CAMBRIDGE NORTH

ENERGY STRATEGY

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PREPARED BY

HOARE LEA

Energy Strategy

ENERGY STRATEGY
CAMBRIDGE NORTH

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ENERGY STRATEGY
CAMBRIDGE NORTH

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ENERGY STRATEGY
1. EXECUTIVE SUMMARY

Hilson Moran was appointed by Brookgate to provide an Energy Strategy to support the master plan hybrid planning application for the development at Cambridge North to support the site-wide masterplan for the Cambridge North hybrid planning application. This Energy Strategy should be read alongside the Energy Statement prepared by Hoare Lea which deals with the detailed elements of the scheme.

The development is located with South Cambridge, and the key driver is to promote a low carbon development, which optimises building fabric performance, and energy efficient design, before introducing low carbon and renewable technology. The masterplan at Cambridge North as a whole is targeting 10% through passive design, in the commercial and residential respectively and 31% improvement over Part L 2013 as a whole.

A hybrid planning application comprising;

1. An Outline Application with all matters reserved (except for access and landscaping) for the construction of three new residential buildings of four to eight storeys, providing flexible Class E and Class F uses on the ground floor, and two commercial buildings of five storeys for Use Classes E(g) i (offices), ii (research and development), providing flexible Class E and Class F uses on the ground floor, with associated car and cycle parking and infrastructure works; and

2. A Full Application for the construction of three commercial buildings of four and seven storeys for Use Classes E(g) i (offices), ii (research and development), providing flexible Class E and Class F uses on the ground floor, with associated car and cycle parking, a multi-storey car and cycle park and associated landscaping and infrastructure works.

This energy strategy supports both the outline and full elements of the application.

The development is a mix use development, that is located alongside Cambridge North Station. It includes, hotel, office, residential and retail.

This report supports the hybrid application with the following buildings forming part of the full application

S4 – Office

S6– Office Lab

S7 –Office Lab

Use	Block	Details
Residential	S11 -S21	425 units
Office Lab	SO4 (Office only)	17,311m² GIA
	S06	29,364m² GIA
	S07	11,345m² GIA
	S08	13,055m² GIA
	S09	24,080m² GIA
MSCP – Car Park	S05	20,584m² GIA

Table 1 - Master Plan Area Schedule

The energy strategy also supports the outline application for the residential and remaining buildings, at S8, S9 and the residential quarter. (Phasing Plan in Appendix).

The proposal has been developed in line with South Cambridgeshire planning policy, with consideration for the draft Greater Cambridge Plan.

Drivers

The development is CO2 emission targets are being driven by local policy, and the applicant, Brookgates desire for a highly sustainable development.

South Cambridge Local Plan 2018

- High energy efficient design
- 10% of energy reduction associated with low energy and renewable technology.

Targets

The development is targeting

- BREEAM Excellent for the commercial buildings with aspirations for a BREEAM outstanding
- All electric systems across the development.
- The development is aspiring to reduce the operational energy of the office and residential areas, and will undertaking operational energy workshops and energy models at the next stage of analysis.
- Meet Part L 2021 and look towards Future Homes and Buildings for the later phases.

Assessment Methodologies

The methodology of this Energy Strategy robustly follows the Energy Hierarchy, the proposed development is providing an all electric solution to provide a route to net zero by 2050:

- **Be Lean**: 10% savings in the commercial buildings, and in the residential. A wide range of passive and energy efficiency measures are incorporated in the design, including good levels of thermal insulation, high levels of building air tightness, good levels of internal daylight reducing reliance on artificial lighting, efficient artificial lighting and controls, as well as high efficiency building services that exceed Part L: 2021 requirements and reduce the overall CO_2 emissions of the scheme.
- **Be Clean**: Deemed unfeasible in the commercial, with design consideration for the residential development. The potential for connecting the development to an existing or planned heat network has been considered. There is currently no proposal to introduce a network at this stage into the commercial but all buildings will be designed with the capacity to connect to a network in the future.

ENERGY STRATEGY
1. EXECUTIVE SUMMARY

- The residential element will consider during the full planning application, if the use of a network to heat blocks is practical and will be economically feasible to future tenants.
- **Be Green**: Air Sour Heat Pumps and Photovoltaics proposed across the site. A detailed assessment of renewable energy opportunities and viability has been undertaken. This has determined that roof mounted photovoltaic (PV) arrays, providing renewable electricity, is a viable technology for integration into the scheme, as well as the use of air source heat pumps (ASHP) throughout the building for space heating and cooling, and hot water generation.
- **Be Seen**: Operational Energy Targets the client is keen to monitor, verify and report on energy performance once the buildings are occupied, to help understand their operation.

ENERGY STRATEGY
1. EXECUTIVE SUMMARY

The following massing identifies the proposed master plan for Cambridge North.

