ENERGY & SUSTAINABILITY STATEMENT

307 Finchley Road

Produced by XCO2 for NTA Planning

September 2021

XCO2
56 Kingsway Place, Sans Walk
London EC1R 0LU

+44 (0)20 7700 1000
mail@xco2.com
xco2.com

CONTENTS

	01					
Remarks	Draft					
Prepared by	LT					
Checked by	KM					
Authorised by	RM					
Date	08/09/2021					
Project reference	9.738					

EXECUTIVE SUMMARY

The sustainability and energy strategy for the 307 Finchley Road development has been developed in line with the relevant policies of the London Plan and of the London Borough of Camden Local Plan.

The proposals incorporate a range of sustainable design and construction measures, primarily addressing the sustainable management of resources, the protection and enhancement of the environment and the effective adaptation and mitigation of the development to climate change.

This report presents the sustainability strategy and assesses the predicted energy performance and carbon dioxide emissions of the proposed development at 307 Finchley Road, located in the London Borough of Camden.

The proposed development comprises the refurbishment of 3 residential units and a single storey extension to develop 4 new residential units.

This document is divided into three parts:

1. Planning policies;
2. Proposed sustainability measures; and,
3. Energy Strategy.

The Planning Policy section provides an overview of the site and planning policies applicable to this development in accordance with the London Borough of Camden Local Plan the London Plan.

The second section on proposed sustainability measures outlines the sustainability measures that have been adopted in the team's aim to maximise sustainability within the site.

The third section describes the predicted energy performance and carbon dioxide emissions of the proposed development at 307 Finchley Road. The development will be compared to a notional building constructed to Part L1A and L1B standards.

Key sustainability features of the proposals include:

- The re-use of previously developed land and retaining the lower floors with dwellings.
- Effective site layout in response to the neighbouring context.
- Efficient design of the proposed massing, openings and internal layouts so that habitable spaces across the site benefit from abundant daylight and sunlight levels, whilst impacts to neighbouring buildings are kept to a minimum.
- The specification of water efficient fittings to limit water consumption to less than 105 litres per person per day for domestic uses.
- Improvement of biodiversity on site through the introduction of green roofs.

The energy strategy for the scheme focuses on the efficiency of the fabric and building services, so that the energy demand is reduced to the extent feasible. Energy efficiency is primarily achieved through a highly insulated building envelope, a good air permeability rate and a thermal bridging y-value in line with the Accredited Construction Details for the new-build dwellings and fabric improvements for the refurbished dwellings. Highly efficient lighting as well as appropriate system controls further reduce the regulated energy demand and consumption of the development. The proposals also incorporate photovoltaic panels as a renewable technology.

In total, the development is expected to achieve regulated CO_2 savings of 28.6% with SAP10 emissions factors compared to a notional development that meets the minimum Part L 2013 Regulations standards of performance for the new-build dwellings and GLA's minimum fabric standards for existing dwellings to be refurbished.

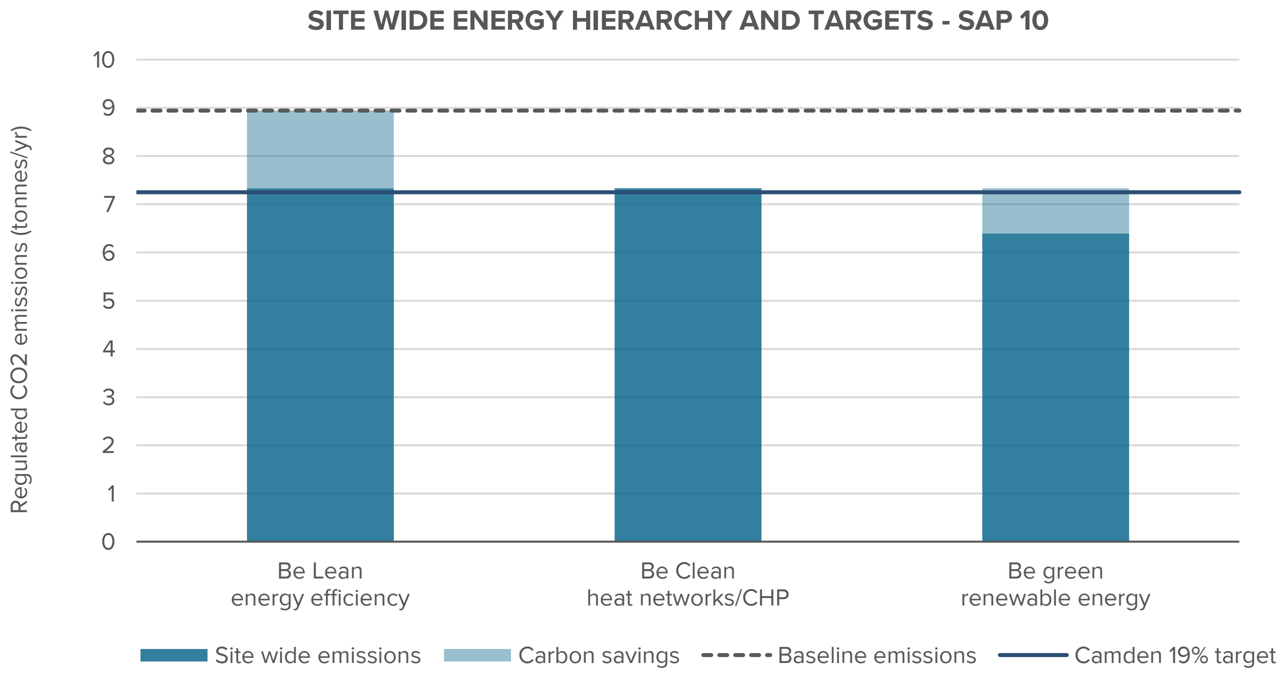


Figure 1: Energy hierarchy and targets (SAP10 carbon factors).

INTRODUCTION

The proposed residential development is located at the junction of Finchley Road and Lithos Road, within the London Borough of Camden. This section presents the description of the site and of the development proposal.

SITE & PROPOSAL

The proposal is for the refurbishment of three existing dwellings and the development of four new residential units through a single storey extension.

The existing building provides both residential and office use floor space totalling approximately 2,260m^2.

The location of the development site is shown in Figure 2 below.

Figure 2: Location of the application site.

PLANNING POLICIES

The proposal will seek to respond to the energy and sustainability policies of the London Plan (where applicable) and of the policies within the London Borough of Camden Local Plan.

The most relevant applicable energy policies in the context of the proposed development are presented below.

THE LONDON PLAN (2021)

The London Plan (2021) published 2nd March 2021 sets out the mayor's overarching strategic spatial development strategy for greater London and underpins the planning framework from 2019 up to 2041. This document replaced the London Plan 2016.

The new Plan has a strong sustainability focus with many new policies addressing the concern to deliver a sustainable and zero carbon London.

Policy GG6 Increasing Efficiency and Resilience is an overarching policy references London's target to become zero carbon by 2050 and the need to design buildings and infrastructure for a changing climate, addressing water, flood and urban heat island.

Sustainability is a trend through the whole Plan but is particularly addressed in chapter 9 Sustainable Infrastructure. The following sections outline the key principles of sustainable design and construction to be incorporated in major proposals.

Policy SI1 Improving air quality requires development proposals to be at least air quality neutral and submit an Air Quality Assessment.

"…
Development plans, through relevant strategic, site specific and area-based policies should seek opportunities to identify and deliver further improvements to air quality and should not reduce air quality benefits that result from the Mayor's or boroughs' activities to improve air quality.
…"

Any mitigation required to meet the Air Quality Neutral target should be done on site preferably.

Policy SI2 Minimising greenhouse gas emissions sets the requirements for all major developments to follow the energy hierarchy and achieve net-zero-carbon for both residential and non-residential schemes (via on-site carbon reductions and offset payments) and introduces new targets at Lean stage:

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

"…
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.
…"

This policy also sets the requirements to consider whole-life carbon emissions, including embodies carbon and unregulated emissions:

"…
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.

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.
…"

The policy supporting text provides additional clarifications on the requirements for major developments:

- Developments including major refurbishments should also aim to meet the net-zero carbon target.
- All developments should maximise opportunities for on-site electricity and heat production from solar technologies (photovoltaic and thermal), use innovative building materials and smart technologies.
- Recommendation to use SAP10 carbon factors as per GLA Energy Guidance.
- Recommended carbon offset price of £95 per tonne CO_2.
- Requirement for major developments to monitor and report operational energy performance to the GLA.

Policy SI 3 Energy Infrastructure requires all major developments within Heat Network Priority Areas will need to utilise a communal low-temperature heating system. Where developments are utilising CHP this policy also requires them to demonstrate that 'the emissions relating to energy generation will be equivalent or lower than those of an ultra-low NOx gas boiler'. Any combustion on site should meet the requirements of part B of Policy SI1.

Policy SI 4 Managing heat risk requires:

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.

Policy SI5 Water infrastructure sets the requirements to manage water resources efficiently:

"…
Development proposals should:
1) through the use of Planning Conditions minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption)
2) achieve at least the BREEAM excellent standard for the 'Wat 01' water category or equivalent (commercial development)
3) incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future-proofing.
…"

Policy SI 7 Reducing waste and supporting the circular economy introduces the notion of circular economy whereby materials are retained in use at their highest value for as long as possible. For referable applications a Circular Economy Statement demonstrating how developments promote circular economy and aim to be net zero-waste must be submitted.

Policy SI12 Flood risk management and **Policy SI 13 Sustainable drainage** sets the requirements for development proposals to ensure that flood risk is minimised, and that sustainable drainage is incorporated. This should be pursued by integrating different strategies including natural flood management. Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. For this green features should be employed, following the drainage hierarchy.

