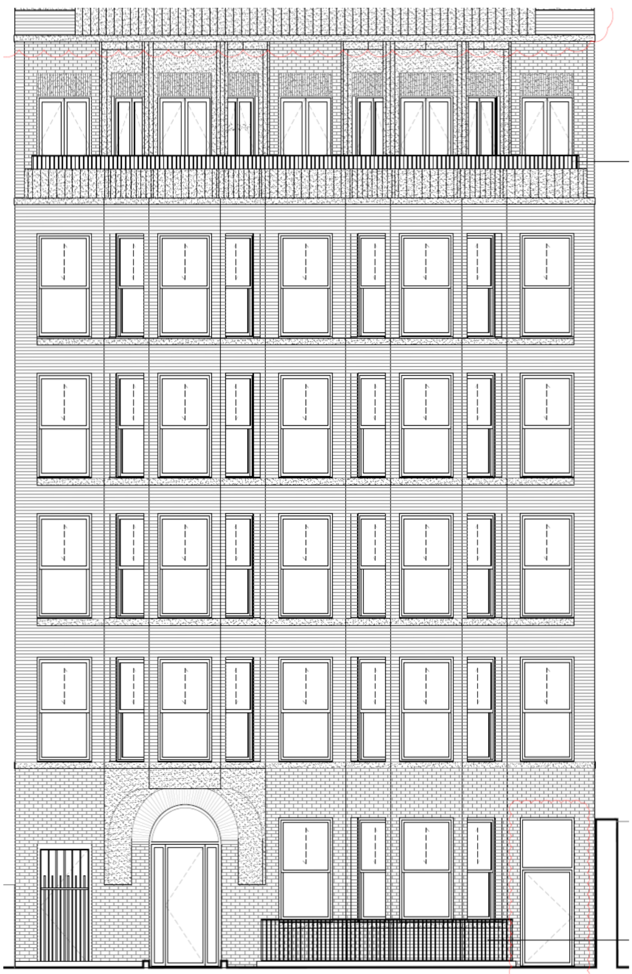
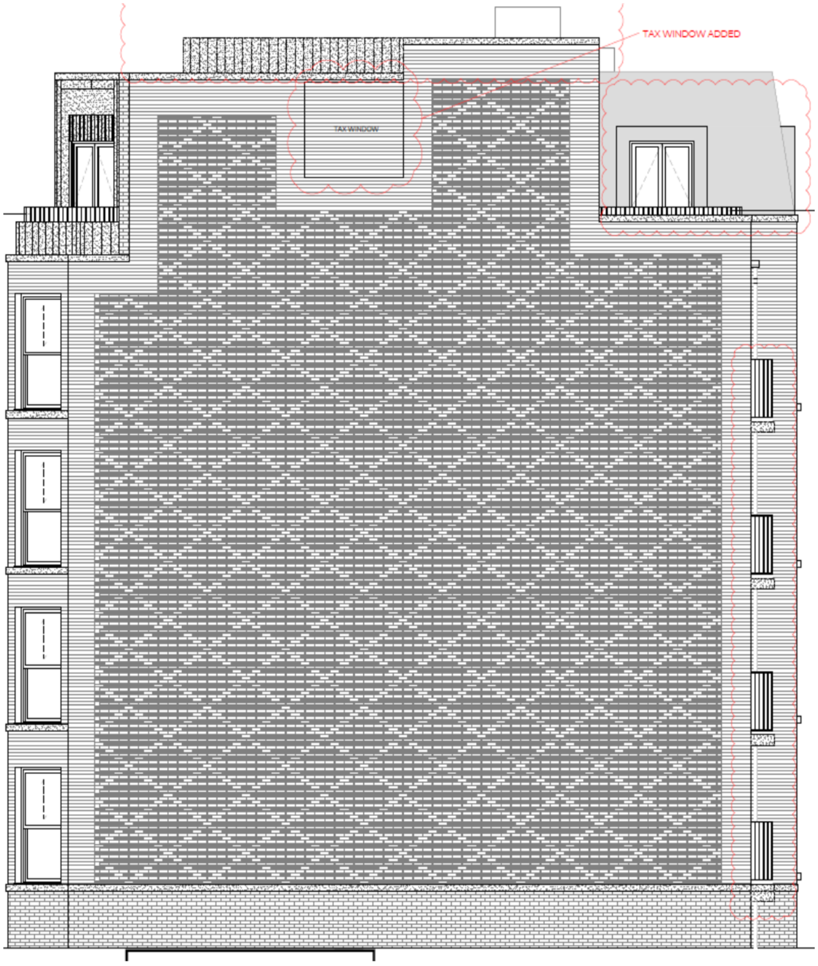
Energy Statement

St. Johns Wood Park

Prepared for Almax Group
April 2021





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ALMAX GROUP

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Author	Signature
Ian Pope BEng (Hons) CEng MCIBSE LCEA	I.Pope
Checked & Authorised	**Signature**
Ciaran Dorrity BEng (Hons) NDEA	Ciaran Dorrity

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EXECUTIVE SUMMARY

1. This Energy Statement has been prepared by Envision Energy to fulfil the conditions of the section 106 agreement associated with the development known as St. John's Wood Park. This statement forms an update to the currently consented energy strategy which was submitted as part of the original planning documentation.

2. The proposed development consist of 9no. apartments of varying configurations across 7 floors and is located within the London borough of Camden.

3. The primary purpose of this document is to demonstrate how the proposed strategy is able to comply with Building Regulations Part L: 2013 conservation of fuel and power, local planning and the Greater London Authority (GLA) Planning Policies.

4. Envision have undertaken a review of the relevant policies and worked with the design team to determine and agree the approach set out within this document to comply with the relevant policies.

5. This report additionally illustrates how the scheme complies with the London Plan Energy Hierarchy and follows passive and efficiency improvements before the application of any Low or Zero Carbon (LZC) sources.

6. Envision have produced Part L1A (2013) compliant SAP calculations in order to determine the energy and CO2 emissions for the proposed development.

7. To reduce the energy demand of the building the following passive design measures have been incorporated into the strategy:

    - Building fabric (U-values) improved over the Building Regulation minimum values.
    - Air permeability greatly reduced compared to Building Regulation minimum values.
    - Enhanced construction details reducing losses associated with thermal bridging.
    - Solar control glazing with low solar gain transmittance (G-value) to reduce risk of overheating.
    - Efficient central mechanical extract systems to provide improved air quality to the wet rooms and kitchens.
    - Encouraged use of natural light through optimised window design to minimise the need for artificial lighting.
    - Low energy lighting to be used throughout to supplement natural light when required.
    - Individual high efficient gas fired boilers within each apartment to meet heating and hot water demand with reduced energy consumption.
    - Energy display devices and associated metering to be provided to tenants to increase awareness of energy consumption.
    - Recommendation to building occupiers to use energy efficient appliances.

8. The figures used as a basis for this report are discussed further in section 3.

Predicted carbon savings

9. The regulated baseline for the development (Part L 2013 compliant) has been calculated as being **19.36 tonnes.CO_2.year**.

10. The CO_2 emissions following reductions at the 'Be-Lean' Stage, i.e. energy-efficient stage, have been calculated at **19.25 tonnes.CO_2.year**. This represents a **0.61%** reduction in carbon emissions over the Part L 2013 compliant baseline.

11. The 'Be-Green' stage, i.e. on-site renewables/low carbon technology accounted for the proposed installation of;

12. A Photovoltaic (PV) array included on the uppermost roof(s) of the building. The PV array is estimated to have an output of **9,520 kWh** per year and an associated active PV area of 57m^2;

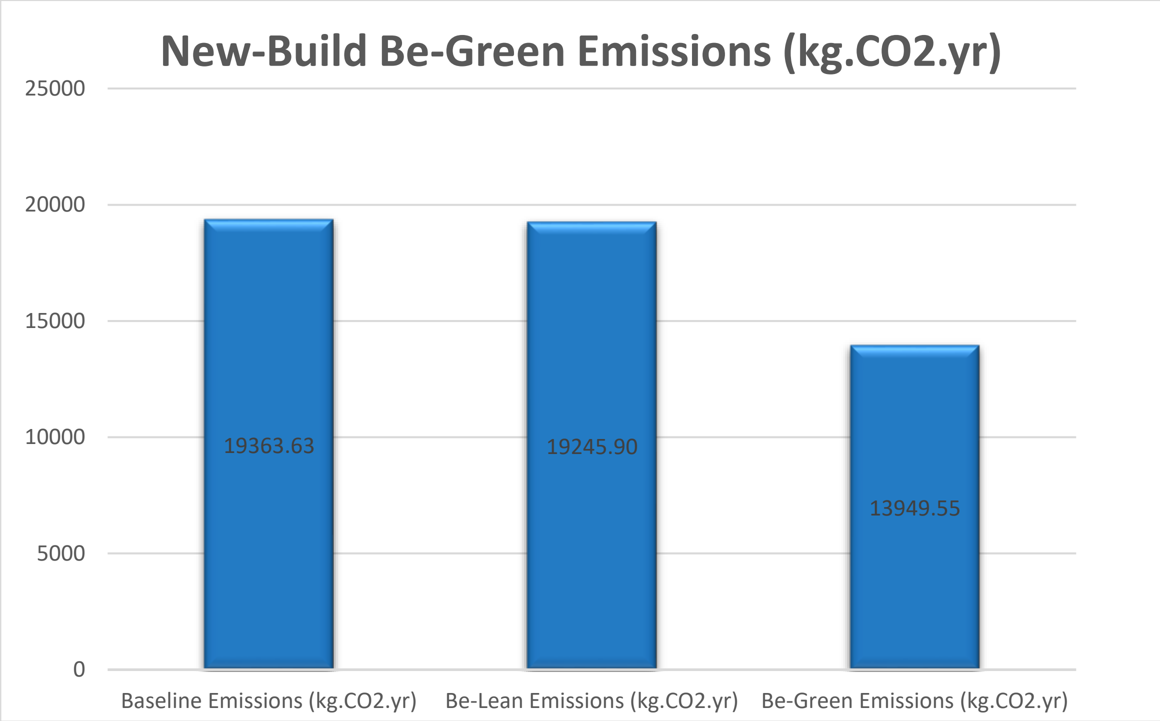
13. The CO_2 emissions following reductions at the 'Be-Green' Stage, i.e. on-site renewables/low carbon technology, have been calculated at **13.95 tonnes.CO_2.year**. This represents a **27.35%** reduction in carbon emissions over the 'Be-Lean' Stage.