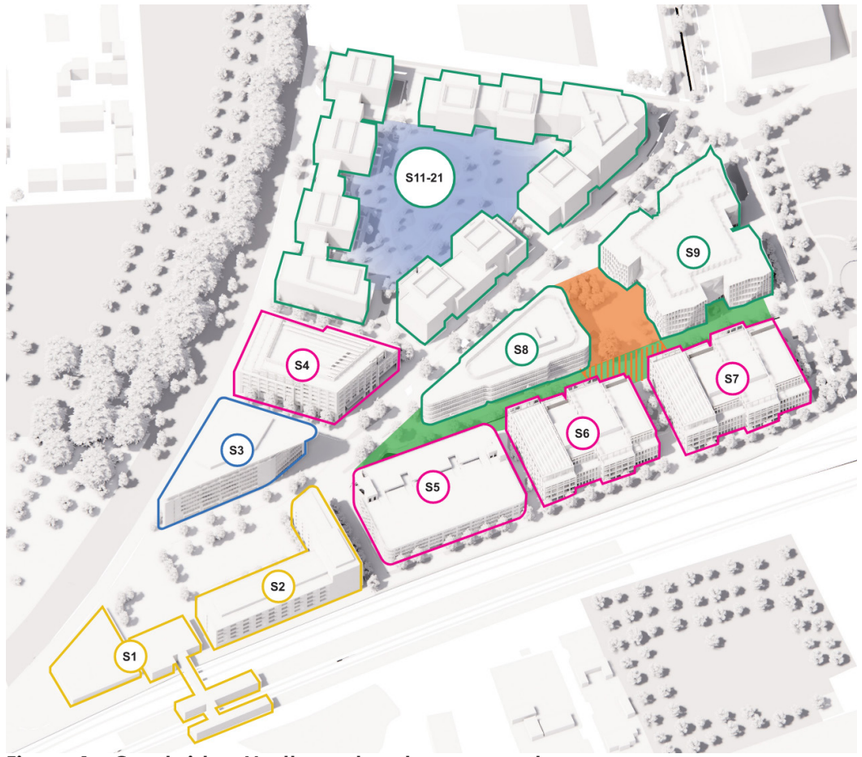


Figure 1 - Cambridge North master plan proposal

Part L (2021 edition)

Energy and CO_2 emissions performance have been estimated using the current Building regulation methodology against Part L: 2013 requirements. The assessment outputs have been converted for the SAP 10 emission factors. The development will be designed to meet both Part L 2013 and 2021. 2021 currently is still within a beta version.

Fuel type	Carbon factors (SAP 2012)	Carbon factors (SAP 10)	Carbon factors (SAP 10.1)
Natural Gas (kgCO^2e/kWh)	0.213	0.210	0.210
Electricity (kgCO^2e/kWh)	0.519	0.233	0.136

Table 2 - Proposed Carbon Factors

This strategy sets out the key measures and CO2 reductions identified as part of the application for each stage of the energy hierarchy. The performance of the domestic and non-domestic elements of the development in relation to the South Cambridgeshire carbon reduction targets for new buildings is as follows:

Use	Regulated carbon dioxide savings (%)
Domestic	30-35%
Non-domestic	40-42%

Table 3 - Master Plan Carbon Savings

The proposal has been developed in line with the South Cambridgeshire Local Plan (2018) , with consideration of the emerging draft North East Cambridge Area Action Plan (NEC AAP)

1.1. Phase 1 – Full Planning Application

The proposal indicates the potential results for Block S4, S5 and S6.

	Total regulated emissions (Tonnes CO^2 / year)	CO2 savings (Tonnes CO^2 / year)	Percentage savings (%)
Part L 2013 baseline	345		
Be lean	311	35	10%
Be clean	311	0	0
Be green	200	111	32%
Total Savings	-	146	42%

Table 4 - Full Planning Application Carbon Emissions

1.2. Outline Planning Application

1.2.1. Commercial

The remaining commercial buildings (S8 and S9) will target a similar approach to be lean, be clean and be green as the full planning application targeting a saving of 42% over Part L 2021 as a minimum, and an operational energy target of 55kW/m^2.

1.2.2. Residential

The residential development will be targeting between 30-35% better than Part L 2021.

	Percentage savings (%)
Part L 2013 baseline	
Be lean	15-25%
Be clean	0
Be green	15-10%
Total Savings	30-35%

Table 5 - Residential Element Carbon Savings

ENERGY STRATEGY
2. INTRODUCTION

This Energy Strategy has been prepared by Hilson Moran on behalf of Brookgate ('the Applicant'), in support of an application for hybrid planning permission for the redevelopment of Cambridge North ('the Site') within the South Cambridgeshire. The proposed master plan includes residential, office, and retail.

The description of development is as follows:

A hybrid planning application comprising;

- An Outline Application with all matters reserved (except for access and landscaping) for the construction of three new residential buildings of four to eight storeys, providing flexible Class E and Class F uses on the ground floor, and two commercial buildings of five storeys for Use Classes E(g) i (offices), ii (research and development), providing flexible Class E and Class F uses on the ground floor, with associated car and cycle parking and infrastructure works; and
- A Full Application for the construction of three commercial buildings of four and seven storeys for Use Classes E(g) i (offices), ii (research and development), providing flexible Class E and Class F uses on the ground floor, with associated car and cycle parking, a multi-storey car and cycle park and associated landscaping and infrastructure works.

Figure 1 - Site overview

Use	Block	Details
Residential	S11 -S21	425 units
	SO4	17,311m² GIA
	S06	29,364m² GIA
Office Lab	S07	11,345m² GIA
	S08	13,055m² GIA
	S09	24,080m² GIA
MSCP – Car Park	S05	20,584m² GIA

Table 6 - Development summary

2.1. Scope

This Energy Strategy will focus on relevant policies of the South Cambridgeshire Plan,

This document identifies drivers relating to an energy efficient design over and above minimum compliance of the whole development with current Building Regulations and other appropriate national and regional policies.

2.1.1. Certification

The project aims to redevelop Cambridge North to create an mixed-use development focused on wellness, flexibility, and environmental responsibility.

The key sustainability measures are driven by BREEAM,seeking a certification of Excellent aspiring towards outstanding. For this reason, a minimum EPRNC of 0.6 has been targeted for the site.

The development is also keen to look at operational energy in the commercial buildings, looking towards a NABERs score as the building progresses.

2.2. Methodology

The development is a hybrid application. We have provided an indicative figure around the emission savings we are targeting for the development as a whole. We have provided an overview of the target measures for the passive design and energy efficiency. We have provided more detail for those building being submitted under the full application.

