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DENVILLE HALL

ENERGY STATEMENT

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All information provided here is based on plans and information available at the time of writing. Prior to implementation of the options discussed, further detailed study, design, and costing, based on ground surveys, structural analysis, over shading studies, etc., as relevant to each renewable/low carbon source, is necessary.

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1. EXECUTIVE SUMMARY

This energy statement has been prepared by CBG Consultants on behalf of Denville Hall in support of its planning application to Hillingdon Borough Council. It is proposed to extend the existing facility with three new buildings with link structures. Twelve new assisted-living apartments are proposed alongside new communal facilities: a café and dining area, a cinema, a yoga studio and rehabilitation gym.

This energy statement has been prepared using the June 2022 GLA Energy Assessment Guidance document. The latest GLA carbon emission reporting spreadsheet has been used for the calculations (part_l_2021_gla_carbon_emission_reporting_spreadsheet_v1.2_beta(1).xlsx) with a carbon offset fund price of £95 per tonne and are targeting zero carbon. The requirements of the zero-carbon target are:

- Energy demand reduction measures need to contribute to more than 15% of the reduction.
- A minimum 35% reduction (over the baseline) is required from improvement measures on site.
- The remainder can be compensated with carbon offset payments.

Carbon savings have been demonstrated using the London Plan 2021 energy hierarchy (Policy SI 2):

- Be Lean: High specification of building fabric and energy efficient services will minimise energy demand.
- Be Clean: The site is not currently suitable for a local CHP system or connection to a district network. Therefore, no carbon savings are possible using this measure.
- Be Green: Space heating and cooling will be provided by Air Source Heat Pumps (ASHPs) with additional carbon offset from photovoltaics.
- Be Seen: The actual operational energy performance will be monitored and reported for at least five years.

Table 1 shows the site-wide carbon emissions and savings from the proposed design. The total offset payment for the site is £25,669.

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2021 baseline	10.6		
Be lean	10.3	0.3	2%
Be clean	10.3	0.0	0%
Be green	9.0	1.3	13%
Total Savings	-	1.6	15%
	-	CO_2 savings off-set (Tonnes CO_2)	-
Off-set	-	270.2	-

Table 1: Site-wide carbon emissions and savings.

The design has been developed during Stage 2 to improve all aspects of the proposal: insulation levels have been improved, glazing areas have been reviewed and reduced, triple glazing is proposed throughout, external shading has been included, and building services efficiencies have been pushed as far as practically possible. However, even with these design improvements, the carbon savings listed in Table 7 do not meet the London Plan targets at the Be Lean and Be Green stages. This due to several factors: the notional building specification has changed in the new Part L 2021, the London Plan baseline has changed to include a heat pump, and limitations in the compliance software which means the flexible nature of the moveable external shading can't be accounted for.

2. INTRODUCTION

This energy statement has been prepared by CBG Consultants on behalf of Denville Hall in support of its planning application to Hillingdon Borough Council. It is proposed to extend the existing facility with three new buildings with link structures. Twelve new assisted-living apartments are proposed alongside new communal facilities: a café and dining area, a cinema, a yoga studio and rehabilitation gym.

This energy statement has been prepared using the June 2022 GLA Energy Assessment Guidance document. It covers requirements set out in London Plan Policies SI 2 to SI 4 inclusive.

2.1 London Plan 2021 Carbon Reduction Targets

In line with the London Plan, major developments are expected to achieve net zero-carbon by following the energy hierarchy:

- Be Lean: Use less energy and manage demand during operation through fabric and servicing improvements and the incorporation of flexibility measures.
- Be Clean: Exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly by connecting to district heating networks.
- Be Green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site.
- Be Seen: monitor, verify and report on energy performance through the Mayor's post construction monitoring platform.

The requirements of the zero-carbon target are:

- Non-domestic developments are expected to achieve 15% carbon reductions beyond Part L 2021 at the Be Lean stage.
- A minimum 35% on-site carbon reduction beyond Part L 2021 at the Be Green stage.
- The remainder can be compensated with carbon offset payments.

It should be noted that these targets apply to regulated carbon only. Regulated carbon refers to the emissions associated with internal lighting, heating, hot water, air conditioning and mechanical ventilation. Other consumptions such as small power equipment (PCs, TVs, laptops etc.) are "unregulated". Regulated energy calculations for the development has been carried out using IES Virtual Environment software which is accredited for Part L2 calculations. A CIBSE TM54 calculation has been conducted to estimate the total operational energy use at the planning stage, including the unregulated energy.

2.2 London Borough of Hillingdon Requirements

Hillingdon Borough Council Local Plan contains several policies relating to sustainable design: Part 1 of the Local Plan has core policies relating to environmental improvement while Part 2 of the Local Plan

has development management policies relating to environment protection and enhancement. However, as these policies refer to the Greater London Authority's London Plan policies and targets this report will refer to the London Plan policies to demonstrate compliance.

3. CARBON REDUCTION CALCULATIONS

Carbon reduction calculations have been conducted in accordance with the June 2022 GLA Energy Assessment Guidance document. The latest GLA carbon emission reporting spreadsheet has been used (part_l_2021_gla_carbon_emission_reporting_spreadsheet_v1.2_beta(1).xlsx) with a carbon offset fund price of £95 per tonne.