14. Therefore, in total the development reduces CO_2 emissions by **27.96%** over the Part L 2013 baseline, thereby complying with Camden Council and the London Plan energy policy with regards to minimum CO_2 emission reductions for minor residential developments.

15. As the site has demonstrated an expected reduction of **27.96%** over the part L 2013 requirements, with 20% being achieved via on-site renewables compliance with the criteria set out within the Section 106 document has been demonstrated. The tables below demonstrates the residential regulated CO_2 savings at each stage of the hierarchy.

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	19.36	15.89
After energy demand reduction	19.25	15.89
After heat network / CHP	n/a	n/a
After renewable energy	13.95	15.89

	Regulated domestic carbon dioxide savings	
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	0.12	0.61%
Savings from heat network / CHP	n/a	n/a
Savings from renewable energy	5.3	27.35%
Cumulative on-site savings	5.41	27.96%


New-Build Be-Green Emissions (kg.CO2.yr)
25000
20000
15000
10000
5000
0
19363.63
19245.90
13949.55
Baseline Emissions (kg.CO2.yr)
Be-Lean Emissions (kg.CO2.yr)
Be-Green Emissions (kg.CO2.yr)

1 INTRODUCTION

1.1 Envision have been appointed by Almax Group to prepare an update for the Energy Statement associated with the St. John's Wood Park development. The updated report will be used to satisfy the requirements of the section 106 agreement relating to the land known as Land Adjacent to 1 St John's Wood Park London NW8 6QS forming part of the planning conditions for the site.

1.2 The site consists of 9no. apartments across 7 floors located within the London borough of Camden.

Scope

1.3 This Energy Statement provides information on the predicted carbon emissions of the development and includes an analysis of the potential contribution that renewable and low carbon technologies could contribute towards reducing the energy and associated CO_2 emissions for the scheme.

1.4 This Energy Statement sets the parameters of detailed design, but remains at a strategic level. The calculations in this document are an indication of system size and carbon emissions based on guidance documents, approved software and practical experience. They are not design calculations but establish the viability and feasibility of various technologies for the proposed development.

1.5 This statement is structured as follows:

- Section 2 provides a description of the site and the development proposals;
- Section 3 provides a description of the main energy policies relevant to the application;
- Section 4 provides an overview of the consented energy strategy for the site;
- Section 5 provides an energy assessment, structured against the requirements of the policies examined in Section 3.

2 CONTEXT AND PROPOSALS

Location

2.1 St. Johns Wood Park is located within the London borough of Camden situated near Primrose Hill and Swiss Cottage underground station, the illustration below indicates the site location.

The Proposed Development

2.2 The development will be located on land currently occupied disused garages which are to be demolished to enable the redevelopment of the land in the form of a 7 story building.

2.3 The proposed apartment building will include 9no. apartments and associated communal/amenity spaces. There is to be a mix of apartment types including duplex's, 2 bed and 3 bed apartments.

3 ENERGY POLICY CONTEXT

3.1 A key mechanism for delivering the principles of low-carbon development lies within the UK planning system, which is implemented through national guidance along with regional and local planning policies. A review of all the relevant policy documents was undertaken in order to gain an understanding of the guiding policies for energy and CO_2 reduction.

National Planning Policy

3.2 The National Planning Policy Framework (NPPF) replaces the majority of the Planning Policy Guidance Notes and Statements. The NPPF sets out a presumption in favour of sustainable development, and the need to support sustainable economic growth through the planning system.

3.3 The NPPF identifies that there are three dimensions to sustainable development: economic, social and environmental. These dimensions give rise to the need for the planning system to perform a number of roles:

- **An economic role** – contributing to building a strong, responsive and competitive economy, by ensuring that sufficient land of the right type is available in the right places and at the right time to support growth and innovation; and by identifying and coordinating development requirements, including the provision of infrastructure;
- **A social role** – supporting strong, vibrant and healthy communities, by providing the supply of housing required to meet the needs of present and future generations; and by creating a high quality built environment, with accessible local services that reflect the community's needs and support its health, social and cultural well-being; and
- **An environmental role** – contributing to protecting and enhancing our natural, built and historic environment; and, as part of this, helping to improve biodiversity, use natural resources prudently, minimise waste and pollution, and mitigate and adapt to climate change including moving to a low carbon economy.

3.4 Planning plays a key role in helping shape places to secure radical reductions in greenhouse gas emissions, minimising vulnerability and providing resilience to the impacts of climate change, and supporting the delivery of renewable and low carbon energy and associated infrastructure. This is central to the economic, social and environmental dimensions of sustainable development. The NPPF does not include detailed measures on sustainable design codes and standards to apply, although expects that when setting any local requirement for a building's sustainability, local planning authorities should do so in a way consistent with the Government's zero carbon buildings policy and adopt nationally described standards.

The London Plan

3.5 The London Plan (2016) sets out the Mayor's vision for London. In accord with the NPPF, it promotes economic development, and endorses the principles of sustainable development. It is the main vehicle for strategic decision-making on London's development, including development decisions.

3.6 The Plan contains a number of policies directly related to a development's sustainable design and energy reduction, including:

- Policy 5.1 Climate change mitigation;
- Policy 5.2 Minimising carbon dioxide emissions;
- Policy 5.3 Sustainable design and construction;
- Policy 5.6 Decentralised energy in development proposals;
- Policy 5.7 Renewable energy;
- Policy 5.9 Overheating and cooling;
- Policy 5.10 Urban greening;
- Policy 5.11 Green roofs and development site environs;
- Policy 5.15 Water use and supplies, and
- Policy 7.2 An inclusive environment.

3.7 Of particular importance to the CO_2 and Energy reductions required for a development is *Policy 5.2: Minimising carbon dioxide emissions.*

3.8 Policy 5.2 requires that development proposals should make the fullest contribution to minimising 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

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

3.10 Targets have been identified within the London Plan for 'Major' Developments which is classified as schemes containing 10 or more dwellings. As this scheme has fewer then 10 dwellings it is not subject to the targets set out within the London plan policy, the strategy for the site has however been established in line with the energy hierarchy set out within the London plan.

Camden Local Plan

3.11 The Camden local Plan was adopted on the 3rd July 2017, replacing the Core Strategy and Camden Development Policies.

3.12 Policy CC1 relates to climate change mitigation measures for the borough. This policy sets out requirements for all new schemes which will be considered by Camden council as part of the planning process. The requirements of Policy CC1 has been extracted below.

3.13 The Council will require all developments 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.

3.14 We will:

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

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

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

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

3.15 Further guidance which form part of the Policy CC1 document details that all developments involving 5 or more dwelling and/or 500 sqm of (gross internal) and floor space will be required to demonstrate a 19% CO_2 reduction below Part L 2013 Building Regulations.

3.16 Furthermore the Council will expect developments of 5 or more dwellings and/or more than 500 sqm of and gross internal floor space to achieve a 20% reduction in carbon dioxide emissions from on-site renewable energy generation, unless it can be demonstrated that such a prevision is not feasible.

Section 106 Agreement

3.17 Following planning consent a section 106 agreement relating to the land known as Land adjacent to 1 St John's Wood Park London NW8 6QS was provided. This details the outstanding planning conditions that need to be discharged in order to satisfy the planning requirements. The following have been highlighted within the agreement regarding the energy statement.

3.18 Section 2.18 of the document states:

A strategy setting out a package of measures to be adopted by the Owner in the management of the Development with a view to reducing carbon energy emissions through (but not be limited to) the following:-

- *The incorporation of the measures set out in the Energy and Sustainability Statement, prepared by Ridge and Partners LLP and dated 26 September 2018, or an alternate Energy & Sustainability Statement, also demonstrating compliance with the requirements of Camden Policy CC1 and which has been approved by the Council in writing.*
- *further details (including detailed drawings, any necessary surveys and system specifications) of how the Owner will reduce the Development's carbon emissions from renewable energy technologies located on the Property ensuring the Owner will target a reduction of at least 20% in carbon emissions in relation to the Property using a combination of complementary low and zero carbon technologies;*
- *separate metering of all low and zero carbon technologies to enable the monitoring of energy and carbon emissions and savings;*
    - *a building management system being an electronic system to monitor the Development's heating cooling and the hours of use of plant;*
- *include a pre-Implementation design-stage review by an appropriately qualified and recognised independent professional in respect of the Property including Full Design stage SAP calculations certifying that the measures incorporated in the Energy Efficiency and Renewable Energy Plan are achievable in the Development and satisfy the aims and objectives of the Council's strategic policies on the reduction of carbon emissions contained within its Development Plan;*
- *measures to secure a post construction review of the Development by an appropriately qualified and recognised independent professional in respect of the Property (including but not limited to photographs, installation contracts and full As-Built SAP calculations certifying that the measures incorporated in the Energy Efficiency and Renewable Energy Plan have been achieved in the Development and will be maintainable in the Development's future management and occupation; and*
- *identifying means of ensuring the provision of information to the Council and provision of a mechanism for review and update as required from time to time*

Summary of Policy Targets

3.19 Therefore, the targets to be met by this development are;

- To follow the energy hierarchy when developing the Energy Strategy for the development;
- Aim to reduce carbon emissions associated with the site by a minimum of 19% over Building Regulation Part L 2013 requirements;
- Off set 20% of the sites carbon emissions through the use of on-site renewable or low carbon technology where feasible.
- Meet the Target Fabric Energy Efficiency requirements set out within the Building Regulations Part L1A conservation of fuel and power.

4 CONSENTED ENERGY STRATEGY

4.1 The scheme gained planning approval based on the consented energy and sustainability statement from the 26th September 2018 which was developed by Ridge and Partners LLP for the site. Due to design progression and technical implications associated with the scheme it has been necessary to revise the consented strategy with the outcome of this being included within this report. This section of the report sets out the key areas of the consented scheme which have been revised within the updated strategy.

4.2 One of the key targets set out within the Consented Energy Strategy was to reduce energy demand as far a technically feasible. The development of the design has prioritised this and the targets have been met within the revised strategy to ensure the demand of the site is minimised. As such the U-values, thermal brigading and air permeability are as identified in the consented strategy.

4.3 The 'Be Clean' measures that were identified within the original strategy have been further considered during the progression of the design. Several technical drawbacks have been identified which have been addressed as part of the revised strategy. The below points summarise the areas that have been identified.