A comprehensive energy and carbon dioxide (CO_2) emissions assessment has been carried out for the development in order to achieve a higher level of energy and CO_2 emissions performance than that required by the 2013 Building Regulations. This analysis has included:

- Consideration has been given to the incoming Part L (Volume 2) 2021 edition, which includes fabric thermal performance upgrades, improved minimum efficiencies for mechanical plant and lighting efficiencies. This energy strategy, however, has not used the new methodology to assess compliance with the new Part L and compliance is still based on Part L2a:2013.
- A hierarchical design approach to develop an energy strategy in line with industry best practice and South Cambridgeshire planning policy (Figure 4).
- A feasibility review of all low and zero carbon technologies, in relation to the 'Be Clean' and 'Be Green' elements of the Energy Hierarchy.
- Estimates have been provided in relation to the five Performance Indicator Groups (Contextual Data; Building Energy Use; Renewable Energy; Energy Storage Equipment; Plant Parameters; and Carbon Emissions) to prepare for post-construction energy monitoring, in line with the 'Be Seen' guidance.

ENERGY STRATEGY
2. INTRODUCTION

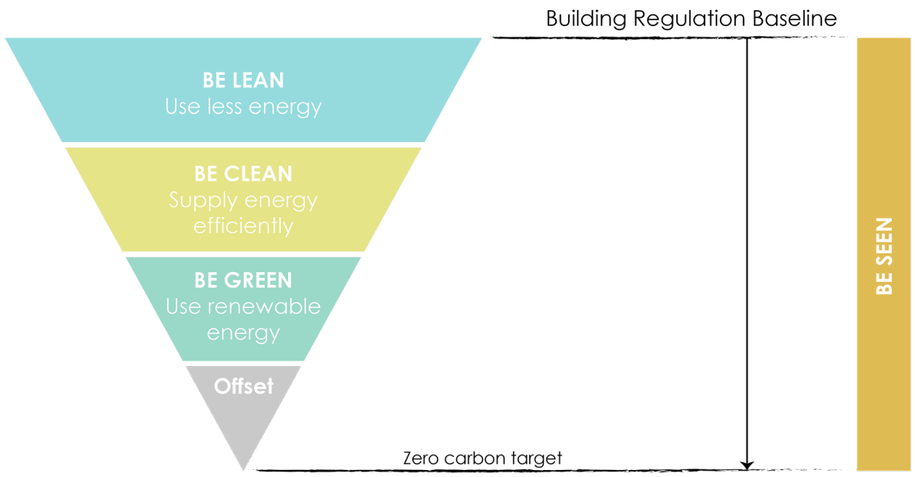


Figure 2 - Energy Hierarchy

2.3. Structure

The introductory section is followed by a review of national and local policies on CO_2 reduction and sustainability.

This is followed by a review of all available opportunities under each tier of the Energy Hierarchy.

An updated summary for the scheme is provided at the end of this document.

2.4. References

Where other documents are being submitted as part of a planning application, it may be appropriate to cross-reference these documents, provided cross-referencing is clear and the documents contain sufficient information to allow an assessment of the application. Cross-referenced documents may include the following:

- Design and Access Statement
- Sustainability statement
- BREEAM pre-assessment report
- Environmental Impact Assessment
- Air Quality Assessment (including an emissions/concentrations assessment)
- Energy Statement Hoare Lea

It will also be beneficial to reference generic guidance documents where appropriate, e.g. London Heat Network Manual.

2.5. Policy

The development is CO_2 emission targets are being driven by local policy, and the applicant, Brookgates desire for a highly sustainable development.

South Cambridge Local Plan 2018

- High energy efficient design
- 10% of energy reduction associated with low energy and renewable technology.

The Cambridge Local Plan 2018, also encourages the installation of zero emission technology, and a target of BREEAM Excellent. The Cambridge Local Plan also puts overheating and thermal comfort at the centre and encourages the use of renewable

More detailed explanation of Local Policy can be found in the appendix.

2.6. Report Author

This report has been prepared by Fiona Batha who is an energy and sustainability consultant with over 3 years of experience in preparing energy strategies. The author has substantial experience in providing passive design and energy efficiency advice to project teams to find cost effective ways of adding value to new developments and achieving challenging low carbon targets. Fiona is not professionally connected to a single low or zero carbon technology manufacture.

ENERGY STRATEGY
3. BE LEAN (DEMAND REDUCTION)

Within the first stage of the energy hierarchy, it was proposed to incorporate high levels of passive and energy efficient design measures to exceed the Building Regulations requirements (Part L 2013) through demand reduction measures alone.

Design recommendations were provided to the project architect and preliminary tests carried out enabling the development of a strategy from an early stage.

The table below summarises some of the viable 'Be lean' measures identified to reduce energy demand and as part of the design approach.

Efficiency measures	Commentary	
Site orientation	The site orientation was fixed based on existing footprint	×
Site layout optimization	The building's layout has been optimised to guarantee enough level of daylight.	✓
Enhanced U-value	Enhanced U-values for both opaque and transparent elements	✓
High performance glass	Solar control glazing within the façade, balancing passive solar control versus overheating and controlling thermal comfort on the commercial floors	✓
Glazing percentage of the building*	The glazing percentage of the buildings is 49.5% and seeks to achieve a balance between overheating/thermal comfort, ingress of daylight and heat losses/gains from the façade.	✓
Air-tightness improvement	Improved levels of air tightness	✓
Thermal bridging	Low thermal bridging applying DCLG Approved Construction Details and use of Ψ values calculated using the guidance set out in BR 497	✓
Thermal mass	A medium level of internal thermal mass surfaces	×
Solar shading	External shading created by balconies	×
Natural ventilation	Natural ventilation through openable windows	×
Lighting	Energy efficient lighting systems	✓
Lighting control	Presence detection on lighting controls in common areas	✓
Mechanical ventilation	Heat recovery integrated into ventilation systems in the residential units and common areas, where applicable	✓
SFP	Low energy, variable volume fans in common areas	✓
Cooling	High efficiency cooling plant for commercial spaces	✓

Table 7 - Proposed Energy efficiency measures

3.1. Passive Design

The fabric's thermal and air permeability performance level exceeds the Part L2a: 2013 minimum standards as well as Part L 2021 values; new Part L 2021 notional constructions have been assumed. The following tables outline the U-values of the external envelope for the opaque and transparent elements. Additionally, for the glazing, the light transmission has been maximised to increase the availability of natural light and reduce the use of artificial lighting. The glazing percentage of the building is 49.5% and seeks to achieve a balance between overheating/thermal comfort, ingress of daylight and heat losses/gains from the façade.

