Energy Strategy

FOR

Mixed Use Redevelopment

AT

101 CAMLEY STREET

LONDON BOROUGH OF CAMDEN

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1. EXECUTIVE SUMMARY

This Energy Statement has been prepared for the proposed mixed use development at 101 Camley Street, London. This document forms part of a series of documents issued in support of the planning application to the London Borough of Camden for 101 Camley Street London. This document shall be read in conjunction with all related information submitted for the application. This document relates to the energy use and carbon emissions reduction required under Local, regional and national policy.

Policy and guidance includes:

The London Plan 2011 (Draft Further Alterations to the London Plan 2014)
The Mayor's Supplementary Planning Guidance – Revised Sustainable design and Construction (2014)
UK National sustainable development policy
Camden Council's Core Strategy (2010)
Camden Council's Development Policies (2010-2015)
Planning Guidance 3 – Sustainability (April 2011)

The proposed development has been assessed and a site wide energy strategy produced in accordance with the Mayor's Energy Hierarchy:

1. **Be lean**: minimise energy use
2. **Be clean**: supply energy efficiently
3. **Be green**: use of renewable energy

The methodology detailed herein is In accordance with the Greater London Authority guidance which states that applications received by the Mayor before the 6 July 2014 may demonstrate compliance with the 40% reduction target beyond 2010 Building Regulations.

This document demonstrates that the London Borough of Camden Planning policies relevant to sustainable energy have been addressed in a structured and comprehensive manner by the proposals in the Planning Application.

The energy strategy demonstrates that regulated carbon dioxide emissions for the proposed scheme have been reduced by more than 40% over Part L 2010 compliant baseline requirements by maximising the contribution of each step of the energy hierarchy.

A CHP (combined heat and power unit) will be specified to meet the minimised energy demand plus a combination of heat pump and photovoltaic array that will meet a significant amount of both the residential and commercial energy and thermal requirements of the development.

Be lean:

- Improved building fabric, better than the limiting standards of the Building Regulations
- Ventilation systems with low specific fan powers, including EC motors on the fan coil units
- High efficiency boilers
- Low energy lighting and, where appropriate, automatic lighting control systems
- Measures to reduce the space cooling demand

These energy efficiency measures result in the building's carbon emissions being **11.87%**better than the Building Regulations 2010 target emissions rate.

Be clean: By optimising the CHP selection to ensure efficient running. The CHP has been selected to meet approx. 60% of the domestic hot water and space heating load of both the residential and employment units. The CHP will also generate electricity which will be fully utilised by the onsite demand reducing the overall consumption on the utilities infrastructure required. As the electricity generated will only meet a proportion of the site demand no electricity will be exported back to the grid.

The carbon emissions reductions from the 'be clean' stage are an additional **28.28%** reduction.

Be green: an assessment has been carried out of current low and zero carbon technologies. The most suitable options are photovoltaic panel arrays to supplement the CHP energy provision and use of heat pumps to contribute to the cooling demand for the proposed business units. The PV array will be approx. 110-350m^2. The heat pump selection will be based on approx. 25kW

The carbon emissions reductions from the 'be green' stage are an additional **10.12%.**

The total reduction in regulated carbon emissions for the proposed development will be over 40% over the Part L 2010 compliant baseline values.

1.1. SITE BACKGROUND

This Energy Statement sets out the methodology used in assessing the proposed development and an assessment of the predicted energy targets and renewable proposals to support the planning application for the proposed mixed use redevelopment (employment and residential) at 101 Camley Street, London.

The site is currently being used as a warehouse and delivery depot by DPD, but the company are relocating to larger premises in the Kentish Town Industrial Estate.

It is proposed that existing building located at 101 Camley Street, London, be demolished and the new development be constructed resulting in a total of 121 dwellings including 30 affordable homes along with the commercial employment units comprising a total of circa 2,220m^2 Gross External Area (GEA). The Site is located at the junction of Camley Street and Granary Street in the London Borough of Camden.

It is the intention of the Client for the proposed building to achieve both a compliance with Part L 2010 Building Regulations and a Code for Sustainable Homes Level 4 certification for the residential dwellings. The employment units are to target BREEAM 'Excellent' but currently achieve 'Very Good'.

2. ENERGY STRATEGY

Methodology

A thorough review has been undertaken of the energy technology options for the site to ensure the most appropriate energy strategy is implemented. This energy strategy has been developed in accordance with requirements of the London Plan and specifically the GLA Energy Team's Guidance Note 'Guidance on Planning Energy Assessments October 2010.

Accordingly, the Mayor's Energy Hierarchy (Use Less Energy - 'Be Lean', Supply Energy Efficiently -'Be Clean' and Use Renewable Energy - 'Be Green') has been applied to energy considerations for the site, starting with a robust 'baseline' energy demand assessment. A final energy strategy consisting of the introduction of a combined heat and power (CHP) has been evaluated as the most appropriate to serve the energy demand profile of the site whilst ensuring optimal energy efficiency and CO_2 emission reductions.

Baseline Energy Demand Assessment

The 101 Camley Street development is assessed under Building Regulations Part L 2010 as requested by the London Borough of Camden. The results in the report are assessed based on a thermal model using Designbuilder V3 with Energy Plus.

In establishing the energy profile of the building, consideration has been given to the various ways in which the building in use will consume energy, and means of making reasonable estimates or calculations of the likely energy use. Appropriate non-regulated loads (small power, equipment, external and common areas lighting, cooking and appliances etc.) have also been established and incorporated in the assessment.

2.1. Energy Hierarchy Step 1 - 'Be Lean' - Reduce Energy Demand

A range of measures have been adopted in the building fabric and services design to reduce the energy demand of the scheme, relative to what would be permissible solely to satisfy the Building Regulations.

- Improved building fabric, better than the limiting standards of the Building Regulations
- Ventilation systems with low specific fan powers, including EC motors on the fan coil units
- High efficiency boilers
- Low energy lighting and, where appropriate, automatic lighting control systems
- Measures to reduce the space cooling demand

These energy efficiency measures result in the building's carbon emissions being **11.87%** better than the Building Regulations 2010 target emissions rate.

2.2. Energy Hierarchy Step 2 - 'Be Clean' - Supply Energy Efficiently

No existing district heating and/or cooling networks have been identified in the immediate area but there is a proposal for a future network (2017-18) in the Phoenix Court area which we have discussed with London Borough of Camden, see separate correspondence.

The proposed building services strategy offers a flexible energy scope to connect to a district heating main in the future without substantial changes to the systems and allowance will be made for further review with the London Borough of Camden during the detailed design phase for possible future connection to their proposed Phoenix Court network due to be constructed in 2017-18.

The site is located a short distance from the Kings Cross Energy centre on the opposite side of the Canal and main rail lines.

Enquiries were made at an early stage to Kings Cross energy centre for a supply to meet the proposed loads of the Development. Following discussions with their Technical team they advised that they did not consider it to be a feasible option due to the location of the development which is adjacent to the canal and network rail property and the required loads.

The development lends itself to CHP as a consistent heat load for domestic hot water exists year round. The electricity generated by the CHP will be fully utilised by the on-site demand. Calculations using FSAP 2009 and SBEM that by providing a gas fired CHP meeting 60% of the total annual heat and domestic hot water demand will result in a **28.28%** reduction in regulated carbon emissions.

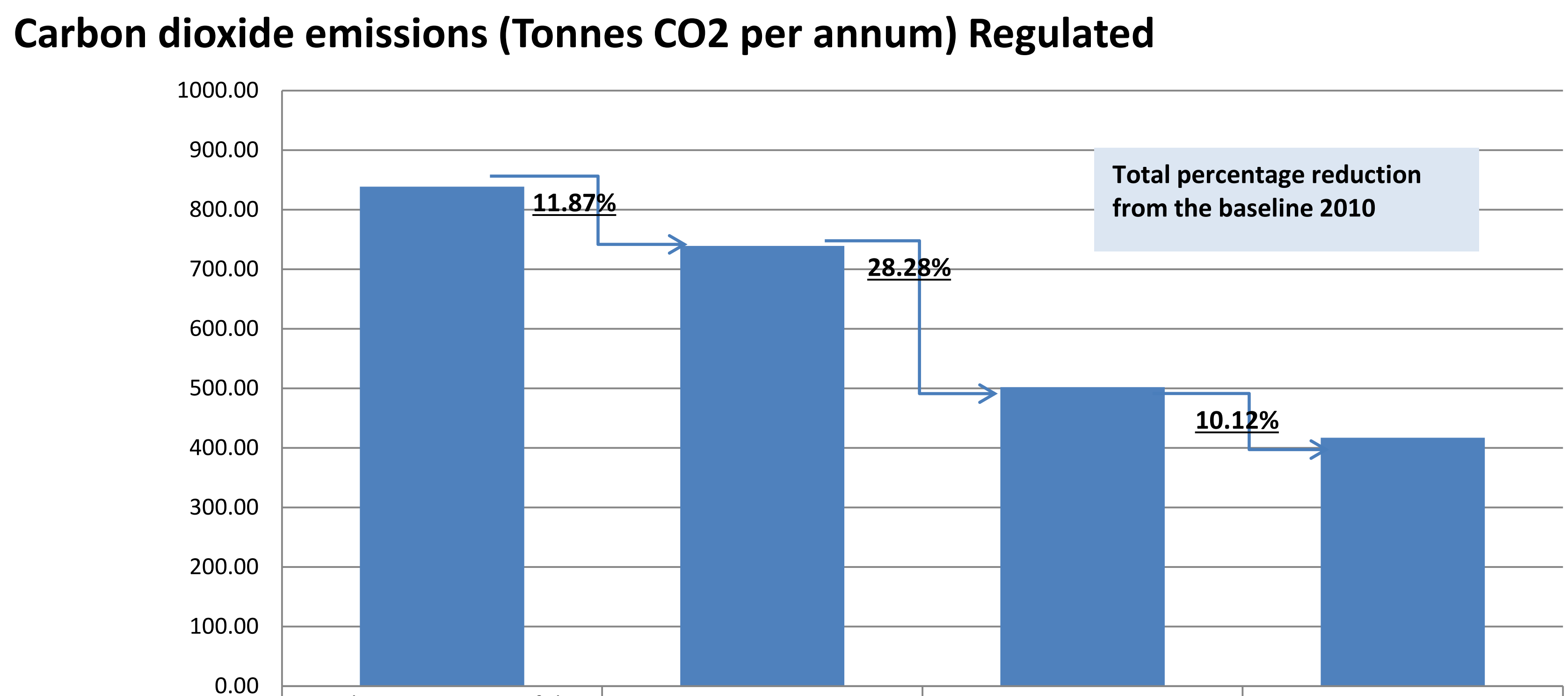
2.3. Energy Hierarchy Step 3 - 'Be Green' - Renewable Energy

The use of renewable energy technologies has been considered. The provision of CHP to meet 60% of the site heat demand, heat pump technology and also an array of photovoltaic collectors will result in a further reduction of **10.12%** reduction in regulated carbon emissions for this final step.