- Based on discussions with manufacturers it has been highlighted that there are issues in reporting efficiencies of communal systems which use Air Source Heat Pumps (ASHPs) as heat sources for both heating and domestic hot water. This is due to the significant change in efficiency associated with the variance of temperatures needed for the different systems. Heating circuits are able to operate at lower temperatures when compared with domestic hot water systems which need to operate above 60^{O}C to mitigate the risk of legionnaires.
- When using a community system there are additional losses associated with the distribution system which can be avoided with an alternative configuration. Due to the size of the system the benefit of introducing a communal system is reduced and as such it is advantageous to utilise independent systems
- The use of a communal heating system requires a centralised billing and metering system to be used within the building that is owned and managed by the building operator. Due to the size of the building it is not financially feasible to have a system of this type installed, costs would be passed onto the tenants who would be tied into paying excessive unit costs for the heat supplied.
- The use of independent systems for each dwelling owned and operated by the individual tenant allows the tenants to have full control over their heating system in regards to both plant and energy supplier.
- While the proposals allow for independent systems, they are to be water based so that in the event of a viable heat network becoming live in the future there is opportunity to facilitate a connection with minimal remedial works being required.

4.4 A number of options were identified within the consented Energy Strategy as part of the Be Green stage. The use of ASHP were deemed the most appropriate for the proposed strategy.

Based on further technical design and discussions with manufacturers in reference to the site specifics a number of considerations have been raised. The following points summarise the key items raised.

- The proposed Mitsubishi heat pump system is unable to provide heating, domestic water and cooling. In order to achieve this 2 sets of external plant would be required to serve each apartment. This is unachievable with the roof space provided without significantly restricting the manufacturers space requirements for both air movement and maintenance access.
- With the scheme providing both heating and domestic hot water the system will not operate with the seasonal efficiency identified within the consented strategy. This would result in the level of savings being significantly lower than stated within the consented strategy.
- The alternative viable technologies identified within the Consented Energy Strategy were Photovoltaic (PV) panels and solar thermal panels. PV panels were discounted due to the limited roof space and inclusion of ASHP taking up a proportion of this. The scheme has been carefully reconsidered to reduce the amount of external plant required at roof level. This has made it viable to include a significant proportion of PV on the roof.

5 ESTABLISHING ENERGY AND CARBON EMISSIONS

5.1 This section summarises the methodology undertake when assessing the energy demand and associated carbon emissions for the site.

5.2 In accordance with NCM guidance, the appropriate methodology for calculating the residential development's energy performance is "The Governments Standard Assessment Procedure (SAP) for Energy Rating of Dwelling". This procedure was undertaken using the accredited software Stroma FSAP 2012 Version 1.0.5.8 which is a DCLG approved methodology and software for undertaking SAP assessments.

5.3 A sample of representative apartments have been modelled to illustrate the impact of the proposed strategy on the energy demand and carbon emissions for the site. The results from the sample have been proportionally extrapolated in order to determine the estimated figures for the whole scheme. The units that have been selected are highlighted in appendix A.

5.4 When assessing the energy savings the results have been broken down in line with the GLA's energy Hierarchy 'Be Lean', 'Be Clean' and 'Be Green'. The following sections summarise the measures and systems that have been incorporated into the scheme to minimise energy demand and consumption for the development.

5.5 The savings set out within this statement have been expressed against a Building Regulation Part L 2013 Target Emission Rate (TER).

5.6 The TER for the development has been calculated using the accredited software indicated in section 5.2.

5.7 The calculated carbon emissions for the target emission rates are illustrated below. The figures demonstrate a Building Regulations 2013 compliant model.

	Target Regulated Emissions (Tonnes.CO_2.yr)	Unregulated Emissions (Tonnes.CO_2.yr)
Residential Development	19.36	15.89

Be Lean- demand reduction

5.8 The Greater London Authority seeks a 'fabric first' approach to reducing the carbon footprint of London's built environment. This is achieved through buildings using less energy by improving u-values, air-tightness and lighting efficiency amongst others. This is the first step to consider in reducing a building's carbon emissions before the efficient delivery of power, heat or renewables are considered by a design-team. The following details the demand reduction measures that have been incorporated into the scheme.

Fabric Efficiency

5.9 The building fabric is a key parameter that effects the energy required to maintain comfortable internal conditions. Fabric performance is centred around the U-value of the building elements that form the buildings thermal envelope. The u-value expresses the ability of a material to transmit heat so the lower the value the better the insulation properties resulting in lower heating energy demand to maintain the internal conditions. The table below summarises the proposed fabric performance for the site.

Elements	New Thermal Elements: U-Values – W/m^2 K	Comment
External Wall	0.16	n/a
Wall to unheated corridor/stairwell	0.25	n/a
Party Walls	0	
Ground/Exposed Floor	0.13	n/a
Flat Roof	0.13	n/a
Residential Window Units	1	Assumed as double-glazed, argon filled with a G-value of 0.45 and a light transmittance of greater than 60%
Apartment Entrance Doors	1	n/a

5.10 Thermal bridging is a significant factor when determining the fabric performance, it is proposed that the allowances set out within the table below are used to improve the thermal efficiency of the building.

Junction Type	Ref	PSI Value (W/mK)	Description
Other Lintels (including other steel lintels)	E2	0.3	ACD
Sill	E3	0.04	ACD
Jamb	E4	0.05	ACD
Ground Floor	E5	0.16	ACD
Intermediate Floor between Dwellings	E6	0.07	ACD
Part Floor Between Dwellings	E7	0.07	ACD
Flat Roof	E14	0.08	Default
Flat Roof (with Parapets)	E15	0.56	Default
Corner (normal)	E16	0.09	ACD
Corner (inverted)	E17	-0.09	ACD
Party Wall between Dwellings	E18	0.06	ACD
Basement Floor	E22	0.07	Default
Staggered Wall Between Dwellings	E25	0.12	Default
Party Wall and Roof	P4	0.24	Default

Air Permeability

5.11 The designed air permeability rate has been set at 3 $m^3/h.m^2$ @ 50Pa for the development.

Lighting Strategy

5.12 The SAP calculations do not allow for the specification of lighting elements. However, it is proposed that all light fittings with be low energy LED type with local manual switching with occupancy sensing where appropriate.

5.13 Where external fittings are to be included they will comply with the following:

5.14 Either a):

- Lamp capacity not greater than 100 lamp-watts per light fitting, and
- All lamps automatically controlled so as to switch off after the area lit by the fitting becomes unoccupied, and
- All lamps automatically controlled so as to switch off when daylight is sufficient.

5.15 Or b):

- Lamp efficiency greater than 45 lumens per circuit-watt, and
- All lamps automatically controlled so as to switch off when daylight is sufficient, and
- Light fittings controllable manually by occupants.

Ventilation strategy

5.16 The apartments will include centralised mechanical extract for each of the wet rooms and kitchens. This will enable indoor air quality to be maintained while minimising the energy associated with the ventilation system.

Heating and hot water

5.17 It is proposed that the heating and hot water for the apartments will be provided by individual gas fired system boilers within each apartment. This will serve underfloor heating and a domestic hot water cylinder to provide the heating and hot water to the apartment.

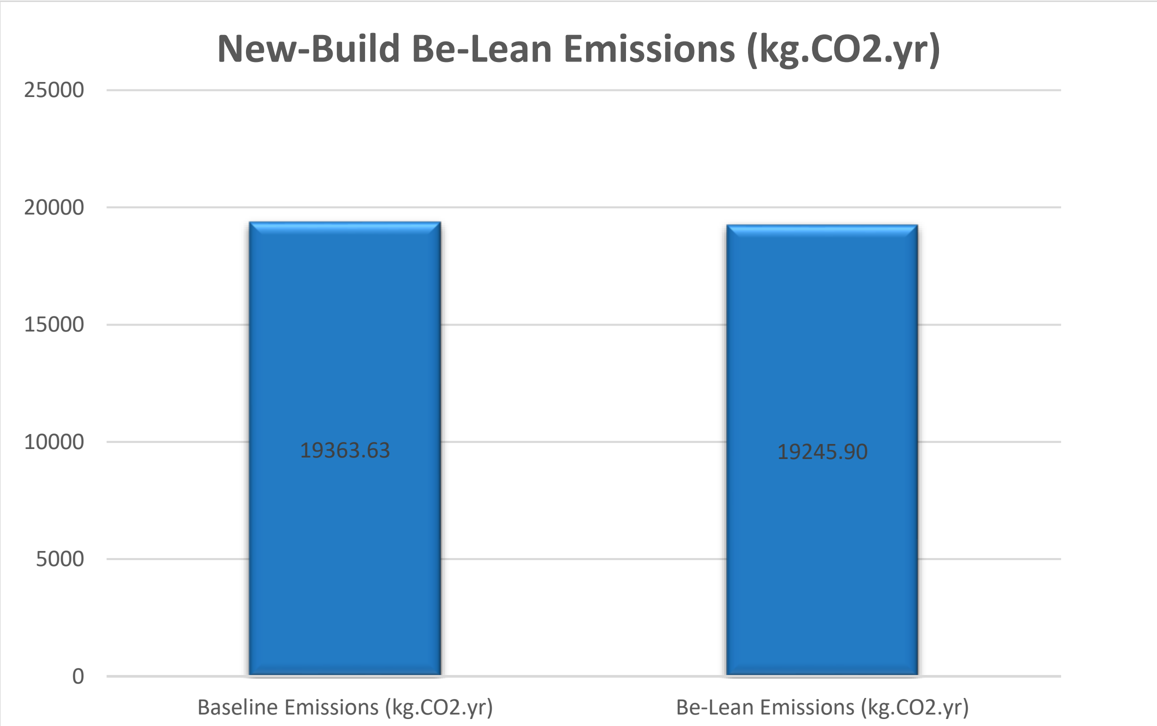
Cooling Strategy

5.18 A direct electric, ASHP system will provide comfort cooling to each bedroom, living, dining and kitchen space. This will serve floor standing fan coil units located within each space.

Be Lean Stage CO_2 Reductions

5.19 The following tables and graphs represent the lean stage improvements for the developments over the Target Emission Rate (TER) baseline emissions;

	Be-Lean Regulated Emissions (Tonnes.CO_2.yr)	Unregulated Emissions (Tonnes.CO_2.yr)
Residential Development	19.25	15.89
Difference over Baseline	0.12	
% Difference	**0.61**	



5.20 As detailed above, the measures as taken at 'Be-Lean' stage would result in a **0.61%** reduction in the sitewide regulated CO_2 emissions over the Building Regulations Part L 2013 Target Emission Rate.

Overheating Mitigation

5.21 Policy 5.9 of the London Plan (2016) seeks to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation, and to reduce overheating due to the impacts of climate change and the urban heat island effect on an area wide basis. This section of the report summaries the measures that have been employed within the scheme to mitigate the risk of overheating.

