a)
Space heating kWh												
-	-	-	-	-	616.25	99.36	64.72	-	-	-	-	(98)
Space cooling kWh												
-	-	-	-	-	195.83	258.17	195.53	-	-	-	-	(104)
Total											649.54	(104)
Cooled fraction											0.80	(105)
Intermittency factor												
-	-	-	-	-	0.25	0.25	0.25	-	-	-	-	(106)
Space cooling requirement for month												
-	-	-	-	-	39.17	51.63	39.11	-	-	-	-	
Space cooling (June to August)											129.91	(107)
Space cooling requirement per m² (kWh/m²/year)											0.43	(108)

9a. Energy requirements

												kWh/year	
												0.1000	**(201)**
Fraction of space heat from main system(s)												0.9000	(202)
Efficiency of main heating system												66.00%	(206)
Efficiency of secondary heating system												100.00%	(208)
Cooling system energy efficiency ratio												4.38%	(209)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement													
4946.8	4140.9	3864.8	2727.9	1780.22	-	-	-	-	2465.5	3705.8	4946.6		(98)
Appendix Q - monthly energy saved (main heating system 1)													
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00		(210)
Space heating fuel (main heating system 1)													
6745.7	5646.7	5270.2	3719.8	2427.6	-	-	-	-	3362.1	5053.3	6745.4		(211)
Appendix Q - monthly energy saved (main heating system 2)													
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00		(212)
Space heating fuel (main heating system 2)													
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00		(213)
Appendix Q - monthly energy saved (secondary heating system)													
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00		(214)
Space heating fuel (secondary)													
494.68	414.09	386.48	272.79	178.02	-	-	-	-	246.55	370.58	494.66		(215)
Water heating													
Water heating requirement													
256.64	226.73	239.37	216.31	213.23	192.33	186.42	202.20	201.10	224.21	234.91	251.05		(64)
Efficiency of water heater												56.00	(216)
65.36	65.33	65.25	65.06	64.64	56.00	56.00	56.00	56.00	64.94	65.23	65.38		(217)
Water heating fuel													
392.63	347.05	366.85	332.48	329.85	343.44	332.89	361.07	359.11	345.28	360.10	384.00		(219)
Annual totals												kWh/year	
Space heating fuel used, main system 1												38970.76	(211)
Space heating fuel (secondary)												2857.86	(215)
Water heating fuel												4254.75	(219)
Space cooling fuel used												29.69	(221)
-	-	-	-	-	8.95	11.80	8.94	-	-	-	-		(221)
Electricity for pumps, fans and electric keep-hot central heating pump												30.00	(230c)
Total electricity for the above, kWh/year												30.00	(231)
Electricity for lighting (100.00% fixed LEL)												816.19	(232)
Energy saving/generation technologies													
Appendix Q -													
Energy saved or generated ():												0.000	(236a)
Energy used ():												0.000	(237a)
Total delivered energy for all uses												46959.26	(238)

10a. Fuel costs using Table 12 prices

	kWh/year	Fuel price p/kWh	£/year	
Space heating - main system 1	38970.764	3.480	1356.18	(240)
Space heating - main system 2	0.000	0.000	0.00	(241)
Space heating - secondary system	2857.856	13.190	376.95	(242)
Water heating cost	4254.75	3.480	148.07	(247)
Space cooling	29.693	13.190	3.92	(248)
Mech vent fans cost	0.000	13.190	0.00	(249)
Pump/fan energy cost	30.000	13.190	3.96	(249)
Energy for lighting	816.193	13.190	107.66	(250)
Additional standing charges			120.00	(251)
Electricity generated - PVs	0.000	0.000	0.00	(252)
Appendix Q -				
Energy saved or generated ():	0.000	0.000	0.00	(253)
Energy used ():	0.000	0.000	0.00	(254)
Total energy cost			2116.73	(255)