2.4. Summarised Results following the 3 Steps

It is estimated that the project as a whole (both residential and commercial units) will achieve **50.27%** reduction in carbon dioxide emissions from a Part L 2010 compliant baseline.

2.5. Summary Graph and Tables



	Baseline: Part L 2010 of the Building Regulations Compliant Development	Be Lean	Be Clean	Be Green
Carbon dioxide emissions (Tonnes CO2 per annum) Regulated	838.29	738.80	501.71	416.91

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy

	Carbon dioxide emissions (Tonnes CO2 per annum)	
	Regulated	Unregulated[1]
Baseline: Part L 2010 of the Building Regulations Compliant Development	838.29	377.23
After energy demand reduction	738.80	332.46
After CHP	501.71	332.46
After renewable energy	416.91	332.46

Table 2: Regulated carbon dioxide savings from each stage of the Energy Hierarchy

	Regulated Carbon dioxide savings	
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	99.49	11.87%
Savings from CHP	237.09	28.28%
Savings from renewable energy	84.80	10.12%
Total Cumulative Savings	421.38	50.27%
Total Target Savings	335.32	40%
Annual Surplus	86.07	10%

[1] Unregulated Energy has been accounted for and is estimated as 40% for commercial spaces and 50% for residential spaces of the total regulated energy. As both space types are nearly equal in energy demand an average of 45% unregulated energy for the Target and 35% has been used after the demand reduction step.

2.6. Carbon Dioxide Emissions savings from each stage of the Energy Hierarchy

The proposed CHP strategy for the development shows CO_2 savings from 'be clean' measures of 99,490kgCO_2/year (11.87% of regulated emissions), 'be Lean' measures of 237,090kgCO_2/year (28.28% of regulated emissions) and 'be Green' measures of 84,800kgCO_2/year (10.12% of regulated emissions).

This is a total saving of 421,380kgCO_2/year (50.27% of regulated emissions), exceeding the London Plan target for a new build development by 10%.

A thorough consideration has been made of the energy technology options for the site to ensure the most appropriate energy strategy is implemented. This report provides an assessment of the issues under consideration, and has demonstrated that the London Borough of Camden's energy policies are generally met or exceeded.

3. OVERVIEW

3.1. Objective

The purpose of this energy strategy is to demonstrate that energy consumption and climate change mitigation measures have been fully considered and appropriately selected and specified as part of the building's design.

In accordance with the guidance note 'Guidance on Planning Energy Assessments' after establishing the baseline energy demand and profile for the site, the strategy for the project follows the Mayor's Energy Hierarchy (Use Less Energy - 'Be Lean', Supply Energy Efficiently - 'Be Clean' and Use Renewable Energy - 'Be Green') in appraising appropriate measures to reduce carbon emissions and other climate impacts from the development.

The following sections provide more details on each of the steps of the Energy Strategy following the London Plan's Energy Hierarchy.[2]

3.2. General Methodology

The Guidance Note provides further detail on addressing the London Plan's energy hierarchy through the provision of an energy assessment to accompany strategic planning applications. Importantly, the Guidance Note acknowledges its requirements should be adapted for different scales of development.

The Guidance Note has been used to structure the appraisal and reporting of energy strategies for this Energy Statement.

[2] All analysis in this document adopts the Building Regulations Part L 2010 CO_2 fuel factors.

4. BASELINE ENERGY ASSESSMENT

4.1. Objective

Before energy efficiency measures are investigated, it is important to establish the baseline energy consumption of the scheme, for comparison and evaluation of energy proposals.

4.2. Scope

For energy assessments being undertaken under the London Plan, the appropriate baseline case against which to assess potential carbon savings is a new development designed to conform to the current Building Regulations Part L (2010[3]); effectively the 'do minimum' case. This baseline case represents a typical building arrangement; where electricity for the development is imported from the grid and space and heating water are provided by standard mains gas-fired boilers.

All energy uses, and not just the conventional building services loads (lighting, heating, cooling and ventilation) and energy loads associated with the function of the site should be considered in the establishment of the energy profile, and especially in the selection of a building services strategy and any renewable energy technology.

The following 'regulated' energy uses are considered in the baseline energy analysis:

- Space Heating/Cooling
- Water Heating
- Ventilation
- Fans, Pumps and Controls
- Lighting (internal)

The regulated energy uses can be established using the robust and well-established calculation methodology of Part L of the Building Regulations Part L 2010 (SAP, SBEM and DSM via the NCM)[4].

4.3. Site Energy Use Estimation

Site energy emissions and consumption figures are based on the data from the sample residential SAP calculations and the business units SBEM.

The data output from the SAP and SBEM is then calculated pro-rata on a square meter basis for the site to give a planning stage estimation of the energy consumption and emissions used within this report.

[3] 2010 regulations to be adhered to as per the GLA guidance for applications made prior to 06 July 2014

[4] Standard Assessment Procedure (SAP), Simplified Building Energy Model (SBEM), Dynamic Simulation Modelling (DSM), National Calculation Method (NCM)

5. BE LEAN

5.1. Objective

The first step in pursuing energy efficient and low-carbon design under the energy Hierarchy is to minimise the development's energy demand. This is achieved both by passive measures and the introduction of more energy efficient plant and services. Any measures implemented at this stage will reduce the extent of measures or size of plant needed to address the subsequent 'be clean' and 'be green' stages.

5.2. Scope

The building services strategy has been developed in response to the following drivers for the project:

maximising the potential of the building to satisfy market expectations (balancing of scope of works with value to create the optimal specification) achieving environmental comfort condition and occupant wellbeing and avoiding unnecessary costs of construction

5.3. Methodology

In establishing the proposed energy strategy and servicing strategy for the development, the requirement to minimise energy consumption through improved building fabric and building services measures has been considered a priority.

As part of this assessment the London Plan's 'Cooling Hierarchy' has been considered in the design process, to reduce where possible the extent and installed capacity of cooling plant.

- Passive strategies and measures that have been considered include:
- Improving building (thermal and air leakage) performance.
- Use of thermal mass.
- Use of natural daylighting

5.4. Key Assumptions - Building Services Strategy for the 'Be Lean' Assessment

THERMAL ELEMENTS

The proposed new building's fabric elements shall be in compliance with the Approved Building Regulations Part L1A 2013.

The proposed 'U' values for 101 Camley Street are as below:

Element	Design U-Values (W/m^2K)
External Walls	0.20
Roof	0.16
Floor	0.2
Windows & Doors	1.4

Table 7: Design U-Values

A design air permeability rate has been set at **5 $m^3/m^2/hr$ at 50Pa**.

HEATING

The residential units will primarily utilise a communal heating system that combines a lead CHP unit and with sequenced high efficiency gas fired boilers that are to be centrally located. This system will serve all dwellings with space heating utilising underfloor or radiant emitters. It will also serve the domestic hot water demand and part of the electricity usage.

DOMESTIC HOT WATER SERVICES

The hot water generation shall be supplied by the same CHP system that serves the building heating systems. Provisionally heat interface units within the dwellings will transfer the main system heat to provide localised DHW without the need for storage.

COMFORT COOLING

The demand for comfort cooling has been minimised by means of minimising heat gains to the space. This has been achieved by a combination of design considerations. These considerations are such as controlled ventilation and mechanical heat recovery systems with summer bypass and boost, improved performance of the building fabric and high performance glazed elements, openable windows, natural shading from structure, low energy lighting, etc.

No mechanical cooling is to be provided to the units. The Penthouses will have a provision for option to install a comfort cooling system post completion should the future purchasers require it.

ARTIFICIAL LIGHTING

The provision of natural daylight is considered an important factor in the design in order to minimise the use of artificial light within the building. Floors from ground level upward have access to natural light with high specification glazing being specified to maximise day lighting levels and minimise associated heat loss. High efficiency lamps will be considered in conjunction with the client's preferences and facilities for automatic switching and dimming systems shall also be incorporated where possible.

Building Energy Management System

The energy throughout the site will be sub-metered for both heating and electricity on a per apartment basis. The metering will provide both historic and live energy use information to the end user and record the same centrally for consumption evaluation.

A dedicated BEMS will be provided for all Landlords areas and plant and will ensure all plant can be operated more efficiently by monitoring and optimising the plant to suit the building profiles and demands. All plant will be selected to suit the energy strategy and include inverter drives for pumps, fans and motors generally. Live and historic energy use can be collated at a central point for consumption evaluation by the Landlord.

SUSTAINABLE CONSIDERATIONS

The 101 Camley Street, London development incorporates rainwater harvesting to minimise mains water consumption. Rainwater shall be collected at the various roof levels and sufficient volume stored for garden irrigations.

	Carbon dioxide emissions after 'Be Lean' Demand Reduction (Tonnes CO2 per annum)	
	Regulated	Unregulated[5]
Baseline: Part L 2010 of the Building Regulations Compliant Development	838.29	377.23
After energy demand reduction	738.80	332.46

The 'Be Lean' demand reduction results in an **11.87%** reduction in regulated carbon emissions.

[5] Unregulated Energy has been accounted for and is estimated as 40% for commercial spaces and 50% for residential spaces of the total regulated energy. As both space types are nearly equal in energy demand an average of 45% unregulated energy for the Target and 35% has been used after the demand reduction step.

6. BE CLEAN

6.1. Objective

The next step in the Energy Hierarchy, 'be clean', is to investigate the options for the efficient supply of energy to the development. This stage follows the incorporation of all practicable energy efficiency measures.

6.2. Scope

Potential approaches include connecting the scheme to existing CHP-led district energy networks, or if no existing schemes exist investigating whether such networks are planned in the area and designing systems with the flexibility to connect to these in the future. Opportunities to provide a communal heating system across buildings/uses within a multiple building scheme should also be pursued.

With or without a communal system, the feasibility of CHP (combined heat and power), including the provision of cooling using the CHP waste heat should be reviewed.