5.22 The scheme has followed the GLA's best practice 'Cooling Hierarchy' when considering overheating mitigation measures. The table below summarises the cooling hierarchy that has been followed.

Table 6.1 – Overheating Mitigation Measures

Cooling Method	Measures Employed
Minimising internal heat generation through energy efficient design	Lateral pipework will run through ventilated residential corridors to ensure internal heat gains are minimised. The g-value of all installed glazing will be as low as feasible possible (currently proposed as 0.45) in order to reduce internal solar gain.
Reducing the amount of heat entering the building in summer	Glazing proportions have been optimised to maximise winter solar gains, lowering heating demand, while limiting summer solar gains. Minimising south facing glazing to reduce the solar gains. Use of solar control glazing to maximise natural light while limiting the solar gains into the space.
Use of thermal mass and high ceilings to manage the heat within the building	The building is proposed to be a medium weight construction to allow heat to be absorbed during peak temperatures and released during cooler night time periods.
Passive ventilation	The dwellings have been designed with a shallow floor plate, openable windows and promote cross-ventilation where possible.
Mechanical ventilation	Centralised mechanical extract in wet rooms and kitchens to promote good air movement within the apartments.

5.23 Living spaces and bedrooms have been provided with active cooling for commercial reasons however the installed capacity has been limited through the use of the cooling demand reduction measures set out within the above table. The flowing demonstrates the effectiveness of the overheating mitigation measures on a sample of bedrooms within the scheme through the use of a TM59 Assessment.

CIBSE TM59 Assessment

5.24 The latest criteria for the assessment of overheating risk have been specified by the Chartered Institute of Building Services Engineers (CIBSE) in CIBSE TM59: Design methodology for the assessment of overheating risk in homes (2017). CIBSE TM59 is based on CIBSE TM52 and CIBSE Guide A guidance documents, and provides a standardised approach to predicting overheating risk for both naturally and mechanically ventilated residential buildings.

5.25 The new CIBSE TM59 guidance requires that the following two criteria must be met in order to demonstrate compliance:

- For living rooms, kitchens and bedrooms: the number of hours during which the operative temperature exceeds the comfort threshold temperature is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 per cent of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance);
- For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours. (CIBSE Guide A Fixed temperature threshold).

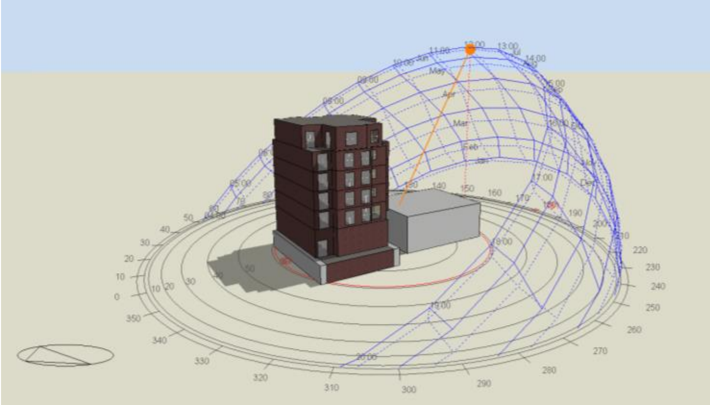
  (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32.85 hours, so 33 or more hours above 26 °C will be recorded as a fail).

5.26 The inclusion of corridors in the overheating analysis is mandatory where community heating pipework runs through them. The overheating test for corridors should be based on the number of annual hours for which an operative temperature of 28 °C is exceeded. Due to no community heating pipework being located in the corridors this has not been applied.

5.27 Whilst there is no mandatory target to meet, if an operative temperature of 28 °C is exceeded for more than 3% of the total annual hours, then this should be identified as a significant risk within the report.

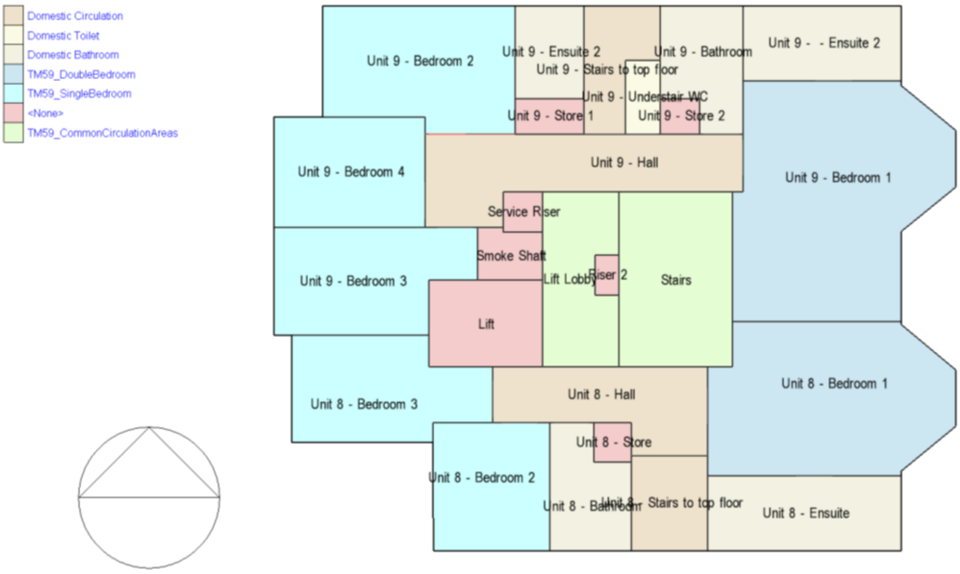
Modelling Methodology

5.28 The performance of the units has been assessed under CIBSE TM59 adaptive comfort model for a primarily natural ventilated scenario through the EnergyPlus engine using DesignBuilder v.6.1.0.006. Figure 6.1 below illustrates the model that has been used as a basis of the analysis.



5.29 For the purposes of the assessment, a number of worst-case single-aspect units were selected, including:

- Unit 1 - South Facing, 4-Bedroom 2 storey-apartment over Ground Floor and Basement
- Unit 4 - North Facing, 2 Bedroom apartment on the 2[nd] floor
- Unit 5 - South Facing, 3 Bedroom apartment on the 2[nd] floor
- Unit 8 - South Facing, 3 Bedroom apartment on the 4th floor



Site External Weather Conditions

5.30 The effects of external conditions are vital in an overheating assessment as, in particular, they influence:

- Solar heat gains (a function of incident direct & diffuse solar radiation and solar altitude);
- Calculated natural ventilation rates (a function of external temperature, wind directions and speeds).

5.31 CIBSE Design Summer Year weather data for London Heathrow (representative of urban areas outside the Central Activity Zone) has been used for the 2020s, high emissions, 50% percentile scenario as required by CIBSE TM59 guidance and as the most relevant to the location of the proposed development site.

Model Inputs

5.32 All fabric and M&E inputs to the EnergyPlus model are in line with the measures outlined in this report. Design Inputs specific to the TM59 analysis have been detailed below:

Table 6.2 – Model Inputs

Input	Parameters	Comment
Building Fabric & Construction	As per inputs detailed in 'Be-Lean' section	-
Window & Balcony Doors	Glazing g-value to be specified at 0.45 as per 'Be-Lean' section.	-
Internal Shading	No blinds have been included.	-
Natural Ventilation	Windows to have effective free area of 40% Balcony doors assumed to open to 90%. All windows to operate in accordance with TM59 schedules.	Windows have been included in detail design.

Internal Gains

5.33 The following internal gains assumptions (Table 4.16) have been made in the DesignBuilder EnergyPlus model, in line with the CIBSE TM59 guidance and mechanical calculations undertaken by the applicant:

Table 6.3 – Internal Gains Assumptions

Unit/Room Type	Occupancy	Equipment Load
2 Bed Apartment: Living/Kitchen	2 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day

3 Bed Apartment: Living/Kitchen	3 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
Double Bedroom	2 people at 70% gains from 11 pm to 8 am 2 people at full gains from 8 am to 9 am and from 10 pm to 11 pm 1 person at full gain in the bedroom from 9 am to 10 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during the sleeping hours
Single Bedroom	1 person at 70% gains from 11 pm to 8 am 1 person at full gains from 8 am to 11 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during sleeping hours
All Rooms – Lighting	n/a	Lighting assumed 2 W/m² from 6pm to 11pm
Internal DHW	n/a	A standing loss of 57 W for the DHW cylinder has been assumed for the cylinder as taken from datasheets presented in Appendix VI.

TM59 Results – Dwellings (DSY 1)

5.34 The table below summarises the results given by running dynamic thermal simulations for the buildings under the current design summer year (1989) for the 2020s high emission, 50% percentile scenario, as required by CIBSE TM59.

Table 4.16 – EnergyPlus TM59 Output (DSY 1)

Block	Zone	Criterion A (%)	Criterion B (hr)	Pass/Fail
Basement - Unit 1	Bedroom1	0	3	Pass
Basement - Unit 1	Bedroom3	0	2	Pass
Basement - Unit 1	Bedroom4	0	3.5	Pass
GroundFloor - Unit 1	Bedroom2	0	7.67	Pass
Second Floor - Unit 4	Bedroom 1	0.23	16.5	Pass
Second Floor - Unit 4	Bedroom 2	0.2	12.83	Pass
Second Floor - Unit 5	Bedroom 1	0.11	14.67	Pass
Second Floor - Unit 5	Bedroom 2	0.16	16	Pass
Second Floor - Unit 5	Bedroom 3	0.48	18.17	Pass
Fourth Floor - Unit 8	Bedroom 1	0.17	3.67	Pass
Fourth Floor - Unit 8	Bedroom 2	0.41	10	Pass
Fourth Floor - Unit 8	Bedroom 3	0.18	6.33	Pass
Fourth Floor - Unit 9	Bedroom 1	0.18	3.83	Pass
Fourth Floor - Unit 9	Bedroom 2	0.16	7.83	Pass
Fourth Floor - Unit 9	Bedroom 3	0.11	7.33	Pass
Fourth Floor - Unit 9	Bedroom 4	0.16	7.83	Pass

5.35 Results presented above demonstrate that, based on the design and internal gain assumptions, all rooms pass the CIBSE TM59 standard. The applicant has therefore determined that the design has demonstrated an acceptable level of overheating risk.

TM59 Results – Communal Corridors

5.36 Under CIBSE TM59 (2017) guidance, the maximum recommended temperature of 28^{o}C should not be exceeded for more than 3% of the total annual hours for the communal corridor areas.