Policy D14 Noise requires that noise impacts are minimised and mitigated to avoid any adverse impacts on health and quality of life and to reflect the principles set in **Policy D13 Agent of Change** that "*places the responsibility for mitigating impacts from existing noise and other nuisance-generating activities or uses on the proposed new noise-sensitive development.*"

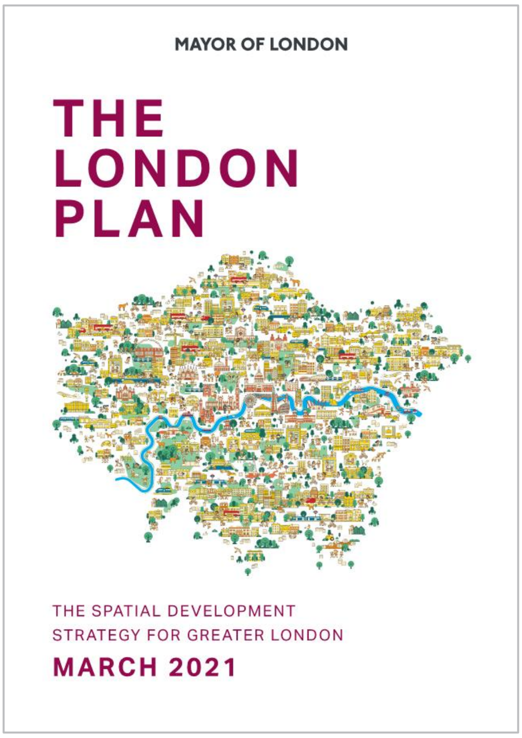
Policy G5 Urban greening requires major developments to contribute to greening of London assessed by an Urban Greening Factor (UGF).

Boroughs should develop their UGF but *"the Mayor recommends a target score of 0.4 for developments that are predominately residential, and a target score of 0.3 for predominately commercial development (excluding B2 and B8 uses)."*

Separate guidance on UGF is under consultation in Spring/Summer 2021.

Policy G6 Biodiversity and access to nature states:

"...
Development proposals should manage impacts on biodiversity and aim to secure net biodiversity gain. This should be informed by the best available ecological information and addressed from the start of the development process.
..."



GLA GUIDANCE ON PREPARING ENERGY ASSESSMENTS

This document (last updated in April 2020) provides guidance on preparing energy assessments to accompany strategic planning applications; it contains clarifications on Policy SI 2, of the new London Plan, carbon reduction targets in the context of zero carbon policy, as well as detailed guidelines on the content of the Energy Assessments undertaken for planning.

The guidance document specifies the emission reduction targets the GLA will apply to applications as follows:

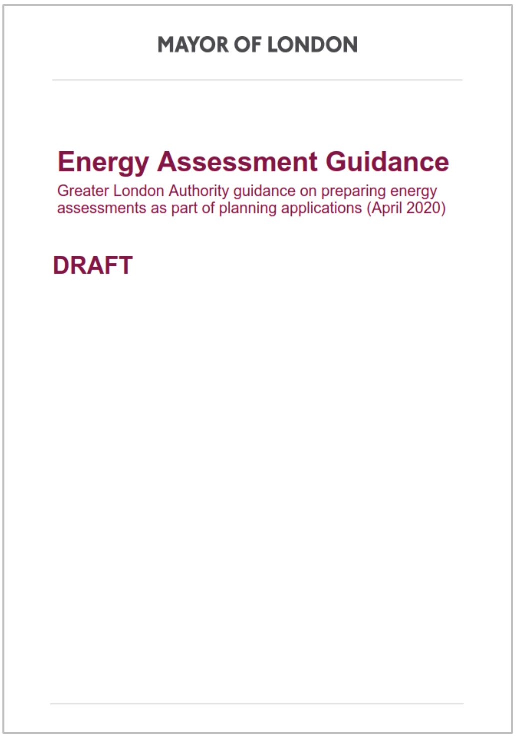
The regulated carbon dioxide emissions reduction target for major domestic and non-domestic development is net zero carbon, with at least a 35% on-site reduction beyond Part L 2013 of the Building Regulations.

The definition of zero carbon homes is provided on Page 54 of the guidance:

> *Zero carbon homes - homes forming part of major development applications (i.e. those with 10 or more units) where the residential element of the application achieves at least a 35 per cent reduction in regulated carbon dioxide emissions (beyond Part L 2013) on-site. The remaining regulated carbon dioxide emissions, to 100 per cent, are to be offset through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.*

The new guidance also includes changes to technical requirements relating to the use of updated carbon factors, cost estimates, overheating risk analysis, the structure of the heating hierarchy and scrutiny over the performance of heat pumps.

The structure of this report and the presentation of the carbon emission information for the development follows the guidance in this document.


MAYOR OF LONDON

Energy Assessment Guidance

Greater London Authority guidance on preparing energy assessments as part of planning applications (April 2020)

DRAFT

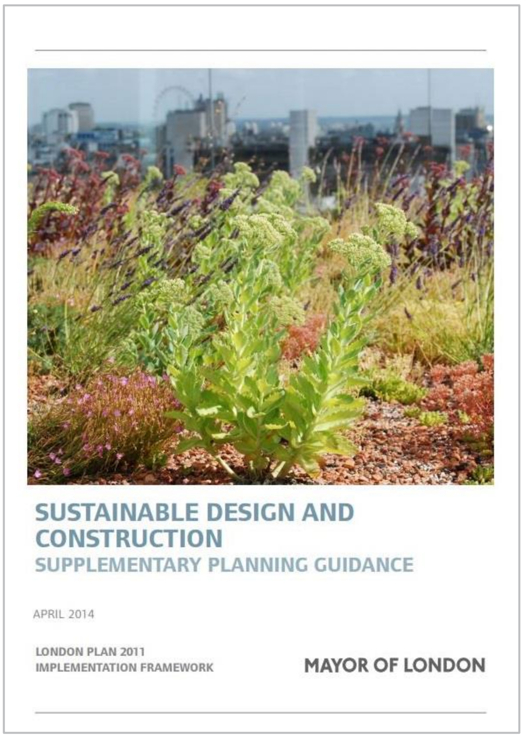
SUSTAINABLE DESIGN AND CONSTRUCTION SPG

The Sustainable Design and Construction SPG, adopted in April 2014, provides additional information and guidance to support the implementation of the Mayor's London Plan. The SPG does not set new policy but explains how policies in the London Plan should be carried through into action.

It is applicable to all major developments and building uses so it is not technically applicable to this development, however in line with the developer's intention to implement the requirements of the London Plan it has been used to guide the design. It covers the following areas:

- Resource Management;
- Adapting to Climate Change and Greening the City; and,
- Pollution Management.

This SPG provides a basis for sustainable design in London and is used as the overarching structure of this report. Where additional local policies are addressed by these areas this has also been indicated.



HOUSING SPG

This document provides guidance on the implementation of housing policies in the London Plan and it replaces the 2012 Housing SPG.

Part 2 covers housing quality and updates London housing standards to reflect the implementation of the government's new national technical standards through the Minor Alterations to the London Plan (2015-2016).

As design affects the quality of life, health & wellbeing, safety and security of users and neighbours, this guidance is integral to sustainable development and will be cross-referenced as relevant in the subsequent sections.

LONDON BOROUGH OF CAMDEN LOCAL PLAN (2017)

The Camden Local Plan (2017) sets out the Council's planning policies and replaces the Core Strategy and Development Policies planning. The Local Plan is a key document in Camden's development plan, which is the name given to the group of documents that set out the Council's planning policies.

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:

- promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;
- support and encourage sensitive energy efficiency improvements to existing buildings;
- require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and
- expect all developments to optimise resource efficiency.

The energy hierarchy is a sequence of steps that minimise the energy consumption of a building. Buildings designed in line with the energy hierarchy prioritise lower cost passive design measures, such as improved fabric performance over higher cost active systems such as renewable energy technologies. The following diagram shows a simplified schematic of the energy hierarchy, which is explained further in supplementary planning document Camden Planning Guidance on sustainability

All developments involving five or more dwellings and/or more than 500 sqm of (gross internal) any floorspace will be required to submit an energy statement demonstrating how the energy hierarchy has been applied to make the fullest contribution to CO2 reduction. All new residential development will also be required to demonstrate a 19% CO2 reduction below Part L 2013 Building Regulations (in addition to any requirements for renewable energy). This can be demonstrated through an energy statement or sustainability statement.

Be lean

Proposals should demonstrate how passive design measures including the development orientation, form, mass, and window sizes and positions have been taken into consideration to reduce energy demand, demonstrating that the minimum energy efficiency requirements required under building regulations will be met and where possible exceeded. This is in line with stage one of the energy hierarchy 'Be lean'.

Be clean

The second stage of the energy hierarchy 'Be clean' should demonstrate how the development will supply energy efficiently through decentralised energy. Please refer to the section below on decentralised energy generation.

Be green

The Council will expect developments of five or more dwellings and/or more than 500 sqm of any gross internal floorspace to achieve a 20% reduction in carbon dioxide emissions from on-site renewable energy generation (which can include sources of site related decentralised renewable energy), unless it can be demonstrated that such provision is not feasible. This is in line with stage three of the energy hierarchy 'Be green'. The 20% reduction should be calculated from the regulated CO2 emissions of the development after all proposed energy efficiency measures and any CO2 reduction from non-renewable decentralised energy (e.g. CHP) have been incorporated.

All major developments will also be expected to demonstrate how relevant London Plan targets for CO2 reduction, including targets for renewable energy, have been met.

In cases where standards change or are superseded, the Council will use the equivalent replacement standards.

POLICY CC2 ADAPTING TO CLIMATE CHANGE

The Council will require development to be resilient to climate change. All development should adopt appropriate climate change adaptation measures such as:

- the protection of existing green spaces and promoting new appropriate green infrastructure;

- not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems;
- incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and
- measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

POLICY CC3 WATER AND FLOODING

The Council will seek to ensure that development does not increase flood risk and reduces the risk of flooding where possible. We will require development to:

- incorporate water efficiency measures;
- incorporate flood resilient measures in areas prone to flooding;
- utilise Sustainable Drainage Systems (SuDS) in line with the drainage hierarchy to achieve a greenfield run-off rate where feasible; and
- not locate vulnerable development in flood-prone areas.

