PLANNING STATEMENT
ENERGY AND PART L COMPLIANCE STRATEGY

81 Belsize Park Gardens, London

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-	27/08/2020	First Issue	JR	JW
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Contents

1.0 Executive Summary

This document details the preliminary intended energy strategy for the proposed refurbishment of 81 Belsize Park Gardens, London.

The report has been prepared to demonstrate to the planning authorities the proposed energy usage of the facility once completed as a nursery, from its current usage as a gym facility.

The building was modelled in both its current state and servicing as well as proposed, to demonstrate significant energy reductions and CO_2 reductions in the order of 78%. This is assisted in no small part by the removal of the swimming pool, but the report demonstrates the benefit and effects of the high efficiency fixed building services that will be installed in the building moving forward.

A further 20% reduction via the use of on-site renewable generation has also been demonstrated, via the use of a photovoltaic panel array mounted on the roof.

2.0 Introduction

This document details the preliminary intended energy strategy for the proposed refurbishment of 81 Belsize Park Gardens, London. The report has been prepared to demonstrate to the planning authorities the proposed energy usage of the facility once refurbishment works are completed to turn the building into a nursery, from its current usage as a gym facility.

The report has been prepared to support the planning application, and provide details of the intended route to compliance with Part L2B 2013 for the completed development, as well as compliance with the local authority requirements to demonstrate a 20% CO_2 reduction via on-site renewables as part of the works.

The report has been prepared to demonstrate the feasibility of and proposed route to compliance with Part L2A 2013. The report takes into account the recognised energy hierarchy to "Be Lean, Be Clean, Be Green", i.e. to minimise the building's energy usage before applying renewable technologies to the design.

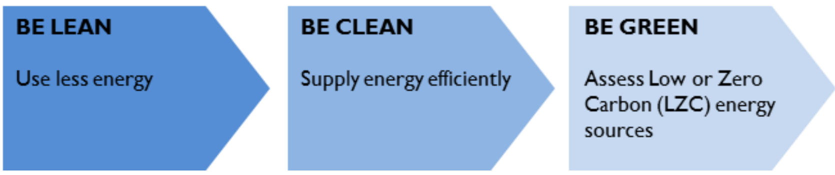


Figure 1: Energy Hierarchy

Further work will be required at later stages in the "design and build" process to ensure that the requirement to comply with the relevant targets and that all statutory guidelines or local planning enforcement requirements are met.

This document explores the proposed route to compliance in line with the project specification and requirements, as well as feasibility and scope for renewable technologies, all in consideration of the above hierarchy.

3.0 Description of the Development

The development currently consists of a gym and fitness complex, incorporating various exercise and changing facilities as well as a swimming pool. Due to the age of the building and the fixed building services, the energy usage for the current building is demonstrably high.

It is proposed to re-purpose the facility to be used as a nursery building. The current ground and first floors will be refurbished, with the second and third floors addressed at a later date as required. The swimming pool will be removed and re-purposed as a garden area, with the relevant walls etc. made good to suit.

4.0 Energy Use in the Built Environment

In line with hierarchy of intervention (Be lean, Be Green, Be Clean) it is essential to ensure that efficient buildings and building services systems have been designed and proposed prior to the consideration of low and zero carbon (LZC) technologies. Design measures that should be considered include, but are not limited to:

- Good insulation of walls, roofs and floors to reduce heat losses (but not at the expense of summertime overheating). For this development the fabric improvements have been limited to those areas made good, which have been modelled in line with current Building Regulations and good practice.
- Maximisation of potential for natural ventilation (where ambient noise levels and room function permit). This is not an option for this development due to limited openings, therefore much of the building is mechanically ventilated, and this will remain the case for the refurbishment. The revised installation will however incorporate all new plant which will exceed the minimum requirements of current Building Regulations in terms of heat recovery efficiencies and specific fan powers.
- Minimisation of requirements for mechanical cooling, by the application of good ventilation techniques. Much of the building is currently mechanically cooled, and this will remain the case for the refurbishment. The revised installation however will incorporate a modern variable refrigerant volume (VRV) system which is very energy efficient and exceeds the minimum requirements of current Building Regulations in terms of efficiency.
- Reduction in electrical power usage via specification of efficient lighting controls, high efficiency luminaires and optimisation of daylighting through careful façade and building design. The lighting installation shall be replaced throughout with high-efficiency LED luminaires, with PIR presence detection incorporated wherever practicable to minimise future energy use.
- Specification of high efficiency plant/equipment. Areas not served by the VRV system shall be heated by modern high-efficiency boiler plant.

To this end, the proposed design should promote significantly reduced CO_2 emissions from delivered energy consumption by minimising operational energy demand through passive and best-practice measures.

The energy usage figures within this report have been based on reasonable but not unrealistic assumptions in line with good industry custom and practice at the present time, and the specified equipment wherever possible to give an accurate assessment of the energy usage going forward against the current building as it stands.

5.0 Methodology

<u>Baseline</u>

To demonstrate compliance with the planning policy requirements, the building was modelled as it stands using dynamic thermal simulation software (EDSL Tas version 9.5.0) by an accredited Level 5 Low Carbon Energy Assessor (LCEA) to validate the energy usage of the building as it currently stands with its previous use. The initial run utilised NCM profiles associated with a D2 building usage class (indoor or outdoor sports or recreations), as well as the plant and equipment information based upon our survey of the installations as currently installed. The resultant carbon emissions due to the energy usage of the pool and hot water loads associated with the shower/change areas was demonstrably high.