6.3. Review

The site is located a short distance from the Kings Cross Energy centre, an existing district heat network, on the opposite side of the Canal and main rail lines.

Enquiries were made at an early stage to Kings Cross energy centre for a supply to meet the proposed loads of the Development. Following discussions with their Technical team they advised that they did not consider it to be a feasible option due to the location of the development which is adjacent to the canal and network rail property and the required loads.

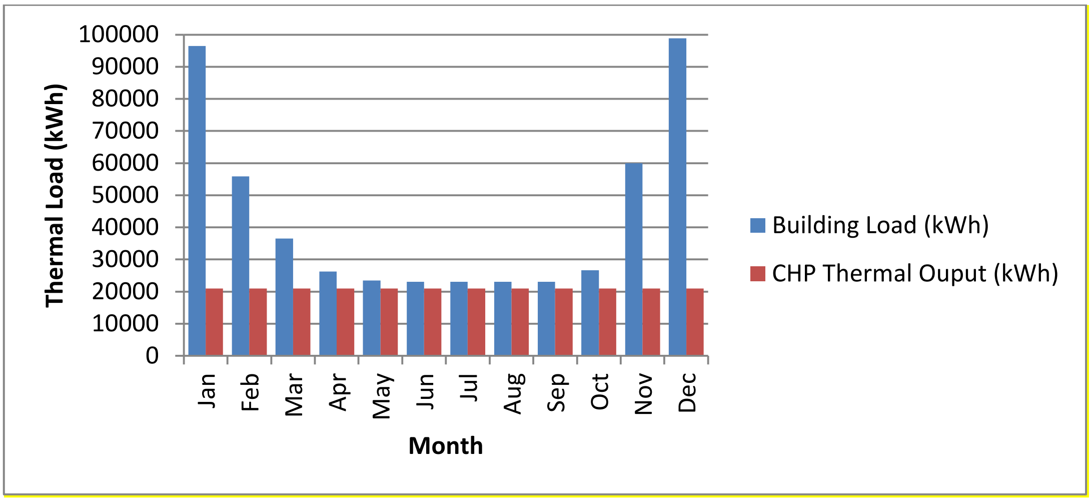
Further enquiries have been made with London Borough of Camden and they have advised that they are potentially providing a district heat network centre at Phoenix Court as part of their Phase 3 works. The current date for the construction of this centre is 2017-18. An allowance will be made for further review with the London Borough of Camden during the detailed design phase for possible future connection to their proposed Phoenix Court network due to be constructed in 2017-18.

Due to the time scales involved in the development and London Borough of Camden proposed dates for the Phoenix Court project it is unlikely a district heating network connection is viable. On this basis we have proceeded to evaluate the installation of a Combined Heat and Power unit for the site.

The mixed nature of the 101 Camley Street development lends itself to CHP as a consistent year round heat load (ensuring the plant runs at its optimal efficiency) exists. The domestic hot water demand of the building provides a good base load for the operation of the CHP, with the additional benefit of the electricity generated by the CHP being consumed on site for general power usage throughout.

The communal heating system serving the residential spaces via heat interface units will be extended to serve commercial units and communal spaces, providing all zones with the opportunity to benefit from carbon efficient heat. This should ensure a thermal load is provided for the CHP by the residential and business units during the day and an increased residential load in the evenings.

In order to do an initial selection for the CHP the likely full load running hours for the CHP must be established to optimise energy efficiency and ensure excess heat or electricity generation is avoided. Based on this it is assumed the CHP will run at the rated output for approximately 14 hours a day for 300 days per year, this allows down time for maintenance etc. this equates to be approximately 4200 hours per year[6].



Indicative monthly thermal load for the CHP

Based on the criteria above a $60kW_{th}$ has been selected at this stage. This selection is based solely on the data produced by the SAP calculations carried out at this stage rather than a full energy assessment of the development and as such the size of the CHP unit is subject to change at detailed design stage when a more detailed analysis would typically be carried out.

Calculations using the Designbuilder and SAP software show that by providing a gas fired CHP meeting 60% of the total annual heat and domestic hot water demand results in a **20.28%** reduction in regulated carbon emissions.

To meet the remaining thermal load high efficiency gas boilers will be specified. Any plant specified will be compliant with the Clean Air Act and local air quality requirements. The main heating plant is to be located on the lower ground floor (see KSR drawing No. CML101_P1) and will be naturally ventilated to atmosphere via louvres at ground floor level. The flues have been route to terminate at roof level.

[6] Running hour may be adjusted during detailed design stages

	Carbon dioxide emissions after 'Be Clean' CHP (Tonnes CO2 per annum)	
	Regulated	Unregulated[7]
Baseline: Part L 2010 of the Building Regulations Compliant Development	838.29	377.23
After energy demand reduction	738.80	332.46
After CHP	501.71	332.46

[7] Unregulated Energy has been accounted for and is estimated as 40% for commercial spaces and 50% for residential spaces of the total regulated energy. As both space types are nearly equal in energy demand an average of 45% unregulated energy for the Target and 35% has been used after the demand reduction step.

7. BE GREEN - INCORPORATION OF RENEWABLE TECHNOLOGIES

7.1. Objective

The third and final stage of the energy hierarchy is to 'be green'. The potential of a range of renewable energy systems that can contribute on-site generation to serve the energy requirements of the site, and thereby further reductions in CO_2 emissions for the proposed development.

7.2. Methodology

This assessment has been undertaken using the methods laid out in the London Energy Partnership's 'integrating renewable energy into new developments: Toolkit for planners, developers and consultants' - the 'Renewables Toolkit'

7.3. Scope

The following renewable energy technologies have been considered for application at the site as they are identified in the London Plan as being potentially technically feasible for projects in London.

- Ground Source Heat Pump
- Air Source Heat Pump
- Solar Thermal Water Heating
- Photovoltaics
- Wind Turbines
- Biomass

7.4. ON-SITE RENEWABLE ENERGY ASSESSMENT

A number of technologies were appraised in terms of technical, physical and financial feasibility, as potential low carbon system for use on the project.

7.4.1. Ground source heat pumps

illustrative images only

Heat pumps use refrigerant gases and an electrical compressor to take heat from a source and deliver it to an output. In this way they can be used to supply heating or cooling to a building. The ground acts as a huge solar collector and thermal store, which dampens fluctuations in ground temperature. The fluctuations reduce with depth and stabilise at the annual mean by about 12m below the surface; for the UK this is in the range 9–12°C.

Ground source heat pumps can make use of heat stored in the ground and raise it to a more useful temperature of around 40-50°C. It should be noted that at these temperatures, the heat produced is only useful for low temperature applications such as under floor heating installations; otherwise, a degree of top-up by conventional means is required when used for generating domestic hot water for example.

Ground source heat pumps can also be used to provide cooling by reverse cycle and transferring rejected heat from the building back into the ground. The heat transferred back into the ground is then stored in thermal banks and can be used later in the year when there is a need for heating again.

The viability of such a system and therefore costs rely almost entirely on the sub-structure build-up, the adjacency and restrictions on sub-structural service distributions and transport systems and the structural interface required to achieve thermal piles below the building.

From the evaluation it shows that the site may have the potential for ground source geothermal heat exchange and storage below the new basement levels of the proposed development due to the building having piled foundations. Based on this a closed loop system could be provided to release heat into the ground as well as draw heat from it depending on the requirements of the building subject to a detailed ground condition survey that would be carried out at the detailed design phase.

7.4.2. Air Source Heat Pumps

Illustrative images only

Air source heat pumps operate using the same reverse refrigeration cycle as ground source heat pumps; however the initial heat energy is extracted from the external air rather than the ground. These heat pumps can be reversed to provide cooling to an area although this reduces the coefficient of performance of the pumps.

The heat pump connects multiple inside units with a single outside unit. The latter resembles a comfort cooling condenser unit and care must be taken to locate the unit where any noise generation is not obtrusive and the location should ensure the unit is not visually obtrusive.

Air source heat pumps are not considered to be well suited for a multi residential building such as this and with the use of communal heating via CHP this technology is not considered to be viable.

7.4.3. Solar Water Heating

Illustrative images only

The hot water load for the development is very high due to the density of occupation and although there is useable space at 11^{th} & 8^{th} floor roof level to accommodate the panels, the building domestic hot water demand is already met by CHP system following the assessment carried out for step 2 of the Hierarchy. Solar hot water heating therefore will not be progressed further.

7.4.4. Photovoltaics

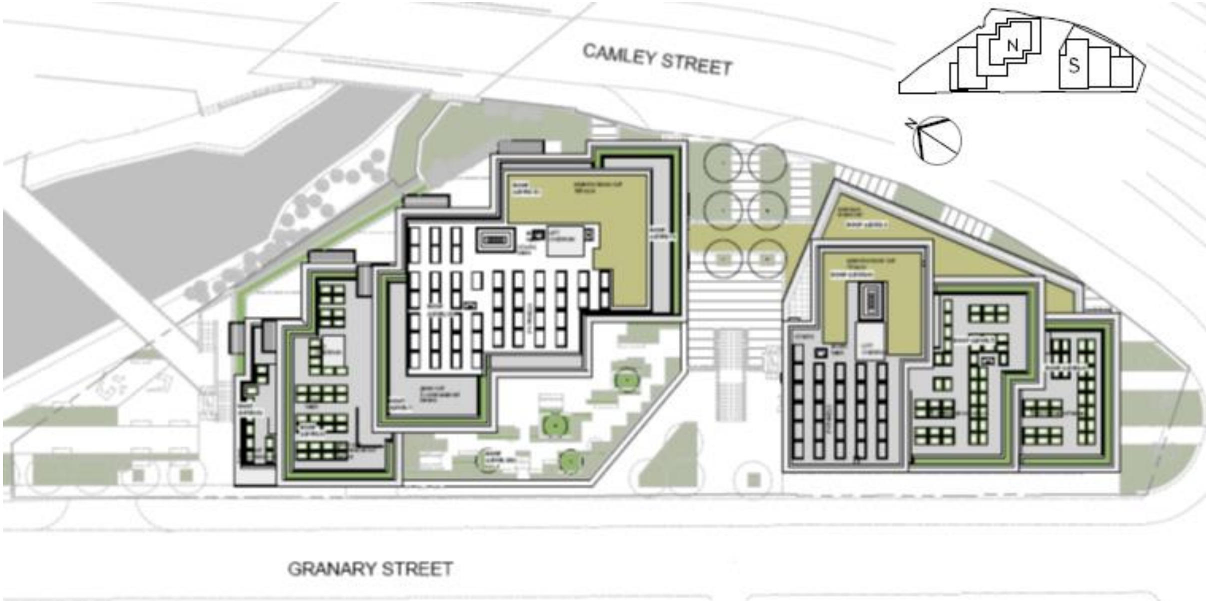
Illustrative images only

Photovoltaic panels (PV) provide clean silent electricity and generate green power during most daylight conditions although they are most efficient when exposed to direct sunlight or are orientated to face plus or minus 30 degrees of due south.