POLICY CC4 AIR QUALITY

The Council will ensure that the impact of development on air quality is mitigated and ensure that exposure to poor air quality is reduced in the borough.

The Council will take into account the impact of air quality when assessing development proposals, through the consideration of both the exposure of occupants to air pollution and the effect of the development on air quality. Consideration must be taken to the actions identified in the Council's Air Quality Action Plan.

Air Quality Assessments (AQAs) are required where development is likely to expose residents to high levels of air pollution. Where the AQA shows that a development would cause harm to air quality, the Council will not grant planning permission unless measures are adopted to mitigate the impact.

POLICY A3 BIODIVERSITY

The Council will protect and enhance sites of nature conservation and biodiversity. We will:

- designate and protect nature conservation sites and safeguard protected and priority habitats and species;
- grant permission for development unless it would directly or indirectly result in the loss or harm to a designated nature conservation site or adversely affect the status or population of priority habitats and species;
- assess developments against their ability to realise benefits for biodiversity through the layout, design and materials used in the built structure and landscaping elements of a proposed development, proportionate to the scale of development proposed;
- seek to improve opportunities to experience nature, in particular where such opportunities are lacking.

The Council will protect, and seek to secure additional, trees and vegetation. We will:

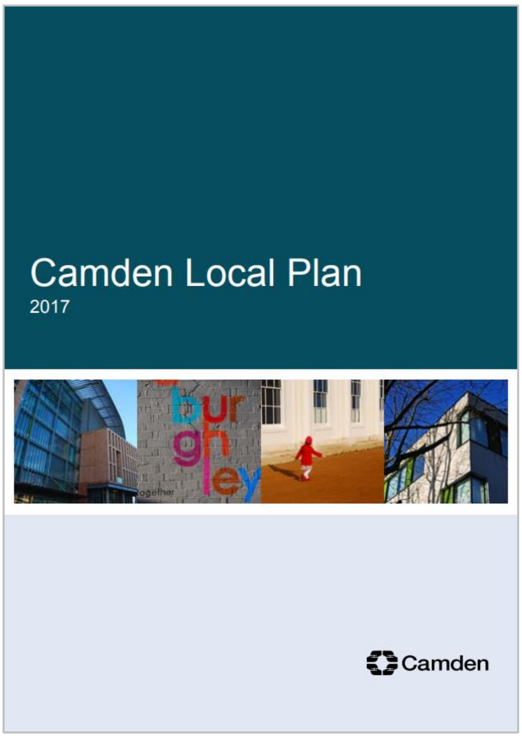
- resist the loss of trees and vegetation of significant amenity, historic, cultural or ecological value including proposals which may threaten the continued wellbeing of such trees and vegetation;
- require trees and vegetation which are to be retained to be satisfactorily protected during the demolition and construction phase of development in line with BS5837:2012 'Trees in relation to Design, Demolition and Construction' and positively integrated as part of the site layout;
- expect replacement trees or vegetation to be provided where the loss of significant trees or vegetation or harm to the wellbeing of these trees and vegetation has been justified in the context of the proposed development;
- expect developments to incorporate additional trees and vegetation wherever possible.

POLICY A4 NOISE AND VIBRATION

The Council will seek to ensure that noise and vibration is controlled and managed.

Development should have regard to Camden's Noise and Vibration Thresholds (Appendix 3). We will not grant planning permission for:

- development likely to generate unacceptable noise and vibration impacts; or
- development sensitive to noise in locations which experience high levels of noise, unless appropriate attenuation measures can be provided and will not harm the continued operation of existing uses.



XCO2

PROPOSED SUSTAINABILITY MEASURES

This part of the report presents the key elements of the proposal that underpin environmental sustainability, demonstrates how the development complies with sustainable development policies and incorporates guidance on sustainable design and construction.

LAND AND SITE LAYOUT

Land use

The land for this proposal is efficiently used as the scheme will be constructed on previously developed land while retaining the building that currently exists on the site.

Reuse of Existing Buildings

The site currently comprises a four-storey building that offers both residential and office use floorspace. This building will be retained, and the proposal offers an extension through the addition of one storey.

Landform and Site Layout

Consideration has been given to the layout and scale of the surrounding buildings. The height of the surrounding context generally low rise with most buildings having four storeys.

The scale of the development follows a principle of densification but, at the same time, it takes into account the neighbouring buildings with regard to height and overall volume.

The proposal will refurbish three residential units and provide four new residential units. The existing storeys on site will continue to offer both residential and office space.

Daylight & Sunlight Impacts

Consideration has been given to neighbouring amenity and open spaces; due to appropriate design of the building and overall site layout these will experience minimal overshadowing effects.

Micro-climate

A microclimate is the distinctive climate of a small-scale area and the variables within it, such as temperature, rainfall, wind or humidity may be subtly different to the conditions prevailing over the area as a while. The main characteristics of microclimates within London are temperatures and wind.

The proposed scheme is not of a scale that could potentially have any significant impact on wind conditions around the site or any adverse effects on pedestrian and residents' comfort.

Urban Greening

The proposed scheme will contribute to the increase of green spaces within London or relevant location by providing green roofs.

Impacts on Neighbours from Demolition and Construction

Construction impacts such as dust generation and increased traffic movements will be minimised through adoption of best practice construction measures, formalised through the production of a Construction and Environmental Management Plan to be delivered by the main contractor where appropriate.

Land Contamination

In the event of any discovery of potentially contaminated soils or materials, this discovery will be quarantined and reported to the most senior member of site staff or the designated responsible person at the site for action. The location, type and quantity will be recorded and the Local Authority, a competent and appropriate third-party environmental consultant will be notified immediately. An approval from the Local Authority will be sought prior to implementing any proposed mitigation action.

HEALTH AND WELLBEING

Open Spaces/Amenity

Private amenity spaces will be provided though terraces to allow residents occupants to connect to the natural environment. This will also enhance the occupant's wellbeing as nature can significantly improve mood and happiness.

Daylight/Sunlight

By providing incorporating large areas of glazing and providing terraces to the dwellings, the proposed development ensures that occupants enjoy satisfactory levels of visual comfort and beneficial effects from daylight exposure, whilst also reducing energy consumption by minimising the use of artificial lighting as far as feasible.

Physical activity

The presence of amenity providers (shops, pharmacies, food outlets) within walking distance to the development will encourage residents to walk rather than use personal vehicles. The provision of cycle storage spaces currently available on the ground floor on site will also encourage the use of alternative means of transportation for longer distances trips.

ENERGY & CARBON DIOXIDE EMISSIONS

The Energy Strategy for the development has been designed in line with the London Plan's Policy SI2 or other local policy, which states that every effort should be made to minimise carbon dioxide emissions in accordance with the following energy hierarchy:

- Be lean: use less energy
- Be clean: supply energy efficiently
- Be green: use renewable energy
- Be seen: monitoring

Be Lean

The buildings have been thoughtfully designed to reduce energy demand through an enhanced building fabric, minimising heat loss through air infiltration, reducing reliance on artificial lighting, utilising low energy lighting and ensuring adequate levels of ventilation are maintained whilst reducing heat loss through the specification of MVHR (for the new-build dwellings only).

Be Clean

As discussed in detail in the Be Clean section of this report, the size and location of this development does not lend itself to incorporation into an existing heat network.

Be Green

A range of renewable technologies were considered for generating on-site renewable energy. Photovoltaic panels were considered a suitable technology for this development due to adequate roof space, easy installation process, and substantial CO_2 savings. The incorporation of this technology into this development would contribute a reduction of 10.5% (over the site-wide baseline) resulting in a total offset of 28.6% of regulated CO_2 emissions over the baseline emissions.

Further details about the strategy, alternative renewable technology options and site-wide CO_2 emission reductions can be found in the Energy Strategy section of this report.

Be Seen

The proposed development will allow for separate metering and submetering in order to be able to report on energy consumption of the development in-use.

WATER

Water Efficiency

The development at 307 Finchley Road aims to reduce water consumption to less than 105 litres per person per day, in line with the recommended target set out in the Housing SPG, through the use of water efficient fittings, and these are listed below.

Table 1: Recommended specification for sanitary fittings

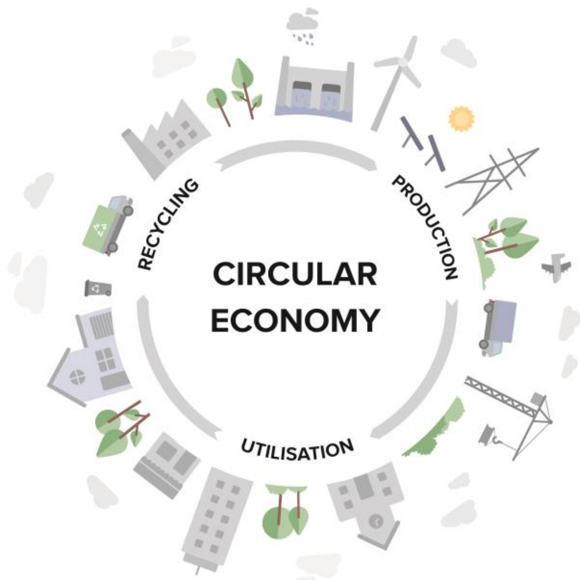
Fitting	Fitting specification
WC	6/3 litres dual flush
Kitchen sink tap	6 litres per min
Wash basin tap	4 litres per min
Shower	8 litres per min
Bath	180 litres
Washing machine	8.17 litres/kg
Dishwasher	1.25 litres/place setting

MATERIALS AND WASTE

Responsible Sourcing

100% of the timber used during construction will be sourced from accredited Forest Stewardship Council (FSC) or Programme for the Endorsement of forestry Certification (PEFC) source.