To undertake a fair comparison based on comparable use, the existing building was remodelled using the same profiles for the refurbished building, i.e. class D1 building usage (non-residential education institutions). These still utilised the existing plant and equipment, but give a more representative comparison of the energy usage if the building were simply re-purposed as a nursery in its current state. These figures represent the baseline scenario for comparison.

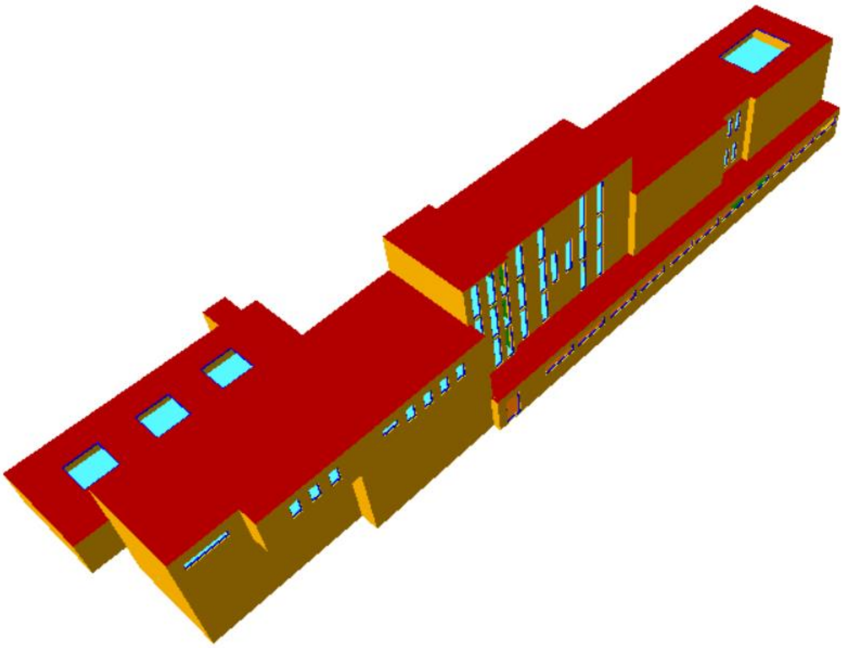


Figure 2 – Model screenshot, existing building including pool

Stage 1 - Be Lean

The first stage of the hierarchy is to consider elements for the building to “Be Lean”, i.e. optimise the building such as to reduce the energy requirements to a minimum before the introduction of clean and green technologies and solutions. The philosophy of “Be Lean” is typically a building first approach, for example to optimise the building orientation and openings to reduce the need for mechanical ventilation and cooling, maximise the potential for natural light, etc. As this is an existing building, the opportunity to “Be Lean” is limited.

The removal of the pool, which is a significant energy user, is the first stage of the “Be Lean” process. This reduces the building energy usage considerably. Also in the sprit of the energy hierarchy, the new wall and associated openings will be constructed in excess of current Building regulation minimum values, as follows:

- New walls: proposed u-value 0.18 W/m²K
- New windows: proposed u-value 1.4 W/m²K, g-value 0.6

It is also proposed that the new walls to the secret garden area (formed by the demolition of the pool) shall be green living walls, whilst not having an effect on the thermal performance over and above the u-values proposed these are discussed in further detail later in this report.

On this basis, the building model was modified in line with the proposed layouts, including removal of the pool and incorporation of new walls/glazing elements, the results of which are presented in the “Be Lean” section accordingly (refer to section 8 for tabulated results). Again the NCM profiles for the D1 usage class were used as these would be applicable to the refurbished building - the NCM profiles were fully considered and assessed and in our opinion reflect an accurate basis for the energy usage and carbon emissions for all the assessed cases.

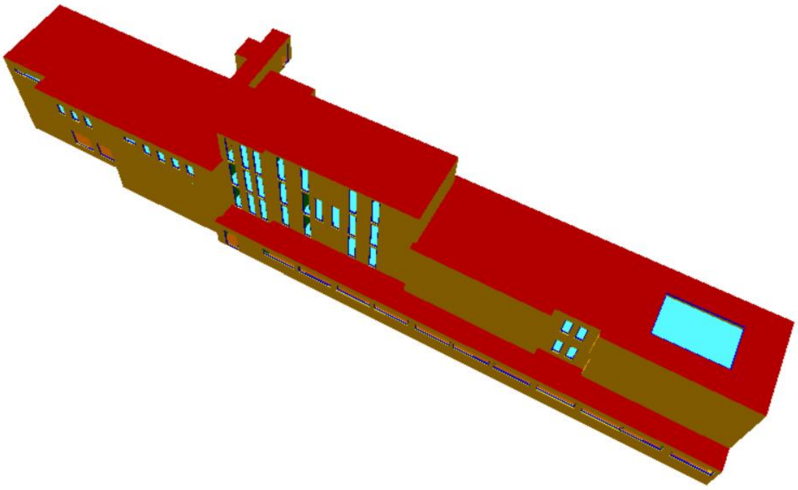


Figure 3 – Model screenshot, proposed building, pool removed

Stage 2 - Be Clean

The second stage of the hierarchy is to consider elements for the building to "Be Clean", i.e. optimise the necessary services to reduce the energy requirements and use as little energy as possible before the introduction of green technologies and solutions (i.e. renewables).