PV panels typically have an electrical warranty of 20 – 25 years and are eligible for the Government's Feed in Tariff (FITS) incentive scheme for the 25 years after the installation.

There is 350m² of space to accommodate PV panels including associated clearances at 11^{th} & 8^{th} floor roof level as shown on the image below, an array of panels is proposed and will add to the electricity produced by the CHP unit and again minimize grid supplied power reliance. In total this equates to a PV installation of approximately 25kW peak. It is assumed that this system will be southeast facing and mounted at a 30 degrees inclination.

Any remaining area not utilised by a PV array could be utilised for extending the proposed green roof.



Plan showing available area for PV Panels at 11th & 8th Floor Roof Level

7.4.5. Wind turbines

Illustrative images only

Wind power can be used to generate electricity either in parallel with mains supplies or as standalone solutions using battery back-up.

In order to generate worthwhile quantities of electricity, average wind speeds of between 5-6 m/s are necessary (the UK government is currently advising 5.5-6.0m/s as the threshold). However Government wind speed database predicts local wind speed at 101 Camley Street, London to be 4.6 m/s at 10 m above ground level and 4.9 m/s at 25 m above ground level thus rendering the option unviable.

7.4.6. Biomass boilers

Illustrative images only

Energy from biomass is produced by burning organic matter. Organic matter is harvested and processed to create bio-energy which can take the form of liquid or solid fuels.

Although biomass is carbon-based (and hence generates carbon emissions), the carbon that is released during combustion is equal to that carbon that was absorbed during growth and so the fuel is classed as carbon neutral (the fuel generally requires treatment and transport, with associated carbon emissions however, but these effects will be ignored here).

Deliveries of fuel for a communal biomass boiler would be considered unacceptable, suitable space for fuel storage would also prove impractical therefore this shall not be considered further.

7.4.7. Summary of Renewable Energy Feasibility

Technology	Feasible For This Site	Reason
Photovoltaics	**YES**	**Proposed at roof level to reduce site reliance on grid supplied electricity. Approx 25kW peak array.**
Solar Water	**No**	Dismissed since load already supplied by CHP.
Ground source heat pumps	**YES**	**Ground Loops or Bore holes may be accommodated**
Air Source heat pumps	**No**	Enough space to accommodate Air source heat pump out door unit (condenser), however not necessary as CHP can accommodate heating load more efficiently.
Wind Generators	**No**	Insufficient wind speeds and turbulence at site.
Biomass Boilers	**No**	Regular fuel deliveries would be unacceptable and require unavailable fuel storage space.

	Carbon dioxide emissions after 'Be Green' Renewables (Tonnes CO_2 per annum)	
	Regulated	Unregulated[8]
Baseline: Part L 2010 of the Building Regulations Compliant Development	838.29	377.23
After energy demand reduction	738.80	332.46
After CHP	501.71	332.46
After renewable energy	416.91	332.46

From the 'Be Green' step the result is a **10.12%** reduction in regulated carbon emissions.

[8] Unregulated Energy has been accounted for and is estimated as 40% for commercial spaces and 50% for residential spaces of the total regulated energy. As both space types are nearly equal in energy demand an average of 45% unregulated energy for the Target and 35% has been used after the demand reduction step.

8. CONCLUSIONS

This report demonstrates how the London plan methodology has been followed and that the three key steps have been taken allowing a reduction of 50.27% over the targeted Part L 2010 Building Regulations CO_2 emissions rate.

Graph and Tables

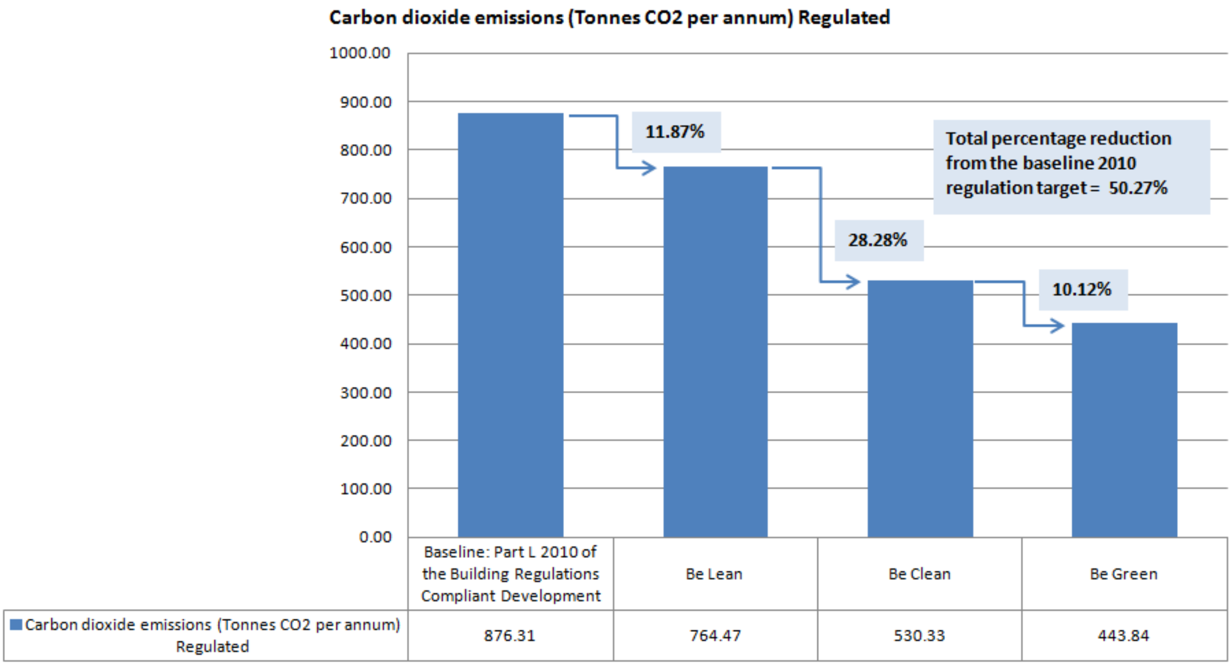


Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy

	Carbon dioxide emissions (Tonnes CO2 per annum)	
	Regulated	Unregulated[9]
Baseline: Part L 2010 of the Building Regulations Compliant Development	838.29	377.23
After energy demand reduction	738.80	332.46
After CHP	501.71	332.46
After renewable energy	416.91	332.46

[9] Unregulated Energy has been accounted for and is estimated as 40% for commercial spaces and 50% for residential spaces of the total regulated energy. As both space types are nearly equal in energy demand an average of 45% unregulated energy for the Target and 35% has been used after the demand reduction step.

Table 2: Regulated carbon dioxide savings from each stage of the Energy Hierarchy

	Regulated Carbon dioxide savings	
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	99.49	11.87%
Savings from CHP	237.09	28.28%
Savings from renewable energy	84.80	10.12%
Total Cumulative Savings	421.38	50.27%
Total Target Savings	335.32	40%
Annual Surplus	86.07	10%

APPENDIX A

Energy Strategy - Calculations and Assumptions

The proposed heating, domestic hot water systems and efficient lighting in conjunction with various low and zero-carbon renewable energy systems have been considered and adopted or dismissed as detailed herein. This proposed building has been specifically assessed in terms of predicted carbon emissions using approved FSAP Software.

The key low carbon technologies deemed as the most viable option for the proposed development is the use of a Combined Heat and Power (CHP) Loads is to be as follows;

- CHP unit sized for approximately 60% of the estimated heating and domestic hot water requirement.
- CHP on site electricity generation is provided in addition to heat output therefore reducing grid electricity reliance.

To further minimise the entire site reliance on grid supplied electricity a suitably sized array of photovoltaic cells will also be installed at roof level serving the commercial and residential units and common parts.

The SAP calculations have been completed for each dwelling layout variation and the average results prepared to determine the energy consumption and CO_2 emission with the new building.

Tables 1 to 3 shows that the results of the Average SAP calculations proposed Dwelling Emission Rate (DER) is considerably lower than both that of the Building Regulations minimum required Target Emissions Rate (TER) and the 40% improvement required.

Core A	
ASSESSMENT	**CO_2 (Kg/m^2/year)**
Average Dwelling TER	16.35
TER +40% Improvement	9.81
Average Dwelling DER	8.33

Table 1: Predicted Annual CO_2 Emissions against Limits (average for Core A)

Core B	
ASSESSMENT	**CO_2 (Kg/m^2/year)**
Average Dwelling TER	16.38
TER +40% Improvement	9.83
Average Dwelling DER	8.48