An Overheating Report has been completed by CBG Consultants. The report outlines the design changes made to limit the risk of overheating: reducing glazing areas, external shading from balcony surrounds, and a mixture of fixed and moveable external shading. Windows and balcony doors have been modelled as fully open to maximise natural ventilation air flow. However, results showed that most spaces did not comply with the Category I (vulnerable occupants) overheating criteria and therefore active cooling is required to maintain acceptable conditions for care home residents during peak summer conditions.

3.1 Baseline Case

The baseline CO_2 emissions are calculated from the 'notional' building using the Part L software tools. The 'notional' building consists of standard set of fabric and services parameters which deliver the Target Emissions Rate. This is then used as the Baseline emissions from which savings from Be Lean, Be Clean, and Be Green measures are calculated. As stated by the guidance document, the baseline CO_2 emissions are determined by the Tart Emission Rate (TER) from the final proposed building specification, i.e. the rate from the modelling results of the Be Green stage of the energy hierarchy.

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	10.6	9.9

Table 2: Baseline carbon emissions.

3.2 Demand Reduction (Be Lean)

Insulation

U-values for external elements have been improved from the Part L2 minimum standards, as shown in the table below.

Element	Targeted U-Values (W/m^2K)	Part L2 Notional Values (W/m^2K)	Part L2 Minimum Values (W/m^2K)
Walls	0.13	0.18	0.26
Ground & Exposed Floors	0.13	0.15	0.18
Roof (pitched)	0.13	0.15	0.16
Roof (flat)	0.11	0.15	0.18
Vertical glazing	0.83 (g value= 0.53)	1.4 (g value= 0.29)	1.6
Rooflights	1.13 (g value= 0.53)	N/A	2.2

Table 3: Building fabric U-values.

Air Tightness

An air permeability of 3 $m^3/m^2/hr$ (@50pa) has been allowed for these calculations, and this represents a low leakage rate for a new building. The intention will be to build the scheme to be as airtight as possible, however this will remain speculative until construction is finished. Following completion, the result of the pressure test will be used to update the calculations.

Heating

As stated in paragraph 7.9 of the energy assessment guidance, the heating system matches the notional building system type and performance values from the Part L 2021 baseline as determined by the final proposed building specification. An ASHP is the proposed low carbon heating source and for the Be Lean stage the efficiency matches the notional building.

Hot Water

As stated in paragraph 7.9 of the energy assessment guidance, the hot water system matches the notional building system type and performance values from the Part L 2021 baseline as determined by the final proposed building specification. In this case instantaneous hot water has been modelled: domestic hot water shall be generated locally to each assisted-living apartment using point-of-use electric water heaters. It is envisaged there will be two water heaters per dwelling, one in the kitchen, and one in the bathroom. Both shall be instantaneous type rather than storage type to limit standing heat losses and the spatial requirements for expansion vessels and temperature and pressure valve discharges.

Cooling

Cooling will be provided by the same VRF system that provides the heating. It is proposed that two Variable Refrigerant Flow (VRF) units are installed to serve the three buildings, with Building A having a stand-alone external unit, and Buildings B & C having a shared external unit.

At this stage a SEER of 7.2 for Building A and 6.3 for Buildings B & C has been used based on an initial selection to suit the capacity.

Ventilation

Mechanical ventilation with heat recovery (MVHR) system has been assumed throughout with 85% heat recovery efficiency and low specific fan powers. The non-domestic type of spaces will also have demand-controlled ventilation to reduce energy consumption when spaces are not occupied.

Lighting

Highly efficient LED lighting is proposed throughout with an average efficacy of at least 140 lm/W. Occupancy sensors in non-domestic type spaces will further reduce energy consumption, along with daylight sensors in appropriate spaces.

3.2.1 Be Lean Carbon Emissions Reduction

Table 4 shows the results after the Be Lean Stage. The energy efficiency measures have enabled a 2% carbon saving over the baseline. Despite the excellent passive and active design measures listed above, the savings are lower than the 15% London Plan target for this stage. This due to several factors: the notional building specification has changed in the new Part L 2021, the London Plan baseline has changed to include a heat pump, and limitations in the compliance software which means the flexible nature of the moveable external shading can't be accounted for.

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2021 baseline	10.6		
Be lean	10.3	0.3	2%

Table 4: Carbon saving after Be Lean stage.

	Area weighted non-domestic cooling demand (MJ/m^2)	Total area weighted non-domestic cooling demand (MJ/year)
Actual	203.4	286,692
Notional	98.4	138,695

Table 5: Cooling demand.

3.3 System Efficiency (Be Clean)

London Plan 2021 Policy SI 3 states developments within Heat Network Priority Areas should have a communal low-temperature heating system and should select a heat source in accordance with the following heating hierarchy:

a) Connect to local existing or planned heat networks.
b) Use zero-emission or local secondary heat sources (in conjunction with heat pump, if required).
c) Use low-emission combined heat and power (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network).
d) Use ultra-low NOx gas boilers.