An assessment was made at this stage for the requirement of air conditioning in the proposed building. The methodology and the results are discussed in further detail in section 9 of this report, however as the results were not favourable a decision was made to utilise high-efficiency VRF/VRV systems to provide heating and cooling to the bulk of the occupied rooms to maximise both energy efficiency and comfort conditions.

The refurbished building services shall be designed and installed with energy efficiency at the forefront, with plant and systems selected to have efficiencies in excess of those required by legislation to maximise carbon reduction. A summary of the preliminary servicing strategy is provided in section 6 which has been used throughout this assessment This has been based on our extensive experience of similar buildings which have informed the specification for the building as currently proposed, although further work will be required at later stages in the design once the detailed servicing strategy and final client requirements have been determined.

Again refer to section 8 for tabulated results.

Stage 3 - Be Green

The final stage of the hierarchy is to consider elements for the building to "Be Green", i.e. to incorporate renewable technologies and solutions.

The requirement is for a 20% CO_2 reduction via on-site renewables, the feasibility of which have been assessed and summarised in section 10.

Due to the nature of the existing building, it was assessed that photovoltaic panels were the optimum solution, and the model has been reiterated to include a relevant size array to achieve the 20% reduction via on-site renewables.

6.0 Description of Services

A summary of the preliminary servicing strategy is provided below. This has been based on our extensive experience of similar buildings which have informed the specification for the building as currently proposed, although further work will be required at later stages in the design once the detailed servicing strategy and final client requirements have been determined.

The main teaching areas shall be provided with heating and cooling via a high efficiency variable refrigerant volume system. Ancillary areas (i.e. corridors, WCs etc.) shall generally be heated via high efficiency gas fired boilers, generally serving low surface temperature (LST) radiators throughout the building, as well as the hot water load. The boilers shall be sized to satisfy the peak heating and hot water demand of the building simultaneously.

Ventilation shall be provided to occupied areas by air handling equipment incorporating heat recovery ventilation units. The air handling plant shall have both high efficiency heat recovery and low specific fan powers which exceed current Building Regulation requirements. Extract only systems shall be provided to WCs and similar areas wherever practicable.

High efficiency/LED lighting has been specified throughout. PIR on/off devices have been provided to corridors, WC areas etc. in line with the project specification and design intent.

7.0 Summary of Key Input Data

As well as the u-values and design air permeability previously indicated, the following information summarises the key input information assumed for this analysis:

Building Fabric
The building fabric was modelled on our assessment of the current constructions and the age of the building. For the minimal areas where new walls and windows are provided, these have been assumed as follows:

- External Walls 0.22 W/m²K
- Windows/Doors/Rooflights 1.40 W/m²K, 0.6 g value

Equally, uncontrolled ventilation losses should be minimised, however given the age of the building it would not be practicable to air test the building, therefore an air permeability rate of 15m³/m²/hr at 50Pa has been assumed for both the current and refurbished building.

Weather File
The NCM London TRY (Test Reference Year) weather file has been utilised for this analysis and is considered to accurately represent the weather for the proposed location based on the BRE SBEM Weather Locations Lookup tool. For the thermal comfort assessment provided in section 9 to demonstrate the requirement for air conditioning, the NCM London DSY (design Summer Year) weather file has been utilised.

HVAC Systems

Wet Radiator System:	
Heat Source:	LTHW boiler
Fuel Type:	Natural gas
Seasonal Efficiency:	95 % new / 90% existing
Circulation pump:	Variable Speed, pressure control across pump (new), / fixed speed (existing)
New System Controls:	Central time control, Weather compensation control
Heat Pump Systems:	
Heat source:	Heat pump (electric): air source
Fuel type:	Electricity
Heating CoP	4.39 new / 4.0 existing

Cooling CoP: 4.0 new / 3.6 existing

Mechanical extract is provided to WCs etc., supply and extract ventilation to occupied/landlocked rooms as follows:

Mechanical extract: SFP: 0.5 W/l/s (new), 0.8 W/l/s (existing)
Supply and extract to teaching spaces etc: SFP 1.3W/l/s, 80% heat recovery (new)
1.8W/l/s, 70& heat recovery (existing)

Hot Water Services:
Hot water services are to be provided via the same heating system as is utilised for the wet radiator space heating system.

Lighting
Lighting based on the design undertaken and issued as part of the design intent, with high efficiency luminaires with efficacies between 95 and 125 lumens per circuit Watt, with PIR control incorporated where proposed. Existing luminaires modelled on an optimistic 55 lumens per circuit Watt based on our assessment of the currently installed lighting.

8.0 Results and Commentary

The baseline figures using the above existing input figures and a D2 usage class were calculated as follows:

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	24.78	11.42
Cooling	3.07	7.54
Auxiliary	20.37	10.65
Lighting	22.75	14.94
Hot water	597.59	584.75
Equipment*	27.8	27.8
TOTAL**	**668.56**	**629.31**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Table 1 – D2 usage class, representative of existing use

The above figures are for information only. As described previously the building was re-run using a D1 usage class for fairer comparison, these figures have been used as the main baseline for assessment and were calculated as follows:

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	15.78	7.57
Cooling	1.77	3.85
Auxiliary	7.94	3.52
Lighting	21.98	14.22
Hot water	218.11	213.25
Equipment*	19.99	19.99
TOTAL**	**265.59**	**242.41**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Table 2 – D1 usage class, representative of the existing building if simply re-purposed