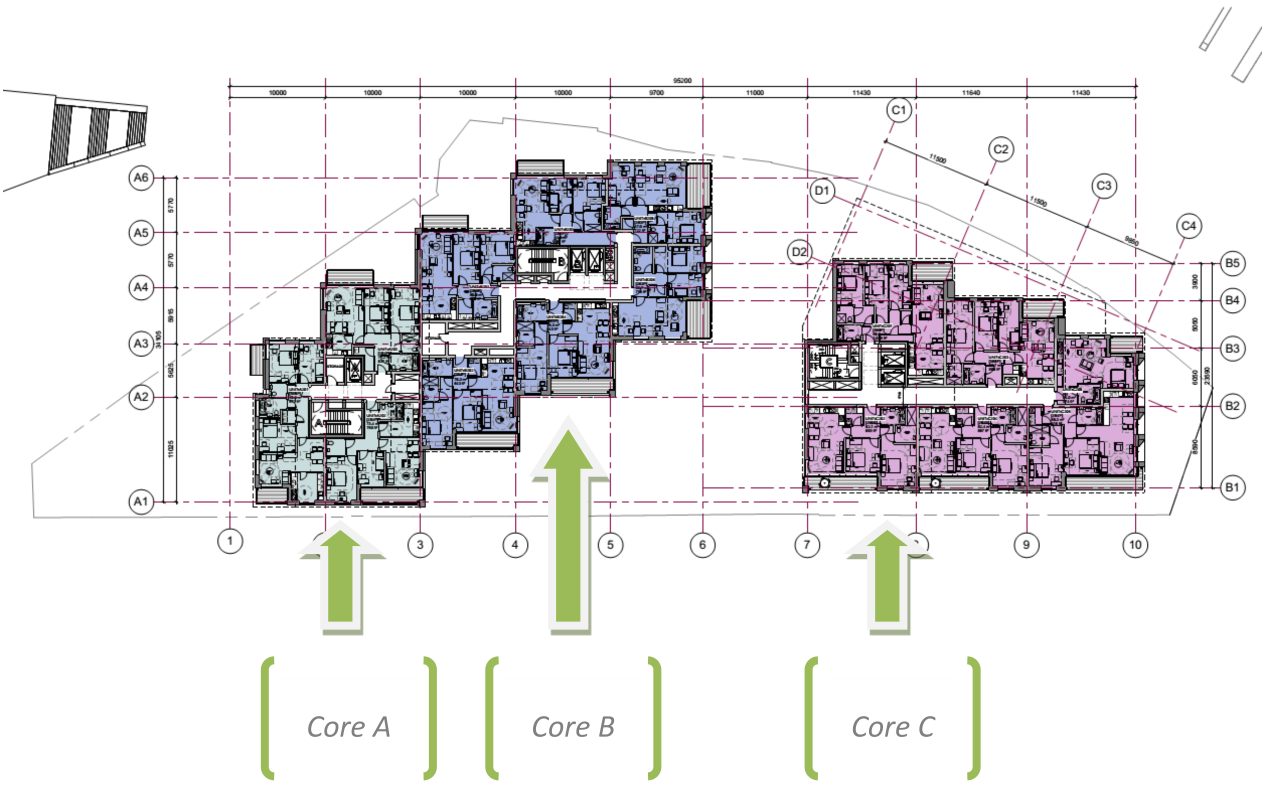
Table 2: Predicted Annual CO_2 Emissions against Limits (average for Core B)

Core C	
ASSESSMENT	**CO_2 (Kg/m^2/year)**
Average Dwelling TER	15.84
TER +40% Improvement	9.50
Average Dwelling DER	7.73

Table 3: Predicted Annual CO_2 Emissions against Limits (average for Core C)

This proposed redevelopment at 101 Camley Street, London is therefore expected to reduce its carbon (CO_2) emissions by **49.05% (Core A), 48.23% (Core B) and 51.20% (Core C)** in accordance with planning policy guidance over Part L 2010 Building Regulations required minimum standards.[10].

The CO_2 compliance has been sub divided into each individual Blocks that correspond to the construction cores of the residential building. This has allowed a more detailed review and a full assessment of all flat layouts.



The non-residential units that are located below the residential cores A, B and C have been analysed using the government approved software Simplified Building Energy Model (SBEM) and as required by planning policy guidance with the same methodology applied as for the residential elements the commercial units also achieve over a 40% reduction in CO_2 emission from the 2010 Part L baseline. Below is the criterion 1 table that shows the reduction estimated within the SBEM[11]:

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

1.1	CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	19.9
1.2	Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	19.9
1.3	Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	6.9
1.4	Are emissions from the building less than or equal to the target?	BER =< TER
1.5	Are as built details the same as used in the BER calculations?	Separate submission

[10] It should also be noted that with weighted averages considering all flats that are not within this sample set the reduction is increased further.

[11] Also see Appendix F for the full BRUKL data output.

The baseline energy demand for a notional residential building has been established within FSAP and used for the building regulation compliance checks;

The energy consumption benchmarks used in the assessment shows in the table below:

Benchmark data / (kWh per annum)					
Building Type	Heating	Hot Water	Cooling	Electricity (power)	Electricity (lighting)
Average Dwelling	4598	3610	0	175	570

Table 6: Benchmark Data

From the Notional calculations the total estimated CO_2 level is estimated as **9323.59 kgCO$_2$/year**

The Carbon emissions factors used in the assessment shows in the table below:

Fuel	Carbon Factors /(Kg/kWh)
Natural Gas	0.198
Electricity	0.517
Electricity Displaced	0.529

Table 6a: Carbon Factors

APPENDIX B

Residential Compliance Sheets

Block Compliance WorkSheet: Be Green_All Blocks

User Details

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP
Software Version: Version: 1.5.0.78

Calculation Details

Dwelling	DER	TER	TFA
UNIT A002_2B4P	8.65	18.15	73.4
UNIT A003_2B3P	10.68	19.28	69.3
UNIT A101_4B5P	6.91	14.97	86.6
UNIT A102_3B5P	8.65	15.25	86.4
UNIT A103_2B4P	8.68	15.22	72.7
UNIT A104_2B4P	6.75	15.09	73.4
UNIT A501_2B4P	8.57	15.8	80.7
UNIT A502_3B5P	7.34	15.3	86.8
UNIT B001_2B4P	10.34	18.31	72.7
UNIT B002_2B4P	10.05	18.09	72
UNIT B003_S	11.66	24.16	38.9
UNIT B1-B32_1B2P	7.76	17.93	54.7
UNIT B102_2B4P	6.62	14.65	78.4
UNIT B103_2B3P	7.41	14.98	72
UNIT B105_S	9.2	20.84	38.9
UNIT B106_1B2P	7.61	18.33	52.7
UNIT B107_1B2P	7.16	15.87	56.5
UNIT B605_2B3P	8.33	16.47	62.6
UNIT B607_3B5P	7.86	15.06	89.6
UNIT B801_3B5P	7.93	14.85	86
UNIT B802_3B5P	7.4	15.53	86
UNIT B1101_4B6P	9.17	15.09	265.3
UNIT C101_3B5P	7.73	14.5	93.9
UNIT C102_2B4P	7.05	15.54	81.3
UNIT C103_3B5P	6.75	13.89	87
UNIT C104_2B4P	6.45	14.41	82.5

Block Compliance WorkSheet: Be Green_All BlocksCont...

Dwelling	DER	TER	TFA
UNIT C105_1B2P	8.36	18.48	49.8
UNIT C106_2B4P	6.94	15.17	80
UNIT C403_3B5P	7.4	15.24	87
UNIT C404_2B4P	7.12	15.41	81.5
UNIT C701_3B5P	8.06	15.4	93.9
UNIT C702_2B4P	7.64	16.63	80.3
UNIT C801_3B5P	9.92	17.71	93.9
UNIT C802 2B4P	9.31	18.92	80.3

Calculation Summary

Total Floor Area	2747.00
Average TER	16.11
Average DER	8.15
Compliance	Pass
% Improvement	49.41

APPENDIX C

SAP and DER Worksheets for dwellings (typical)

Attached seperately

APPENDIX D

Code for Sustainable Homes Report (typical)

Attached seperately

Code for Sustainable Homes Report

Assessor and House Details

Assessor Name: **Assessor Number:**
Property Address:

Buiding regulation assessment

	kg/m²/year
TER	18.33
DER	7.61

The following code calculations are taken from the Code for Sustainable Homes Technical Guide (Nov 10)

Ene 1 Assessment - Dwelling Emission Rate

Total Energy Type CO2 Emissions for Codes Levels 1 - 5

	%	kg/m²/year	
DER from SAP 2009 DER Worksheet		7.61	*(ZC1)*
TER		18.33	
Residual CO2 emissions offset from biofuel CHP		0	*(ZC5)*
CO2 emissions offset from additional allowable electricty generation		0	*(ZC7)*
Total CO2 emissions offset from SAP Section 16 allowances		0	
DER accounting for SAP Section 16 allowances		7.61	
% improvement DER/TER	58.5		

Total Energy Type CO2 Emissions for Codes Levels 6

	kg/m²/year	
DER accounting for SAP Section 16 allowances	7.61	*(ZC1)*
CO2 emissions from appliances, equation (L14)	17.28	*(ZC2)*
CO2 emissions from cooking, equation (L16)	3.06	*(ZC3)*
Net CO2 emissions	27.9	*(ZC8)*

Result:

Credits awarded for Ene 1 = 6

Code Level = 4

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Ene 2 - Fabric energy Efficiency

Fabric energy Efficiency: 35.32
Credits awarded for Ene 2 = 7.9

Ene 7 - Low or Zero Carbon (LZC) Technologies

Reduction in CO2 Emissions

	%	kg/m²/year
Standard Case CO2 emissions		38.34
Standard DER		18
Actual Case CO2 emissions		27.95
Actual DER		7.61
Reduction in CO2 emissions	27.1	

Credits awarded for Ene 7 = 2

Technologies eligible to contribute to achieving the requirements of this issue must produce energy from renewable sources and meet all other ancillary requirements as defined by Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

The following requirements must also be met:

- Where not provided by accredited external renewables there must be a direct supply of energy produced to the dwelling under assessment.
- Where covered by the Microgeneration Certification Scheme (MCS), technologies under 50kWe or 300kWth must be certified.
- Combined Heat and Power (CHP) schemes above 50kWe must be certified under the CHPQA standard.
- All technologies must be accounted for by SAP.

CHP schemes fuelled by mains gas are eligible to contribute to performance against this issue. Where these schemes are above 50kWe they must be certified under the CHPQA.
It is the responsibly of the Accredited OCDEA and Code Assessor to ensure all technologies use in the calculation are appropriate before awarding credits.

