RIDGE

ABACUS BELSIZE PRIMARY SCHOOL

01 February 2019

ABACUS BELSIZE PRIMARY SCHOOL
ENERGY STRATEGY REPORT

01 February 2019

Prepared for

Department for Education
Fourth Floor
Sanctuary Buildings 20 Great Smith Street
London
SW1P 3BT

Prepared by

Ridge and Partners LLP
Eden Office Park
65 Macrae Road
Ham Green
Bristol
BS20 0DD

Tel: 01275 813 500

Contact

Konstantinos Pyrintsos
Mechanical Engineer / Energy Assessor
kpyrintsos@ridge.co.uk
07467 335844

VERSION CONTROL

VERSION	DATE	DESCRIPTION	CREATED BY	REVIEWED BY
1.0	01.02.2019	First Issue	KP	SM
2.0	01.03.2019	Amendments to DfE comments	KP	SM
2.1	08.04.2019	Amendments to JLL comments	KP	AT
2.2	17.04.2019	Amendments to JLL comments. Updated to latest Camden Planning Guidance	KP	AT
2.3	19.07.2019	Amendments to Planning comments	KP	AT
2.4	29.08.2019	Renewables contribution detailed	KP	SM
2.5	04.09.2019	Minor modification to PV considerations	KP	SM
2.6	24.10.2019	Further PV considerations following planning comments	SM	SM
2.7	28.10.2019	Further PV considerations following planning comments	AT	AM

CONTENTS

1. EXECUTIVE SUMMARY

This report relates to the Abacus Belsize Primary School, London. The project comprises the refurbishment of a listed building and its conversion from a police station to a primary school and a Business and Enterprise Space (B1 use class).

The proposed refurbishment is exempt from the requirements of Part L2B due to the listed status of the building. However, any proposed building services and new thermal elements are expected to meet the energy efficiency criteria.

The report presents the energy strategy for the refurbishment in line with the GLA guidance and the energy hierarchy. Comparing BRUKL CO_2 figures for each element of the scheme enables the DfE to demonstrate a reduction in carbon emissions.

The main aspects of the proposed energy strategy include efficient gas boilers as the main heat generator and mechanical ventilation with heat recovery. Efficient LED lighting and lighting controls have been assumed.

The simulation results show a potential for significant energy and CO_2 savings from the refurbishment when compared to the previous building use as a police station (overall average improvement of 87%).

This has been split into three elements for demonstrating the reduction in CO_2. School building, Business and Enterprise Space (B1 use class) and the Stable Block.

2. INTRODUCTION

This report relates to the Abacus Belsize Primary School, London. The project comprises the refurbishment of a listed building and its conversion from a police station to a primary school and a Business and Enterprise Space (B1 use class). The proposed works include the removal of modern interventions from the rear of the building, while maintaining the main elements of the historic building fabric and the re-arrangement of internal layout with new partitioning to accommodate the new use (primary school and Business and Enterprise Space).

Figure 1-Front elevation of the existing building.

Ridge have prepared this energy strategy based on the following information provided by Satellite Architects:

- Building Information Model relating to the current (existing) state of the building.
- General Arrangement floor plans relating to the proposed works to the building.

The current report has also considered the M&E design developed by Ridge.

The energy simulations were carried out using IES VE, which is an approved software for Part L calculations and CO_2 emissions. It should be noted that modelling requires assumptions on fabric and occupancy patterns and for this reason the simulation results presented here should be assessed within the context of the methodology followed.

3. PART L REQUIREMENTS

The proposed refurbishment would normally have to meet the requirements of Approved Document L2B "Conservation of fuel and power in existing buildings other than dwellings".

However, the listed status of the building relates to section 3.5 of the Part L2B which "[…] grants an exemption from compliance with energy requirements to certain classes of buildings: Buildings which are: Listed in accordance with section 1 of the Planning (Listed Building and Conservation Areas) Act 1990; […]" (HM Government, 2010)

Similarly, sections 3.6 to 3.13 of Part L2B apply and the building should therefore be exempt from the energy efficiency requirements.

Ridge understand that the current design proposal includes no extensions as defined in Approved Document L, Part L2B. With regards to new thermal elements (external envelope) there is only a wall section added in the Lower Ground Floor corridor next to Year 1&2 classrooms as shown in Figure 2. This item would have to meet the energy efficiency requirements.