Denville Hall is not in a Heat Network Priority Area (Figure 1), but the Energy Assessment Guidance also states that communal systems are also recommended for developments outside HNPAs. The following sections therefore address the heating hierarchy.

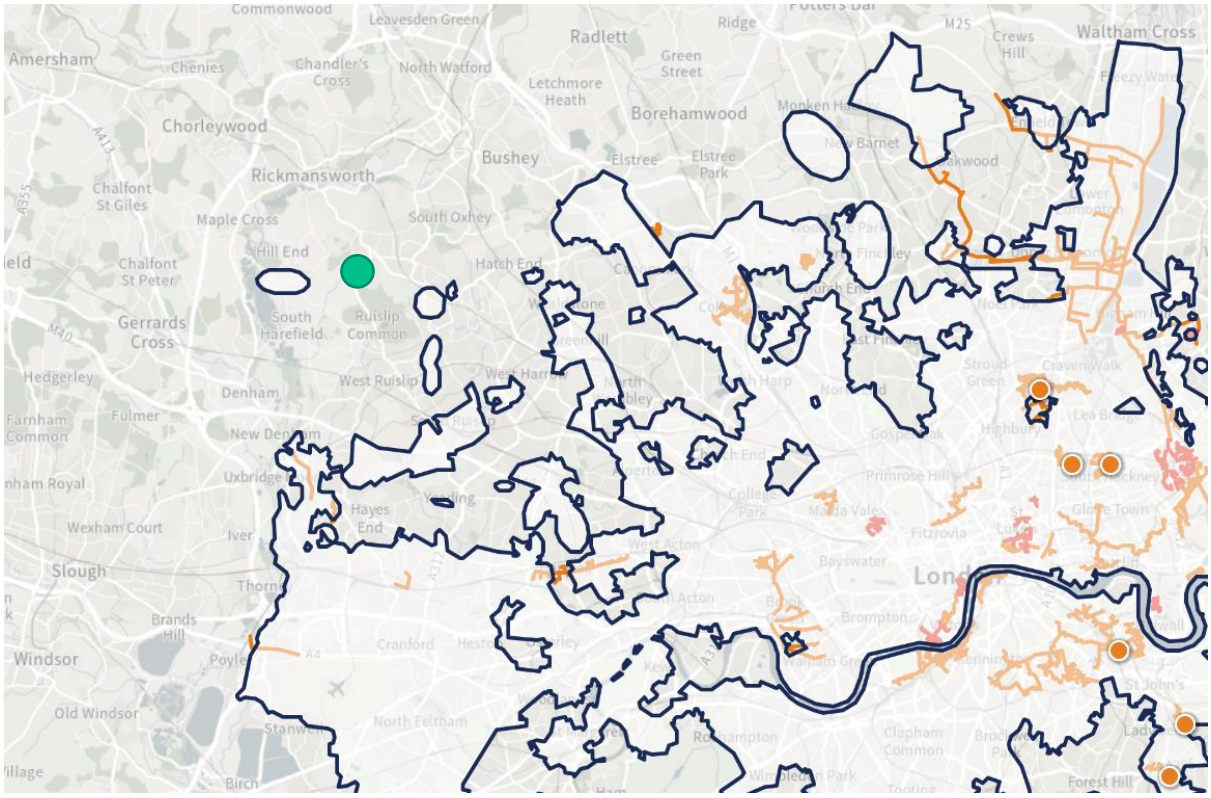

Figure 1: Heat Network Priority Areas (HNPAs). The green dot shows the development site.

3.3.1 Connection to District Heating Network

Figure 2 shows the proposed development (green circle) in relation to existing (red) and potential district heat networks (orange). As the nearest proposed district heating network is over 7km away it would not be economical to connect into a heat network at this stage.