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2009 | **Software Version:** Version: 1.5.0.78

Property Address: UNIT B106_1B2P

Address :

1. Overall dwelling dimensions:

	Area(m²)		Ave Height(m)		Volume(m³)	
Ground floor	52.7	(1a) x	2.8	(2a) =	147.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52.7	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	147.56	(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			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.25	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides on which sheltered			2	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor		(21) = (18) x (20) =	0.21	(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=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

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DER WorkSheet: New dwelling design stage

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

0.29	0.27	0.27	0.24	0.22	0.21	0.2	0.2	0.22	0.24	0.26	0.27

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) =	77.35	(23c)

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

(24a)m=	0.4	0.38	0.38	0.35	0.33	0.32	0.31	0.31	0.34	0.35	0.37	0.38	(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=	0.4	0.38	0.38	0.35	0.33	0.32	0.31	0.31	0.34	0.35	0.37	0.38	(25)

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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			7.04	x1/[1/(1.4)+ 0.04]		=	9.33			(27)
Windows Type 2			9.9	x1/[1/(1.4)+ 0.04]		=	13.12			(27)
Walls Type1	28	7.04	20.96	x	0.2	=	4.19			(29)
Walls Type2	22.4	9.9	12.5	x	0.2	=	2.5			(29)
Total area of elements, m²			50.4							(31)
Party wall			47.6	x	0	=	0			(32)
Party floor			52.7							(32a)
Party ceiling			52.7							(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) =	29.15	(33)
Heat capacity Cm = S(A x k)	((28)...(30) + (32) + (32a)...(32e) =	5109.44	(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		7.56	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	36.71	(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=	19.48	18.71	18.71	17.16	16.12	15.6	15.09	15.09	16.38	17.16	17.93	18.71	(38)

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

(39)m=	56.19	55.42	55.42	53.87	52.83	52.31	51.8	51.8	53.09	53.87	54.64	55.42	

Average = $Sum(39)_{1...12}$ /12= 53.89 (39)

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DER WorkSheet: New dwelling design stage

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

(40)m=	1.07	1.05	1.05	1.02	1	0.99	0.98	0.98	1.01	1.02	1.04	1.05

Average = Sum(40)$_{1...12}$ /12= 1.02 (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 1.77 (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 76.23 (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=	83.85	80.8	77.76	74.71	71.66	68.61	68.61	71.66	74.71	77.76	80.8	83.85	
											Total = Sum(44)$_{1...12}$ =	914.77	(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=	124.65	109.02	112.5	98.08	94.11	81.21	75.25	86.35	87.38	101.84	111.16	120.72	
											Total = Sum(45)$_{1...12}$ =	1202.28	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	18.7	16.35	16.87	14.71	14.12	12.18	11.29	12.95	13.11	15.28	16.67	18.11	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (47)

Temperature factor from Table 2b 0 (48)

Energy lost from water storage, kWh/year (47) x (48) = 0 (49)

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

Cylinder volume (litres) including any solar storage within same 110 (50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year ((50) x (51) x (52) x (53) = 1.03 (54)

Enter (49) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 360 (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=	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(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)

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DER WorkSheet: New dwelling design stage

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(62)m=	187.24	165.55	175.09	158.65	156.7	141.78	137.84	148.94	147.96	164.43	171.74	183.31	(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=	187.24	165.55	175.09	158.65	156.7	141.78	137.84	148.94	147.96	164.43	171.74	183.31	

Output from water heater (annual)$_{1...12}$ 1939.22 (64)

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

(65)m=	91.52	81.48	87.48	81.07	81.36	75.46	75.09	78.78	77.51	83.93	85.42	90.21	(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=	88.49	88.49	88.49	88.49	88.49	88.49	88.49	88.49	88.49	88.49	88.49	88.49	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	13.75	12.21	9.93	7.52	5.62	4.75	5.13	6.66	8.95	11.36	13.26	14.13	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	154.24	155.84	151.81	143.22	132.38	122.2	115.39	113.79	117.82	126.41	137.25	147.44	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-70.79	-70.79	-70.79	-70.79	-70.79	-70.79	-70.79	-70.79	-70.79	-70.79	-70.79	-70.79	(71)
Water heating gains (Table 5)													
(72)m=	123.01	121.24	117.58	112.59	109.36	104.8	100.93	105.89	107.66	112.81	118.64	121.25	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	340.55	336.84	328.86	312.88	296.91	281.29	271	275.89	283.97	300.13	318.69	332.36	(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)	
Southeast 0.9x	0.77	x	9.9	x	37.39	x	0.72	x	0.8	=	147.75	(77)
Southeast 0.9x	0.77	x	9.9	x	63.74	x	0.72	x	0.8	=	251.87	(77)
Southeast 0.9x	0.77	x	9.9	x	84.22	x	0.72	x	0.8	=	332.8	(77)
Southeast 0.9x	0.77	x	9.9	x	103.49	x	0.72	x	0.8	=	408.96	(77)
Southeast 0.9x	0.77	x	9.9	x	113.34	x	0.72	x	0.8	=	447.88	(77)
Southeast 0.9x	0.77	x	9.9	x	115.04	x	0.72	x	0.8	=	454.63	(77)
Southeast 0.9x	0.77	x	9.9	x	112.79	x	0.72	x	0.8	=	445.72	(77)
Southeast 0.9x	0.77	x	9.9	x	105.34	x	0.72	x	0.8	=	416.28	(77)

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Southeast 0.9x	0.77	x	9.9	x	92.9	x	0.72	x	0.8	=	367.11	(77)
Southeast 0.9x	0.77	x	9.9	x	72.36	x	0.72	x	0.8	=	285.96	(77)
Southeast 0.9x	0.77	x	9.9	x	44.83	x	0.72	x	0.8	=	177.14	(77)
Southeast 0.9x	0.77	x	9.9	x	31.95	x	0.72	x	0.8	=	126.26	(77)
Southwest 0.9x	0.77	x	7.04	x	37.39		0.72	x	0.8	=	105.06	(79)
Southwest 0.9x	0.77	x	7.04	x	63.74		0.72	x	0.8	=	179.11	(79)
Southwest 0.9x	0.77	x	7.04	x	84.22		0.72	x	0.8	=	236.66	(79)
Southwest 0.9x	0.77	x	7.04	x	103.49		0.72	x	0.8	=	290.82	(79)
Southwest 0.9x	0.77	x	7.04	x	113.34		0.72	x	0.8	=	318.49	(79)
Southwest 0.9x	0.77	x	7.04	x	115.04		0.72	x	0.8	=	323.29	(79)
Southwest 0.9x	0.77	x	7.04	x	112.79		0.72	x	0.8	=	316.96	(79)
Southwest 0.9x	0.77	x	7.04	x	105.34		0.72	x	0.8	=	296.02	(79)
Southwest 0.9x	0.77	x	7.04	x	92.9		0.72	x	0.8	=	261.05	(79)
Southwest 0.9x	0.77	x	7.04	x	72.36		0.72	x	0.8	=	203.35	(79)
Southwest 0.9x	0.77	x	7.04	x	44.83		0.72	x	0.8	=	125.97	(79)
Southwest 0.9x	0.77	x	7.04	x	31.95		0.72	x	0.8	=	89.78	(79)

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

(83)m=	252.61	430.97	569.46	699.78	766.37	777.92	762.65	712.3	626.16	469.31	303.11	216.04	(83)

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

(84)m=	593.36	769.62	896.32	1012.66	1063.26	1059.21	1033.65	966.2	912.13	769.44	621.79	546.41	(84)

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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=	0.96	0.9	0.78	0.63	0.46	0.32	0.21	0.21	0.39	0.66	0.92	0.97	(86)

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

(87)m=	20.36	20.64	20.85	20.96	20.99	21	21	21	21	20.95	20.65	20.35	(87)

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

(88)m=	20.03	20.04	20.04	20.07	20.08	20.09	20.1	20.1	20.08	20.07	20.05	20.04	(88)

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

(89)m=	0.96	0.88	0.75	0.59	0.41	0.27	0.16	0.17	0.34	0.61	0.9	0.96	(89)

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

(90)m=	19.22	19.62	19.88	20.03	20.08	20.09	20.1	20.1	20.08	20.03	19.64	19.22	(90)

fLA = Living area ÷ (4) = 0.49 (91)

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

(92)m=	19.78	20.12	20.36	20.46	20.53	20.54	20.54	20.54	20.53	20.46	20.14	19.77	(92)

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

(93)m=	19.78	20.12	20.36	20.46	20.53	20.54	20.54	20.54	20.53	20.46	20.14	19.77	(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

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Utilisation factor for gains, hm:

(94)m=	0.95	0.88	0.76	0.61	0.44	0.29	0.18	0.19	0.36	0.64	0.9	0.96	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	565.2	675.4	682.59	616.01	463.91	310.48	188.72	188.71	330.12	502.46	559.06	526.49	(95)

Monthly average external temperature from Table 8

(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	858.72	838.15	751.28	634.81	466.48	310.69	188.73	188.73	330.84	521.64	717.82	824.28	(97)

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

(98)m=	218.38	109.37	51.1	13.53	1.91	0	0	0	0	14.27	114.31	221.56

Total per year (kWh/year) = Sum(98)$_{1...5,10...12}$ = 744.43 (98)

Space heating requirement in kWh/m²/year 14.13 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community CHP		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		744.43	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	468.99	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	312.66	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1939.22	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1221.71	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	814.47	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	28.18	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		119.27	(330a)

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warm air heating system fans						0	(330b)
pump for solar water heating						0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =					119.27	(331)
Energy for lighting (calculated in Appendix L)						242.64	(332)
Electricity generated by PVs (Appendix M) (negative quantity)						-238.26	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)						0	(334)
12b. CO2 Emissions – Community heating scheme							
Electrical efficiency of CHP unit						31	(361)
Heat efficiency of CHP unit						62	(362)
		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	756.44	x	0.2		149.78	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	234.5	x	0.53		-124.05	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	1970.5	x	0.2		390.16	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	610.85	x	0.53		-323.14	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.2	=	232.47	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	14.57	(372)
Total CO2 associated with community systems	(363)...(366) + (368)...(372)				=	339.78	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.2	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					339.78	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	61.66	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	125.55	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1				0.53	x 0.01 =	-126.04	(380)
Total CO2, kg/year	sum of (376)...(382) =					400.95	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					7.61	(384)
EI rating (section 14)						94.5	(385)

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2009 | **Software Version:** Version: 1.5.0.78

Property Address: UNIT B106_1B2P

Address :

1. Overall dwelling dimensions:

	Area(m²)		Ave Height(m)		Volume(m³)	
Ground floor	52.7	(1a) x	2.8	(2a) =	147.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52.7	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		147.56	(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)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(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 *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*			0	(11)
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			10	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.64	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides on which sheltered			2	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor		(21) = (18) x (20) =	0.54	(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=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

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

	0.73	0.69	0.69	0.61	0.55	0.53	0.5	0.5	0.57	0.61	0.65	0.69

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]

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

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)

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]

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0.77	0.74	0.74	0.68	0.65	0.64	0.62	0.62	0.66	0.68	0.71	0.74	(24d)
(25)m=	0.77	0.74	0.74	0.68	0.65	0.64	0.62	0.62	0.66	0.68	0.71	0.74	(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			1.65	x	2	=	3.7			(26)
Windows			11.325	x	1/[1/(2)+ 0.04]	=	20.97			(27)
Walls	50.4	13.17	37.23	x	0.35	=	13.03			(29)
Total area of elements, m²			50.4							(31)
Party floor			52.7							(32a)
Party ceiling			52.7							(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) =	37.7	(33)
Heat capacity Cm = S(A x k)	((28)...(30) + (32) + (32a)...(32e) =	3689.0001	(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		5.54	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	43.24	(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=	37.3	35.9	35.9	33.34	31.81	31.1	30.43	30.43	32.16	33.34	34.58	35.9	(38)