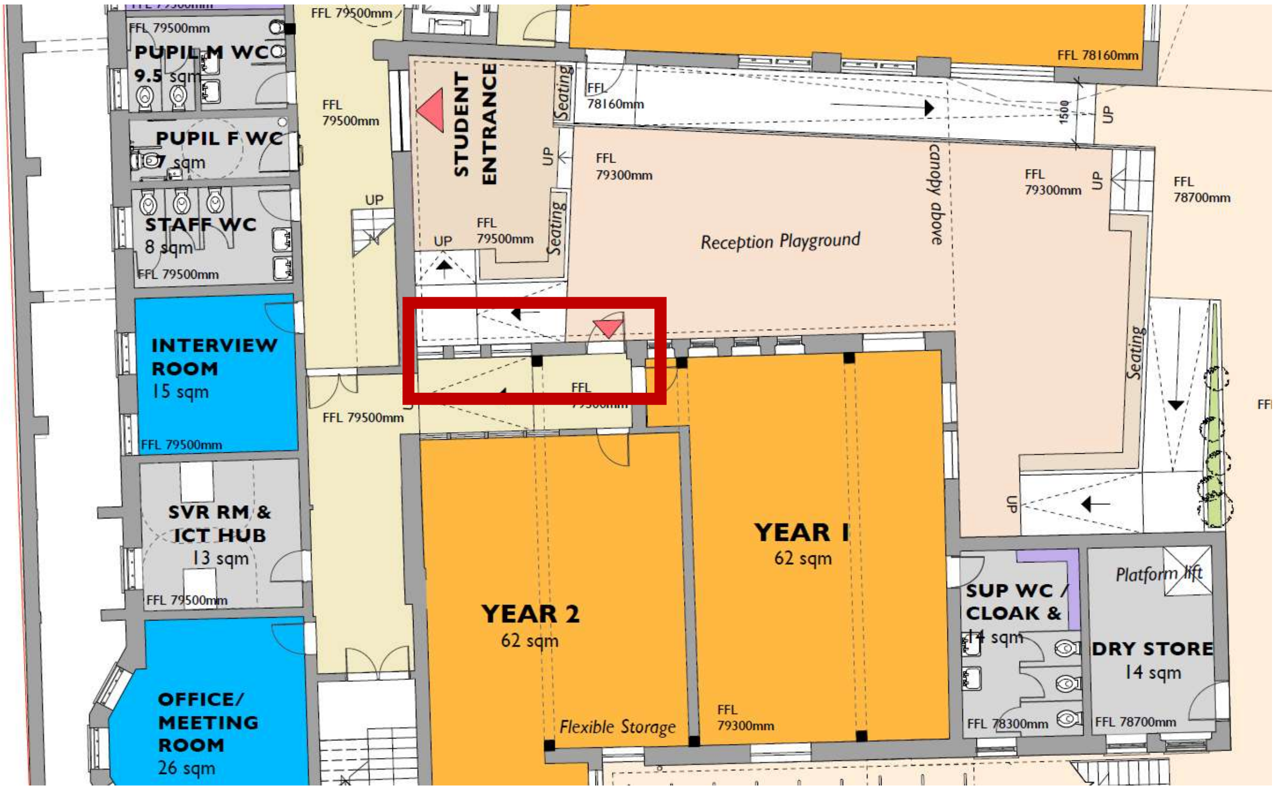


Figure 2-Snapshot showing the proposed new wall (new thermal element).

All proposed building services will have to meet the requirement of the *Non-Domestic Building Services Compliance Guide.*

4. LOCAL PLANNING POLICY

The London Plan (Policies 5.2-5.9) and the relevant GLA guidance requires "an estimate of the CO_2 savings from the refurbishment of the building" (GLA, 2016). It suggests that the Building Emission Rate-BER ($kgCO_2/m^2$ per year) of the existing building (before the refurbishment) is calculated and used as a Baseline for the energy hierarchy assessment, against which the improvement of the proposed works can be measured.