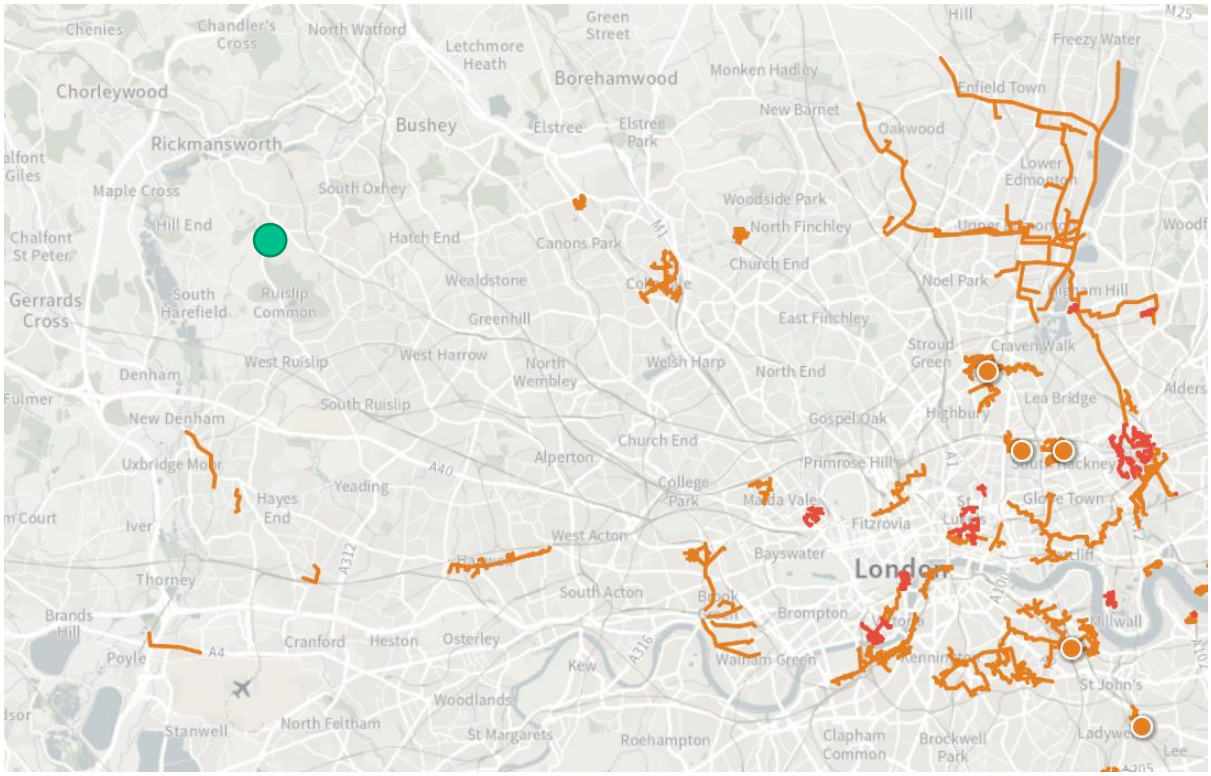

Figure 2: London heat map. The green dot shows the development site. Red indicates existing networks, proposed networks are shown in orange.

3.3.2 Zero Emission and/or Local Secondary Heat Sources

The second step of the heating hierarchy encourages the exploitation of local energy opportunities to maximise the use of locally available energy sources whilst minimising primary energy demand and carbon emissions. Sources of waste heat are not available on or adjacent to the site.

3.3.3 Combined Heat and Power (CHP)

CHP has not been considered appropriate on the basis that the revised fuel factors reflecting decarbonisation of grid electricity makes CHP unfavourable.

3.3.4 Use Ultra-Low Nox Gas Boilers

A heating strategy led by ultra-low NOx gas boilers should only be considered when it has been clearly demonstrated that all other options in the heating hierarchy (a to c) have been fully investigated and ruled out. The above options have been ruled out, but the use of gas boilers is not required, as the proposed solution uses heat pumps as a green energy source.

3.3.5 Carbon Emissions Reduction

Since a district heating connection or on-site CHP is unviable, no carbon emissions reductions are available using these measures.

3.4 Renewable Energy (Be Green)

An initial review was conducted to eliminate any technologies which from the outset have been identified as unviable. This can be found in Appendix 1. From this study, air source heat pumps (ASHPs) and photovoltaics (PV) have been identified as the most appropriate for the site.

3.4.1 Air Source Heat Pumps

It is proposed that two Variable Refrigerant Flow (VRF) units are installed to serve the three buildings, with Building A having a stand-alone external unit, and Buildings B & C having a shared external unit.