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

(39)m=	80.54	79.14	79.14	76.58	75.06	74.35	73.67	73.67	75.43	76.58	77.82	79.14	

Average = Sum(39)1...12 /12= 76.76 (39)

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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=	1.53	1.5	1.5	1.45	1.42	1.41	1.4	1.4	1.43	1.45	1.48	1.5		
Average = Sum(40)1…12 /12=													1.46	(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 — 1.77 (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 — 80.24 (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=	88.27	85.06	81.85	78.64	75.43	72.22	72.22	75.43	78.64	81.85	85.06	88.27		
Total = Sum(44)1…12 =													962.92	(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=	131.21	114.76	118.42	103.24	99.06	85.46	79.21	90.9	91.98	107.2	117.02	127.07		
Total = Sum(45)1…12 =													1265.55	(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=	19.68	17.21	17.76	15.49	14.86	12.82	11.88	13.63	13.8	16.08	17.55	19.06	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):	0	(47)
Temperature factor from Table 2b	0	(48)
Energy lost from water storage, kWh/year (47) x (48) =	0	(49)
If manufacturer's declared cylinder loss factor is not known:		
Cylinder volume (litres) including any solar storage within same	150	(50)

If community heating and no tank in dwelling, enter 110 litres in box (50)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	0.93	(52)
Temperature factor from Table 2b	0.54	(53)
Energy lost from water storage, kWh/year ((50) x (51) x (52) x (53) =	1.44	(54)
Enter (49) or (54) in (55)	1.44	(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=	44.53	40.22	44.53	43.09	44.53	43.09	44.53	44.53	43.09	44.53	43.09	44.53	(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=	44.53	40.22	44.53	43.09	44.53	43.09	44.53	44.53	43.09	44.53	43.09	44.53	(57)

Primary circuit loss (annual) from Table 3 — 610 (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=	51.81	46.79	51.81	50.14	51.81	50.14	51.81	51.81	50.14	51.81	50.14	51.81	(59)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

TER WorkSheet: New dwelling design stage

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=	227.55	201.77	214.78	196.47	195.4	178.71	175.55	187.23	185.21	203.53	210.24	223.41	(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=	227.55	201.77	214.78	196.47	195.4	178.71	175.55	187.23	185.21	203.53	210.24	223.41	

Output from water heater (annual)$_{1...12}$ 2399.84 (64)

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

(65)m=	120.7	107.77	116.44	108.91	110.01	103.01	103.41	107.29	105.17	112.71	113.49	119.32	(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=	88.49	88.49	88.49	88.49	88.49	88.49	88.49	88.49	88.49	88.49	88.49	88.49	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	23.41	20.79	16.91	12.8	9.57	8.08	8.73	11.35	15.23	19.34	22.57	24.06	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	154.24	155.84	151.81	143.22	132.38	122.2	115.39	113.79	117.82	126.41	137.25	147.44	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	(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=	-70.79	-70.79	-70.79	-70.79	-70.79	-70.79	-70.79	-70.79	-70.79	-70.79	-70.79	-70.79	(71)
Water heating gains (Table 5)													
(72)m=	162.23	160.37	156.51	151.26	147.86	143.06	138.99	144.21	146.07	151.5	157.63	160.38	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	399.42	396.55	384.77	366.83	349.36	332.88	322.65	328.89	338.66	356.79	376.99	391.42	(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)	
East	0.9x	1	x	11.32	x	19.87	x	0.72	x	0.7	=	78.61	(76)
East	0.9x	1	x	11.32	x	38.52	x	0.72	x	0.7	=	152.38	(76)
East	0.9x	1	x	11.32	x	61.57	x	0.72	x	0.7	=	243.52	(76)
East	0.9x	1	x	11.32	x	91.41	x	0.72	x	0.7	=	361.57	(76)
East	0.9x	1	x	11.32	x	111.22	x	0.72	x	0.7	=	439.93	(76)
East	0.9x	1	x	11.32	x	116.05	x	0.72	x	0.7	=	459.04	(76)
East	0.9x	1	x	11.32	x	112.64	x	0.72	x	0.7	=	445.55	(76)
East	0.9x	1	x	11.32	x	98.03	x	0.72	x	0.7	=	387.78	(76)

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East	0.9x	1	x	11.32	x	73.6	x	0.72	x	0.7	=	291.14	(76)
East	0.9x	1	x	11.32	x	46.91	x	0.72	x	0.7	=	185.55	(76)
East	0.9x	1	x	11.32	x	24.71	x	0.72	x	0.7	=	97.73	(76)
East	0.9x	1	x	11.32	x	16.39	x	0.72	x	0.7	=	64.84	(76)

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

(83)m=	76.61	152.36	243.52	361.57	439.93	459.04	445.55	387.78	291.14	185.55	97.73	64.84	(83)

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

(84)m=	476.03	548.91	628.29	728.4	789.29	791.93	768.21	716.67	629.6	542.33	474.71	456.26	(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	0.9	0.76	0.57	0.39	0.42	0.71	0.92	0.98	0.99	(86)

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

(87)m=	19.57	19.76	20.12	20.51	20.83	20.96	20.99	20.99	20.9	20.53	19.95	19.62	(87)

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

(88)m=	19.67	19.69	19.69	19.73	19.75	19.76	19.77	19.77	19.74	19.73	19.71	19.69	(88)

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

(89)m=	0.99	0.97	0.94	0.86	0.69	0.47	0.27	0.29	0.61	0.89	0.97	0.99	(89)

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

(90)m=	18.42	18.64	18.97	19.36	19.65	19.74	19.77	19.77	19.7	19.38	18.82	18.46	(90)

fLA = Living area ÷ (4) = | 0.49 | (91)

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

(92)m=	18.99	19.2	19.54	19.93	20.23	20.34	20.37	20.37	20.29	19.95	19.38	19.05	(92)

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

(93)m=	18.99	19.2	19.54	19.93	20.23	20.34	20.37	20.37	20.29	19.95	19.38	19.05	(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=	0.98	0.97	0.94	0.87	0.72	0.52	0.33	0.35	0.66	0.89	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	470.2	533.45	590.56	632.04	565.73	412.5	254.34	253.62	413.98	465.25	461.46	449.26	(95)
Monthly average external temperature from Table 8													
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1166.91	1124.02	1008.35	859.86	640.21	427.04	255.63	255.76	452	700.55	963.43	1119.52	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	518.36	396.86	310.83	164.04	55.41	0	0	0	0	160.19	361.42	498.67	

Total per year (kWh/year) = Sum(98)1…5,10…12 = | 2465.78 | (98)

Space heating requirement in kWh/m²/year | 46.79 | (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0.1	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	0.9	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	0.9	(204)
Efficiency of main space heating system 1		78.9	(206)
Efficiency of secondary/supplementary heating system, %		100	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	518.36	396.86	310.83	164.04	55.41	0	0	0	0	160.19	361.42	498.67		
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)	591.28	452.7	354.56	187.11	63.21	0	0	0	0	182.72	412.26	568.83		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													2812.68	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] + (214) m } x 100 ÷ (208)														
(215)m=	51.84	39.69	31.08	16.4	5.54	0	0	0	0	16.02	36.14	49.87		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													246.58	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	227.55	201.77	214.76	196.47	195.4	178.71	175.55	187.23	185.21	203.53	210.24	223.41		
Efficiency of water heater													68.8	(216)
(217)m=	75.28	74.93	74.17	72.8	70.64	68.8	68.8	68.8	68.8	72.66	74.6	75.23		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	302.28	269.28	289.54	269.88	276.62	259.76	255.16	272.14	269.2	280.13	281.83	296.97		
Total = Sum(219a)$_{1...12}$ =													3322.79	(219)

DRAFT

Annual totals

	kWh/year	kWh/year	
Space heating fuel used, main system 1		2812.68	
Space heating fuel used, secondary		246.58	
Water heating fuel used		3322.79	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	130		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year (sum of (230a)…(230g) =)		175	(231)
Electricity for lighting		413.38	(232)

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	0.194 =	545.66	(261)
Space heating (secondary)	(215) x	0.422 =	104.06	(263)
Water heating	(219) x	0.194 =	644.62	(264)

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Space and water heating	(261) + (262) + (263) + (264) =		1294.34	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.422 =	73.85	(267)
Electricity for lighting	(232) x	0.422 =	174.45	(268)
Total CO2, kg/year		sum of (265)...(271) =	1542.63	(272)

TER = 18.33 (273)

DRAFT

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APPENDIX E

Business Unit- Typical BRUKL Data Output

BRUKL Output Document

HM Government

Compliance with England and Wales Building Regulations Part L 2010

Project name **Shell and Core**

Lower Ground Floor Units

As designed

Date: Tue Sep 09 12:28:44 2014

Administrative information

Building Details

Address: London,

Certification tool

Calculation engine: SBEM

Calculation engine version: v4.1.d.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v3.0.0

BRUKL compliance check version: v4.1.d.0

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Darryl Vardill

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

1.1	CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	19.9
1.2	Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	19.9
1.3	Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	6.9
1.4	Are emissions from the building less than or equal to the target?	BER =< TER
1.5	Are as built details the same as used in the BER calculations?	Separate submission

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

2.a Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	Lower Ground Floor - Employment use EAST_W_5
Floor	0.25	0.11	0.11	Lower Ground Floor - Employment use EAST_S_3
Roof	0.25	0.18	0.18	Lower Ground Floor - Employment use EAST_R_4
Windows***, roof windows, and rooflights	2.2	1.6	1.6	Lower Ground Floor - Employment use EAST_G_8
Personnel doors	2.2	-	-	"No heat loss personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No heat loss vehicle access doors"
High usage entrance doors	3.5	-	-	"No heat loss high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

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

2.b Building services

The building services parameters listed below are expected to be checked by the BCO against guidance.
No automatic checking is performed by the tool.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- CHP PV

Heating seasonal efficiency	**Cooling nominal efficiency**	**SFP [W/(l/s)]**	**HR seasonal efficiency**
0.93	-	-	-
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system			YES

1- Project DHW

Heating seasonal efficiency	**Hot water storage loss factor [kWh/litre per day]**
Hot water provided by HVAC system	-