The figures for the proposed refurbished building utilising the revised layouts, and updated building fabric where appropriate (“Be Lean”) were calculated as follows:

Energy Consumption by End Use [kWh/m²]		
	Actual	**Notional**
Heating	7.7	3.81
Cooling	3.19	6.02
Auxiliary	8.61	4.28
Lighting	19.21	11.66
Hot water	17.29	16.57
Equipment*	16.39	16.39
TOTAL**	**55.99**	**42.33**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Table 3 – "Be Lean" modifications to building and fabric

The figures for the proposed refurbished building utilising the revised layouts, and updated building fabric where appropriate ("Be Lean"), and updates to the fixed building services etc. with high-efficiency replacement plant ("Be Clean") were calculated as follows:

Energy Consumption by End Use [kWh/m²]		
	Actual	**Notional**
Heating	7.99	3.81
Cooling	2.51	6.02
Auxiliary	6.3	4.28
Lighting	12.3	11.66
Hot water	16.38	16.57
Equipment*	16.39	16.39
TOTAL**	**45.47**	**42.33**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Table 4 – "Be Clean" modifications to the building services installations

Equipment loads shall be ignored in the commentary below as these are not part of the fixed building services, however the nursery building will have a very minimal small power and equipment load based on our experience with the client and their similar facilities.

As can be seen from table 5, the energy usage reduction of the refurbished building is significantly reduced, and the overall CO_2 production from the building has reduced in the order of 78% based on comparable use.

This is naturally helped in no small part from the removal of the pool areas, which is a significant energy user, however it can also be seen that the fixed building services as proposed contribute a significant reduction in energy use and CO_2 production, i.e. lighting loads have reduced from 21.98kWh/m² to 12.3kWh/m², a reduction of 45%. All new plant exceeds Building Regulation minimum requirements, with significant improvements on the existing efficiencies, specific fan powers etc. as demonstrated by the input data provided.

In order to achieve compliance with a further 20% reduction in CO_2 via on-site renewables, photovoltaic panels were concluded to be the most appropriate solution (refer to the feasibility provided in section 10).

On this basis and the figures below for Case 4 ("Be Lean" and "Be Clean"), a reduction of 4204.2 kg/ CO_2 /annum is required to achieve compliance, this equates to a yield of 8,100 kWh at a carbon factor of 0.519 kg. CO_2 /kWh, equivalent to 3.24kWh/m². This would be satisfied by an array of circa 9.5kWp, or 28No. high efficiency 340W panels mounted at a 10°C incline and South-West facing. This array can be accommodated on the rear roof of the building.

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	7.99	3.81
Cooling	2.51	6.02
Auxiliary	6.3	4.28
Lighting	12.3	11.66
Hot water	16.38	16.57
Equipment*	16.39	16.39
TOTAL**	**45.47**	**42.33**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	3.24	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Table 5 – “Be Green” modifications to the building services installations

The above BRUKL output tables and calculated CO_2 emissions can therefore be summarised as follows:

Scenario	Gas Energy Consumption (kWh)	Gas CO_2 emissions (kg. CO_2 / annum)	Electrical Energy Consumption (kWh)	Electrical CO_2 emissions (kg. CO_2 / annum)	Total CO_2 emissions (kg. CO_2 / annum)
Case 1 - D2 usage as existing	888,744	191,969	65,959	34,233	226,201
Case 2 - D1 usage as existing for fair comparison of use against proposed (Baseline)	333,994	72,143	45,253	23,486	95,629
Case 3 - As case 2 but pool omitted, introduction of energy efficient building fabric and openings, existing plant retained ("Be Lean")	32,387	6,996	40,189	20,858	27,854
Case 4 - As case 3 but all plant replaced with high efficiency new alternatives, LED lighting throughout etc. ("Be Clean")	31,584	6,822	27,359	14,199	21,021
PV Generation	N/A	N/A	-8,100	-4,204	
Case 5 - As case 4 but added PV ("Be Green")	31,584	6,822	19,259	9,995	16,817

Table 6 – Summary of hierarchal improvements

The overall results can therefore be summarised below, with a 20% reduction in CO_2 via on-site renewable generation highlighted:

Scenario	Total tCO_2	Stage reduction, tCO_2	Stage reduction, %
Baseline	95.629	N/A	N/A
Be Lean	27.584	-68.045	71.16%
Be Clean	21.021	-6.563	23.79%
Be Green	16.817	-4.204	20.00%

Table 7 – Summary of stage improvements

An indicative layout for the proposed panels on the rear roof, facing South-West is provided below.