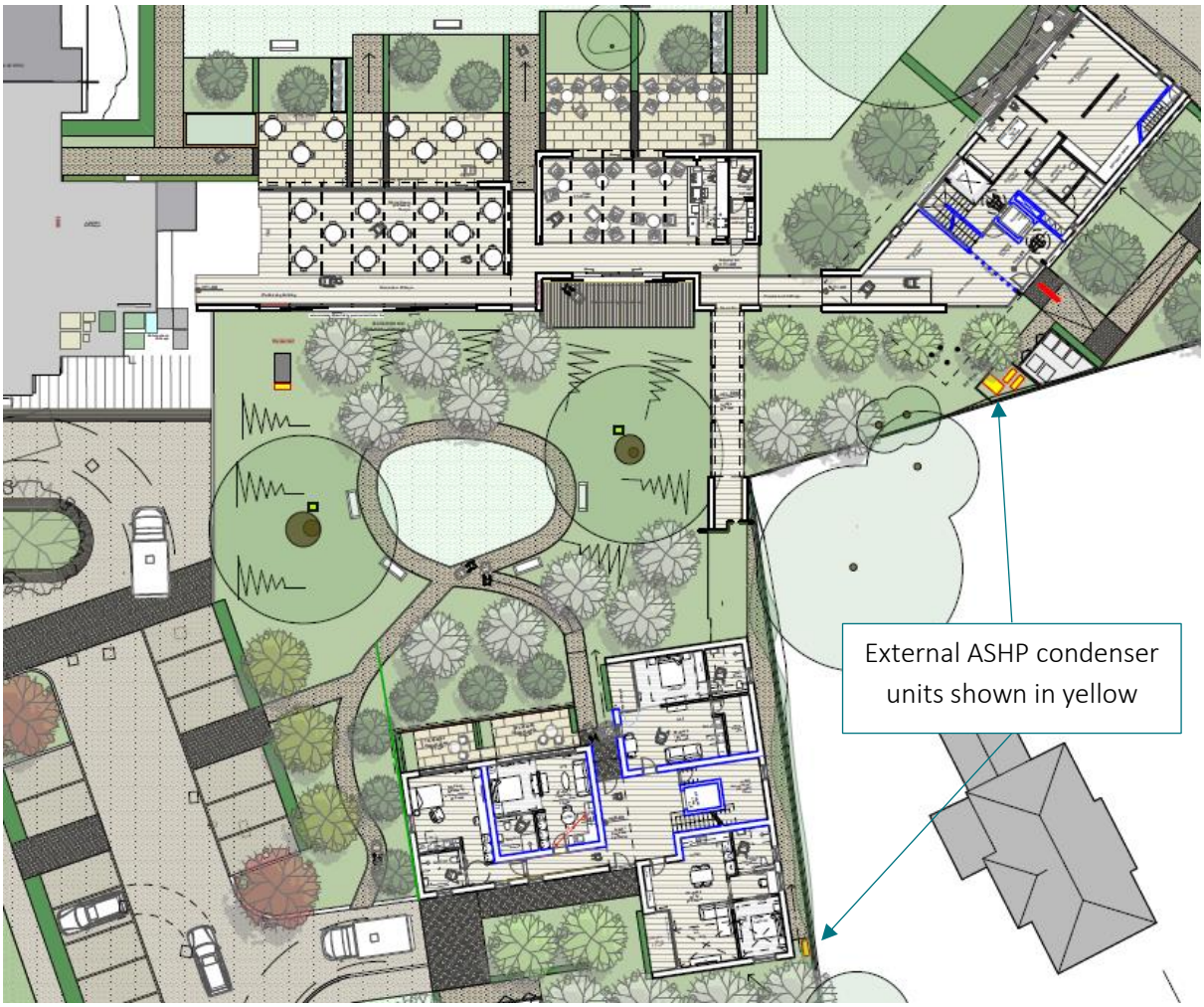

Figure 3: Location of external condenser units.

Each building will be provided with heating and cooling via ducted units located in ceiling voids (lower floors of Buildings A & B) or concealed floor standing units (top floors of Buildings A & B, and all of Building C). Refrigerant pipework will generally be routed in floor and ceiling voids to serve each indoor unit.

The external units shall be 3-pipe heat recovery type such that heating and cooling can occur simultaneously using different indoor units with heat/coolth rejected from one being used at another.

Each extra care apartment will have an individual controller for each indoor unit or bank of units depending on load. Generally ceiling mounted units shall be installed above bathrooms to serve the bedroom areas to avoid nuisance noise. The units shall be selected/sized such that the heating (and cooling) load can be provided at low fan speed to reduce noise even further.

At this stage a SCOP of 4.2 for Building A and 4.4 for Buildings B & C has been used based on an initial selection to suit the capacity. The respective SEERs are 7.2 and 6.3.

3.4.2 Photovoltaics

The design proposal includes photovoltaic panels on the flat roofs of Buildings A and B. A PV array is not viable on the roof of Building C due to the amount of external plant. It is proposed to include 14 PV panels on Building A facing south-east at an inclination of 10°, and 14 panels on Building B facing south-west at an inclination of 10°.