3.1.1. Residential

The residential development is being submitted as an outline application for 425 units. The passive measures below describe the indicative performance we will be targeting. We will be targeting a minimum of Part L 2021, and aspiring towards Future Homes standard.

Figure 3 - Master plan residential element

ENERGY STRATEGY
3. BE LEAN (DEMAND REDUCTION)

Opaque Fabric Performance	Site		
	Part L2A:2013 limiting factors	Part L 2021 limiting factors	Proposed performance
External wall	0.35	0.26	0.18
Glazing	2.20	1.60	1.2
Curtain Walling	-	-	Opaque 0.18 Glazing 1.3
Roof	0.25	0.18	0.13
Floor	0.25	0.18	0.13
Air Permeability	10 m^3/ ($h.m^2$) @50Pa.	8 m^3/ ($h.m^2$) @50Pa.	<5m^3/ ($h.m^2$) @50Pa.

Table 8 - Residential: Proposed fabric performance

External wall refers to any exposed wall or wall to an unheated space

Roof refers to the top roof of the building and any terrace/exposed ceiling

Floor refers to any ground/exposed floor or any floor above an unheated space or space heated in a different pattern.

Glass Performance	Site		
	Part L2A:2013 limiting factors	Part L 2021 limiting factors	Proposed performance
Centre pane U-value, (W/m^2K)	2.20	1.60	1.20-1.3
Frame U-value, (W/m^2K)			
Frame Percentage			10%
Light transmission	-	-	Min 70%
Solar transmittance (g-value)	-	-	~ 0.42

Table 9 - Residential: Proposed glazing performance

3.1.1.1. Active Design

High efficiency plant and equipment is specified to limit the energy consumed to provide the required and best practice indoor environment performance and control. Performance efficiency values were tested and improved in the SAP and dynamic thermal model to benchmark the resulting predicted carbon dioxide reduction.

The equipment efficiency measures include high efficiency artificial lighting with the following light power densities and controls:

3.1.1.2. Mechanical System Efficiencies

Use	System*	
Air Source *Heat Pump	Heating SCOP	3.5
	DHW SCOP	2.5
Ventilation	Mechanical Ventilation with heat recovery	SFP < 0.5W/l/s Heat recovery >73%
Lighting	LED Throughout	>45 lumens/ CW

*Be Lean modelling a Boiler for the purposes of the energy hierarchy.

Table 10 - Residential: Systems performance

3.1.1.3. Residential Element - Be Lean Savings

SAPs undertaken using Part L 2021 notional minimum values have indicated at the Be Lean stage the development will be targeting a saving of 15-25% over Part L 2013, using SAP 10 carbon factors.

	Total regulated emissions (Tonnes CO^2 / year)	CO2 savings (Tonnes CO^2 / year)	Percentage savings (%)
Part L 2013 baseline	128.7		
Be lean	95.2	33.5	26%
Total Savings	-	42.9	33%

Table 11 - Residential: Be Lean savings

ENERGY STRATEGY
3. BE LEAN (DEMAND REDUCTION)

3.1.2. Commercial

The proposed development is undertaking a hybrid application, building S4, S6 and S7 are being submitted for a full planning application, and the remaining commercial buildings are being submitted under a outline application. The following proposals for fabric performance are to be adopted as a minimum for all blocks.

Figure 4 - Master plan commercial element

3.1.2.1. Fabric Performance

Opaque Fabric Performance	Site		
	Part L2A:2013 limiting factors W/m²K	Part L 2021 limiting factors W/m²K	Proposed performance W/m²K
External wall	0.35	0.26	0.18
Glazing (average frame and glass)	2.20	1.60	1.30
Spandrel Panel - typical	-	-	0.60
Spandrel Panel – increased depth			
Roof	0.25	0.18	0.15
Floor	0.25	0.18	0.15
Air Permeability	10 m³/ (h.m²) @50Pa.	8 m³/ (h.m²) @50Pa.	3m³/ (h.m²) @50Pa.

Table 12 - Commercial: Proposed fabric performance

External wall refers to any exposed wall or wall to an unheated space
Roof refers to the top roof of the building and any terrace/exposed ceiling

Floor refers to any ground/exposed floor or any floor above an unheated space or space heated in a different pattern.

Glass Performance	Site		
	Part L2A:2013 limiting factors	Part L 2021 limiting factors	Proposed performance
Centre pane U-value (W/m²K)	2.20	1.60	1.30
Frame U-value (W/m²K)			
Light transmission	-	-	Min 60%
Solar transmittance (g-value)	-	-	0.3-0.36

Table 13 - Commercial: Proposed glazing performance

Thermal comfort analysis on the offices is being undertaken to confirm the glazing performance.

3.1.2.2. Lighting Performance

The lighting will be designed to have a low power density, with auto presence detection and daylight control where feasible. Lighting will be designed to minimise energy with high efficient lighting systems. This will be designed through the next phase of the design, and will form part of the operational energy strategy and Part L analysis.

ENERGY STRATEGY
3. BE LEAN (DEMAND REDUCTION)

The efficiency performance of mechanical system has been carefully assessed and selected to exceed Part L2A: 2013 and 2021 minimum compliance requirements, as detailed below. For the retail areas to be fitted out by tenants on the ground floor, figures from the non-domestic building services compliance guide.