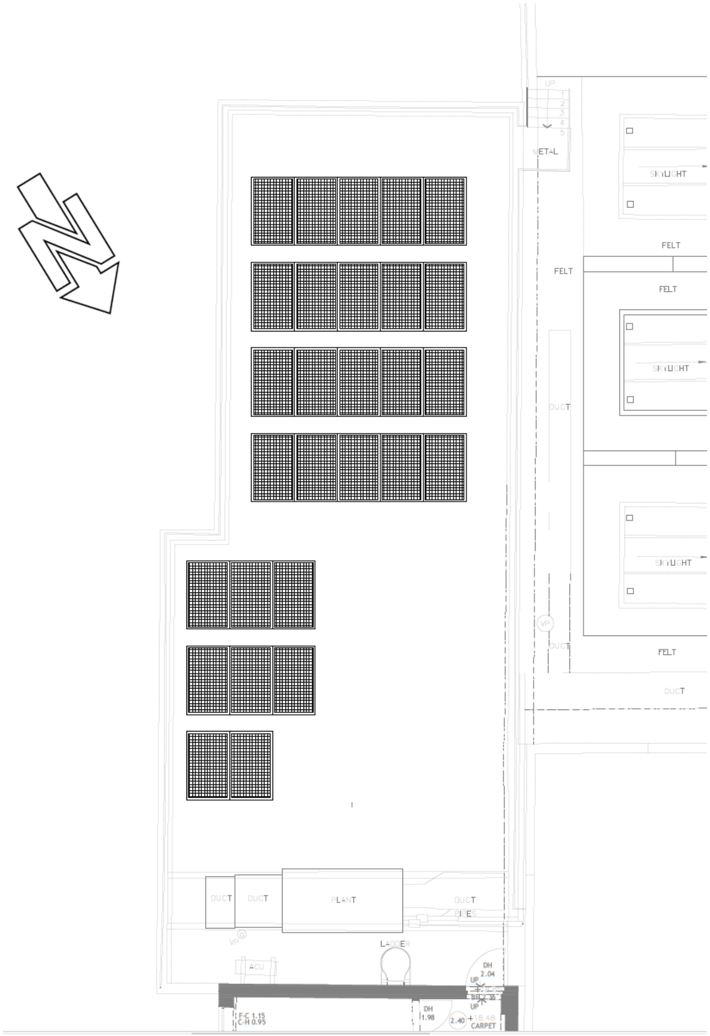


Figure 4 – Indicative PV panel layout

9.0 Thermal Comfort Assessment

9.1 Compliance Requirements

An assessment of thermal comfort without the use of any air conditioning or comfort cooling was conducted in accordance with CIBSE TM52:2013, which requires compliance with two of the three following criteria**:**

Criteria 1 - Hours of Exceedance (H_e):
The number of hours (H_e) during which ΔT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 per cent of occupied hours.

Criteria 2 – Daily Weighted Exceedance (W_e):
To allow for the severity of overheating the weighted Exceedance (W_e) shall be less than or equal to 6 in any one day.

Where $W_e = (\Sigma he) \times WF = (he0 \times 0) + (he1 \times 1) + (he2 \times 2) + (he3 \times 3)$

Where the weighting factor WF = 0 if LIT ≤ 0, otherwise WF = LI T, and hey = time in hours when WF=y

The value of 6 is an initial assessment of what constitutes an acceptable limit of overheating on any single day.

Criteria 3 - Upper Limit Temperature (Tupp):
To set an absolute maximum value for the indoor operative temperature the value of LIT shall not exceed 4K.

The results of this assessment are provided and discussed later in this report.

9.2 Weather Data

The NCM London DSY weather file has been utilised for this analysis.

9.3 Internal Conditions

Where appropriate NCM room type/conditions have been utilised to form the basis of the internal conditions modelled, modified as appropriate to represent the building and use.

Lighting installed power densities have been adjusted to represent the proposed design, as have ventilation rates and heating set points. Ventilation rates have been assumed to match the detailed design information, however cooling was omitted in its entirety.

9.4 Apertures

Openings are a key function in a naturally ventilated building in order to prevent or minimise overheating. The following aperture details have been assumed:

- External windows and doors have been modelled to represent the information and opening sections as detailed on the elevations, with the assumption that 100mm restrictors will be fitted throughout.
- Internal corridor doors have been modelled as open during the peak summer months as part of the thermal comfort analysis. Where there is a secure line to be maintained, i.e. to staff areas, to staircases, either side of the reception area, etc. these corridor doors have been modelled as closed.

- Doors to secure rooms such as the staff room were assumed to be open when occupied as part of the thermal comfort model, this needs to be managed to maintain security when not occupied.

9.5 Limitations of the report

The thermal comfort analysis has been carried out using EDSL Tas version 9.4.2 in accordance with CIBSE AM11. The parameters and assumptions used in this calculation are deemed to be accurately represent the building to the best of our knowledge and our experience of similar care home buildings.

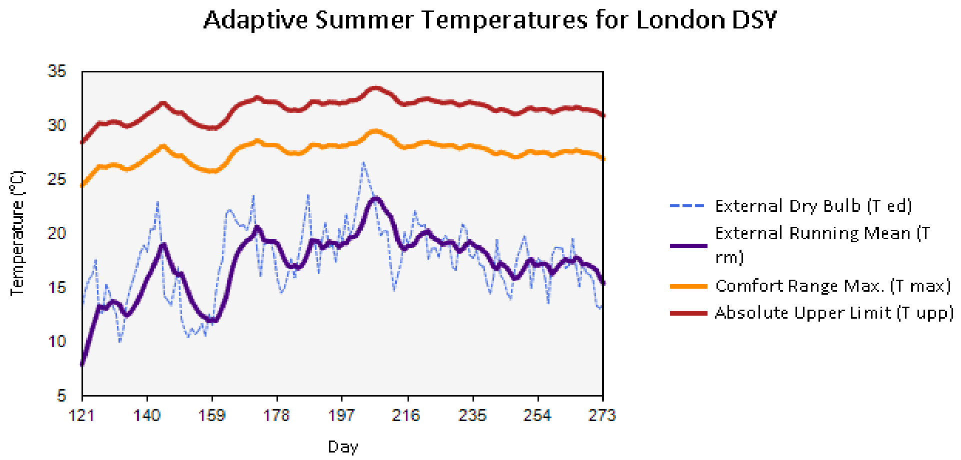
Although every effort has been made to simulate the building on anticipated heat gain values and occupancy profiles, the 'real' building may have differing operations and heat gain patterns with external weather conditions not normal to the historical data provided by the standard CIBSE weather files. It therefore should be noted that there is no guarantee that the thermal comfort assessment will match the occupied building. As with all naturally ventilated buildings, it should also be noted of the limitations of such an approach, and this needs to be fully understood by the client and occupiers to avoid overheating complaints when temperatures rise within the parameters that they are permitted to do so in line with the ventilation approach and stated guidance.