The main contractor will be required to prioritise products holding responsible sourcing certification (EMS/ISO14001) for the key process as per minimum, to ensure economic, social and environmentally responsible practices are implemented throughout construction products supply chain.



Healthy Materials

To minimise potential sources of indoor air pollution, low VOC paints, finishes and other products will be prioritised as far as practically possible. Best practice design detailing and careful construction techniques will also be employed to reduce the risk of thermal bridging and condensation issues, limiting the potential for mould growth.

Embodied Carbon

To further reduce carbon emissions over the lifecycle of the building, low embodied carbon materials will be used as far as practically possible, whilst also focusing on design practices to reduce waste production.

Circular Economy

Circular economy is based on three key principles: design out waste, keep products and materials in use, and regenerate natural systems. These principles will be applied during the design and construction of the proposed development by following the actions noted below:

- Design out the need for building components and materials;
- Use of reclaimed materials and remanufactured components over new;
- Product selection considering its entire lifecycle, such as products which can be remanufactured or reused; products with high recycled content; products designed for disassembly; and recyclable or compostable materials.

NATURE CONSERVATION & BIODIVERSITY

The proposed development aims to improve the green cover of the site by introducing private amenity spaces and green roofs in the building.

The image below shows the roof plan and the green roof areas.

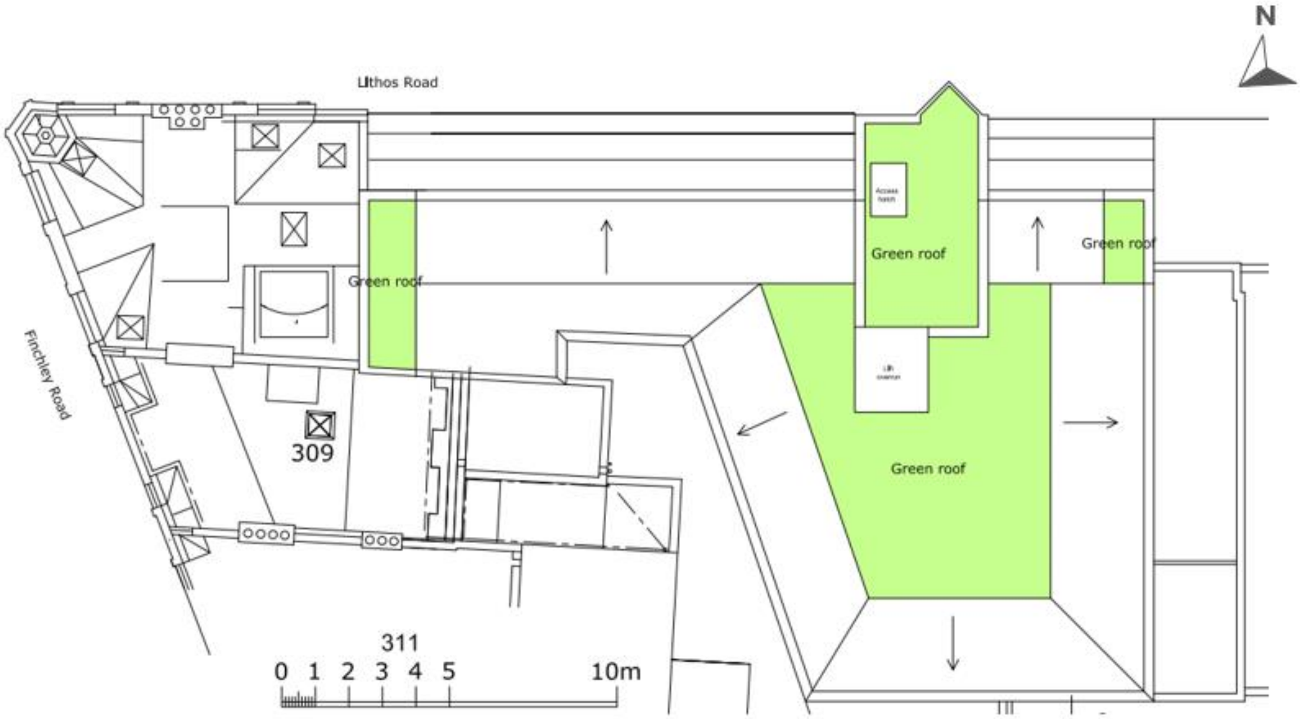


Figure 3: Green roofs.

CLIMATE CHANGE ADAPTATION

Overheating

The potential risk of overheating will be mitigated by incorporating both passive and active design measures.

The space heating and hot water to the development will be provided by electric heating and photovoltaic panels (which benefits from the decarbonisation of the grid).

Efficient lighting will be used to further minimise internal heat gains and reduce energy expenditure.

Appropriately sized windows will reduce solar heat gains.

During peak summer periods the thermal mass of the buildings will absorb and store excess heat. The buildings will release heat in the cooler evenings to allow for cooler internal spaces, dampening the peak diurnal weather conditions.

Surface Water and Flooding

Sustainable urban drainage systems (SuDS), comprising green roofs, will be incorporated on site and the buildings' fabric and structure will be designed to minimise risk of infiltration and damage via flooding where possible.

Additionally, as shown from the image below, the proposed site falls under an area of low risk of flooding.

Figure 4: Flood risk map.

AIR, NOISE AND LIGHT

Air Quality

Air pollution risks from construction and demolition activities on site will be minimal in line with the SPG 'The control of dust and emissions from construction and demolition' under the following categories:

- demolition;
- earthworks;
- construction;
- trackout; and,
- non-road mobile machinery (NRMM).

During the operational phase of the development, combustion of fossil fuels and associated combustion emissions for heating will be eliminated via improved levels of insulation and air tightness for the buildings' fabric, and the specification of electric based heating systems.

Noise

The development will incorporate design and building fabric measures to mitigate potential noise levels from the proposed development and ensure the impact of any external sources on internal ambient noise levels are within acceptable limits.

LIGHT POLLUTION

The lighting design of the proposed development will follow the recommendations of the Institution of Lighting Engineers' Guidance Notes for the Reduction of Obtrusive Light (2005), to minimise light pollution.

Water Pollution

Water pollution to surrounding watercourses has been minimised by the introduction of green roofs, thereby reducing surface water runoff. In addition, contractors will adopt best practice policies to mitigate water pollution from construction activities on site.

The development will discharge domestic sewage via a connection to the public foul sewer or combined sewer network where it is reasonable to do so.

TRANSPORT

Alternative means of transportation

In order to underpin the reduction of emissions from transport, the development has been designed to encourage cycling; cycle parking is provided on the ground floor of the existing building on site in dedicated ground floor stores.

Public Transport Accessibility

The proposed site has excellent access to public transport with Finchley Road and Frognal railway station 50m away and Finchley Road underground station 380m away.

The site falls under the PTAL category 6a with 28.09 as a total score.

Proximity to Amenities

Many amenities are available within close proximity to the proposed site including food outlets, cash points, shops, pharmacies, etc.

ENERGY STRATEGY

This section describes the predicted energy performance and carbon dioxide emissions of the proposed 307 Finchley Road development based on the information provided by the design team.

The overall regulated CO_2 savings *on site* against the baseline are estimated at 28.6% for the site with SAP10 emissions factors.

METHODOLOGY - BE LEAN, BE CLEAN, BE GREEN, BE SEEN

The methodology used to determine CO_2 emissions is in accordance with the London Plan's four-step Energy Hierarchy (Policy SI2). The new-build portion of development is compared to a Building Regulations Part L 2013 compliant scheme whilst the refurbishment portion against GLA's specification for existing buildings. The reductions made through each step are outlined below.

BE LEAN – USE LESS ENERGY

The proposals incorporate a range of passive and active design measures that will reduce the energy demand for space conditioning, hot water, ventilation and lighting. Measures will also be put in place to reduce the risk of overheating.

PASSIVE DESIGN MEASURES

ENHANCED U-VALUES

The heat loss of different building fabric elements is dependent upon their U-value, which is a measure of the thermal transmittance through the element. An element with low U-value provides better levels of insulation and reduced heating demand.

The proposed development will incorporate high levels of insulation and high-performance glazing beyond Part L 2013 targets and notional building specifications, in order to reduce the demand for space heating.

The tables to the right show the improved performance of the proposed building fabric beyond the Building Regulations requirements for both the refurbishment and new-build elements.

Table 2: Thermal Envelope U-values

New Build Dwellings (U-values in W/m^2.K)			
Element	**Building Regulations**	**Proposed**	**Improvement**
Walls	0.30	0.15	50%
Floor	0.25	0.10	60%
Roof	0.20	0.10	50%
Windows	2.00	1.30	35%
Refurbished Dwellings (U-values in W/m^2.K)			
Element	**Baseline figures***	**Proposed**	**Improvement**
Walls	0.55	0.30	45%
Floor	0.55	0.25	55%
Roof	0.18	0.10	44%
Windows	1.60	1.30	19%

*Figures from GLA Energy Assessment Guidance Appendix 4

AIR TIGHTNESS IMPROVEMENT

Heat loss may also occur due to air infiltration. Although this cannot be eliminated altogether, good construction detailing, and the use of best practice construction techniques can minimise the amount of air infiltration.

The proposed development will aim to improve upon the Part L 2013 minimum standards for air tightness by targeting air permeability rates of 3m^3/m^2 at 50Pa for all new build residential units and $10m^3/m^2$ at 50Pa for refurbished residential units.

REDUCING THE NEED FOR ARTIFICIAL LIGHTING

The design of the development incorporates large areas of glazing across all building elevations, to optimise daylight in occupied spaces. Good internal daylight levels will translate to less dependency on artificial lighting and will indirectly deliver energy and carbon savings, together with pleasant, healthy spaces for occupants.

ACTIVE DESIGN MEASURES

HIGH EFFICACY LIGHTING

The development intends to incorporate low energy lighting fittings throughout the residential spaces. All light fittings will be specified as low energy lighting and will primarily accommodate LEDs.