3.1.2.3. Mechanical System Efficiencies

Use	System*	
Air Source Heat Pump	Heating SCOP	3.5
	Cooling SEER	4.5
	DHW SCOP	3.5

Table 14 - Commercial: Systems efficiencies

**Note at the be lean stage of the hierarchy a gas boiler is modelled.*

Further to the above specifications:

- A power factor correction (> 0.95) will be included to improve the electric stability and efficiency of the transmission network.
- Retail areas are shell and core and therefore reasonable assumptions have been made for minimum plant efficiencies, with reference to the Non-Domestic Building Services Compliance Guide.

3.2. Efficiency Targets

The strategy has targeted, a meaningful reduction during the Be Lean stage of the energy hierarchy, and a overall reduction in line with the BREEAM Excellent criteria.

3.3. Energy Demand

Following the energy efficiency measures, the total energy demand (in MWh/year) for each building use is reported in the table below.

Building use	Energy demand following energy efficiency measures (kWh/year)					
	Space Heating	Hot Water	Lighting	Auxiliary	Cooling	Unregulated electricity
Non-residential	1.45	23.42	11.08	7.92	31.11	57.17

Table 15 - Commercial: Total energy demand

3.4. Cooling and Overheating

3.4.1. The Cooling Hierarchy

The design was developed in line with the GLA's recommended 'Cooling Hierarchy' approach (Policy 5.9) which applies a similar principle to the thorough decision-making process of the 'Energy Hierarchy' applied specifically with the aim of reducing CO□ emissions from cooling:

Action	Measure
Minimising internal heat generation through energy efficient design	Heat gain from lighting is kept to a minimum as a result of an energy-efficient lighting design solution.
	The availability of natural light is maximised to discourage the use of artificial lighting by optimising the light transmittance of the glass elements of the façade.
	Heat gains from tenant equipment can be influenced by low energy recommendations provided in a Building User Guide for tenants.
Reduction of the amount of heat entering the building in summer	All commercial spaces comply with the Part L2A recommendation to limit solar gains.
	Office spaces were assessed using the CIBSE TM 52: 2014 'The Limits of Thermal Comfort: Avoiding Overheating in European buildings'
Management of the heat within the building through exposed thermal mass and high ceilings	Commercial shell and core spaces will be designed to enable lighting and building services solutions that allow for exposed thermal mass surfaces.
Passive ventilation	Windows have not been modelled as openable
Mechanical ventilation	The commercial spaces are assumed to be cooled by fan coil units with compliant backstop fan efficiencies.
	Cooling is assumed to be provided by air-cooled chillers via a variable refrigerant distribution system, therefore enabling a demand-led performance.
Active cooling	Cooling is delivered to the building by highly efficient air-cooled chillers with a seasonal energy efficiency rating (SEER) of 5.23

Table 16 - Commercial: Cooling hierarchy

3.4.2. Active Cooling

The table below shows how the cooling demand of the development. The proposed design reduces the actual cooling demand below the notional building for each of the non-domestic spaces where an active cooling load exists.

	Total area weighted non-domestic energy demand (MWh)
Cooling	156
Heating	208
Hot Water	192
Auxiliary	735
Unregulated	1,489

Table 17 - Commercial: Cooling demand

These numbers will be developed further during the next stage of design as more detailed models and design are developed.

ENERGY STRATEGY
4. THERMAL COMFORT AND OVERHEATING

4.1. Commercial Buildings

All commercial buildings will target both credits under BREEAM 2018 Hea 04. The buildings in phase 1 will undertake thermal comfort modelling during the next stage of design.

- All buildings will be assessed against 2020, 2050 and 2080 DSY1 H50 weather files.

Note the commercial buildings that are currently going for outline planning permission will also be developed and assessed to meet Hea 04 credits, using the above weather files.

4.2. Residential Overheating

The development is keen to comply not only to be compliant with Part O but undertake a full TM59 analysis on the residential element. The early stage of design has helped to support the development of the residential layouts and inform areas of glazing. During the next stage of design more detailed analysis will be undertaken on the residential developments to inform the future design, and support the full planning applications

The buildings will be assessed under 2020, 2050 and 2080 weather files.

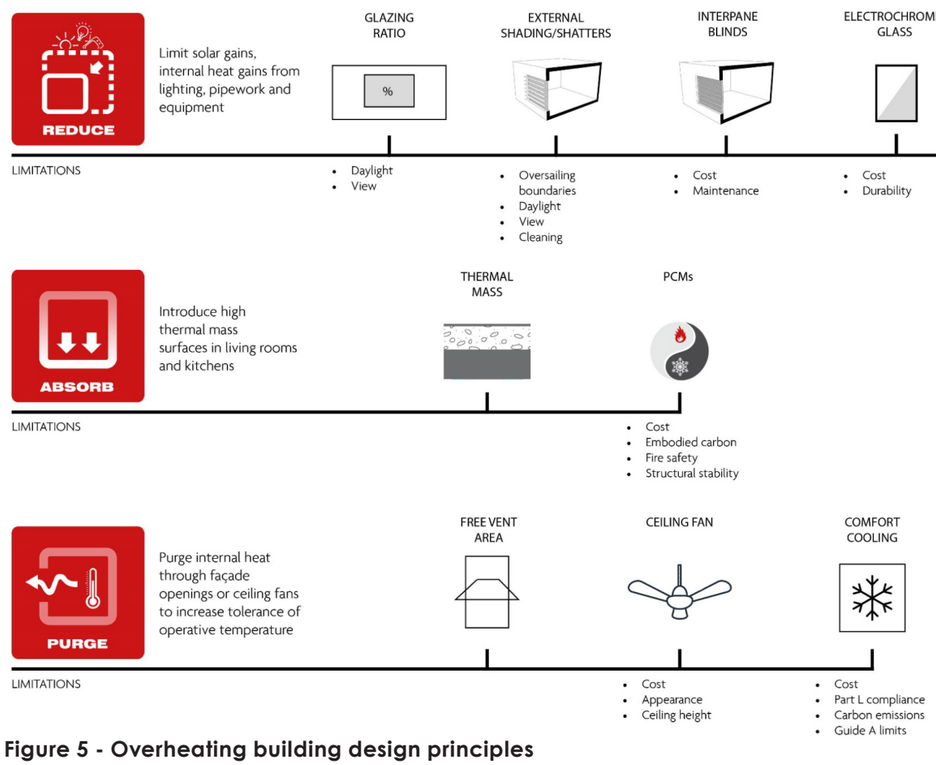


Figure 5 - Overheating building design principles

4.2.1. Weather Files

Initial analysis has been undertaken looking at future weather files using Cambridge DSY 2020, 2050 and 2080 Medium 50%.