9.6 Commentary on analysis and findings

Initial analysis was undertaken using the proposed design along with the CIBSE design summer year (DSY) weather file for London, which would be the weather data to be used for this location when undertaking a Part L compliance assessment/provision of an EPC (as dictated by the BRE weather locations lookup tool).

The results are provided in Table 8 below.

As can be seen, due to the limited openings and ability for natural ventilation, the thermal comfort criteria is not met in the vast majority of areas, cementing the proposal to utilise a high efficiency VRF/VRF system for this building, which not only has benefits for comfort but also energy efficiency overall.



The adaptive overheating assessment tests rooms against three criteria. If a room fails any two of the three criteria then it is said to overheat.
1. The first criterion sets a limit for the number of hours that the operative temperature exceeds the comfort temperature by 1°C or more during the occupied hours over the summer period (1st May to 30th September).
2. The second criterion deals with the severity of the overheating within any one day. This sets a daily limit for acceptability.
3. The third criterion sets an absolute maximum daily temperature for the room.

Zone Name	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
Changing Art/Craft	1441	43	2	2.0	0	Pass
Circulation 1	1441	43	298	25.0	0	Fail
Circulation 2	1441	43	73	18.0	0	Fail
Circulation 3	1441	43	53	10.0	0	Fail
Stair2	1441	43	31	9.0	0	Pass
Circulation 5	1441	43	2	2.0	0	Pass
Circulation 4	1441	43	106	13.0	4	Fail
Stair1	1441	43	18	8.0	0	Pass
Circulation 6	1441	43	63	11.0	0	Fail
Circulation 7	1441	43	5	3.0	0	Pass
Circulation 8	1441	43	29	9.0	0	Pass
Circulation 9	1441	43	28	10.0	0	Pass
Circulation 10	1441	43	12	5.0	0	Pass
Circulation 11	1441	43	14	6.0	0	Pass
Circulation 12	1441	43	298	23.0	3	Fail
Staff Room	1683	50	129	17.0	4	Fail
Kitchen	444	13	0	0.0	0	Pass
Milk Kitchen	444	13	0	0.0	0	Pass
Office 1	814	24	0	0.0	0	Pass
Office 2	814	24	0	0.0	0	Pass
Office 3	814	24	0	0.0	0	Pass
Meeting Room	814	24	0	0.0	0	Pass
Training Room	814	24	0	0.0	0	Pass
Offices Future1	814	24	0	0.0	0	Pass
Offices Future2	814	24	0	0.0	0	Pass
Offices Future3	814	24	0	0.0	0	Pass
Reception 1	592	17	0	0.0	0	Pass
Store 1	740	22	0	0.0	0	Pass
Store 2	740	22	0	0.0	0	Pass
Store 3	740	22	0	0.0	0	Pass
Store GF New	740	22	0	0.0	0	Pass
Store FF New	740	22	0	0.0	0	Pass
Store 4	740	22	0	0.0	0	Pass
Art/Craft	1989	59	95	15.0	4	Fail
Nursery Room 1	1989	59	149	17.0	6	Fail
Nursery Room 2	1989	59	327	22.0	65	Fail
Nursery Room 3	1989	59	508	19.0	208	Fail
Nursery Room 4	1989	59	206	17.0	16	Fail
Nursery Room 5	1989	59	249	19.0	35	Fail
Cubbies	1989	59	374	23.0	93	Fail

Table 8: Summary of Thermal Comfort results (excluding comfort cooling)

Zone Name	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Criterion 2: Peak Daily Weighted Exceedance	Criterion 3: #Hours Exceeding Absolute Limit	Result
Nursery Future 1	1989	59	607	18.0	341	Fail
Nursery Future 2	1989	59	206	17.0	21	Fail
Nursery Future 3	1989	59	340	22.0	75	Fail
Nursery Future 4	1989	59	288	19.0	46	Fail
WC1 Disabled WC	1441	43	0	0.0	0	Pass
WC2 Staff	1441	43	4	3.0	0	Pass
WC3 Visitor	1441	43	4	4.0	0	Pass
WC4 Nursery GF	1441	43	12	11.0	0	Pass
WC5 Nursery FF	1441	43	93	16.0	2	Fail
WC6 Nursery FF	1441	43	37	9.0	2	Fail
WC SF Future1	1441	43	226	23.0	11	Fail
WC SF Future2	1441	43	475	35.0	45	Fail
Workshop1	888	26	0	0.0	0	Pass
Laundry	444	13	0	0.0	0	Pass

Table 8 (cont…): Summary of Thermal Comfort results (excluding comfort cooling)

10.0 Renewable and Low Carbon Technologies Feasibility

This section provides a brief overview of available renewable and low/zero carbon technologies, and discusses the advantages and disadvantages that are specific to the project. A tabulated summary of the technologies is provided at the end of this section.