5.37 The table below summarises the outputs given by running dynamic thermal simulations under the CIBSE Design Summer Year, for the 2020s, high emissions, 50% percentile scenario. This has been run on access corridors and apartment circulation areas.

Table 4.17 – EnergyPlus TM59 Output - Corridor

Block	Zone	% Hours Exceded	Pass/Fail
Basement - Unit 1	Lobby	0	Pass
Basement - Unit 1	Stairs To FF	0	Pass
GroundFloor - Unit 1	CommunalStairs	0	Pass
GroundFloor - Unit 1	Hall	0	Pass
Ground Floor	Lobby	0	Pass
Ground Floor	Lobby2	0	Pass
Ground Floor	Stairs	0	Pass
Second Floor	Lobby	0	Pass
Second Floor	Stairs	0	Pass
Second Floor - Unit 4	Hall	0	Pass
Second Floor - Unit 5	Hall	0	Pass
Fourth Floor - Unit 8	LiftLobby	0	Pass
Fourth Floor - Unit 8	Stairs	0	Pass
Fourth Floor - Unit 8	Hall	0	Pass
Fourth Floor - Unit 9	Hall	0	Pass

5.38 As detailed above, the communal corridor achieves compliance with the TM59 communal corridor criteria through the use of these mitigation measures.

TM59 Results – Future Weather Scenarios

5.39 In line with the 'GLA guidance on preparing energy assessments', additional TM59 testing was undertaken using the 2020 versions of the following more extreme design weather years:

- DSY2 – 2003: a year with a very intense single warm spell;
- DSY3 – 1976: a year with a prolonged period of sustained warmth.

5.40 CIBSE DSY2 and DS3 weather files for London Heathrow (representative of urban areas outside the Central Activity Zone) have been used for the 2020s, high emissions, 50% percentile scenario as required by CIBSE TM59 guidance and as the most relevant to the location of the proposed development site.

Table 4.18 – EnergyPlus TM59 Output (DSY2 – 2020s)

Block	Zone	Criterion A (%)	Criterion B (hr)	Pass/Fail
Basement - Unit 1	Bedroom1	0.04	7.83	Pass
Basement - Unit 1	Bedroom3	0	6	Pass
Basement - Unit 1	Bedroom4	0.09	8.67	Pass
GroundFloor - Unit 1	Bedroom2	0.35	21.33	Pass
Second Floor - Unit 4	Bedroom 1	0.77	40	Fail
Second Floor - Unit 4	Bedroom 2	0.91	36.17	Fail
Second Floor - Unit 5	Bedroom 1	0.55	35.33	Fail
Second Floor - Unit 5	Bedroom 2	0.63	36.83	Fail
Second Floor - Unit 5	Bedroom 3	0.86	39.33	Fail
Fourth Floor - Unit 8	Bedroom 1	0.71	7	Pass
Fourth Floor - Unit 8	Bedroom 2	0.87	24.17	Pass
Fourth Floor - Unit 8	Bedroom 3	0.71	17	Pass
Fourth Floor - Unit 9	Bedroom 1	0.7	7.33	Pass
Fourth Floor - Unit 9	Bedroom 2	0.58	20.5	Pass
Fourth Floor - Unit 9	Bedroom 3	0.54	17.17	Pass
Fourth Floor - Unit 9	Bedroom 4	0.58	17.83	Pass

Table 4.19 – EnergyPlus TM59 Output (DSY3 – 2020s)

Block	Zone	Criterion A (%)	Criterion B (hr)	Pass/Fail
Basement - Unit 1	Bedroom1	0	17.83	Pass
Basement - Unit 1	Bedroom3	0	14.5	Pass
Basement - Unit 1	Bedroom4	0	18.17	Pass
GroundFloor - Unit 1	Bedroom2	0.4	37.5	Fail
Second Floor - Unit 4	Bedroom 1	1.1	64.33	Fail
Second Floor - Unit 4	Bedroom 2	0.98	55.5	Fail
Second Floor - Unit 5	Bedroom 1	0.88	62	Fail
Second Floor - Unit 5	Bedroom 2	0.91	62.17	Fail
Second Floor - Unit 5	Bedroom 3	1.37	67	Fail
Fourth Floor - Unit 8	Bedroom 1	0.58	13.5	Pass
Fourth Floor - Unit 8	Bedroom 2	1.24	39.5	Fail
Fourth Floor - Unit 8	Bedroom 3	0.69	26.33	Pass
Fourth Floor - Unit 9	Bedroom 1	0.65	13.83	Pass
Fourth Floor - Unit 9	Bedroom 2	0.88	37.17	Fail
Fourth Floor - Unit 9	Bedroom 3	0.63	29.17	Pass
Fourth Floor - Unit 9	Bedroom 4	0.71	30.67	Pass

5.41 As noted in the two figures above, under either weather scenario the dwellings perform well against requirements of TM59 Criterion A (hours of exceedance). Against Criterion B, relating to maximum bedroom temperatures, there are moderate failures.

5.42 The applicant notes the GLA guidance in relation to this issue which states: *"It is acknowledged that meeting the CIBSE compliance criteria is challenging for the DSY 2 & 3 weather files. Where the CIBSE compliance criteria is not met for a particular weather file the applicant must demonstrate that the risk of overheating has been reduced as far as practical and that all passive measures have been explored, including reduced glazing and increased external shading".*

5.43 The strictness of Criterion B is also acknowledged which requires; "For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours. (CIBSE Guide A Fixed temperature threshold). Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32.85 hours, so **33** or more hours above 26 °C will be recorded as a fail.

5.44 Therefore, given the cooling hierarchy has been followed and implemented, the mandatory TM59 standard (using DSY 1 weather files) has been passed, and the extent of DSY 2 & 3 non-compliance is deemed to be moderate, the applicant believes the development has demonstrated that the risk of overheating has been reduced as far as practical.

5.45 Through the above assessment it has been demonstrated that, while active cooling has been provided to suit market demands, the development has been designed to prioritise passive mitigation measures. This reduces the requirement to use comfort cooling as part of the core overheating mitigation strategy and further more reduces the cooling demand for any comfort cooling being utilised.

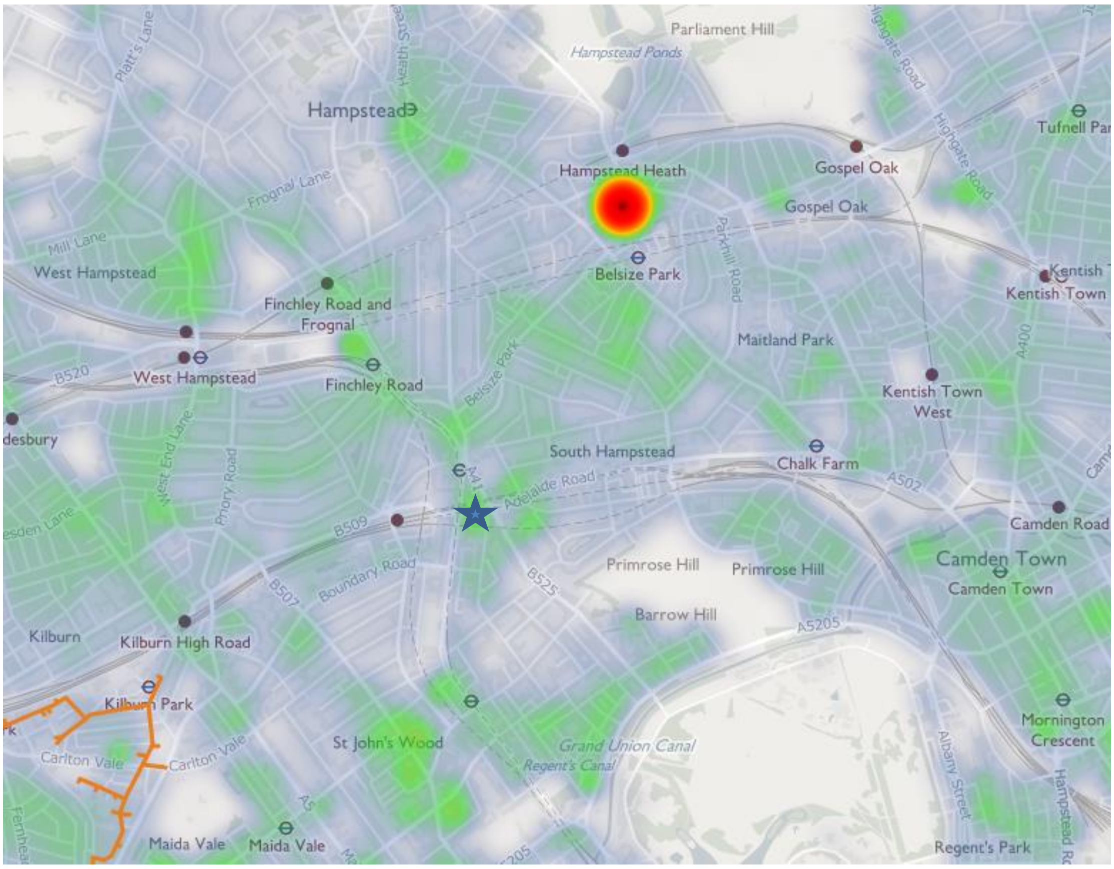
Be Clean – Heating Infrastructure

5.46 The 'Be-Clean' stage requires that any energy supplied to major developments should be as efficient as possible by selecting energy systems in accordance with the following hierarchy:

- Connection to existing heating or cooling networks (including potential networks);
- Site wide CHP network;
- Communal heating and cooling.

Connection to Existing Heating or Cooling Networks

5.47 Consideration has been given to connection to existing heating or cooling networks, the feasibility study used the London Heat Map to assess if there are any suitable networks in the vicinity of the site. The figure below indicates the site location on the heat map and it can be seen that there are no suitable proposed or existing heat networks that would be feasible for the site to connect to.



5.48 The site has been indicated on the map, currently there are now networks in the area. The closest proposed network is around a mile away in the Kilburn area.

5.49 It has been deemed unfeasible to connect to heat networks at this time.

Site Wide CHP Heating Network

5.50 As outlined in GLA guidance, medium-large residential led mixed use developments are suitable for the installation of Combined Heat and Power (CHP), with it being the lead heat source for a site heat network, with top-up boiler plant meeting the peak demands.

5.51 CHP engines work by generating electricity through burning natural gas and recapturing the waste heat to provide low temperature hot water. The cogeneration process produces greater fuel efficiencies being achieved and reduces transmission losses.