HEAT RECOVERY VENTILATION

Mechanical ventilation heat recovery (MVHR) is proposed for the new build dwellings. The mechanical ventilation system will include heat recovery in order to achieve ventilation in the most energy-efficient way. Natural ventilation is proposed for the refurbished dwellings.

HEAT GENERATION

Space heating and domestic hot water will be provided in residential units by electric heating.

CONTROLS

Advanced lighting and space conditioning controls will be incorporated, specifically heating controls in dwellings will comprise programmer and room thermostats.

MONITORING

Smart meters will be installed to monitor the heat and electricity consumption of each dwelling; the display board will demonstrate real-time and historical energy use data and will be installed at an accessible location within the dwellings.

MINIMISING OVERHEATING

The potential risk of overheating will be mitigated by incorporating passive and active design measures, in line with the London Plan Policy SI4 and the Cooling Hierarchy, as follows.

MINIMISING INTERNAL HEAT GENERATION THROUGH ENERGY EFFICIENT DESIGN

Efficient lighting will be used to further minimise internal heat gains and reduce energy expenditure.

REDUCING THE AMOUNT OF HEAT ENTERING THE BUILDING IN SUMMER

The openings across the development have been appropriately designed to offer satisfactory daylight and views to occupied spaces, without disproportionately increasing solar gains and overheating risks.

The development also incorporates balconies, which apart from offering private amenity space for occupants, will also serve as shading elements for the openings of the floor below, obstructing direct solar gains during the peak hours of the summer.

PASSIVE VENTILATION

The development has allowed for passive ventilation in the refurbished units as the main strategy for providing fresh air and dissipating heat that builds up within the building(s). The passive ventilation strategy includes single-sided ventilation, cross ventilation and night purge ventilation through openable windows and doors, operated by the occupants. Communal corridors will also have openable windows which will be occupant controlled to maintain a comfortable temperature. New-build dwellings are also proposed to benefit from opening windows in summer for heat dissipation.

MECHANICAL VENTILATION

The primary strategy in the new-build units for fresh air supply will be through an MVHR system, with a by-pass ‘summer mode’ activated to allow for free cooling of occupied spaces through the incoming outdoor air and the dissipation of built-up heat.

OVERHEATING RISK ASSESSMENT

The potential risk of overheating was assessed via the Part L Building Regulation compliance tool SAP.

A slight to medium overheating risk was found for the representative dwelling types modelled in SAP. The SAP overheating risk assessment outputs for a sample of the dwelling types modelled can be found in Appendix A.

ENERGY USE

The table below shows a breakdown of carbon dioxide emissions associated with the proposed development's fossil fuel and electricity consumption for the different uses. The site-wide data are presented, i.e. the sum of the demand for both the new build and refurbished parts of the development. The figures provide a comparison between the baseline condition and the proposed development once energy efficiency measures (Lean) have been applied.

This table demonstrates the energy savings achieved through energy efficiency measures (Lean stage of the Energy Hierarchy)

Table 3: Breakdown of energy consumption and CO_2 emissions for the baseline and the proposed schemes after 'Lean' measures are implemented

	Baseline			Lean		
	Energy (kWh/yr.)	**$kgCO_2$ /yr.**	**$kgCO_2/m^2$**	**Energy (kWh/yr.)**	**$kgCO_2$ /yr.**	**$kgCO_2/m^2$**
Hot Water	13,330	2,799	8	12,900	2,709	7
Space Heating	26,380	5,540	15	18,600	3,906	11
Cooling	0	0	0	0	0	0
Auxiliary	660	154	0	1,330	310	1
Lighting	1,960	456	1	1,760	409	1
Equipment	14,600	3,402	9	14,600	3,402	9
Total Part L	**42,320**	**8,948**	**24.5**	**34,590**	**7,334**	**20.1**
Total (incl. equipment)	**56,930**	**12,350**	**33.8**	**49,190**	**10,736**	**29.4**

BE LEAN CO_2 EMISSIONS & SAVINGS

By means of energy efficiency measures alone, regulated CO_2 emissions are shown to reduce by 18.0% (1.6 tonnes per annum) across the whole site.

BE CLEAN – SUPPLY ENERGY EFFICIENTLY

The size and location of this development does not lend itself to incorporation into an existing heat network. Therefore, no regulated carbon savings are achieved for this step of the Energy Hierarchy.

ENERGY SYSTEM HIERARCHY

The energy system for the development has been selected in accordance with the London Plan decentralised energy hierarchy. The hierarchy listed in Policy SI3 states that energy systems should consider:

- Connection to existing heating and cooling networks;
- Site wide CHP network; and,
- Communal heating and cooling.

Local heat and power sources minimise distribution losses and achieve greater efficiencies when compared to separate energy systems, thus reducing CO_2 emissions.

In a communal energy system, energy in the form of heat, cooling, and/or electricity is generated from a central source and distributed via a network of insulated pipes to surrounding residences.

CONNECTION TO AN EXISTING NETWORK

The London Heat Map identifies existing and potential opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study.

An excerpt from the London Heat Map can be seen on the following page which highlights any existing and proposed district heating networks within the vicinity of the development.

A review of the map shows that no existing district heating network exists within the close proximity of the proposed development.

SITE-WIDE CHP

CHP is not proposed due to the changes in the carbon factors.

COMMUNAL HEATING AND COOLING

A communal heating system would not be feasible for this development because it is an existing building and associated spatial constraints as well as because the scale of the development is not significant to benefit from a communal heating system.

It is therefore proposed that the refurbished dwellings retain their existing electric heating system and the new-build dwellings also connect to the existing services within the building. The use of electric heating eliminates the combustion of fossil fuels on site and the development will benefit from the decarbonisation of the electricity grid. Both the refurbished and new-build dwellings within 307 Finchley Road are proposed to benefit from significant improvements in their building fabric which would reduce significantly the demand for space heating.

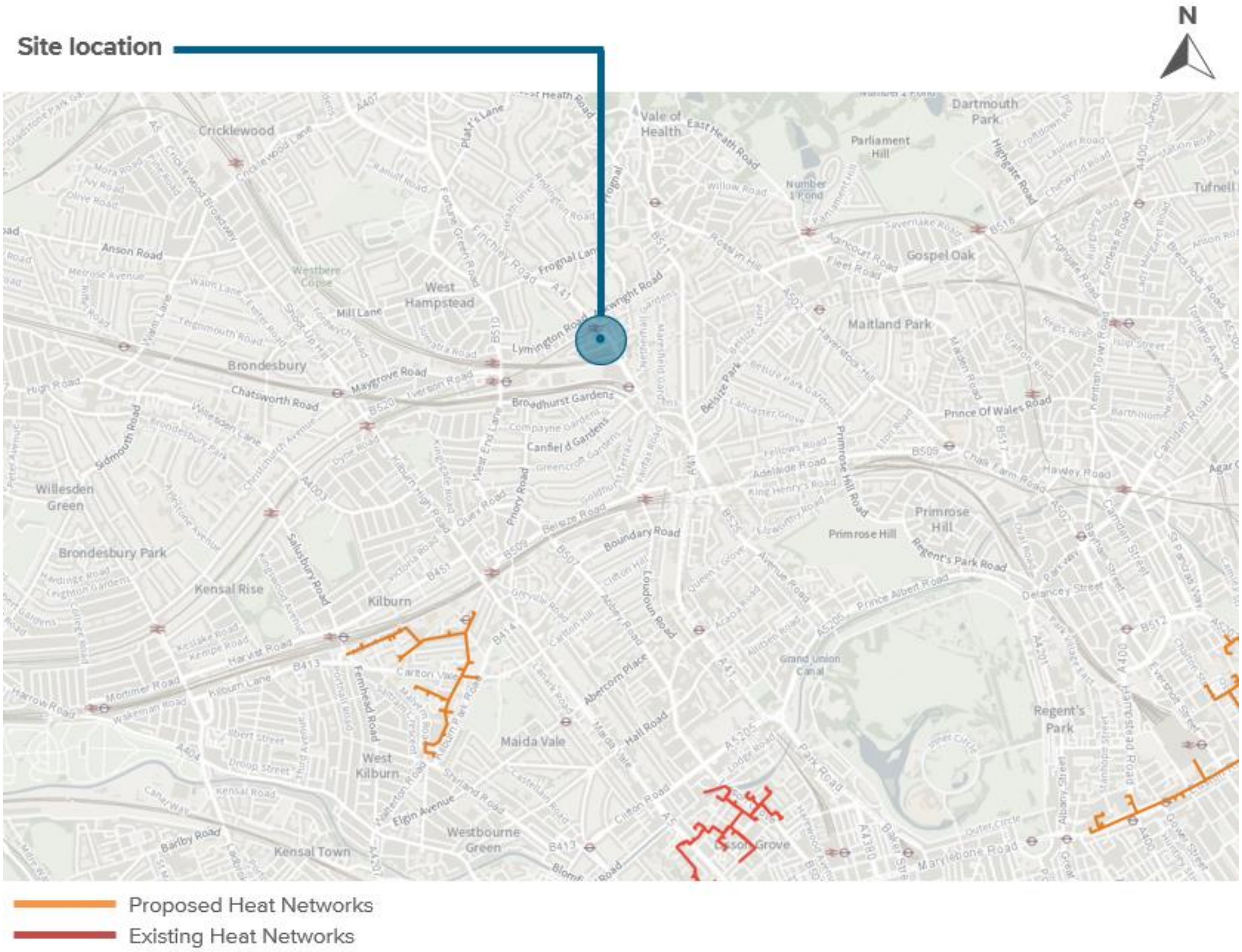


Figure 5: Excerpt from the London Heat Map. Existing district networks outlined in red, proposed networks in orange.

BE CLEAN CO_2 EMISSIONS & SAVINGS

Given that it has not been found feasible or viable for the proposed development to incorporate the supply of low carbon heating or cooling, no carbon savings are achieved for this step of the Energy Hierarchy.