11a. SAP rating

	0.42	**(256)**
	2.57	**(257)**
SAP value	64.17	
	64	(258)
SAP band	**D**	

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating, main system 1	38970.76	0.216	8417.68	(261)
Space heating, main system 2	0.00	0.000	0.00	(262)
Space heating, secondary	2857.86	0.519	1483.23	(263)
Water heating	4254.75	0.216	919.03	(264)
Space and water heating			10819.94	(265)
Space cooling	29.69	0.519	15.41	(266)
Electricity for pumps and fans	30.00	0.519	15.57	(267)
Electricity for lighting	816.19	0.519	423.60	(268)
Electricity generated - PVs	0.00	0.519	0.00	(269)
Electricity generated - µCHP	0.00	0.000	0.00	(269)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(270)
Energy used ():	0.00	0.000	0.00	(271)
Total CO2, kg/year			11274.52	(272)

	kg/m²/year	
CO2 emissions per m²	**37.43**	(273)
EI value	56.28	(273a)
EI rating	**56**	(274)
EI band	**D**	

Calculation of stars for heating and DHW

Main heating energy efficiency	(3.48 / 0.6600) x (1 + (0.29 x 0.25)) = 5.6550, stars = 3
Main heating environmental impact	(0.2160 / 0.6600) x (1 + (0.29 x 0.25)) = 0.3510, stars = 3
Water heating energy efficiency	3.48 / 0.6210 = 5.6039, stars = 3
Water heating environmental impact	0.2160 / 0.6210 = 0.3478, stars = 3

EAL CONSULT
Assessor : Mark Simons
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Project Information
Building type Top-floor flat

Reference
Date 4 October 2022
Email: NONE Project Flat 29
Gainsborough House
Frognal Rise
LONDON
NW3 6PZ

REGULATION COMPLIANCE REPORT - Approved Document L1A, 2012 Edition, England
assessed by program JPA Designer version 6.05.069, printed on 31/10/2022 at 10:17:21

Existing dwelling

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1 TER and DER
Fuel for main heating system: Gas (mains) (fuel factor = 1.00)

Target Carbon Dioxide Emission Rate	TER = 13.89	
Dwelling Carbon Dioxide Emission Rate	DER = 26.57	Fail
Excess emissions = 12.68kg/m² (91.3%)		

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	TFEE = 55.7	
Dwelling Fabric Energy Efficiency (DFEE)	DFEE = 99.1	Fail

2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15

2b Fabric U-values

Element	Average	Highest	
Wall	1.04 (max. 0.30)	1.55 (max. 0.70)	Fail
Floor	0.00 (max. 0.25)	0.00 (max. 0.70)	OK
Roof	0.15 (max. 0.20)	0.17 (max. 0.35)	OK
Openings	2.40 (max. 2.00)	2.40 (max. 3.30)	Fail

---

3 Air permeability

Air permeability at 50 pascals:	10.00	OK
Maximum :	10.00	

4 Heating efficiency

Main heating system:

Boiler and underfloor heating, mains gas
Vaillant ecoFIT pure 630

Source of efficiency: from boiler database
Vaillant ecoFIT pure 630 VU 306/6-3 (H-GB)
Efficiency: 89.9% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system:

None -

5 Cylinder insulation

Hot water storage

Manufacturer's declared cylinder loss factor (kWh/day)		2.32	
Permitted by DBSCG		2.86	OK
Primary pipework insulated	Yes		OK

6 Controls

(Also refer to "Domestic Building Services Compliance Guide" by the DCLG)

Space heating controls	Time and temperature zone control	OK
	Cylinderstat - Yes	OK
	Independent timer for DHW - Yes	OK
Boiler Interlock	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100.0%
Minimum: 75.0% OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames Valley): OK

Not significant OK

Based on:

Thermal mass parameter :	123.74
Overshading :	Average or unknown (20-60 % sky blocked)

Orientation : NorthEast

Ventilation rate :	8.00

Blinds/curtains :

None with blinds/shutters closed 0.00% of daylight hours

10 Key features

Fixed cooling system

JPA Designer Version 6.03x , SAP Version 9.92
Licensed to Energy Assessors London Ltd
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EAL CONSULT
Assessor : Mark Simons
17 Dobree Avenue
LONDON
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0208 930 5668

Project Information
Building type Top-floor flat

Reference
Date 4 October 2022
Email: NONE Project Flat 29
Gainsborough House
Frognal Rise
LONDON
NW3 6PZ