5.52 While the residential nature of the scheme would provide a suitable heating baseload which would enable the CHP unit to run without dumping excess heat, the size of the scheme would not be suitable to enable a CHP to run efficiently.

Site Wide Heating Network

5.53 Due to the size of the scheme it would be beneficial to utilise decentralised heating plant. It is proposed that each apartment incorporates a high efficiency system boiler and local hot water cylinder. This would remove the need to run distribution pipework through communal areas thus reducing the risk of overheating in these areas.

Be Clean Stage CO_2 Reductions

5.54 Due to the configuration and size of the development it has been deemed unfeasible to introduce a CHP led communal heating system to the building, furthermore due to the limited savings and site constraints it has been proposed that a communal system is not used on the site in favour of individual high efficiency boilers.

Be Green – Renewable Energy

5.55 As detailed in the consented energy statement the three technologies that have been determined to be feasible for the site are:

- Air source heat pumps;
- Photovoltaic Panels;
- Solar thermal Panels.

Air Source Heat Pumps

5.56 Air Source Heat Pump (ASHP) are devices that transfer heat energy from a source to a heat sink through a working fluid. The working fluid is subjected to compression and evaporation to achieve this heat transfer via the heat pump. The process is fully reversible allowing heat pumps to provide both heating and/or cooling to the conditioned space. Unit efficiency ratings are calculated from the units Coefficient of Performance (COP). This is a measure of the unit's heat delivery for each unit of electricity used to operate the pump. ASHPs operate on a closed loop system where the heat energy is either absorbed or rejected to the atmosphere via an evaporator depending upon if the conditioned space is being heated or cooled. The plant for these systems typically contains an indoor heat pump and outdoor evaporator.

5.57 The consented scheme proposed that ASHP were used to provide both the heating and hot water via a communal heating system. Due to the technical viability and plant space availability this has since been excluded from the scheme for heating and hot water.

5.58 ASHP are to be used to provide comfort cooling to living spaces only, this enables limited roof space to be used for the external plant allowing greater roof area to be available for a PV installation.

Photovoltaic Panels

5.59 PV's work by using sun light shining on a cell made from layers of semi-conducting material, this creates an electrical field across the layers inducing electrical current flow. This electrical current can then be used, in conjunction with an inverter, to supply electricity to the property with surplus energy being fed back to the local electrical grid.

5.60 PV's don't need direct sunlight in order to operate however the stronger the light levels are the more electricity is produced so it is proposed that they are positioned in a non-shaded location preferably south facing.

5.61 Due to the technical limitations associated with the site restricting the renewable technologies available, it has been identified that PV's are able to meet the required reduction targets whilst remaining feasible for the development. It is proposed that a system, sized to produce 9,520 kWh per annum, is included at roof level, appendix IV illustrates the proposed PV layout. This has an impact on the proposed green roof provision which, due to the level of PV required, will have insufficient roof space to enable it to thrive and provide any significant benefit. For this reason the green roof has been excluded from the current scheme.

Solar Hot Water Panels

5.62 Solar Hot Water (SHW) absorbs solar heat energy to generate hot water. These systems typically accounts for 50% of the annual hot water demand. In the UK the peak solar radiation is about 1kW/m^2, this can be harnessed to provide heat for hot water systems. Solar thermal systems consist of solar collectors, typically on a building roof, filled with liquid which is then pumped to a storage vessel, i.e. hot water tanks where it is used to heat the contents of the tank via an incident coil. The tank is normally a dual cylinder where a secondary coil, supplied from a separate heat source (typically a boiler), provides additional heating to the cylinder during periods of little solar radiation. There are two main types of collector; either flat plate collectors which are simply a dark plate in an insulated box with a transparent cover or evacuated to be collectors which are more efficient, more effective in differing weather conditions but more expensive.

5.63 Due to the limited roof space and the priority of incorporating PV's the use of SHW has not been included within the scheme.

Renewable generation summary

5.64 Based on the assessment above the table below summarises the performance and impact on the overall carbon emissions of the site.

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	19.36	15.89
After energy demand reduction	19.25	15.89
After heat network / CHP	n/a	n/a
After renewable energy	13.95	15.89

	Regulated domestic carbon dioxide savings	
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	0.12	0.61%
Savings from heat network / CHP	n/a	n/a
Savings from renewable energy	5.30	27.35%
Cumulative on-site savings	5.41	27.96%

6 CONCLUSION

6.1 This Energy Statement has been prepared by Envision Energy to fulfil the conditions of the section 106 agreement associated with the development known as St. John's Wood Park. This statement forms an update to the currently consented energy strategy which was submitted as part of the original planning documentation.

6.2 The proposed development consist of 9no. apartments of varying configurations across 7 floors and is located within the London borough of Camden.

6.3 The primary purpose of this document is to demonstrate how the proposed strategy is able to comply with Building Regulations Part L: 2013 conservation of fuel and power, local planning and the Greater London Authority (GLA) Planning Policies.

6.4 Envision have undertaken a review of the relevant policies and worked with the design team to determine and agree the approach set out within this document to comply with the relevant policies.

6.5 The figures used as a basis for this report are discussed further in section 3.

Predicted carbon savings

6.6 The regulated baseline for the development (Part L 2013 compliant) has been calculated as being **19.36 tonnes.CO_2.year**.

6.7 The CO_2 emissions following reductions at the 'Be-Lean' Stage, i.e. energy-efficient stage, have been calculated at **19.25 tonnes.CO_2.year**. This represents a **0.61%** reduction in carbon emissions over the Part L 2013 compliant baseline.

6.8 The 'Be-Green' stage, i.e. on-site renewables/low carbon technology accounted for the proposed installation of;

6.9 A Photovoltaic (PV) array included on the uppermost roof(s) of the building. The PV array is estimated to have an output of **9,520 kWh** per year and an associated active PV area of 57m^2;

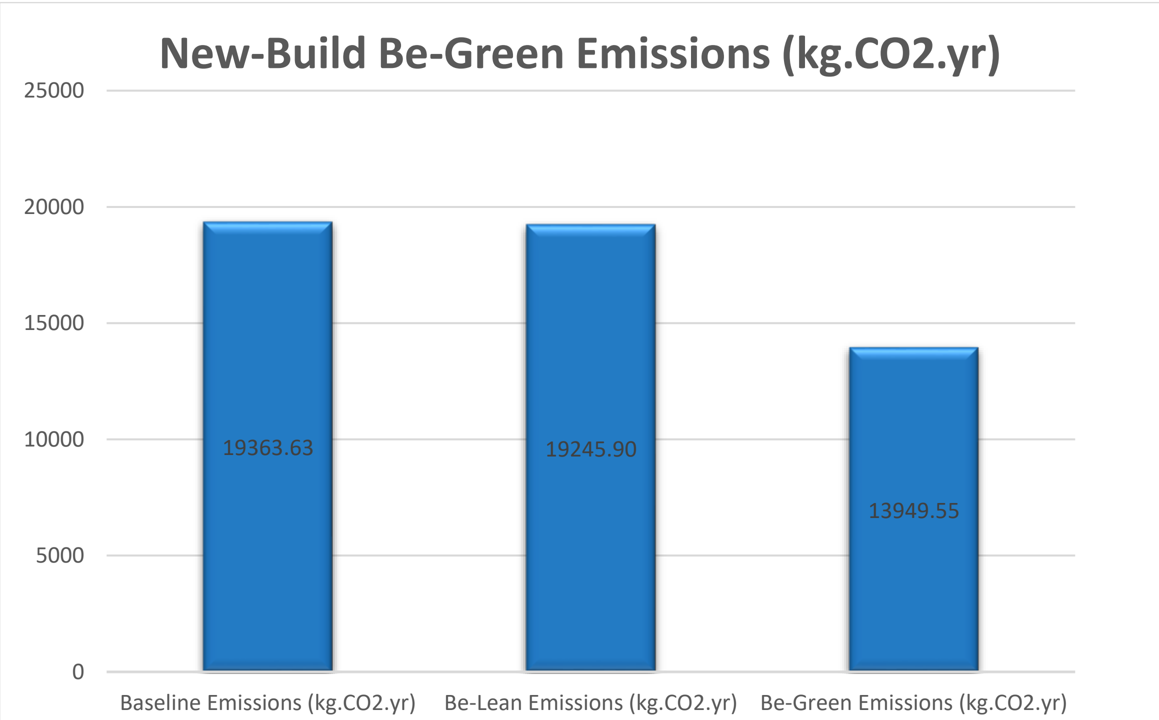
6.10 The CO_2 emissions following reductions at the 'Be-Green' Stage, i.e. on-site renewables/low carbon technology, have been calculated at **13.95 tonnes.CO_2.year**. This represents a **27.35%** reduction in carbon emissions over the 'Be-Lean' Stage.

6.11 Therefore, in total the development reduces CO_2 emissions by **27.96%** over the Part L 2013 baseline, thereby complying with Camden Council and the London Plan energy policy with regards to minimum CO_2 emission reductions for minor residential developments.

6.12 As the site has demonstrated an expected reduction of **27.96%** over the part L 2013 requirements, with 20% being achieved via on-site renewables compliance with the criteria set out within the Section 106 document has been demonstrated. The tables below demonstrates the residential regulated CO_2 savings at each stage of the hierarchy.