BE GREEN – USE RENEWABLE ENERGY

The renewable technologies feasibility study carried out for the development identified photovoltaics as the most suitable technology for the development. The regulated carbon saving achieved in this step of the Energy Hierarchy is 10.5% over the site wide baseline level with SAP10 emissions factors.

It should be noted that given the Baseline emissions include the refurbished elements of the scheme, which were calculated based on the existing building's performance, the emissions associated with this scenario are quite high. In this instance, it would be more appropriate to measure the contribution of the renewables savings relative to the proposed scheme post-efficiency (Be Lean stage emissions) as this represents the emissions of the actual scheme, rather than a baseline which is not the proposed development. The on-site renewable energy generation was found to be 12.8% for this development. PVs have been maximised on the roof and a certain number of panels has been apportioned to the previous planning application for 309 Finchley Road, which also shares the roof with 307 Finchley Road.

RENEWABLE TECHNOLOGIES FEASIBILITY STUDY

Methods of generating on-site renewable energy (Green) were assessed, once Lean and Clean measures were taken into account.

The proposed development will benefit from an energy efficient building fabric which will reduce the energy consumption of the proposed development in the first instance. A range of renewable technologies were subsequently considered including:

- Biomass;
- Ground/water source heat pumps;
- Air source heat pump;
- Wind energy;
- Photovoltaic panels, and,
- Solar thermal panels.

In determining the appropriate renewable technology for the site, the following factors were considered:

- CO_2 savings achieved;
- Site constraints;
- Any potential visual impacts, and,

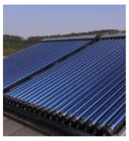
Compatibility with the 'Clean' stage proposals where applicable.

RENEWABLE ENERGY APPRAISAL SUMMARY

The table below summarises the factors taken into account in determining the appropriate renewable technologies for this project. This includes estimated capital cost, lifetime, level of maintenance and level of impact on external appearance. The final column indicates the feasibility of the technology in relation to the site conditions (10 being the most feasible and 0 being infeasible). It is important to note that the information provided is indicative and based upon early project stage estimates.

The feasibility study demonstrates that photovoltaics would be the most feasible renewable technology for the proposed development. Detailed assessments for the proposed technologies can be found in the following sections.

Table 4: Summary of renewable technologies feasibility study.

		Comments	Lifetime	Maintenance	Impact on external appearance	Site feasibility
Biomass		Not adopted – Burning of wood pellets releases high NOx emissions and there are limitations for their storage and delivery within an urban location.	20 yrs.	High	High	1
PV		Adopted – Due to significant savings provided.	25 yrs.	Low	Med	8
Solar thermal		Not adopted – Due to the visual impact both to the street scene and to overlooking neighbours, this technology has not been used.	25 yrs.	Low	Med	3
GSHP		Not adopted – The installation of ground loops requires significant space, additional time at the beginning of the construction process and very high capital costs.	20 yrs.	Med	Low	1
ASHP		Not adopted – Electric heating has been adopted as it is already present in the building and roof space has been utilised for green roofs with PV.	20 yrs.	Med	Med	2
Wind		Not adopted – Wind turbines located at the site will have a significant visual impact on the existing site context.	25 yrs.	Med	High	1

DETAILED ASSESSMENT OF PHOTOVOLTAIC PANELS

Four types of solar cells are available on the market at present and these are mono-crystalline, poly-crystalline, thin film and hybrid panels. Although mono-crystalline and hybrid cells are the most expensive, they are also the most efficient with an efficiency rate of 12-20%. Poly-crystalline cells are cheaper but they are less efficient (9-15%). Thin film cells are only 5-8% efficient but can be produced as thin and flexible sheets.

Photovoltaics are considered a suitable technology for this development for the following reasons:

- The development provides an extent of roof space for the installation of PV panels;
- PV arrays are relatively easy to install when compared to other renewable systems; and
- PV panels provide a significant amount of CO_2 savings.

The PV shall comprise 4.2kWp (28.2m^2) of roof mounted arrays. The PV array will be connected to the domestic part of the development (landlord areas).

The table below summarises the technical data for the proposed PV array and estimated CO_2 savings from the application of this technology. In total the PV installation would produce regulated CO_2 savings of 8.4% for the development.

The PV panels have been maximised on the roof space as majority of the remaining space are not south facing and have overshadowing from the lift overrun and would not provide efficient results. Utilising the remaining south facing areas would also compromise the appearance of the building.

The roof accommodates a total of approximately 77sqm of PV panels, from which 28.2sqm will be allocated to the proposed development with the rest being connected to the adjacent property at 309 Finchley Road.

An indicative area for the installation of the PV panels on the roof can be found in the following page and the PV areas have been approved previously in the planning application submitted for 309 Finchley Road (Reference: 2019/1438/P).

Table 5:Summary of technical/operational data and estimated CO2 savings for PVs.

Photovoltaics		
Module efficiency	15	%
Orientation	Horizontal	
Carbon intensity for electricity	0.233	kgCO2/kWh
Predicted site solar energy	950.6	kWh/m^2.yr
System losses	20	%
System peak power	4.24	kWp
Array area	28.2	m^2
Primary energy offset by PV	3,222	kWh/yr.
Total CO_2 savings	0.8	t/yr.
Regulated baseline CO_2 emissions	8.9	t/yr.
Total baseline CO_2 emissions	12.4	t/yr.
% Regulated CO_2 reduction*	8.4%	%
% Total CO_2 reduction*	6.1%	%

* % reduction from site baseline

Figure 6: Monocrystalline PV arrays

Figure 7. Proposed PV layout.

BE GREEN CO_2 EMISSIONS & SAVINGS

The incorporation of renewable technologies will further reduce CO_2 emissions by a further 10.5% (0.9 tonnes per annum) across the whole site when compared to the baseline emissions and with SAP10 carbon factors.

It should be noted that given the Baseline is based on the 'existing building's' performance, the emissions associated with this scenario are quite high (8.9 tCO2/ year) and this makes the on-site contribution from PV panels appear lower. In this case, it may be more appropriate to measure the contribution of the renewables savings relative to the proposed scheme post-efficiency ('Be Lean' stage CO2 emissions which are 7.3 tCO2/ year) as this represents the emissions of the actual scheme, rather than a baseline which is not the proposed development. The scheme incorporates notable fabric improvements and it would be readily appreciated that it is more reasonable to measure the contribution of CO2 savings from renewables against the emissions of the proposed scheme.

The savings achieved from the incorporation of photovoltaic panels are 12.8% of the Be Lean stage emissions of the development.

CUMULATIVE ON-SITE SAVINGS

The total regulated CO_2 savings for the site are 2.6 tonnes, equivalent to 28.6% of the baseline emissions with SAP10 carbon factors.

CONCLUSIONS

The sustainability strategy for the scheme at 307 Finchley Road has been developed in line with the relevant policies of the London Plan and of the London Borough of Camden Local Plan and aims at the efficient management of resources, environmental protection and the effective adaptation and mitigation of the development to climate change.

The energy strategy has been developed in line with the three-step Energy Hierarchy and the cumulative CO_2 savings on site are estimated at 28.6% for the development, against a Part L 2013 compliant scheme.

SUSTAINABILITY

The proposed development has been designed in line with the targets set out by Camden and the Greater London Authority (GLA).

Key sustainability features of the proposals include:

- The re-use of previously developed land and retaining the lower floors with dwellings.
- Effective site layout in response to the neighbouring context.
- Efficient design of the proposed massing, openings and internal layouts so that habitable spaces across the site benefit from abundant daylight and sunlight levels, whilst impacts to neighbouring buildings are kept to a minimum.
- The specification of water efficient fittings to limit water consumption to less than 105 litres per person per day for domestic uses.
- Improvement of biodiversity on site through the introduction of green roofs.

The sustainability measures incorporated reflect the client and design team's aspirations in integrating sustainability measures and demonstrates that the project is designed to exceed the planning policy sustainability requirements.

ENERGY STRATEGY

By implementing the three step Energy Hierarchy as detailed in the previous sections, the Regulated CO_2 emissions for the development have been reduced against a Part L 2013 compliant scheme through on-site measures alone by 28.6% (2.6 tonnes per annum) across the whole site.

The tables in the following pages summarise the implementation of the Energy Hierarchy for the proposed scheme and detail the CO_2 emissions and savings against the baseline scheme for each step of the hierarchy; as well as the savings achieved through carbon offset.

Overall, the proposed development has been designed in line with the energy policies set out by the GLA and the London Borough of Camden, which demonstrates the client and the design team's commitment to enhancing sustainability of the scheme.

SITE-WIDE CUMULATIVE SAVINGS

Table 6: Site wide regulated CO_2 emissions and savings

	Total regulated emissions (tonnes CO_2/year)	Regulated CO_2 savings (tonnes CO_2/year)	Percentage saving (%)
Baseline	8.9		
Be Lean	7.3	1.6	18.0%
Be Clean	7.3	0.0	0.0%
Be Green	6.4	0.9	10.5%
Total		2.6	28.6%

APPENDIX A – OVERHEATING RISK ASSESSMENT

The table below lists a sample of the typical flats that were modelled using SAP methodology and the associated overheating risk that has been calculated for each flat.

The following pages show the Overheating FSAP2012 worksheets for a sample flat. The SAP outputs for all sample flats are available on request.