REGULATION COMPLIANCE REPORT - Approved Document L1A, 2012 Edition, England
assessed by program JPA Designer version 6.05.069, printed on 31/10/2022 at 10:39:46

Existing dwelling

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1 TER and DER
Fuel for main heating system: Gas (mains) (fuel factor = 1.00)

Target Carbon Dioxide Emission Rate	TER = 13.89	
Dwelling Carbon Dioxide Emission Rate	DER = 26.52	Fail
Excess emissions = 12.63kg/m² (90.9%)		

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	TFEE = 55.7	
Dwelling Fabric Energy Efficiency (DFEE)	DFEE = 99.1	Fail

2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15

2b Fabric U-values

Element	Average	Highest	
Wall	1.04 (max. 0.30)	1.55 (max. 0.70)	Fail
Floor	0.00 (max. 0.25)	0.00 (max. 0.70)	OK
Roof	0.15 (max. 0.20)	0.17 (max. 0.35)	OK
Openings	2.40 (max. 2.00)	2.40 (max. 3.30)	Fail

---

3 Air permeability

Air permeability at 50 pascals:	10.00	OK
Maximum :	10.00	

4 Heating efficiency

Main heating system:

Boiler and underfloor heating, mains gas
Vaillant ecoFIT pure 630

Source of efficiency: from boiler database
Vaillant ecoFIT pure 630 VU 306/6-3 (H-GB)
Efficiency: 89.9% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system:

None -

5 Cylinder insulation

Hot water storage

Manufacturer's declared cylinder loss factor (kWh/day)		2.32	
Permitted by DBSCG		2.86	OK
Primary pipework insulated	Yes		OK

6 Controls

(Also refer to "Domestic Building Services Compliance Guide" by the DCLG)

Space heating controls	Time and temperature zone control	OK
	Cylinderstat - Yes	OK
	Independent timer for DHW - Yes	OK
Boiler Interlock	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100.0%
Minimum: 75.0% OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames Valley): OK

Not significant OK

Based on:

Thermal mass parameter :	123.74
Overshading :	Average or unknown (20-60 % sky blocked)

Orientation : NorthEast

Ventilation rate :	8.00

Blinds/curtains :

None with blinds/shutters closed 0.00% of daylight hours

10 Key features

None

EAL CONSULT
Assessor : Mark Simons
17 Dobree Avenue
LONDON
NW10 2AD
0208 930 5668

Project Information
Building type Top-floor flat

Reference
Date 4 October 2022
Email: NONE Project Flat 29
Gainsborough House
Frognal Rise
LONDON
NW3 6PZ

SAP 2012 worksheet for Existing dwelling - calculation of energy ratings

1. Overall dwelling dimensions

	Area (m^2)	Av. Storey height (m)	Volume (m^3)	
Second floor	157.93	2.84	448.52	(3a)
Third floor	111.23	3.45	383.74	(3b)
Fourth and other floors	32.02	2.20	70.44	(3c)
	301.18			**(4)**
			902.71	**(5)**

2. Ventilation rate

	main + seondary + 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	5	x 10	50.00	(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	
			0.06	**(8)**
(ns)	3			(9)
			0.20	**(10)**
			0.35	**(11)**
			0.00	**(13)**
		100.00		**(14)**
			0.05	**(15)**
Infiltration rate			0.66	(16)
Air permeability			0.66	(18)
			2.00	**(19)**
			0.85	**(20)**
Infiltration rate incorporating shelter factor			0.56	(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)

0.71	0.70	0.68	0.61	0.60	0.53	0.53	0.52	0.56	0.60	0.63	0.65	
											7.31	(22b)