The energy assessment should follow the stages of the energy hierarchy:
Baseline
Be Lean: energy efficiency
Be Clean: heat networks / CHP
Be Green: renewable energy

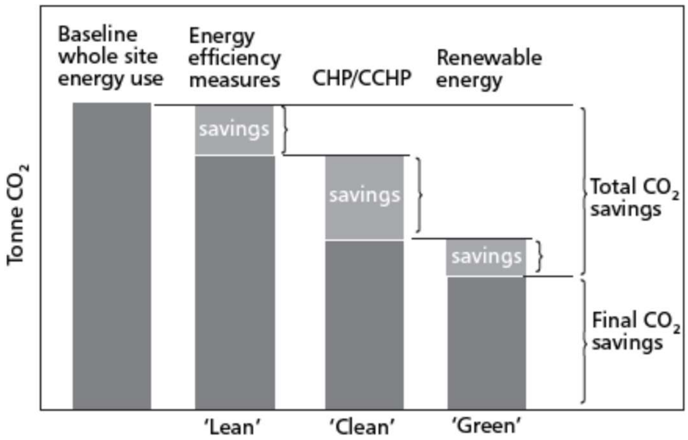


Figure 3-GLA Energy hierarchy by CIBSE Guide F (CIBSE, 2012).

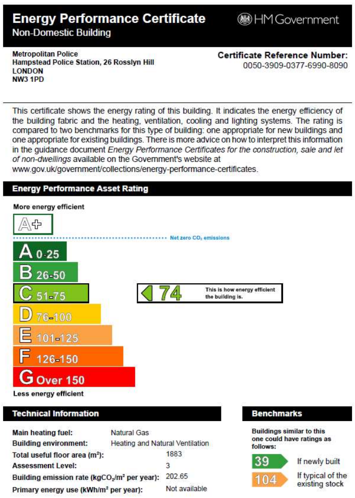
4.1. Camden Planning Guidance: Energy efficiency and adaptation

All development in Camden is expected to reduce carbon dioxide emissions by following the energy hierarchy in accordance with Local Plan policy CC1.

4.2. Existing EPC

The building as it stands has a valid EPC[1] registered which includes a BER figure at 202.65 $kgCO_2/m^2$ per year. The Certificate Reference Number of this EPC is 0050-3909-0377-6990-8090.

For consistency, this report adopts the BER figure of the current EPC as the baseline for the energy assessment.



Energy Performance Certificate
Non-Domestic Building
HM Government

Metropolitan Police
Hampstead Police Station, 26 Rosslyn Hill
LONDON
NW3 1PD

Certificate Reference Number:
0050-3909-0377-6990-8090

This certificate shows the energy rating of this building. It indicates the energy efficiency of the building fabric and the heating, ventilation, cooling and lighting systems. The rating is compared to two benchmarks for this type of building: one appropriate for new buildings and one appropriate for existing buildings. There is more advice on how to interpret this information in the guidance document *Energy Performance Certificates for the construction, sale and let of non-dwellings* available on the Government's website at www.gov.uk/government/collections/energy-performance-certificates.

Energy Performance Asset Rating

More energy efficient
A+
Net zero CO_2 emissions
A 0-25
B 26-50
C 51-75
D 76-100
E 101-125
F 126-150
G Over 150
Less energy efficient

74 This is how energy efficient the building is.

Technical Information

Main heating fuel:	Natural Gas
Building environment:	Heating and Natural Ventilation
Total useful floor area (m^2):	1883
Assessment Level:	3
Building emission rate ($kgCO_2/m^2$ per year):	202.65
Primary energy use (kWh/m^2 per year):	Not available

Benchmarks

Buildings similar to this one could have ratings as follows:
39 If newly built
104 If typical of the existing stock

Figure 4-Preview of the currently registered EPC

[1] Energy Performance Certificate

5. BUILDING FABRIC

The building fabric was modelled based on information provided by Satellite Architects and the available historic benchmark construction types from the NCM databases[2]. As there is limited information on the existing building fabric, assumptions had to be made which reflect a scenario of a relatively badly insulated building.

Due to the listed status of the building it is anticipated that there will be limited scope for radical fabric alterations which could offer significant improvements in the thermal performance of the fabric. Secondary glazing as detailed by Satellite Architects has been allowed. Also, it has been assumed that loft insulation and additional roof insulation for flat roofs will be possible to accommodate. Any new thermal elements (refer to section 4) were assumed to match the notional building specification.