4.2.2. Modelling Assumptions

FABRIC PROPERTIES (u-value)

Roof = 0.15 W/m²K

Wall = 0.15 W/m²K

Glazing = 1.4 W/m²K

GLAZING PROPERTIES

Window centre pane = 1.3 W/m²K

Window g-value = 0.42 (TBC in line with the Energy Strategy)

Light Transmittance = 0.7

Frame = 3.3 W/m²K

Frame percentage = 10%

WEATHER SCENARIO

Future Scenario = Cambridge (DSY 2050 Med 50%)

INTERNAL GAINS

Lighting = 2 W/m²*

Sensible = 75 W/m²*

Latent = 55 W/m²*

Communal corridor = no pipework.

Apartment = excluded at this stage (the apartments layout is optimised to avoid crossing bedrooms to reach bathroom and kitchen)

Figure 6 - Modelling assumptions

ENERGY STRATEGY
4. THERMAL COMFORT AND OVERHEATING

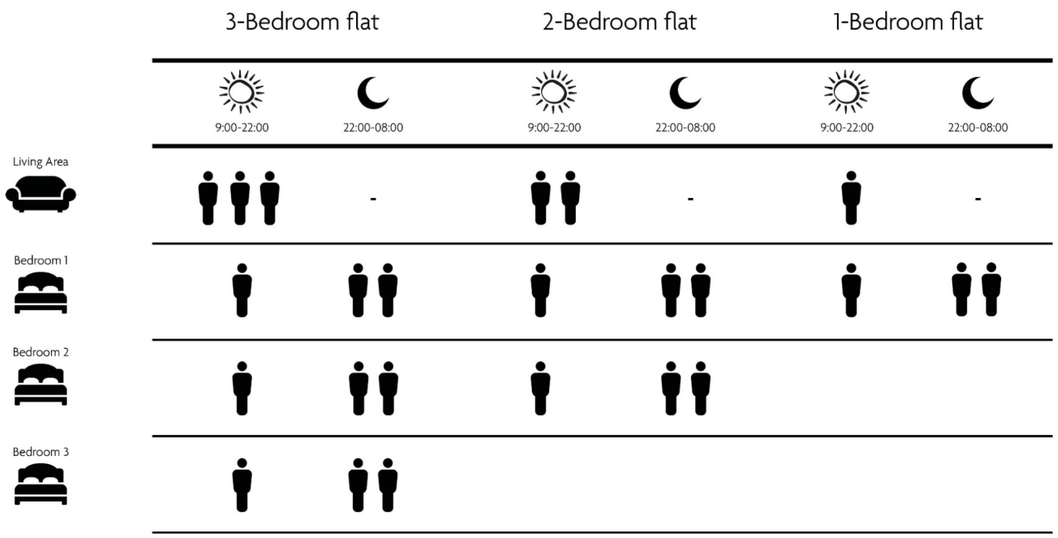


Figure 7 - Occupancy pattern

4.2.3. Results Summary

LIVING ROOMS

Key considerations	West facing rooms are exposed to sun at lower, direct angles. Glazing ratio and adequate airflow are critical to avoid the overheating risk. Balconies are advised be staggered to provide view of the sky and to not compromise daylight.	
Unit	**1 Bedroom (R6 -108)**	**2 Bedroom (R6 -105)**
Orientation	West	East
Recommended maximum glazing ratio (Window to wall area)	<60% (with semi-recessed balcony) <70% (with recessed balcony)	<75%
Recommended minimum free ventilation area	100%	>66%
Recommended minimum MVHR flow rate	25 l/s	25 l/s

Figure 8 - Living rooms results

BEDROOMS

Key considerations	Adequate airflow is critical to avoid the overheating risk. If a restrictor is applied to the window, the airflow is consistently reduced and side ventilation panels are recommended.	
Unit	**1 Bedroom (R6 -108)**	**2 Bedroom (R6 -105)**
Orientation	West	East
Recommended glazing ratio* (Window to wall area)	25%	25%
Recommended minimum free ventilation area (no restrictors)	>50%	>50%
Recommended minimum side vent area**	>0.3m²	>0.3m²
Recommended MVHR flow rate	21 l/s	21 l/s

*Glazing ratio below 25% might affect sufficient daylight levels

** If restrictors are installed

Figure 9 - Bedrooms results

4.3. Part O

The development will undertake TM59 analysis prior to full outline planning permission, as the layouts and full elevations for the development are produced.

The principles of the simplified method for meeting Building Regulations Part O – Overheating in Residential buildings will be followed where possible.

Orientation	Maximum Glazing Area (%)	Maximum glazing area in most glazed room (%)
North	18	37
East	18	37
South	15	30
West	11	22

Table 18 - Part O Table 1.1 Limiting solar gains for buildings with cross ventilation

ENERGY STRATEGY
5. BE CLEAN (OVERHEATING INFRASTRUCTURE)

In line with policy aspirations opportunities to supply energy efficiently and reduce CO_2 emissions have been investigated. The potential for the proposed development to connect to a district heating system have been reviewed for the scheme.