Ventilation : natural ventilation, intermittent extract fans

Effective air change rate

0.75	0.74	0.73	0.69	0.68	0.64	0.64	0.63	0.66	0.68	0.70	0.71	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	kappa-value kJ/m²K	A x K kJ/K	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR			**1.369**	**2.19 (2.40)**	3.00			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR			**12.080**	**2.19 (2.40)**	26.45			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) FRONT			**3.020**	**2.19 (2.40)**	6.61			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) SIDE			**12.080**	**2.19 (2.40)**	26.45			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) SIDE			**1.230**	**2.19 (2.40)**	2.69			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast) SIDE			**1.230**	**2.19 (2.40)**	2.69			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) FRONT			**1.230**	**2.19 (2.40)**	2.69			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR			**1.230**	**2.19 (2.40)**	2.69			(27)
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR			**4.040**	**2.40**	9.70			(26)
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) SIDE			**4.040**	**2.40**	9.70			(26)
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) FRONT			**4.040**	**2.40**	9.70			(26)
Walls EXTERNAL			93.44	1.55	144.83	18.00	1681.94	(29)
Walls ROOF VOID WALL			64.42	0.65 (Ru=0.90)	41.69	18.00	1159.56	(29)

4. Water heating energy requirements **kWh/year**

Assumed occupancy, N 3.13 (42)

Annual average hot water usage in litres per day Vd,average 108.62 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month												
119.48	115.14	110.79	106.45	102.10	97.76	97.76	102.10	106.45	110.79	115.14	119.48	(44)
Energy content of hot water used												
177.19	154.97	159.91	139.42	133.77	115.44	106.97	122.75	124.22	144.76	158.02	171.60	

Energy content (annual) 1709.01 (45)

Distribution loss												
26.58	23.25	23.99	20.91	20.07	17.32	16.05	18.41	18.63	21.71	23.70	25.74	(46)

Cylinder volume, l 300.00 (47)

Manufacturer's declared cylinder loss factor (kWh/day) 2.32 (48)

Temperature Factor 0.5400 (49)

Energy lost from hot water cylinder (kWh/day) 1.25 (55)

Total storage loss												
38.84	35.08	38.84	37.58	38.84	37.58	38.84	38.84	37.58	38.84	37.58	38.84	(56)
Net storage loss												
38.84	35.08	38.84	37.58	38.84	37.58	38.84	38.84	37.58	38.84	37.58	38.84	(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												
239.29	211.06	222.01	199.51	195.87	175.53	169.07	184.85	184.31	206.86	218.11	233.70	(62)
Output from water heater for each month, kWh/month												
239.29	211.06	222.01	199.51	195.87	175.53	169.07	184.85	184.31	206.86	218.11	233.70	(64)

2440.18 (64)

Heat gains from water heating, kWh/month												
108.59	96.40	102.85	94.43	94.16	86.46	85.25	90.49	89.38	97.81	100.62	106.74	(65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	(66)
Lighting gains												
115.54	102.62	83.46	63.18	47.23	39.87	43.08	56.00	75.17	95.44	111.40	118.75	(67)
Appliances gains												
685.40	692.51	674.59	636.44	588.27	543.00	512.76	505.65	523.57	561.73	609.89	655.16	(68)
Cooking gains												
56.93	56.93	56.93	56.93	56.93	56.93	56.93	56.93	56.93	56.93	56.93	56.93	(69)
Pumps and fans gains												
3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (negative values)												
-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	(71)
Water heating gains												
145.96	143.45	138.24	131.16	126.56	120.08	114.58	121.63	124.14	131.47	139.75	143.46	(72)
Total internal gains												
1069.51	1061.19	1018.89	953.38	884.66	825.56	793.03	805.89	845.48	911.24	983.64	1039.98	(73)

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR	0.9 x 1.369 36.79	0.63 x 0.70	0.77	15.3940
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR	0.9 x 12.080 36.79	0.63 x 0.70	0.77	135.8357
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) FRONT	0.9 x 3.020 11.28	0.63 x 0.70	0.77	10.4136
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) SIDE	0.9 x 12.080 11.28	0.63 x 0.70	0.77	41.6544
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) SIDE	0.9 x 1.230 11.28	0.63 x 0.70	0.77	4.2413
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast) SIDE	0.9 x 1.230 36.79	0.63 x 0.70	0.77	13.8309
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) FRONT	0.9 x 1.230 11.28	0.63 x 0.70	0.77	4.2413
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR	0.9 x 1.230 36.79	0.63 x 0.70	0.77	13.8309
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) REAR	0.9 x 4.040 36.79	0.63 x 0.70	0.77	45.4285