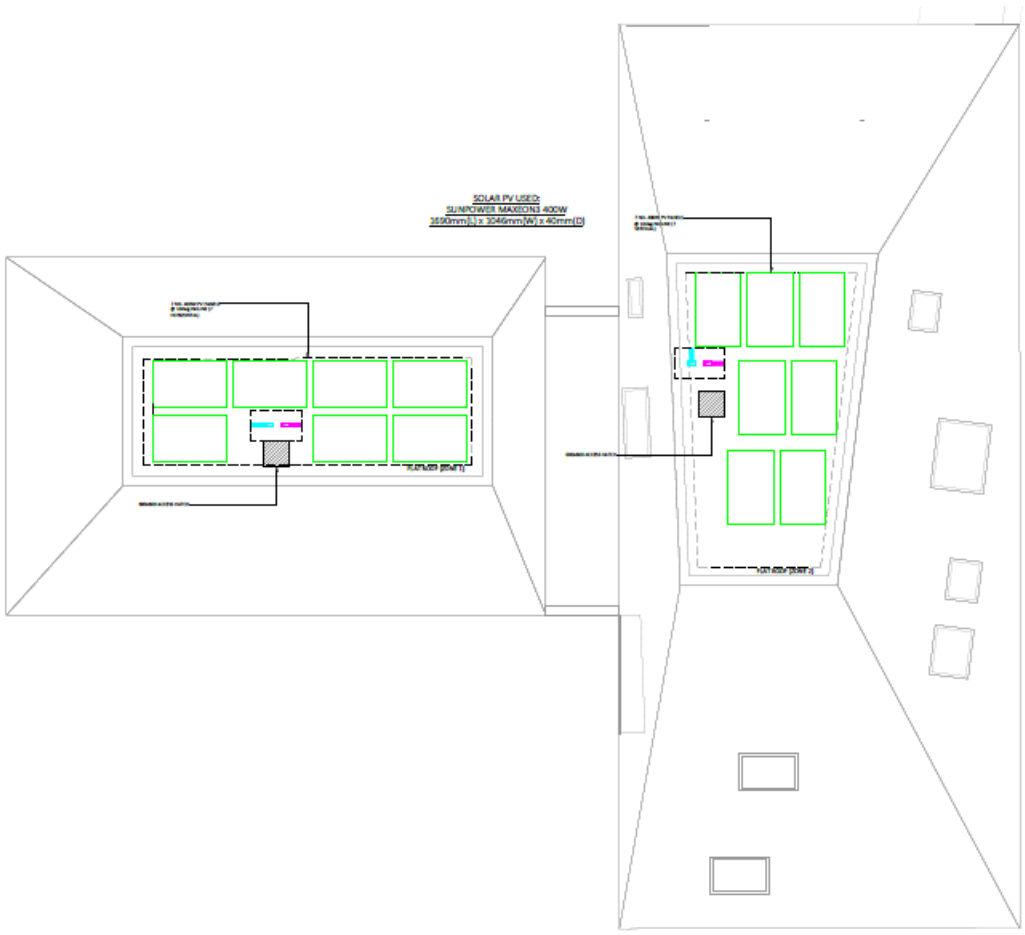

Figure 4: Proposed location of PV panels on Building A.

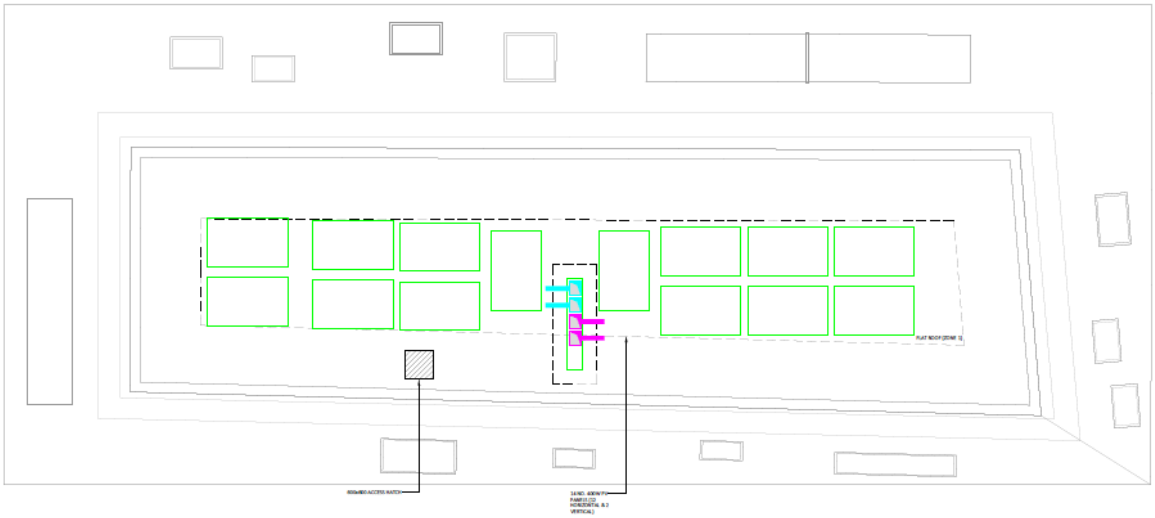

Figure 5: Proposed location of PV panels on Building B.

3.4.3 Be Green Carbon Emissions Reduction

Table 6 shows the carbon reduction when the proposed air-source heat pumps and photovoltaics are included in the design. Carbon emissions are now reduced to 9.0 tonnes, which is a 15% saving over the baseline.

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2021 baseline	10.6		
Be lean	10.3	0.3	2%
Be clean	10.3	0.0	0%
Be green	9.0	1.3	13%
Total Savings	-	1.6	15%
	-	CO2 savings off-set (Tonnes CO_2)	-
Off-set	-	268.5	-

Table 6: Carbon saving after Be Green stage.

3.5 Metering & Monitoring

As per the London Plan, metering will be provided to enable tenants to monitor their energy consumption and understand how their energy is used.

3.6 Cost to Occupants

Energy demand reduction has been prioritised to reduce running costs. This has been achieved with a highly insulated and airtight envelope, the use of mechanical ventilation with heat recovery, and low energy lighting. With the energy demand reduced, the proposed energy systems have been selected with consideration to cost occupants as well as carbon reduction.

3.7 Peak Energy Demand

The GLA is encouraging applicants to investigate the potential for energy flexibility in new developments to reduce the capacity required for each site and to the reduce the peak demand. This is particularly important as new developments move away from gas to an all-electric solution, like the Denville Hall development.

A key aspect of managing demand will be to reduce peak energy loadings. Opportunities for reducing the energy demand have been explored and implemented into the design as part of the energy hierarchy process.

3.8 Energy Monitoring (Be Seen)

The Be Seen Energy Monitoring Guidance document explains the process that needs to be followed to comply with the Be Seen post-construction monitoring requirement of Policy SI 2 of the London Plan. The 'be seen' stage requires monitoring and reporting of the actual operational energy performance of major developments for at least five years.