SAP Ref No.	Unit Type.	Overheating risk
1	Refurbishment	Slight
2	Refurbishment	Medium
3	New build	Slight
4	New build	Slight
5	New build	Medium

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 07 September 2021

Property Details: Flat 4

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	No
Number of storeys:	1
Front of dwelling faces:	North West
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	Light-coloured curtain or roller blind
Ventilation rate during hot weather (ach):	2.5 (Windows open half the time)

Overheating Details:

Summer ventilation heat loss coefficient:	80.73	**(P1)**
Transmission heat loss coefficient:	34.3	
Summer heat loss coefficient:	115.01	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
North West (Flat 4 NW window)	0	1
South West (Flat 4 SW window)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
North West (Flat 4 NW window)	0.6	0.9	1	0.54	**(P8)**
South West (Flat 4 SW window)	0.6	0.9	1	0.54	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
North West (Flat 4 NW window)	0.9 x	9.2	98.85	0.63	0.7	0.54	194.9	
South West (Flat 4 SW window)	0.9 x	2.3	119.92	0.63	0.7	0.54	59.12	
						Total	254.02	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	288.6	278.4	283.76	
Total summer gains	561.06	532.42	498.37	**(P5)**
Summer gain/loss ratio	4.88	4.63	4.33	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	21.13	22.78	22.38	**(P7)**
Likelihood of high internal temperature	**Slight**	**Medium**	**Medium**	

Assessment of likelihood of high internal temperature: Medium

APPENDIX B – SAP RESULTS

The table below lists a sample of the typical flats that were modelled using SAP methodology, the TER and DER outputs and the % CO_2 reduction achieved after the Be Lean measures have been applied.

The results from these 5 flats were extrapolated over the entire development, in order to predict the energy consumption and carbon dioxide emissions for the domestic spaces of the Development.

The following pages show the DER/TER FSAP2012 worksheets for a sample flat. The SAP outputs for all sample flats are available on request.

SAP Ref No.	Unit Type.	Baseline ($kgCO_2/m^2/yr.$)	DER ($kgCO_2/m^2/yr.$)	% CO_2 reduction
1	Refurbishment	36.86	27.98	24.1%
2	Refurbishment	26.66	20.75	22.2%
3	New build	20.44	19.85	2.9%
4	New build	20.32	19.39	4.6%
5	New build	23.96	22.64	5.5%

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.45

Property Address: Flat 4

Address : 307 Finchley Road, NW3 6EH

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	37.35	(1a)	x	2.62	(2a)	=	97.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	37.35	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			97.86	(5)

2. Ventilation rate:

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.2	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.45	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DRAFT

TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.49	0.48	0.47	0.42	0.42	0.37	0.37	0.36	0.39	0.42	0.43	0.45

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(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)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.64	x	1	=	1.64			(26)
Windows Type 1			1.54	x1/[1/(1.4)+ 0.04]		=	2.04			(27)
Windows Type 2			1.54	x1/[1/(1.4)+ 0.04]		=	2.04			(27)
Walls Type1	38.57	7.7	30.87	x	0.18	=	5.56			(29)
Walls Type2	2.28	1.64	0.64	x	0.18	=	0.12			(29)
Roof	47.36	0	47.36	x	0.13	=	6.16			(30)
Total area of elements, m²			88.21							(31)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 23.68 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 426.24 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.6 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 29.28 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	20.06	19.91	19.76	19.06	18.93	18.32	18.32	18.21	18.55	18.93	19.19	19.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	49.34	49.19	49.04	48.34	48.21	47.6	47.6	47.48	47.83	48.21	48.47	48.75	

Average = Sum(39)$_{1…12}$ /12= 48.34 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.32	1.32	1.31	1.29	1.29	1.27	1.27	1.27	1.28	1.29	1.3	1.31

Average = Sum(40)$_{1…12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.34 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 65.97 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	72.57	69.93	67.29	64.65	62.01	59.38	59.38	62.01	64.65	67.29	69.93	72.57	
										Total = Sum(44)$_{1…12}$ =		791.68	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	107.62	94.13	97.13	84.68	81.25	70.11	64.97	74.56	75.45	87.92	95.98	104.22	
										Total = Sum(45)$_{1…12}$ =		1038.02	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	16.14	14.12	14.57	12.7	12.19	10.52	9.75	11.18	11.32	13.19	14.4	15.63	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

TER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	36.98	32.19	34.29	31.88	31.6	29.28	30.26	31.6	31.88	34.29	34.49	36.98	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	144.6	126.31	131.42	116.56	112.85	99.4	95.23	106.16	107.33	122.22	130.46	141.21	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	144.6	126.31	131.42	116.56	112.85	99.4	95.23	106.16	107.33	122.22	130.46	141.21	

Output from water heater (annual)$_{1...12}$ 1433.75 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	45.03	39.34	40.87	36.13	34.92	30.63	29.17	32.69	33.06	37.81	40.53	43.9	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	66.89	66.89	66.89	66.89	66.89	66.89	66.89	66.89	66.89	66.89	66.89	66.89	(66)

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

(67)m=	10.29	9.14	7.43	5.63	4.21	3.55	3.84	4.99	6.69	8.5	9.92	10.57	(67)

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

(68)m=	114.93	116.12	113.12	106.72	98.64	91.05	85.98	84.79	87.79	94.19	102.27	109.86	(68)

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

(69)m=	29.69	29.69	29.69	29.69	29.69	29.69	29.69	29.69	29.69	29.69	29.69	29.69	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

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

(71)m=	-53.51	-53.51	-53.51	-53.51	-53.51	-53.51	-53.51	-53.51	-53.51	-53.51	-53.51	-53.51	(71)

Water heating gains (Table 5)

(72)m=	60.52	58.55	54.93	50.18	46.93	42.55	39.2	43.94	45.91	50.82	56.3	59.01	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	231.81	229.88	221.55	208.59	195.85	183.22	175.09	179.78	186.47	199.58	214.55	225.51	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a	g_ Table 6b		FF Table 6c		Gains (W)	
Southwest 0.9x	0.77	x	1.54	x	36.79	0.63	x	0.7	=	17.32	(79)
Southwest 0.9x	0.77	x	1.54	x	62.67	0.63	x	0.7	=	29.5	(79)
Southwest 0.9x	0.77	x	1.54	x	85.75	0.63	x	0.7	=	40.36	(79)
Southwest 0.9x	0.77	x	1.54	x	106.25	0.63	x	0.7	=	50.01	(79)
Southwest 0.9x	0.77	x	1.54	x	119.01	0.63	x	0.7	=	56.01	(79)

Southwest	0.9x	0.77	x	1.54	x	118.15		0.63	x	0.7	=	55.61	(79)
Southwest	0.9x	0.77	x	1.54	x	113.91		0.63	x	0.7	=	53.61	(79)
Southwest	0.9x	0.77	x	1.54	x	104.39		0.63	x	0.7	=	49.13	(79)
Southwest	0.9x	0.77	x	1.54	x	92.85		0.63	x	0.7	=	43.7	(79)
Southwest	0.9x	0.77	x	1.54	x	69.27		0.63	x	0.7	=	32.6	(79)
Southwest	0.9x	0.77	x	1.54	x	44.07		0.63	x	0.7	=	20.74	(79)
Southwest	0.9x	0.77	x	1.54	x	31.49		0.63	x	0.7	=	14.82	(79)
Northwest	0.9x	0.77	x	1.54	x	11.28	x	0.63	x	0.7	=	21.24	(81)
Northwest	0.9x	0.77	x	1.54	x	22.97	x	0.63	x	0.7	=	43.24	(81)
Northwest	0.9x	0.77	x	1.54	x	41.38	x	0.63	x	0.7	=	77.9	(81)
Northwest	0.9x	0.77	x	1.54	x	67.96	x	0.63	x	0.7	=	127.93	(81)
Northwest	0.9x	0.77	x	1.54	x	91.35	x	0.63	x	0.7	=	171.97	(81)
Northwest	0.9x	0.77	x	1.54	x	97.38	x	0.63	x	0.7	=	183.33	(81)
Northwest	0.9x	0.77	x	1.54	x	91.1	x	0.63	x	0.7	=	171.5	(81)
Northwest	0.9x	0.77	x	1.54	x	72.63	x	0.63	x	0.7	=	136.73	(81)
Northwest	0.9x	0.77	x	1.54	x	50.42	x	0.63	x	0.7	=	94.92	(81)
Northwest	0.9x	0.77	x	1.54	x	28.07	x	0.63	x	0.7	=	52.84	(81)
Northwest	0.9x	0.77	x	1.54	x	14.2	x	0.63	x	0.7	=	26.73	(81)
Northwest	0.9x	0.77	x	1.54	x	9.21	x	0.63	x	0.7	=	17.35	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	38.56	72.73	118.26	177.94	227.98	238.94	225.12	185.86	138.62	85.44	47.47	32.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	270.37	302.61	339.81	386.53	423.83	422.16	400.2	365.64	325.09	285.02	262.02	257.67	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.94	0.84	0.67	0.51	0.57	0.83	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.65	19.8	20.08	20.46	20.78	20.95	20.99	20.98	20.85	20.45	19.99	19.63	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.83	19.83	19.85	19.85	19.86	19.86	19.86	19.86	19.85	19.84	19.84	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.92	0.79	0.57	0.38	0.44	0.75	0.95	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.05	18.27	18.68	19.23	19.64	19.83	19.86	19.86	19.74	19.22	18.56	18.03	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.83	19.02	19.36	19.83	20.2	20.37	20.41	20.4	20.28	19.82	19.26	18.81	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

TER WorkSheet: New dwelling design stage

(93)m=	18.83	19.02	19.36	19.83	20.2	20.37	20.41	20.4	20.28	19.82	19.26	18.81	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.92	0.81	0.62	0.45	0.51	0.78	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	268.28	298.56	329.95	356.45	341.87	260.4	178.77	185.67	253.89	270.48	258.39	256.05	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	716.92	694.52	630.73	528.33	409.52	274.82	181.34	190.17	295.75	444.43	589.22	712.11	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	333.79	266.08	223.78	123.75	50.33	0	0	0	0	129.42	238.2	339.31	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1704.67 (98)