Table 1 summarises the assumed fabric parameters.

Table 1-Fabric specification.

Construction Type	Description	Assumed U-value (W/m²K)
External Wall	Existing wall ~360mm	1.25
External Wall	Existing wall ~460mm	1.04
Floor	Solid Ground floor-uninsulated	0.58
Internal Floor	300mm	2.41
Roof	Pitched Roof, Loft insulation to Part L2B	0.16
Roof	Flat Roof, concrete deck, insulated to Part L2B	0.18
Roof-Light	4mm Single glazed	6.25
Glazing (secondary)	4mm Single glazed-80mm gap-Low-e Glass pane	2.89
Air Permeability	Improved due to refurbishment	7 (m³/(m²hour)

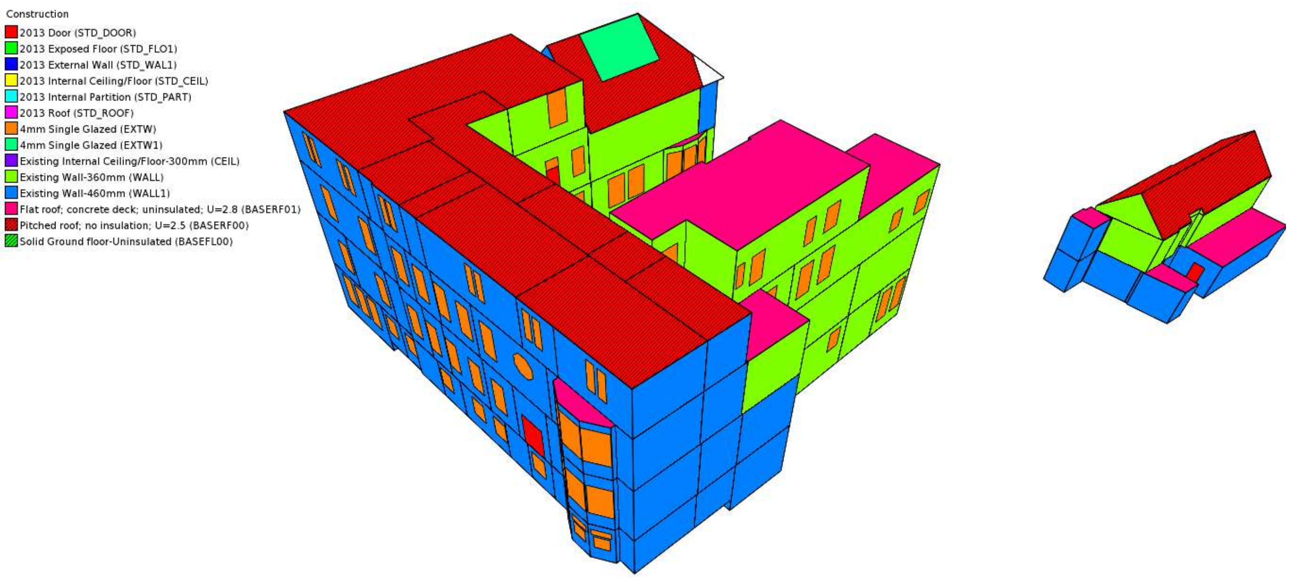


Figure 5 - Energy model, constructions.

[2] National Calculation Methodology

6. BUILDING SERVICES

6.1. Ventilation

Natural ventilation has been adopted for areas where there are no air quality constraints. The building however, will be predominantly served by mechanical ventilation units with heat recovery which have been considered for teaching areas in the lower ground and ground floor and other areas where windows are facing the main roads. In general, mechanical ventilation was taken as per the design by Ridge (drawing series 43). Mechanical extract ventilation will be required for wet areas such as toilets. Extract fans in wet areas should achieve 0.30 W/l/s or better.

6.2. Heating

The heating fuel availability is the driver for the selection of the heating system along with the associated carbon emissions and the system efficiencies that can be achieved. The main heating strategy comprises efficient gas fired condensing boilers as the main heat generator and the main heat emitter as radiators. The seasonal efficiency of the heat generators calculated as per the Non-Domestic Building Services Compliance Guide was set to 95.69% for the school and the Business & Enterprise Space zone and 93% for the Stable Block.