The development will be designed to enable post construction monitoring and the information set out in Be Seen guidance is submitted to the GLA at the appropriate stages. The first submission of the planning stage data has been submitted to the GLA through the Be Seen planning stage webform.

3.9 Energy Use Intensity

As required by the GLA, the Energy Use Intensity (EUI) and space heating demand have been calculated in accordance with the Be Seen energy monitoring guidance document (September 2021). In addition to the Building Regulations Part L figures, a CIBSE TM54 analysis has been conducted to estimate both the regulated and unregulated energy loads at planning stage. CIBSE TM54 provides a methodology for evaluating operational energy use at design stage. A combination of dynamic simulation modelling and spreadsheet calculations have been used for the CIBSE TM54 analysis which is appropriate for Stage 2 calculations. The following results are also provided in the GLA carbon emission reporting spreadsheet:

- EUI: 95.6 kWh/m^2/year
- Space heating demand: 26.3 kWh/m^2/year

Figure 6 shows the estimated energy use breakdown for both regulated and unregulated energy from the TM54 analysis, including the estimated energy generated by PV panels on site.

The total EUI of 95.6 kWh/m^2/year exceeds the target of 55 kWh/m^2/year. The largest proportion of energy consumption is catering for the Dining Room and Café in Building C. As these spaces are sized to serve the existing site as well as the new development the estimated energy consumption will be larger than catering facilities sized to serve the proposed development only. For example, if 80% of the catering energy is attributed to serving the existing buildings, and 20% for the proposed development, the EUI is reduced to 60.6 kWh/m^2/year which is significantly closer to the target.

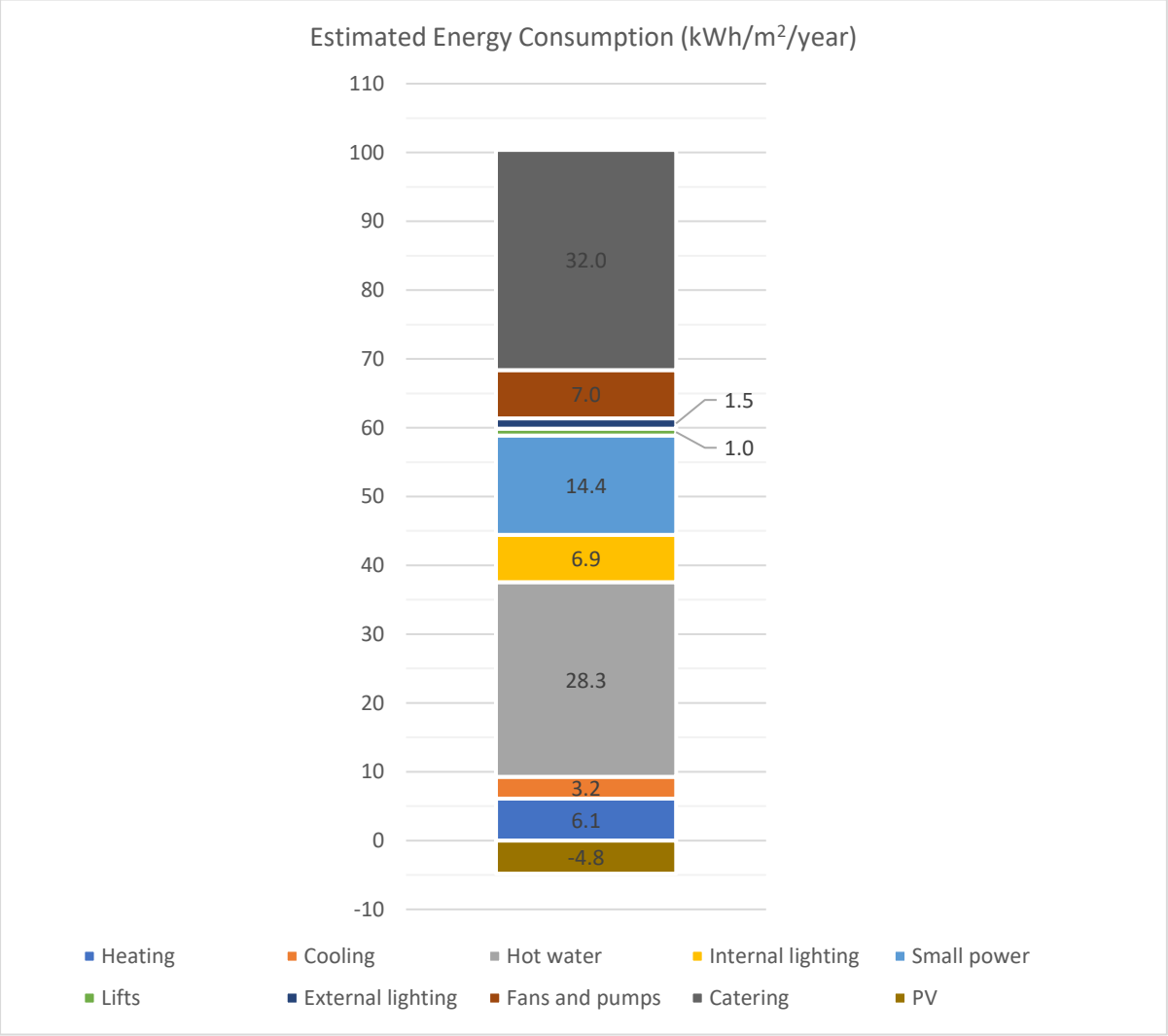

Figure 6: Estimated Energy Consumption

4. CONCLUSIONS

The Be Lean, Clean, Green hierarchy has been followed to achieve a low energy, low carbon design for the Denville Hall development:

- Be Lean: High specification of building fabric and energy efficient services will minimise energy demand.
- Be Clean: The site is not currently suitable for a local CHP system or connection to a district network. Therefore, no carbon savings are possible using this measure.
- Be Green: Space heating and cooling will be provided by Air Source Heat Pumps (ASHPs) with additional carbon offset from photovoltaics.

Table 7 shows the site-wide carbon emissions and savings from the proposed design. The total offset payment for the site is £25,669.

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
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Be green	9.0	1.3	13%
Total Savings	-	1.6	15%
	-	CO_2 savings off-set (Tonnes CO_2)	-
Off-set	-	270.2	-

Table 7: Site-wide carbon emissions and savings.

The design has been developed during Stage 2 to improve all aspects of the proposal: insulation levels have been improved, glazing areas have been reviewed and reduced, triple glazing is proposed throughout, external shading has been included, and building services efficiencies have been pushed as far as practically possible. However, even with these design improvements, the carbon savings listed in Table 7 do not meet the London Plan targets at the Be Lean and Be Green stages. This due to several factors: the notional building specification has changed in the new Part L 2021, the London Plan baseline has changed to include a heat pump, and limitations in the compliance software which means the flexible nature of the moveable external shading can't be accounted for.

APPENDIX 1: PRELIMINARY APPRIASAL OF RENEWABLE ENERGY OPTIONS

LZC Technology	Basic Technical Information	Technical, Environmental & Economic implications / Considerations	Suited Application	Site Specific Comment	Detailed Analysis?
Solar thermal	Solar collectors (flat plate or tube) transfer energy into transfer liquid to a closed loop twin coil hot water cylinder	+ Government grants available (RHIs) +/- Can meet a significant proportion of the DHW demand - Efficiency effected by site factors – shading, orientation and roof/ground space -Requires considerable hot water demand all year round to be finically beneficial	Domestic and commercial applications with high annual hot water load; leisure centres, canteens, washrooms	There is limited unshaded roof space and hot water storage would be required. This is not compatible with the instantaneous hot water that is proposed to eliminate standing and distribution losses.	No
Wind turbine	Turbine/generator converts wind energy to electrical power.	+ Government grants available (FITs) + Allows on site generation of renewable electricity - Can create structural, vibrations and noise implications - Not suited for urban environments - Costs can be high in relation to the actual amount of electricity generated - Potential for additional planning issues	Large sized turbines in non-urban or offshore locations will be more effective	The site is located in a dense urban area and further planning approvals would be required.	No
Solar Photovoltaics	Converts sunlight to DC electrical power which then using an inverter to convert to DC.	+ Allows on site generation of renewable electricity + Generally payback between 7-12 years + Low maintenance requirements - No government grants available - Efficiency effected by site factors – shading, orientation and roof/ground space	Wide range of building types particularly buildings with limited solar shading and south facing roof	There is significant shading on the proposed buildings from existing tall trees. This will limit the efficiency of PV panels. However, as the proposal is an all-electric design, PV will be maximised where feasible to generate electricity directly on site.	Yes

LZC Technology	Basic Technical Information	Technical, Environmental & Economic implications / Considerations	Suited Application	Site Specific Comment	Detailed Analysis?
Air source heat pump	Air Source Heat Pumps (ASHP) capture heat from the outside air and transfer the heat directly to the air inside the building or transferring the heat to a liquid medium that can be pumped around the building	+ Lower installation cost that ground source heat pump + Can provide heating and cooling + Government grants available (RHIs) - COP is not as good during the heating season when the outside air temperature is often less than the ground temperature - Can restrict distribution strategies	Wide range of building types particularly building designed to have low temperature heat emitters.	Both heating and cooling can be provided by air source heat pumps. It is proposal is a VRF system with multiple indoor units to minimise distribution heat losses.	Yes
Ground Source Heat Pump	Ground Source Heat Pumps (GSHP) capture heat from the ground and transfer the heat to a liquid medium that can be pumped around the building	+ COP is better than air source heat pumps + Government grants available (RHIs) - Requires area for ground collector or borehole - High initial capital cost - Can restrict distribution strategies	Suits building designed to have low temperature heat emitters with sufficient space for necessary ground works	The high capital cost of this is prohibitive.	No
Biomass	Uses biomass as a fuel source for space heating and hot water	+ Government grants available (RHIs) + Renewable source of heating - Requires large fuel storage capacity - Generally a large capital cost	Building/site with sufficient access and storage facilities and a capable maintenance team	Although it is a renewable heating source, an ASHP is better suited to provide both heating and cooling.	No

APPENDIX 2: BRUKL DOCUMENTS