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains	
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest)	0.9 x 4.040	11.28	0.63 x 0.70	0.77	13.9308	
SIDE						
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast)	0.9 x 4.040	11.28	0.63 x 0.70	0.77	13.9308	
FRONT						
Total solar gains, January					312.73	(83-1)

Solar gains

312.73	562.07	847.05	1180.28	1441.35	1483.42	1408.33	1205.53	961.18	642.23	379.93	264.17	(83)

Total gains

1382.24	1623.26	1865.94	2133.7	2326.0	2309.0	2201.4	2011.4	1806.66	1553.48	1363.57	1304.15	(84)

Lighting calculations

	Area	g	FF x Shading	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest)	0.9 x 1.37	0.80	0.70 x 0.83	0.57
REAR				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest)	0.9 x 12.08	0.80	0.70 x 0.83	5.05
REAR				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast)	0.9 x 3.02	0.80	0.70 x 0.83	1.26
FRONT				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest)	0.9 x 12.08	0.80	0.70 x 0.83	5.05
SIDE				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest)	0.9 x 1.23	0.80	0.70 x 0.83	0.51
SIDE				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast)	0.9 x 1.23	0.80	0.70 x 0.83	0.51
SIDE				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast)	0.9 x 1.23	0.80	0.70 x 0.83	0.51
FRONT				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest)	0.9 x 1.23	0.80	0.70 x 0.83	0.51
REAR				

GL = 14.00 / 301.18 = 0.046
C1 = 0.500
C2 = 1.084
El = 816

7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C) 21.00 (85)

Heating system responsiveness 0.75

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau											
15.72	15.79	15.86	16.19	16.26	16.56	16.56	16.62	16.44	16.26	16.13	16.00
alpha											
2.05	2.05	2.06	2.08	2.08	2.10	2.10	2.11	2.10	2.08	2.08	2.07
Utilisation factor for gains for living area											
0.99	0.98	0.97	0.95	0.91	0.84	0.75	0.79	0.90	0.96	0.98	0.99 (86)
Mean internal temperature in living area T1											
18.02	18.21	18.59	19.16	19.72	20.25	20.54	20.48	20.05	19.33	18.60	18.01 (87)
Temperature during heating periods in rest of dwelling Th2											
19.21	19.22	19.22	19.25	19.26	19.28	19.28	19.29	19.27	19.26	19.25	19.24 (88)
Utilisation factor for gains for rest of dwelling											
0.98	0.98	0.96	0.93	0.87	0.75	0.58	0.64	0.85	0.95	0.98	0.99 (89)
Mean internal temperature in the rest of dwelling T2											
15.38	15.66	16.22	17.04	17.85	18.57	18.92	18.88	18.33	17.30	16.24	15.38 (90)

Living area fraction (97.09 / 301.18) 0.32 (91)

Mean internal temperature (for the whole dwelling)

16.23	16.48	16.99	17.72	18.46	19.11	19.44	19.39	18.88	17.95	17.00	16.23 (92)

Apply adjustment to the mean internal temperature, where appropriate

16.23	16.48	16.99	17.72	18.46	19.11	19.44	19.39	18.88	17.95	17.00	16.23 (93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains											
0.98	0.97	0.95	0.91	0.85	0.74	0.60	0.65	0.83	0.93	0.97	0.98 (94)
Useful gains											
1349.65	1569.02	1770.52	1948.71	1976.96	1714.93	1327.89	1312.16	1494.73	1445.73	1319.24	1276.96 (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											
7856.8	7594.5	6844.3	5640.4	4301.7	2820.4	1777.95	1865.35	3010.1	4682.5	6353.4	7782.7 (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											
4841.3	4049.1	3774.9	2658.0	1729.62	-	-	-	-	2408.1	3624.6	4840.2

Total space heating requirement per year (kWh/year) (October to May) 27925.94 (98)

Space heating requirement per m² (kWh/m²/year) 92.72 (99)