The has included

- Connecting to an existing heat network
- Installing CHP
- Providing an overall master plan network

5.1. Existing and Planned District Heating Networks

The potential for the proposed development to connect to a district heating system has been reviewed for the scheme. The conclusion highlighted that it was not considered feasible to currently install a site wide energy network.

5.1.1. Commercial Network

An early study was undertaken to understand if a commercial network could be incorporated into the design. It was considered unfeasible at this stage to connect the proposed energy systems to develop a network, due to how the future tenants were requesting stand- alone developments. The commercial units had a low heating demand and were dominated by the cooling load.

5.1.2. Residential Network

During the detailed design, the residential units will consider the opportunity to link the blocks together in a communal heating system. This will reduce the overall requirement for heat pumps.

This will be developed throughout the detailed planning application of the residential element of Cambridge North.

There are no existing DH systems in the vicinity of the site. It is however, approximately 650 m from the proposed South Bank Employers' Group (SBEG) District Heating Network and at the time of writing, the timescales and capacities for the Proposed District Heating Network are uncertain and plans for extending closer to the development site are not provided.

5.1.2.1. Low Temperature Heating

Industry Best Practice and CIBSE guidance has identified that the effective integration of CHP requires the plant to operate more than 4000 hours per annum, in order to realise emissions and running cost benefits.

The GLA indicates that CHP is not a viable option for developments with a simultaneous demand for heat and power of less than 5,000 hours per annum. Examples of buildings for which CHP could be viable include hotels, hospitals, university halls of residence, leisure centres, prisons and residential led mixed-use developments with more than 500 dwellings.

Due to the relatively low amount of heat required by the proposed land use and the impact on local air quality, an individual Combined Heat and Power system has been dismissed for the Proposed Development (see Appendix 4). Gas boilers were also dismissed due to air quality constraints.

The Development proposes an electric heating system to overcome air quality constraints and due to the predicted rapid decarbonisation of the electrical grid. The Department for Business, Energy & Industrial Strategy (BEIS) is predicting that the Grid Carbon Factor will be as low as approximately 70 grams CO_2e/kWh by 2035, less than a third of what it is now in SAP 10, 0.233.

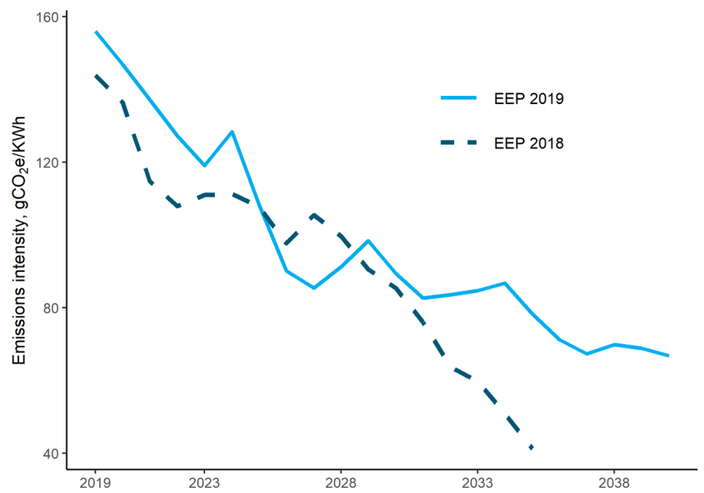


Figure 10 - 2018 and 2019 projection of the Grid Carbon Factor (GCF), published by BEIS[1]

The heat pump in heating mode is considered in the 'be green' step of the energy hierarchy covering both heating and Domestic Hot water requirements.

5.1.2.2. Air Quality

The use of all electric systems and not introducing CHP are in line with Cambridge Policy for all electric systems. The impacts of the development on local air quality have been considered during design. An air quality assessment has been prepared by Hilson Moran which should be consulted for more detailed information on air quality. No combustion on site is proposed and this is expected to help to limit the negative impacts of the development on local air quality.

[1] BEIS, Updated Energy and Emissions Projections 2019 (October 2020).

ENERGY STRATEGY
6. BE GREEN (RENEWABLE ENERGY)

All the currently available 'Be Green' or renewable technologies have been assessed in detail for viability within the built environment and for the development.

The following summary table sets out the complete list of potential renewable technologies along with their concluding viability at this design stage of the development. Further details of each technology and their associated assessment in relation to the development are provided in Appendix 1:

Energy Hierarchy	Design Approach/Technology	Viable?
Be Green	Photovoltaics	Yes. 20% of the roof area will be supporting PV.
	Solar thermal	No. Roof space is prioritised for PV panels due to the high electricity (and low Hot water) demands.
	Biofueled heating	No. Local urban constraints in relation to air quality and fuel delivery and storage makes biofuel heating an unviable option in this context
	Ground/Water source heat pump	Air source heat pumps are proposed, whose performance is slightly lower than ground source, but without the bore-hole costs.
	Aerothermal energy for heating	Yes. ASHP are providing the energy to the office.
	Wind power	No. There is considerable evidence of urban wind turbines failing to perform to manufacturer's output estimates. Significant planning and integration issues also exist and consequently wind turbines are not viable
	Hydro/ocean energy	No. Hydro/ocean energy is not appropriate for this urban development due to an absence of the resource.

Table 19 - Summary review of 'Be Green' measures

6.1. Phase 1 – Full Planning Application

The proposal indicates the potential results for Block S4, S5 and S6.

	Total regulated emissions (Tonnes CO^2 / year)	CO2 savings (Tonnes CO^2 / year)	Percentage savings (%)
Part L 2013 baseline	345		
Be lean	311	35	10%
Be clean	311	0	0
Be green	200	111	32%
Total Savings	-	146	42%

Table 20 - Full planning application carbon emissions

6.2. Outline Planning Application

6.2.1. Commercial

The remaining commercial buildings will target a similar approach to be lean, be clean and be green as the full planning application targeting a saving of 42% over Part L 2021 as a minimum, and an operational energy target of 55W/m^2

6.2.2. Residential

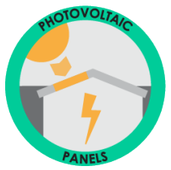
The residential development will be targeting between 30-35% better than Part L 2021.