A biomass boiler, although low in CO_2 emissions, would require significant space for storage of fuel and ongoing maintenance liability and therefore it has not been considered as a feasible option. An air source heat pump (ASHP) system across the building would require additional space for condensing units and components on the roof and in the plantroom. However, heat pumps have been introduced in only three refurbished areas on the second floor where AC units are provided set to provide heating and cooling.

A Combined Heat and Power (CHP) solution would use gas as its main fuel to generate electricity and thermal energy for the heating system. However, this option would not be feasible for this project due to the small heating load and the expected heating profile of the site (mainly school hours). The latter cannot guarantee an efficient operation of a CHP engine which requires a more or less continuous operation to ensure energy and savings.

A connection to an existing district heating network would not be feasible as shown in the London Heat Map below (Figure 6). The map shows in red the existing district heating networks (DH) in relation to the project's address.

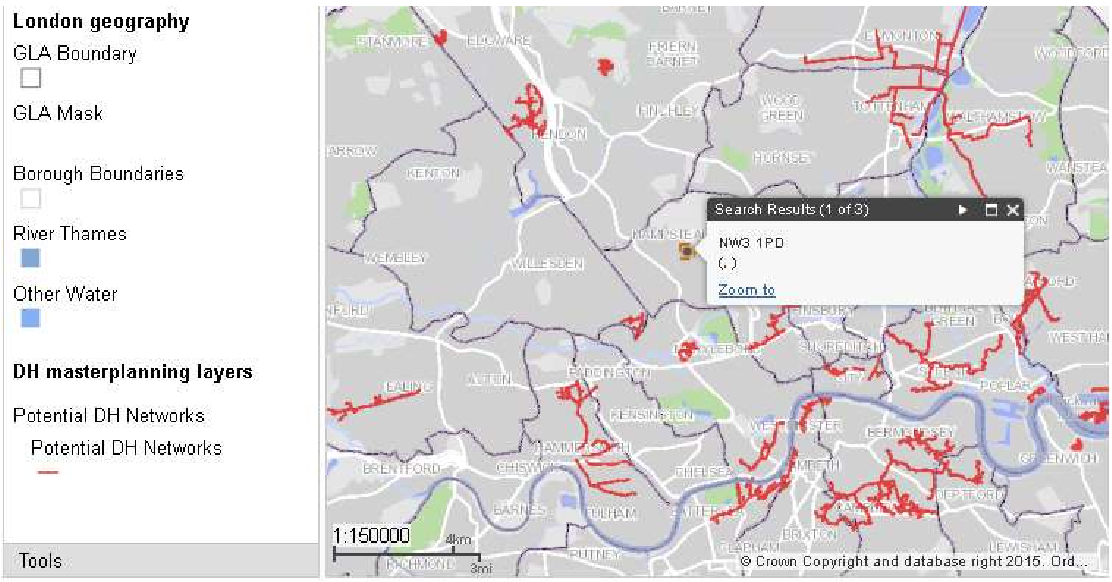


Figure 6-London Heat Map and the project location. https://maps.london.gov.uk/heatmap/

In addition to the London Heat Map, Susana Espino, Senior Energy Efficiency Officer at Camden, confirmed in correspondence on the 10th December 2018, that the existing DH network feeding from the Royal Free Hospital is currently not available for further connections.

6.3. Cooling

Active cooling (heat pumps) has been based on the design by Ridge using the efficiencies of the products specified (COP 4.1, SCOP 3.93, EER 3.65, SEER 6.74). Active cooling has been considered for areas on the second floor where there is risk of overheating and in the SEN areas on the first floor where tighter temperature controls are required.

6.4. Domestic Hot Water

Efficient gas fired water heaters can be utilised for the generation of domestic hot water (DHW) (assumed 300litres capacity). This will have to be a well-insulated cylinder (~60mm factory insulation). Secondary HWS circulation will be required to mitigate any legionella risks. In this case, pipework will be well insulated to ensure minimal heat loss and compliance with Part L (pipework heat loss assumed at 8W/m). In the Stable Block, DHW will be provided by the gas combi boiler.

6.5. Lighting

Efficient LED lighting (70lm/W, LoR 1) has been assumed along with daylight dimming sensors in the classrooms and the main corridor. Occupancy sensing has been considered in most areas.