10.1 Photovoltaic System (PV)

A PV system uses layers of semi-conductor material to produce electricity generated directly from sunlight. Several types of PV are available with varying costs and performance.

The efficiency ranges from approximately 8% to 20% for high performance panels, based on peak output under ideal conditions. For the panels to function effectively, they must be installed in an unshaded location, and correctly orientated based on the site latitude.

Figure 5: Frame mounted PV on a flat roof

Due to the design of the building, PV panels mounted on the flat roof areas would appear to be feasible and easily accommodated, subject to structural confirmation due to the additional weights and loads. It would be proposed for this development to use a small incline of 10° to limit the ballast required and minimise aesthetic impact.

10.2 Solar Thermal

Solar thermal panels convert solar radiation into thermal energy which can be used to supplement conventional heat generation methods such as gas boilers. There are 2 main types of system, evacuated tube collectors and flat plate collectors. Evacuated tube collectors can have efficiencies of up to 60%, and flat plate collectors of around 50%.

Similar to photovoltaic panels, the positioning of the panels requires careful consideration, however several manufactures of evacuated tube panels can lay their panels onto flat roofs without the requirement for A-frames as the tubes themselves can be set to the correct angle.

Our experience of this technology is due to the relatively low yields payback periods are high. They would also necessitate increased plant space for additional storage vessels, and would not be a cost effective addition to the current building design.

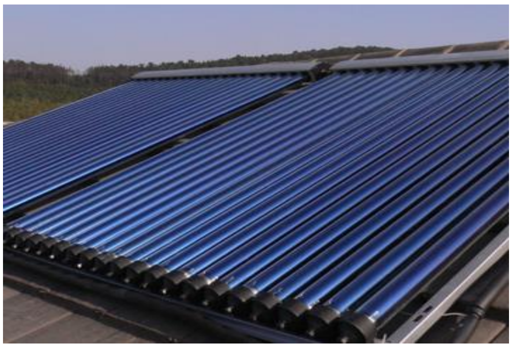


Figure 6: Evacuated tube solar thermal panels

10.3 Wind Turbines

Wind turbines convert the kinetic energy contained in wind into electricity. To ensure that they operate economically, most manufacturers recommend an average wind speed of 6ms-1. The average wind speed for the site is approximately 5 m/s and whilst this is likely to be suitable for a reasonable yield, the nature of the development and close proximity to residences is also likely to cause planning issues. Factors such as nearby obstacles (buildings, trees and planting), potential shadow flicker on the development and surrounding residential properties, noise etc. would suggest that this is not a suitable technology for consideration on this development.

Estimated average windspeeds around NW3 4..

Wind speed at 10m above ground level (m/s)		
5.6	5.1	4.9
5	**5**	4.9
4.9	4.9	4.8

Wind speed at 25m above ground level (m/s)		
6.3	6	5.7
5.8	**5.8**	5.6
5.7	5.7	5.6

Wind speed at 45m above ground level (m/s)		
6.7	6.4	6.2
6.3	**6.3**	6.1
6.2	6.2	6.1

Figure 7: Micro-wind turbine and average wind speed results

10.4 District Heating

District heating is a system for distributing heat generated in a centralized location through a system of insulated pipes for residential and commercial heating requirements such as space heating and water heating. It is not believed there is an appropriate district heating system available in the local area, and this solution does not suit the proposed building services strategy, demand and operation.

10.5 Biomass

Biomass boilers can be used as an alternative to conventional gas boilers. Biomass, usually wood chips or pellets, are burned instead of gas. A conventional gas back-up boiler will typically still be provided to ensure the building demands are met in the event of mechanical failure or a problem with fuel supply. Biomass fuel is deemed low carbon as the fuel absorbs CO_2 whilst growing, and hence burning the fuel is merely releasing this carbon back into the atmosphere. It is not zero carbon; however, as there are carbon emissions associated with the farming, processing and transportation of the biomass.

There are two main types of solid biofuel; wood chips and wood pellets. Wood chips are cheaper to buy as they require less processing, however wood pellets have a higher energy density (in terms of kWh per m^3 of fuel), and a more predictable moisture content because of its processed nature. However, this processing produces a higher costing fuel, but the regular size of wood pellets means that boilers operating on pellets are less prone to jamming and problems associated with delivery of fuel from the store.

Biomass boilers require storage for the fuel – the size of store depends on the size of boiler, and the required length of storage which is often determined by the frequency of deliveries and minimum delivery volumes. A 6 week frequency of delivery is a typical value for storage calculations. Discharge of flue gases, and inherent particulate such as ash, may also be an issue for this development.

Based on the urban nature of the site and the lack of a suitable place for fuel stores and delivery areas, the management and availability of supply and the potential impact of discharging particulates in a residential area it is not proposed to consider biomass for this development.

10.6 Heat Pumps

Heat pumps take a low grade source of heat e.g. a lake or external air, and though a process similar to that of a domestic refrigerator, "upgrade" the heat for use in a heating system, or for domestic hot water generation.

Variable Refrigerant Flow (VRF) or Varaiable Refrigerant Volume (VRV) systems can be utilised to move energy around a building and provide simultaneous heating and cooling to areas. Such systems are very energy efficient and ideally suited to this development.