Space heating requirement in kWh/m²/year 45.64 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	333.79	266.08	223.78	123.75	50.33	0	0	0	0	129.42	238.2	339.31		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	357.38	284.89	239.6	132.5	53.88	0	0	0	0	138.56	255.03	363.28		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1825.12	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	144.6	126.31	131.42	116.56	112.85	99.4	95.23	106.16	107.33	122.22	130.46	141.21		
Efficiency of water heater													80.3	(216)
(217)m=	87.09	86.88	86.38	85.2	83.17	80.3	80.3	80.3	80.3	85.2	86.55	87.18		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	166.04	145.38	152.14	136.81	135.7	123.78	118.59	132.2	133.66	143.45	150.74	161.97		
Total = Sum(219a)$_{1...12}$ =													1700.47	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1825.12

TER WorkSheet: New dwelling design stage

Water heating fuel used			1700.47	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			181.71	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			3782.3	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	394.23	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	367.3	(264)
Space and water heating	(261) + (262) + (263) + (264) =			761.53	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	94.31	(268)
Total CO2, kg/year		sum of (265)…(271) =		894.76	(272)
TER =				23.96	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.45

Property Address: Flat 4

Address : 307 Finchley Road, NW3 6EH

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	37.35	(1a)	x	2.62	(2a)	=	97.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	37.35	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	97.86	(5)

2. Ventilation rate:

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	73.95	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(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)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.64	x	1.3	=	2.132			(26)
Windows Type 1			2.3	x1/[1/(1.3)+ 0.04]		=	2.84			(27)
Windows Type 2			2.3	x1/[1/(1.3)+ 0.04]		=	2.84			(27)
Walls Type1	38.57	11.5	27.07	x	0.15	=	4.06			(29)
Walls Type2	2.28	1.64	0.64	x	0.27	=	0.18			(29)
Roof	47.36	0	47.36	x	0.1	=	4.74			(30)
Total area of elements, m²			88.21							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	25.32	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	426.24	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		8.96	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	34.28	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	9.46	9.35	9.25	8.74	8.63	8.12	8.12	8.01	8.32	8.63	8.84	9.04	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	43.73	43.63	43.53	43.01	42.91	42.39	42.39	42.29	42.6	42.91	43.11	43.32	

Average = Sum(39)$_{1…12}$ /12= 42.98 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.17	1.17	1.17	1.15	1.15	1.14	1.14	1.13	1.14	1.15	1.15	1.16	

Average = Sum(40)$_{1...12}$ /12= 1.15 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.34 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 65.97 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	72.57	69.93	67.29	64.65	62.01	59.38	59.38	62.01	64.65	67.29	69.93	72.57	

Total = Sum(44)$_{1...12}$ = 791.68 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	107.62	94.13	97.13	84.68	81.25	70.11	64.97	74.56	75.45	87.92	95.98	104.22	

Total = Sum(45)$_{1...12}$ = 1038.02 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	16.14	14.12	14.57	12.7	12.19	10.52	9.75	11.18	11.32	13.19	14.4	15.63	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	36.98	32.19	34.29	31.88	31.6	29.28	30.26	31.6	31.88	34.29	34.49	36.98	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	144.6	126.31	131.42	116.56	112.85	99.4	95.23	106.16	107.33	122.22	130.46	141.21	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	144.6	126.31	131.42	116.56	112.85	99.4	95.23	106.16	107.33	122.22	130.46	141.21	

Output from water heater (annual)1…12 | 1433.75 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	45.03	39.34	40.87	36.13	34.92	30.63	29.17	32.69	33.06	37.81	40.53	43.9	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	66.89	66.89	66.89	66.89	66.89	66.89	66.89	66.89	66.89	66.89	66.89	66.89	(66)

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

(67)m=	10.25	9.1	7.4	5.6	4.19	3.54	3.82	4.97	6.67	8.46	9.88	10.53	(67)

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

(68)m=	114.93	116.12	113.12	106.72	98.64	91.05	85.98	84.79	87.79	94.19	102.27	109.86	(68)

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

(69)m=	29.69	29.69	29.69	29.69	29.69	29.69	29.69	29.69	29.69	29.69	29.69	29.69	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

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

(71)m=	-53.51	-53.51	-53.51	-53.51	-53.51	-53.51	-53.51	-53.51	-53.51	-53.51	-53.51	-53.51	(71)

Water heating gains (Table 5)

(72)m=	60.52	58.55	54.93	50.18	46.93	42.55	39.2	43.94	45.91	50.82	56.3	59.01	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	238.77	236.84	228.52	215.57	202.83	190.2	182.07	186.76	193.44	206.54	221.51	232.46	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a	g_ Table 6b		FF Table 6c		Gains (W)	
Southwest 0.9x	0.77	x	2.3	x	36.79	0.63	x	0.7	=	25.86	(79)
Southwest 0.9x	0.77	x	2.3	x	62.67	0.63	x	0.7	=	44.05	(79)
Southwest 0.9x	0.77	x	2.3	x	85.75	0.63	x	0.7	=	60.28	(79)
Southwest 0.9x	0.77	x	2.3	x	106.25	0.63	x	0.7	=	74.69	(79)
Southwest 0.9x	0.77	x	2.3	x	119.01	0.63	x	0.7	=	83.65	(79)

Southwest	0.9x	0.77	x	2.3	x	118.15		0.63	x	0.7	=	83.05 (79)
Southwest	0.9x	0.77	x	2.3	x	113.91		0.63	x	0.7	=	80.07 (79)
Southwest	0.9x	0.77	x	2.3	x	104.39		0.63	x	0.7	=	73.38 (79)
Southwest	0.9x	0.77	x	2.3	x	92.85		0.63	x	0.7	=	65.27 (79)
Southwest	0.9x	0.77	x	2.3	x	69.27		0.63	x	0.7	=	48.69 (79)
Southwest	0.9x	0.77	x	2.3	x	44.07		0.63	x	0.7	=	30.98 (79)
Southwest	0.9x	0.77	x	2.3	x	31.49		0.63	x	0.7	=	22.13 (79)
Northwest	0.9x	0.77	x	2.3	x	11.28	x	0.63	x	0.7	=	31.72 (81)
Northwest	0.9x	0.77	x	2.3	x	22.97	x	0.63	x	0.7	=	64.57 (81)
Northwest	0.9x	0.77	x	2.3	x	41.38	x	0.63	x	0.7	=	116.34 (81)
Northwest	0.9x	0.77	x	2.3	x	67.96	x	0.63	x	0.7	=	191.07 (81)
Northwest	0.9x	0.77	x	2.3	x	91.35	x	0.63	x	0.7	=	256.83 (81)
Northwest	0.9x	0.77	x	2.3	x	97.38	x	0.63	x	0.7	=	273.81 (81)
Northwest	0.9x	0.77	x	2.3	x	91.1	x	0.63	x	0.7	=	256.14 (81)
Northwest	0.9x	0.77	x	2.3	x	72.63	x	0.63	x	0.7	=	204.2 (81)
Northwest	0.9x	0.77	x	2.3	x	50.42	x	0.63	x	0.7	=	141.76 (81)
Northwest	0.9x	0.77	x	2.3	x	28.07	x	0.63	x	0.7	=	78.91 (81)
Northwest	0.9x	0.77	x	2.3	x	14.2	x	0.63	x	0.7	=	39.92 (81)
Northwest	0.9x	0.77	x	2.3	x	9.21	x	0.63	x	0.7	=	25.91 (81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	57.59	108.63	176.62	265.75	340.49	356.86	336.21	277.58	207.03	127.6	70.89	48.04	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	296.35	345.47	405.14	481.32	543.32	547.06	518.28	464.34	400.47	334.14	292.41	280.5	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.86	0.69	0.49	0.36	0.42	0.69	0.93	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.91	20.09	20.39	20.74	20.93	20.99	21	21	20.95	20.66	20.22	19.87	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.94	19.95	19.95	19.96	19.96	19.97	19.97	19.97	19.97	19.96	19.96	19.95	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.94	0.83	0.62	0.41	0.28	0.32	0.6	0.9	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.51	18.78	19.2	19.68	19.9	19.97	19.97	19.97	19.93	19.59	18.97	18.47	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.19	19.42	19.78	20.2	20.41	20.47	20.47	20.47	20.43	20.11	19.58	19.16	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.19	19.42	19.78	20.2	20.41	20.47	20.47	20.47	20.43	20.11	19.58	19.16	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.94	0.84	0.65	0.45	0.32	0.37	0.64	0.91	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	293.06	337.51	381.65	403.23	353.8	246.23	163.9	171.58	256.6	302.54	285.96	278.05	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	651.34	633.53	578.18	485.84	373.61	248.73	164.23	172.28	269.72	408.17	538.13	647.86	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	266.56	198.93	146.22	59.47	14.74	0	0	0	0	78.59	181.56	275.14	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1221.21 (98)

Space heating requirement in kWh/m²/year 32.7 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	266.56	198.93	146.22	59.47	14.74	0	0	0	0	78.59	181.56	275.14	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	297.83	222.27	163.38	66.45	16.47	0	0	0	0	87.8	202.86	307.41	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1364.48 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	144.6	126.31	131.42	116.56	112.85	99.4	95.23	106.16	107.33	122.22	130.46	141.21	
Efficiency of water heater													89.5 (216)
(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	161.57	141.13	146.84	130.24	126.09	111.06	106.4	118.61	119.92	136.55	145.77	157.77	

Total = Sum(219a)$_{1...12}$ = 1601.95 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1364.48

DER WorkSheet: New dwelling design stage

Water heating fuel used			1601.95	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		93.6		(230a)
central heating pump:		120		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		213.6	(231)
Electricity for lighting			180.95	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			3360.99	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	294.73	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	346.02	(264)
Space and water heating	(261) + (262) + (263) + (264) =			640.75	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	110.86	(267)
Electricity for lighting	(232) x	0.519	=	93.91	(268)
Total CO2, kg/year		sum of (265)…(271) =		845.52	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		22.64	(273)
EI rating (section 14)				86	(274)

XCO2
56 Kingsway Place, Sans Walk
London EC1R 0LU

+44 (0)20 7700 1000
mail@xco2.com
xco2.com