6.6. Renewables

Figure 7 - Appropriate flat roof areas for PV installation (if not listed)

Efficient Air Source Heat pumps have been considered in areas within the School where active cooling needs to be provided.

An appraisal of implementing a solar photovoltaic (PV) array to further reduce CO2 emissions has been undertaken based on the suitable flat roof area as shown indicatively on Figure 7 highlighted in yellow.

A solar energy simulation undertaken in accordance with Figure 7 has indicated that approximately 8 PV panels (approx. 1.6m² each) were deemed to fit on the proposed area with little or no over-shading. It is estimated that this would produce a total of 2.4kW annually which reduces the school BER from 21.9 to 21.1 kgCO2/m². per annum. This equates to 1,173 kgCO2 less, due to PV generated electricity.

As a result, the site total emissions after these renewables drop to 49,737 from 50,910kgCO2. This, however, doesn't alter significantly the overall renewable savings calculations for the scheme, which remain at 2% and therefore indicates at best an extremely limited improvement.

A cost estimate to the order of c.£6500 for the installation of the PVs as shown within Figure 7 and a further ongoing annual maintenance cost for the necessary upkeep, and potential access issues, have all been contributing factors in discounting the suitability of introducing a photovoltaic array to the flat roof areas for this scheme.

It should be noted that whilst undertaking this PV appraisal, further areas were identified as being potentially suitable for installation as shown within Figure 8. However, this was later discredited after consideration was given to the Grade II listed building status and location within the Hampstead Conservation Area. When coupled with the orientation and steep pitch of the existing roofs it was deemed that there were limited opportunities and therefore unfeasible for the installation of PVs within these building areas.

Figure 8 - Appropriate pitched roof areas for PV installation (if not listed).

Whilst PVs have been deemed unsuitable, an 87% potential energy and C02 saving from the proposed refurbishment has been reported to date when compared from the previous building use.

Ground source heat pumps would require extensive groundworks and would be very difficult to achieve under the current project timeframe.

Wind turbines are also excluded due to the historical character of the building and the unfeasible installation requirements (height) at this urban location.

The most suitable renewable heat technology which is both financially viable and reduces carbon emissions is the installation of an Air Source Heat Pump (ASHP). A suitable system which complements the space and occupant requirements has been designed and selected. Efficient Air Source Heat pumps have been considered as indicated on H&V layouts, where active cooling and heating needs to be provided. This is equivalent to a CO2 reduction of 7 Tonnes, equivalent to a 2% reduction for the development. Figures can be found in the design stage BRUKL document.

7. RESULTS

Table 2 summarises the results of the calculations for the regulated carbon emissions. As mentioned in section 4, the pre-refurbishment BER was taken from the currently registered EPC and was used to estimate the existing kgCO2 emissions.

It can be seen that an 87% improvement can be achieved overall on regulated emissions.

Table 2 - CO2 emissions, Before and After

BUILDING ENTITY	AREA (M^2)	EXISTING KG CO2	PROPOSED BER KGCO2/M^2	PROPOSED KG CO2	IMPROVEMENT %
School	1466	297,085	21.9	32,105	89%
Business and Enterprise Zone	289.4	58,647	50.5	14,615	75%
Stable Block	159	32,221	26.4	4,198	87%
TOTAL		387,953		50,918	87%

In addition to this and to assist comparisons, CIBSE Guide F energy benchmarks have been taken into account for a typical police station.

The GLA guidance requires an estimate of unregulated emissions as well. The SBEM calculation showed that the un-regulated energy consumption for equipment approximates to 30% of total energy use and therefore a similar proportion has been used for the unregulated emissions. These are detailed in Table 3 below.

The results show that a significant saving in energy and CO2 emissions can be achieved. The detailed output of the SBEM calculation (BRUKL report) can be found in the Appendix.