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	19.36	15.89
After energy demand reduction	19.25	15.89
After heat network / CHP	n/a	n/a
After renewable energy	13.95	15.89

	Regulated domestic carbon dioxide savings	
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	0.12	0.61%
Savings from heat network / CHP	n/a	n/a
Savings from renewable energy	5.30	27.35%
Cumulative on-site savings	5.41	27.96%



APPENDIX I - DRAWING LIST

Drawing No.	Drawing Name	Revision
0908(PL)500	GA Basement Floor Plan As Proposed	C
0908(PL)501	GA Ground Floor Plan As Proposed	B
0908(PL)502	GA First Floor Plan As Proposed	B
0908(PL)503	GA Second Floor Plan As Proposed	B
0908(PL)504	GA Third Floor Plan As Proposed	B
0908(PL)505	GA Fourth Floor Plan As Proposed	B
0908(PL)506	GA Fifth Floor Plan As Proposed	B
0908(PL)507	GA Roof Plan As Proposed	B
0908(PL)600	Front Elevation (EAST) As Proposed	C
0908(PL)601	Side Elevation (North) As Proposed	D
0908(PL)602	Rear Elevation (west) As Proposed	C
0908(PL)603	Side Elevation (South)	D
0908(PL)700	Section A-A As Proposed	B
0908(PL)701	Section B-B As Proposed	B

APPENDIX II - SYSTEM PERFORMANCE

Infiltration

- 3 $m^3/(hr.m^2)$ @ 50Pa

Heating

- Individual System Boiler
- Model: Vitodens 100 W Wb1B
- 26kW

Air-Handling Unit / Fans

- Whole house extract fans
- Kitchen extract fans

Cooling

- Electric heat pump
- Grid supplied electricity
- EER 5.25

Domestic Hot Water

- Provided by main heating system (see above)
- Cylinder Volume: 200l

Lighting

- 100% Low energy lighting

APPENDIX III - TYPICAL SAP SUMMARY SHEET

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.33

Property Address: Unit 1 - 4B8P

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	94.9	(1a) x	3.05	(2a) =	289.45	(3a)
Ground floor	116.29	(1b) x	4.35	(2b) =	505.86	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	211.19	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		795.31	(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)

DRAFT

			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		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.14	(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

SAP WorkSheet: New dwelling design stage

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

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

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16

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) =	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=	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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=	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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	
Windows Type 1			5.75	x	1/[1/(1)+ 0.04]	=	5.53			(27)
Windows Type 2			3.41	x	1/[1/(1)+ 0.04]	=	3.28			(27)
Windows Type 3			8.6	x	1/[1/(1)+ 0.04]	=	8.27			(27)
Windows Type 4			8.6	x	1/[1/(1)+ 0.04]	=	8.27			(27)
Windows Type 5			2.6	x	1/[1/(1)+ 0.04]	=	2.5			(27)
Windows Type 6			6.8	x	1/[1/(1)+ 0.04]	=	6.54			(27)
Windows Type 7			2.6	x	1/[1/(1)+ 0.04]	=	2.5			(27)
Floor Type 1			94.9	x	0.13	=	12.337			(28)
Floor Type 2			21.39	x	0.13	=	2.7807			(28)
Walls Type1	110.96	18.56	92.4	x	0.16	=	14.78			(29)
Walls Type2	183.13	19.8	163.33	x	0.16	=	26.13			(29)
Walls Type3	53.2	0	53.2	x	0.23	=	12.01			(29)
Walls Type4	90.48	0	90.48	x	0.23	=	20.42			(29)
Total area of elements, m²			554.06							(31)
Party floor			94.9							(32a)
Party ceiling			116.29							(32b)

* *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) =	125.35	(33)

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Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	63226.05	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Low	100	(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		31.73	(36)

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

Total fabric heat loss	(33) + (36) =	157.08	(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=	131.23	131.23	131.23	131.23	131.23	131.23	131.23	131.23	131.23	131.23	131.23	131.23	(38)

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

(39)m=	288.31	288.31	288.31	288.31	288.31	288.31	288.31	288.31	288.31	288.31	288.31	288.31	

Average = Sum(39)1…12 /12= 288.31 (39)

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

(40)m=	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	

Average = Sum(40)1…12 /12= 1.37 (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	3.02	(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	105.84	(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=	116.43	112.19	107.96	103.72	99.49	95.26	95.26	99.49	103.72	107.96	112.19	116.43

Total = Sum(44)1…12 = 1270.1 (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=	172.66	151.01	155.82	135.85	130.35	112.48	104.23	119.61	121.04	141.06	153.98	167.21

Total = Sum(45)1…12 = 1665.3 (45)

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

(46)m=	25.9	22.65	23.37	20.38	19.55	16.87	15.64	17.94	18.16	21.16	23.1	25.08	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	200	(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):		1.69	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0.91	(50)

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

SAP WorkSheet: New dwelling design stage

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)	0.91	(55)

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

(56)m=	28.29	25.55	28.29	27.38	28.29	27.38	28.29	28.29	27.38	28.29	27.38	28.29	(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=	28.29	25.55	28.29	27.38	28.29	27.38	28.29	28.29	27.38	28.29	27.38	28.29	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	224.21	197.57	207.38	185.74	181.91	162.37	155.79	171.16	170.93	192.61	203.87	218.76	(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=	224.21	197.57	207.38	185.74	181.91	162.37	155.79	171.16	170.93	192.61	203.87	218.76	

Output from water heater (annual)1…12 | 2272.29 | (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=	98.65	87.46	93.05	85.08	84.58	77.31	75.9	81.01	80.16	88.14	91.11	96.84	(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=	180.99	180.99	180.99	180.99	180.99	180.99	180.99	180.99	180.99	180.99	180.99	180.99	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	88.81	78.88	64.15	48.57	36.3	30.65	33.12	43.05	57.78	73.36	85.62	91.28	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	569.49	575.4	560.51	528.81	488.79	451.17	426.05	420.14	435.03	466.73	506.75	544.36	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	56.12	56.12	56.12	56.12	56.12	56.12	56.12	56.12	56.12	56.12	56.12	56.12	(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=	-120.66	-120.66	-120.66	-120.66	-120.66	-120.66	-120.66	-120.66	-120.66	-120.66	-120.66	-120.66	(71)
Water heating gains (Table 5)													
(72)m=	132.59	130.15	125.07	118.17	113.69	107.38	102.02	108.89	111.33	118.47	126.54	130.16	(72)

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

(73)m=	910.34	903.88	869.18	814.99	758.22	708.65	680.63	691.52	723.58	778.01	838.36	885.25	(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)	
North	0.9x	0.54	x	3.41	x	10.63	x	0.5	x	0.76	=	6.7	(74)
North	0.9x	0.54	x	3.41	x	20.32	x	0.5	x	0.76	=	12.8	(74)
North	0.9x	0.54	x	3.41	x	34.53	x	0.5	x	0.76	=	21.75	(74)
North	0.9x	0.54	x	3.41	x	55.46	x	0.5	x	0.76	=	34.93	(74)
North	0.9x	0.54	x	3.41	x	74.72	x	0.5	x	0.76	=	47.05	(74)
North	0.9x	0.54	x	3.41	x	79.99	x	0.5	x	0.76	=	50.37	(74)
North	0.9x	0.54	x	3.41	x	74.68	x	0.5	x	0.76	=	47.03	(74)
North	0.9x	0.54	x	3.41	x	59.25	x	0.5	x	0.76	=	37.31	(74)
North	0.9x	0.54	x	3.41	x	41.52	x	0.5	x	0.76	=	26.15	(74)
North	0.9x	0.54	x	3.41	x	24.19	x	0.5	x	0.76	=	15.23	(74)
North	0.9x	0.54	x	3.41	x	13.12	x	0.5	x	0.76	=	8.26	(74)
North	0.9x	0.54	x	3.41	x	8.86	x	0.5	x	0.76	=	5.58	(74)
Northeast	0.9x	0.54	x	2.6	x	11.28	x	0.5	x	0.76	=	5.42	(75)
Northeast	0.9x	0.54	x	2.6	x	22.97	x	0.5	x	0.76	=	11.03	(75)
Northeast	0.9x	0.54	x	2.6	x	41.38	x	0.5	x	0.76	=	19.87	(75)
Northeast	0.9x	0.54	x	2.6	x	67.96	x	0.5	x	0.76	=	32.63	(75)
Northeast	0.9x	0.54	x	2.6	x	91.35	x	0.5	x	0.76	=	43.86	(75)
Northeast	0.9x	0.54	x	2.6	x	97.38	x	0.5	x	0.76	=	46.76	(75)
Northeast	0.9x	0.54	x	2.6	x	91.1	x	0.5	x	0.76	=	43.74	(75)
Northeast	0.9x	0.54	x	2.6	x	72.63	x	0.5	x	0.76	=	34.87	(75)
Northeast	0.9x	0.54	x	2.6	x	50.42	x	0.5	x	0.76	=	24.21	(75)
Northeast	0.9x	0.54	x	2.6	x	28.07	x	0.5	x	0.76	=	13.48	(75)
Northeast	0.9x	0.54	x	2.6	x	14.2	x	0.5	x	0.76	=	6.82	(75)
Northeast	0.9x	0.54	x	2.6	x	9.21	x	0.5	x	0.76	=	4.42	(75)
East	0.9x	0.54	x	5.75	x	19.64	x	0.5	x	0.76	=	20.86	(76)
East	0.9x	0.54	x	8.6	x	19.64	x	0.5	x	0.76	=	31.19	(76)
East	0.9x	0.54	x	5.75	x	38.42	x	0.5	x	0.76	=	40.8	(76)
East	0.9x	0.54	x	8.6	x	38.42	x	0.5	x	0.76	=	61.02	(76)
East	0.9x	0.54	x	5.75	x	63.27	x	0.5	x	0.76	=	67.19	(76)
East	0.9x	0.54	x	8.6	x	63.27	x	0.5	x	0.76	=	100.49	(76)
East	0.9x	0.54	x	5.75	x	92.28	x	0.5	x	0.76	=	97.99	(76)
East	0.9x	0.54	x	8.6	x	92.28	x	0.5	x	0.76	=	146.56	(76)
East	0.9x	0.54	x	5.75	x	113.09	x	0.5	x	0.76	=	120.09	(76)
East	0.9x	0.54	x	8.6	x	113.09	x	0.5	x	0.76	=	179.62	(76)