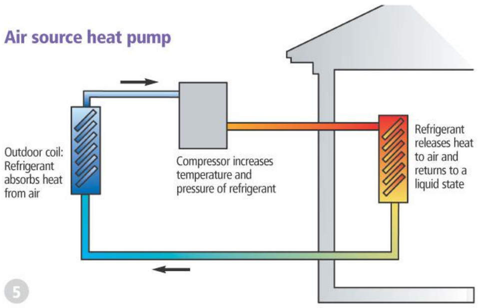


Figure 8: Air Source Heat Pump

Ground source heat pumps work on a similar principle but use the ground rather than the air as a heat sink/source. Such systems require extensive open land areas or boreholes for the necessary ground loops, are therefore not suitable for this development.

10.7 Combined Heat and Power (CHP)

Combined heat and power (CHP) systems comprise a generator to provide electricity, and a system to convert waste heat from the generator to useful heating energy. Most small-scale CHP units are powered by natural gas so typically not classed as renewable energy, however, local planning policy does state that this low carbon solution can be used to achieve the 20% reduction in CO_2 emissions required. CHP can contribute significantly to carbon improvement targets; the generation of on-site electricity is regarded favourably as it is more efficient that using grid electricity with its associated transmission and generation losses.

Most CHP units use an automotive engine as the source of energy, so there is a maintenance requirement associated with their use.

There are also small-scale CHP units that can be run from liquid biofuel. These units generate heat and electricity with very low carbon emissions, however a reliable source of fuel would have to be sourced to make this a viable proposition for the development.

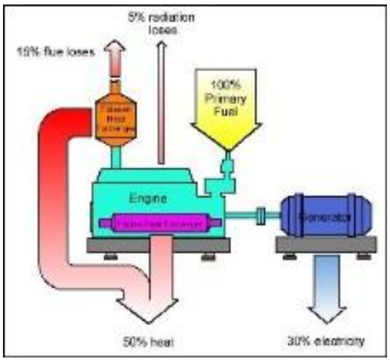


Figure 10: CHP Diagrammatic

Due to the lack of a high heating base load demand year round, a CHP unit would not be a suitable technology to consider for this development.

10.8 Summary

The technical feasibility of installing each LZC technology has been assessed in order to discount any unsuitable options at an early stage. A summary of the feasibility process is presented in the following table:

Technology	Brief Description	Benefits	Issues/Limitations	Feasible for site
Solar Photovoltaic	Photovoltaic panels convert solar radiation into electrical energy	Low maintenance. No moving parts. Easily integrated into building design.	Any overshadowing affects panel performance. Panels ideally inclined and facing southerly direction.	Yes
Solar Thermal	Solar thermal energy can contribute towards space heating and hot water requirements.	Low maintenance.	Must be sized for the building base load hot water requirements Panels ideally inclined and facing southerly direction	Yes, but not ideal for proposed servicing strategy

Table 9: Summary of Renewable and Low Carbon Technology Energy Options

Technology	Brief Description	Benefits	Issues/Limitations	Feasible for site
Wind Turbine	Wind generation equipment operates on the basis of wind turning a turbine to generate electricity. Small scale (1kW – 15kW) wind turbines can be pole or roof mounted.	Low maintenance/ On-going cost. Excess electricity can be exported to the grid	Planning issues. Aesthetic impact. Background noise Space limitations on site. Minimum wind speed requirements. Wind survey to be undertaken to verify 'local' viability.	No
Biomass	Modern wood-fuel boilers are highly efficient, clean and almost carbon	Stable long term running costs. Potential good CO_2 saving.	Large area needed for fuel delivery and storage. Reliable fuel supply chain required. Regular maintenance required Significant plant space required. Air pollution / Clean Air Act limits use.	No
Ground Source Heat Pump (GSHP)	GSHP systems tap into the earth's considerable energy store to provide both heating and cooling to buildings.	Minimal maintenance. Unobtrusive technology. Flexible installation options to meet available site footprint.	Large area required for horizontal pipes Full ground survey required to determine geology. More beneficial to the development if cooling is required. Integration with piled foundations must be done at an early stage.	No
Air Source Heat Pump	Electric air source heat pumps extract thermal energy from the surrounding air and transfer it to the working fluid (air or water).	Efficient use of fuel. Relatively low capital costs.	Specialist maintenance. Some additional plant space required. Potential noise issues from external condensers	Yes
Combined Heat and Power	A Combined Heat and Power (CHP) installation is effectively a mini on-site power plant providing both electrical power and thermal heat. CHP is strictly an energy efficiency measure rather than a renewable energy technology.	Potential high CO_2 saving available. Efficient use of fuel. Excess electricity can be exported to the grid	Maintenance intensive. Sufficient base thermal and electrical demand required. Some additional plant space required.	No
District Heating	A system for distributing heat generated in a centralized location through a system of insulated pipes for residential and commercial heating requirements	Efficient use of boiler plant	Significant pipework network required, with associated losses. Not available for this site.	No

Table 9 (cont…): Summary of Renewable and Low Carbon Technology Energy Options

On the basis of the above, it is proposed to utilise a gas boiler solution to heat ancillary areas, with the remainder of the building served via a high efficiency VRF/VFV heat pump system, supplemented by a photovoltaic panel array to comply with the on-site renewable generation targets.

11.0 Green Wall

It is proposed to utilise a green wall to the newly formed areas within the garden, created by the demolition of the pool.

The green wall shall form a vertical garden and will create additional energy reduction benefits through shading. A typical example is shown below, further details will be subject to the detailed design and specialist involvement during the next stage.

Figure 11: Typical green wall