"No zones in project where local mechanical ventilation or exhaust is applicable"

Shell and core configuration

Zone	**Assumed shell?**
Lower Ground Floor - Employment use EAST	YES

General lighting and display lighting

Zone	**General lighting [W]**	**Display lamps efficacy [lm/W]**
Lower Ground Floor - Employment use EAST	2[illegible]00	-

Criterion 3: The spaces in the building should have propriate passive control measures to limit solar gains

Zone	**Solar gain limit exceeded? (%)**	**Internal blinds used?**
Lower Ground Floor - Employment use EAST	NO (5[illegible]2%)	NO

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

Separate submission

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

Separate submission

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	484.9	484.9
External area [m²]	1167.3	1167.3
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	5	5
Average conductance [W/K]	232.77	367.04
Average U-value [W/m²K]	0.2	0.31
Alpha value* [%]	15.12	11.55

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Telephone exchanges
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	22.23	28.73
Cooling	0	0
Auxiliary	1.68	0.98
Lighting	14.77	19.15
Hot water	4.52	3.51
Equipment*	42.19	41.13
TOTAL	**36.9**	**52.38**

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

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	8.16	0
Wind turbines	0	0
CHP generators	6.3	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Indicative Target
Heating + cooling demand [MJ/m²]	165.47	184.84
Total consumption [kWh/m²]	36.9	52.38
Total emissions [kg/m²]	6.9	19.9

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] District heating, [HFT] District Heating, [CFT] Natural Gas										
	Actual	23.2	107.5	7.4	0	1.7	0.87	0	0.93	0
	Notional	81.9	102.9	28.7	0	1	0.79 / 0.81	0	----	----

Key to terms

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

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U_{i-Typ}	U_{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.2	Lower Ground Floor - Employment use EAST_W_5
Floor	0.2	0.11	Lower Ground Floor - Employment use EAST_S_3
Roof	0.15	0.18	Lower Ground Floor - Employment use EAST_R_4
Windows, roof windows, and rooflights	1.5	1.6	Lower Ground Floor - Employment use EAST_G_8
Personnel doors	1.5	-	"No heat loss personnel doors"
Vehicle access & similar large doors	1.5	-	"No heat loss vehicle access doors"
High usage entrance doors	1.5	-	"No heat loss high usage entrance doors"

U_{i-Typ} = Typical individual element U-values [W/(m²K)] U_{i-Min} = Minimum individual element U-values [W/(m²K)]

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

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	5

APPENDIX F

KINGS CROSS ENERGY CENTRE CORRESPONDENCE

From: Paul Dakin
Sent: 07 February 2014 12:15
To: Chris Rowe
Cc: Paul Bushell; 'Clare Hebbes'; Robert Clarke
Subject: RE: 140128 2601-6 101 Camley Street Mixed Use Development

Dear Chris

In response to your previous e mail requesting the feasibility of supplying 485kw heat/hot water load from the Kings Cross energy centre to your site, having discussed this with both our technical team and the client I can advise that we do no t believe this to be a feasible option. The reasons are as you have stated previously that the location of your site would be difficult to serve due to the crossing of the canal and the network rail and the associated legal/easement requirements that would need to be secured from the relevant parties.

Best Regards

Paul

From: Chris Rowe
Sent: 28 January 2014 14:05
To: Paul Dakin
Cc: Paul Bushell
Subject: 140128 2601-6 101 Camley Street Mixed Use Development

Dear Mr Dakin

I have been given your name via Vital Energy and note you are responsible for the Kings Cross Development CHP Energy Centre

We have been requested as part of our Planning Application (planned not submitted yet) by Camden to enquire about the potential for the KC CHP plant to serve our development also

We have a heating/hot water demand of approx. 485kw and would appreciate your thoughts on the feasibility of supplying such a load to our site;I attach a site plan showing your site and ours and their relationship

Appreciate the issue of the Network Rail line and Canal but as noted above would be pleased to receive your initial comments

Kind Regards,
Chris Rowe
Director

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APPENDIX G

KSR - DESIGN FOR SHADING

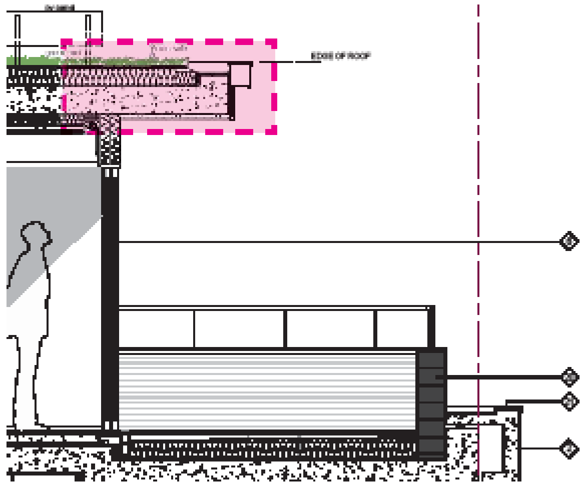
DESIGN FOR SHADING

The external building envelope has been designed to minimise excessive solar heat gain in particular south and west facing facades. Deep balconies and external blinds have been provided as necessary. All 121 units have at least one of following features;

1) Deep roof overhang (on Penthouse unit)

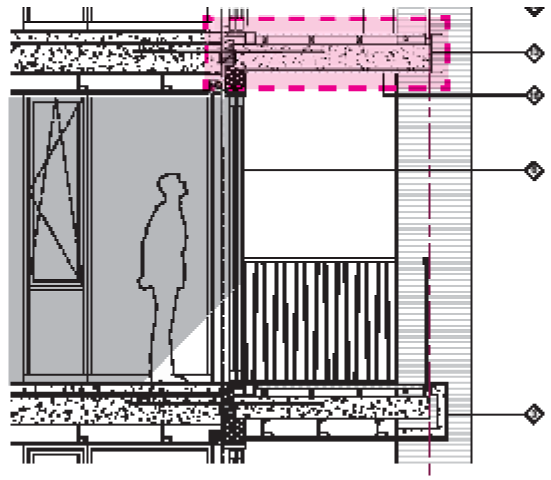
2) Typical deep balconies for main living area (shown as Green Dot)

3) External blind (shown as Blue Dot)



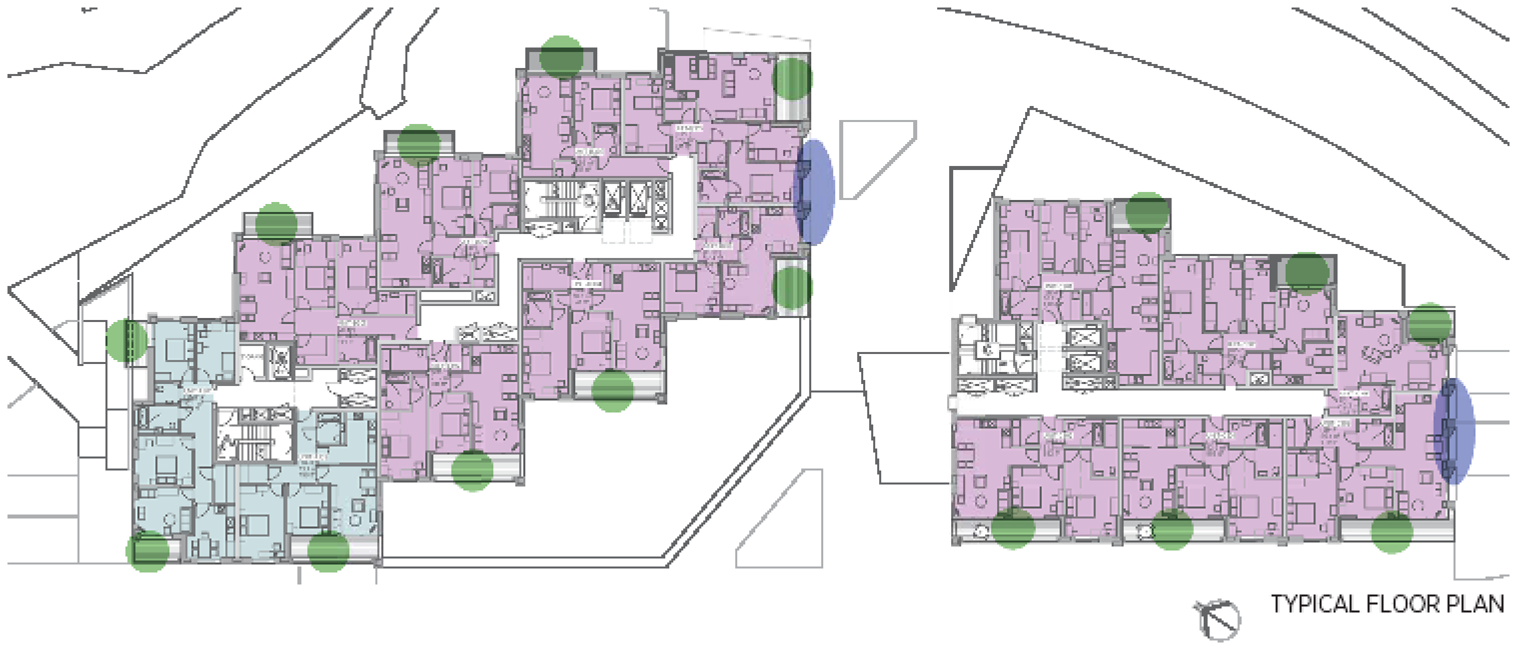
TYPICAL SECTION 1

Deep roof overhang on penthouse unit
(refer to planning drawing CML-334 for further detail)

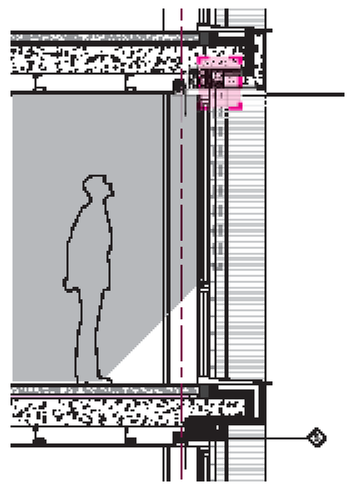


TYPICAL SECTION 2

Deep balcony (refer to planning drawing CML-330 for further detail)



TYPICAL FLOOR PLAN



TYPICAL SECTION 3

External Blind (refer to planning drawing CML-332 for further detail)

101 CAMLEY STREET
SUPPLEMENTARY SUBMISSION

DESIGN FOR SHADING