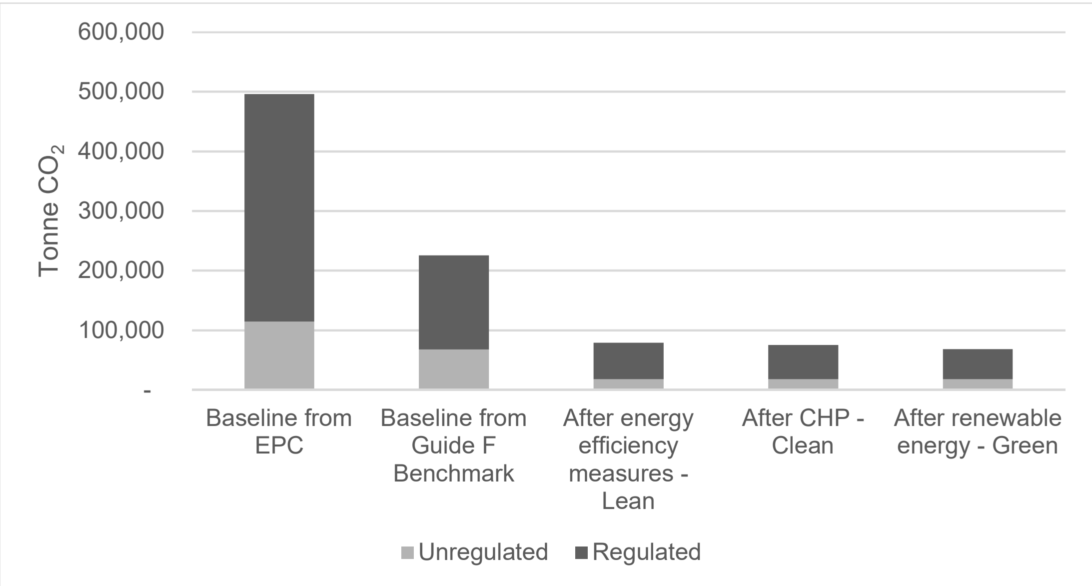


Figure 8-Energy Hierarchy results

	REGULATED KGCO2	UNREGULATED KGCO2	% REDUCTION OVER REGULATED
Baseline (from EPC)	381,590	114,477	
Baseline (CIBSE Guide F benchmark)	157,945	67,690	

	REGULATED KGCO2	UNREGULATED KGCO2	% REDUCTION OVER REGULATED	
After energy efficiency measures - Lean (BER)	50,918	17,442		
After CHP – Clean (not applicable)	50,918	17,442		
After renewable energy - Green	50,918	17,442	87%	63% over the CIBSE Guide F benchmark

Table 3 - SBEM calculation results

		BE LEAN		BE CLEAN		BE GREEN	
Building	Area (m²)	kgCO2/m²	kgCO2	kgCO2/m²	kgCO2	kgCO2/m²	kgCO2
SCHOOL	1466	27.7	40,608	26.4	38,702	21.9	32,105
BUSINESS & ENTERPISE SPACE	289.4	54.6	15,801	50.5	14,615	50.5	14,615
ANNEX	158.7	32.8	5,205	26.4	4,190	26.4	4,190
SITE TOTAL			61,615		57,507		50,910

Table 4 - Detailed Site Emissions

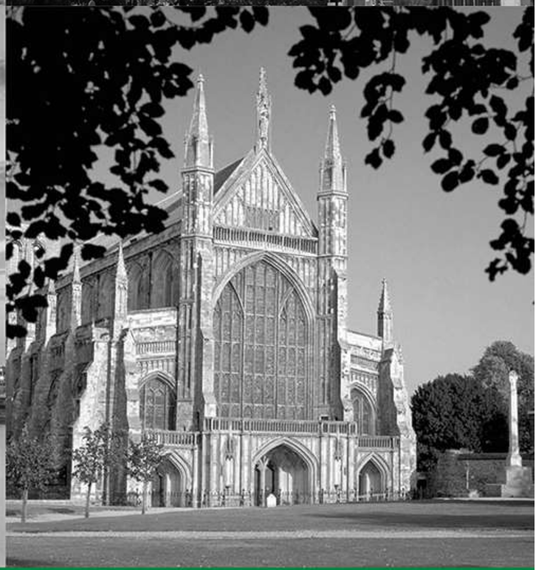
	TONNES CO2 PER ANNUM	%
Baseline (A)	382	
Savings from energy demand reduction	320	84%
Savings from heat network/CHP/ efficient services	4	1%
Savings from renewable energy	7	2%
Total Cumulative Savings	331	87%

Table 5 - Detailed Savings

8. APPENDIX A – BRUKL REPORTS





RIDGE

www.ridge.co.uk