8c. Space cooling requirement - not applicable

9a. Energy requirements

kWh/year

No secondary heating system selected

Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main heating system	90.90%	(206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement												
4841.3	4049.1	3774.9	2658.0	1729.62	-	-	-	-	2408.1	3624.6	4840.2	(98)
Appendix Q - monthly energy saved (main heating system 1)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(210)
Space heating fuel (main heating system 1)												
5326.0	4454.5	4152.8	2924.1	1902.77	-	-	-	-	2649.2	3987.4	5324.8	(211)
Appendix Q - monthly energy saved (main heating system 2)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(212)
Space heating fuel (main heating system 2)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(213)
Appendix Q - monthly energy saved (secondary heating system)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(214)
Space heating fuel (secondary)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(215)
Water heating												
Water heating requirement												
239.29	211.06	222.01	199.51	195.87	175.53	169.07	184.85	184.31	206.86	218.11	233.70	(64)
Efficiency of water heater												80.20 (216)
90.33	90.30	90.23	90.06	89.68	80.20	80.20	80.20	80.20	89.95	90.22	90.34	(217)
Water heating fuel												
264.90	233.72	246.05	221.53	218.41	218.87	210.81	230.48	229.81	229.97	241.77	258.67	(219)

Annual totals	kWh/year	
Space heating fuel used, main system 1	30721.60	(211)
Space heating fuel (secondary)	0.00	(215)
Water heating fuel	2804.99	(219)
Electricity for pumps, fans and electric keep-hot		
central heating pump	30.00	(230c)
boiler with a fan-assisted flue	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (100.00% fixed LEL)	816.19	(232)
Energy saving/generation technologies		
Appendix Q -		
Energy saved or generated ():	0.000	(236a)
Energy used ():	0.000	(237a)
Total delivered energy for all uses	34417.79	(238)

SAP 2012 worksheet for Existing dwelling - calculation of energy ratings

10a. Fuel costs using Table 12 prices

	kWh/year	Fuel price p/kWh	£/year	
Space heating - main system 1	30721.603	3.480	1069.11	(240)
Space heating - main system 2	0.000	0.000	0.00	(241)
Water heating cost	2804.99	3.480	97.61	(247)
Mech vent fans cost	0.000	13.190	0.00	(249)
Pump/fan energy cost	75.000	13.190	9.89	(249)
Energy for lighting	816.193	13.190	107.66	(250)
Additional standing charges			120.00	(251)
Electricity generated - PVs	0.000	0.000	0.00	(252)
Appendix Q -				
Energy saved or generated ():	0.000	0.000	0.00	(253)
Energy used ():	0.000	0.000	0.00	(254)
Total energy cost			1404.27	(255)

11a. SAP rating

	0.42	**(256)**
	1.70	**(257)**
SAP value	76.23	
	76	(258)
SAP band	**C**	

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating, main system 1	30721.60	0.216	6635.87	(261)
Space heating, main system 2	0.00	0.000	0.00	(262)
Space heating, secondary	0.00	0.519	0.00	(263)
Water heating	2804.99	0.216	605.88	(264)
Space and water heating			7241.74	(265)
Electricity for pumps and fans	75.00	0.519	38.93	(267)
Electricity for lighting	816.19	0.519	423.60	(268)
Electricity generated - PVs	0.00	0.519	0.00	(269)
Electricity generated - µCHP	0.00	0.000	0.00	(269)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(270)
Energy used ():	0.00	0.000	0.00	(271)
Total CO2, kg/year			7704.27	(272)

	kg/m²/year	
CO2 emissions per m²	**25.58**	(273)
EI value	70.18	(273a)
EI rating	**70**	(274)
EI band	**C**	

Calculation of stars for heating and DHW

Main heating energy efficiency	(3.48 / 0.9090) x (1 + (0.29 x 0.25)) = 4.1059, stars = 4
Main heating environmental impact	(0.2160 / 0.9090) x (1 + (0.29 x 0.25)) = 0.2549, stars = 4
Water heating energy efficiency	3.48 / 0.8683 = 4.0080, stars = 4
Water heating environmental impact	0.2160 / 0.8683 = 0.2488, stars = 4