East	0.9x	0.54	x	5.75	x	115.77	x	0.5	x	0.76	=	122.94	(76)
East	0.9x	0.54	x	8.6	x	115.77	x	0.5	x	0.76	=	183.87	(76)
East	0.9x	0.54	x	5.75	x	110.22	x	0.5	x	0.76	=	117.04	(76)
East	0.9x	0.54	x	8.6	x	110.22	x	0.5	x	0.76	=	175.05	(76)
East	0.9x	0.54	x	5.75	x	94.68	x	0.5	x	0.76	=	100.54	(76)
East	0.9x	0.54	x	8.6	x	94.68	x	0.5	x	0.76	=	150.37	(76)
East	0.9x	0.54	x	5.75	x	73.59	x	0.5	x	0.76	=	78.15	(76)
East	0.9x	0.54	x	8.6	x	73.59	x	0.5	x	0.76	=	116.88	(76)
East	0.9x	0.54	x	5.75	x	45.59	x	0.5	x	0.76	=	48.41	(76)
East	0.9x	0.54	x	8.6	x	45.59	x	0.5	x	0.76	=	72.41	(76)
East	0.9x	0.54	x	5.75	x	24.49	x	0.5	x	0.76	=	26.01	(76)
East	0.9x	0.54	x	8.6	x	24.49	x	0.5	x	0.76	=	38.89	(76)
East	0.9x	0.54	x	5.75	x	16.15	x	0.5	x	0.76	=	17.15	(76)
East	0.9x	0.54	x	8.6	x	16.15	x	0.5	x	0.76	=	25.65	(76)
Southeast	0.9x	0.54	x	2.6	x	36.79	x	0.5	x	0.76	=	17.67	(77)
Southeast	0.9x	0.54	x	2.6	x	62.67	x	0.5	x	0.76	=	30.09	(77)
Southeast	0.9x	0.54	x	2.6	x	85.75	x	0.5	x	0.76	=	41.18	(77)
Southeast	0.9x	0.54	x	2.6	x	106.25	x	0.5	x	0.76	=	51.02	(77)
Southeast	0.9x	0.54	x	2.6	x	119.01	x	0.5	x	0.76	=	57.15	(77)
Southeast	0.9x	0.54	x	2.6	x	118.15	x	0.5	x	0.76	=	56.73	(77)
Southeast	0.9x	0.54	x	2.6	x	113.91	x	0.5	x	0.76	=	54.7	(77)
Southeast	0.9x	0.54	x	2.6	x	104.39	x	0.5	x	0.76	=	50.12	(77)
Southeast	0.9x	0.54	x	2.6	x	92.85	x	0.5	x	0.76	=	44.58	(77)
Southeast	0.9x	0.54	x	2.6	x	69.27	x	0.5	x	0.76	=	33.26	(77)
Southeast	0.9x	0.54	x	2.6	x	44.07	x	0.5	x	0.76	=	21.16	(77)
Southeast	0.9x	0.54	x	2.6	x	31.49	x	0.5	x	0.76	=	15.12	(77)
West	0.9x	0.54	x	8.6	x	19.64	x	0.5	x	0.76	=	31.19	(80)
West	0.9x	0.54	x	6.8	x	19.64	x	0.5	x	0.76	=	24.66	(80)
West	0.9x	0.54	x	8.6	x	38.42	x	0.5	x	0.76	=	61.02	(80)
West	0.9x	0.54	x	6.8	x	38.42	x	0.5	x	0.76	=	48.25	(80)
West	0.9x	0.54	x	8.6	x	63.27	x	0.5	x	0.76	=	100.49	(80)
West	0.9x	0.54	x	6.8	x	63.27	x	0.5	x	0.76	=	79.46	(80)
West	0.9x	0.54	x	8.6	x	92.28	x	0.5	x	0.76	=	146.56	(80)
West	0.9x	0.54	x	6.8	x	92.28	x	0.5	x	0.76	=	115.89	(80)
West	0.9x	0.54	x	8.6	x	113.09	x	0.5	x	0.76	=	179.62	(80)
West	0.9x	0.54	x	6.8	x	113.09	x	0.5	x	0.76	=	142.02	(80)
West	0.9x	0.54	x	8.6	x	115.77	x	0.5	x	0.76	=	183.87	(80)
West	0.9x	0.54	x	6.8	x	115.77	x	0.5	x	0.76	=	145.39	(80)
West	0.9x	0.54	x	8.6	x	110.22	x	0.5	x	0.76	=	175.05	(80)
West	0.9x	0.54	x	6.8	x	110.22	x	0.5	x	0.76	=	138.41	(80)
West	0.9x	0.54	x	8.6	x	94.68	x	0.5	x	0.76	=	150.37	(80)

West	0.9x	0.54	x	6.8	x	94.68	x	0.5	x	0.76	=	118.9	(80)
West	0.9x	0.54	x	8.6	x	73.59	x	0.5	x	0.76	=	116.88	(80)
West	0.9x	0.54	x	6.8	x	73.59	x	0.5	x	0.76	=	92.42	(80)
West	0.9x	0.54	x	8.6	x	45.59	x	0.5	x	0.76	=	72.41	(80)
West	0.9x	0.54	x	6.8	x	45.59	x	0.5	x	0.76	=	57.25	(80)
West	0.9x	0.54	x	8.6	x	24.49	x	0.5	x	0.76	=	38.89	(80)
West	0.9x	0.54	x	6.8	x	24.49	x	0.5	x	0.76	=	30.75	(80)
West	0.9x	0.54	x	8.6	x	16.15	x	0.5	x	0.76	=	25.65	(80)
West	0.9x	0.54	x	6.8	x	16.15	x	0.5	x	0.76	=	20.28	(80)

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

(83)m=	137.69	265.01	430.43	625.59	769.42	789.93	751.03	642.48	499.26	312.45	170.79	113.86	(83)

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

(84)m=	1048.03	1168.89	1299.6	1440.57	1527.64	1498.58	1431.66	1334	1222.84	1090.46	1009.15	999.11	(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=	0.98	0.97	0.96	0.92	0.87	0.77	0.66	0.7	0.85	0.94	0.97	0.98	(86)

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

(87)m=	18.65	18.82	19.15	19.61	20.08	20.48	20.69	20.65	20.32	19.72	19.1	18.61	(87)

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

(88)m=	19.79	19.79	19.79	19.79	19.79	19.79	19.79	19.79	19.79	19.79	19.79	19.79	(88)

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

(89)m=	0.97	0.97	0.95	0.91	0.83	0.7	0.54	0.59	0.8	0.92	0.96	0.98	(89)

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

(90)m=	16.65	16.89	17.37	18.04	18.71	19.24	19.49	19.46	19.05	18.2	17.3	16.58	(90)

fLA = Living area ÷ (4) = 0.18 (91)

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

(92)m=	17	17.23	17.69	18.32	18.95	19.46	19.71	19.67	19.28	18.48	17.62	16.94	(92)

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

(93)m=	16.85	17.08	17.54	18.17	18.8	19.31	19.56	19.52	19.13	18.33	17.47	16.79	(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=	0.96	0.95	0.92	0.88	0.8	0.67	0.51	0.56	0.76	0.9	0.95	0.96	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1007.26	1109.05	1201.65	1263.55	1216.92	999.33	729.61	741.88	928.22	976.68	956.08	964.04	(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=	3619.36	3512.34	3183.63	2672.64	2047.78	1358.23	853.13	899.77	1449.12	2227.18	2990.74	3630.81	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(98)m=	1943.4	1615.01	1474.6	1014.54	618.16	0	0	0	0	930.37	1464.95	1984.08		
Total per year (kWh/year) = Sum(98)1...5,9...12 =													11045.12	(98)

Space heating requirement in kWh/m²/year | 52.3 | (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)														
(100)m=	0	0	0	0	0	2710.08	2133.47	2191.13	0	0	0	0		(100)
Utilisation factor for loss hm														
(101)m=	0	0	0	0	0	0.54	0.61	0.57	0	0	0	0		(101)
Useful loss, hmLm (Watts) = (100)m x (101)m														
(102)m=	0	0	0	0	0	1450.67	1297.47	1242.58	0	0	0	0		(102)
Gains (solar gains calculated for applicable weather region, see Table 10)														
(103)m=	0	0	0	0	0	1729.64	1651.19	1521.36	0	0	0	0		(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m														
(104)m=	0	0	0	0	0	0	263.17	0	0	0	0	0		
Total = Sum(104) =													263.17	(104)
Cooled fraction — f C = cooled area ÷ (4) =													0.64	(105)
Intermittency factor (Table 10b)														
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0		
Total = Sum(104) =													0	(106)
Space cooling requirement for month = (104)m × (105) × (106)m														
(107)m=	0	0	0	0	0	0	41.81	0	0	0	0	0		
Total = Sum(107) =													41.81	(107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = | 0.2 | (108)

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		89.6	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		6.56	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	1943.4	1615.01	1474.6	1014.54	618.16	0	0	0	0	930.37	1464.95	1984.08		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	2168.97	1802.47	1645.76	1132.3	689.91	0	0	0	0	1038.36	1634.99	2214.38		
Total (kWh/year) =Sum(211)1...5,10...12=													12327.14	(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)

SAP WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

224.21	197.57	207.38	185.74	181.91	162.37	155.79	171.16	170.93	192.61	203.87	218.76

Efficiency of water heater 78.9 (216)

(217)m=	88.36	88.29	88.13	87.76	86.92	78.9	78.9	78.9	78.9	87.56	88.14	88.41	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	253.74	223.76	235.32	211.65	209.28	205.8	197.45	216.94	216.64	219.97	231.3	247.44

Total = Sum(219a)$_{1...12}$ = 2669.28 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	0	6.37	0	0	0	0	0

Total = Sum(221)$_{6...8}$ = 6.37 (221)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		12327.14	
Water heating fuel used		2669.28	
Space cooling fuel used		6.37	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	214.43		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		289.43	(231)
Electricity for lighting		627.37	(232)
Electricity generated by PVs		-1801.18	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		14197.3	(338)

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10a. Fuel costs - individual heating systems:

		Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x		3.48	x 0.01 =	428.98	(240)
Space heating - main system 2	(213) x		0	x 0.01 =	0	(241)
Space heating - secondary	(215) x		13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		3.48	x 0.01 =	92.89	(247)
Space cooling	(221)		13.19	x 0.01 =	0.84	(248)
Pumps, fans and electric keep-hot	(231)		13.19	x 0.01 =	38.18	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	82.75	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost (245)...(247) + (250)…(254) = 763.64 (255)

SAP WorkSheet: New dwelling design stage

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.25	(257)
SAP rating (Section 12)		82.54	(258)

12a. CO_2 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	=	2662.66	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	576.56	(264)
Space and water heating	(261) + (262) + (263) + (264) =				3239.23	(265)
Space cooling	(221)	x	0.519	=	3.31	(266)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	150.21	(267)
Electricity for lighting	(232)	x	0.519	=	325.6	(268)
Energy saving/generation technologies						
Item 1			0.519	=	-934.81	(269)
Total CO2, kg/year			sum of (265)…(271) =		2783.54	(272)
CO2 emissions per m²			(272) ÷ (4) =		13.18	(273)
EI rating (section 14)					85	(274)

13a. Primary Energy

	Energy kWh/year		**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	15039.11	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	3256.52	(264)
Space and water heating	(261) + (262) + (263) + (264) =				18295.63	(265)
Space cooling	(221)	x	3.07	=	19.56	(266)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	888.55	(267)
Electricity for lighting	(232)	x	0	=	1926.02	(268)
Energy saving/generation technologies						
Item 1			3.07	=	-5529.63	(269)
'Total Primary Energy			sum of (265)…(271) =		15600.13	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		73.87	(273)

APPENDIX IV - ROOF PLAN