	Percentage savings (%)
Part L 2013 baseline	-
Be lean	15-25%
Be clean	0
Be green	15-10%
Total Savings	30-35%%

Table 21 - Domestic element carbon emissions reduction

ENERGY STRATEGY
6. BE GREEN (RENEWABLE ENERGY)

6.3. Photovoltaics (PV)



Photovoltaic cells directly convert sunlight into electrical current using semi-conductors. The output of a cell is directly proportional to the intensity of the light received by the active surface of the cell. Exposure to sunlight causes electricity to flow through the cells. Direct sunlight produces the greatest output, but power is produced even when overcast.

Discussion	Commentary
Local planning Criteria	Roof mounted PV panels, particularly angled arrays, must not exceed the maximum design envelope imposed on the development. Safe access around the panels and to another roof plant should be maintained.
Feasibility of exporting energy from the system	TBC
Available grants and subsidies	Smart Export Guarantee scheme (availability depends on electricity supplier) *
Microgeneration certification Scheme (MCS)	Yes
Reasons for excluding this technology	Not excluded

*The 'Smart Export Guarantee (SEG)' scheme has replaced the Feed in tariff, as a means of compensating building owners for installing local renewable energy generating systems. Unlike the FIT, the tariff is decided by the building's energy supplier, and might not be available at all. Since office and retail buildings have high electricity demands, it has been assumed that all the generated electricity will be used onsite, and hence the SEG tariff is not relevant, and not factored into the payback calculations.

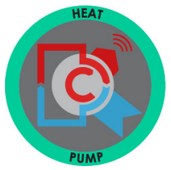
Table 22 - Feasibility of PV

Performance Summary	Value	Unit
Approximate total net area of active PV	360	m^2
System size	TBC	kWp
Performance per unit	TBC	kWh/kWp
Estimated electricity generation	180	MWh/annum Across S4, S6, S7
Total CO_2 emissions reduction	41.9	Tonnes CO_2/annum S4, S6 & S7
Total CO_2 emissions reduction	TBC	% CO_2 of regulated scheme emissions

Table 23 - PV performance summary

Are PVs recommended?	Yes

6.4. Aerothermal Energy for Heating (Heat Pumps)



Using ambient air as a thermal resource for a heat pump can provide lower emissions heating, although typically the highest heating loads occur when the outside ambient air temperature, and subsequent heat pump efficiency, is at their lowest. Rejected heat from typical non-domestic buildings are traditionally used for pre-heating of incoming air within a simpler heat recovery system.

Additionally, recovered heat cannot be truly classed as 'renewable' by relevant guidance including BSRIA Guidance BG 1/2008 and EU Directive 2009/28/EC.

Discussion	Commentary
Local planning Criteria	Where viable, heat pumps are relatively quiet in operation and are typically contained within plant spaces without any significant impact on the local environment.
Feasibility of exporting energy from the system	The waste heat when cooling during mid-season and winter will be used to heat other elements of the building
Available grants and subsidies	N/A

Table 24 - Feasibility of ASHP

Performance Summary	Value	Unit
System size	Sized for individually	kW
Seasonal Coefficient of Performance (SCOP)	3.5	
Seasonal Energy Efficiency Ratio (SEER)	4.5	
DHW SCOP	3.5	
Total CO_2 emissions reduction		Tonnes CO_2/annum
Percentage CO_2 emissions reduction		% CO_2 of regulated scheme emissions

Table 25 - ASHP performance summary

Are ASHPs recommended?	Yes

ENERGY STRATEGY
7. FLEXIBILITY AND PEAK ENERGY DEMAND

The flexibility of the peak energy demand has been considered.

Flexibility and Peak Energy Demand	Value
Smart Buildings	The development is currently undertaking a feasibility study into smart buildings. This study will highlight the smart elements to be incorporated into the design. This will consider landlord and tenant, and security systems.
Renewable Technology	The development has incorporated PV panels as noted in the Be Green session.
District Heat Networks	Not currently applicable
Electric Vehicle Charging	TBC
BMS/ EMS	The development will include a Building Management System and Environmental Management System. The data will be available to occupants and buildings owners remotely.
Metering	Suppliers will be able to obtain consumption through secure remote communication. Metering points will be compliant with relevant pattern approval and measuring instrument directive (MID) standards for fiscal billing. An open protocol that allows devices to be connected without having to use proprietary systems.
Detailed Design Calculations	These will be undertaken post planning including, revisiting factors of safety applied to sizing the equipment.

Flexibility achieved through		Value
Electrical Energy Storage Capacity	No	
Heat Energy Storage	Yes	Heat pumps are being installed within the development with the potential to connect into a wider heat network in the future.
Renewable Energy Generation	Yes	PV is being installed
Smart System Integration	Potential	A feasibility study is being undertaken
Electric Vehicle Charging	Yes	TBC.
Other initiative	No	

ENERGY STRATEGY
8. SUMMARY

This Energy Statement has assessed all opportunities under the 'Energy Hierarchy' in order to target the overall reduction of CO_2 emissions, in compliance with relevant policy and guidance detailed in section 2. All viable measures for the development and their CO_2 emissions reduction contribution are summarised in the following table:

Energy Hierarchy	Design Approach /Technology	Notes	Commercial % Regulated CO_2 Reduction	Residential % Regulated CO_2 Reduction
Baseline	The outline design of the scheme has been optimised for energy and CO_2 emissions performance across all stages of the best practice 'Energy Hierarchy'. These identified measures and associated levels of CO_2 emissions reduction (estimated via dynamic thermal modelling) will be used to inform the detailed design of the evolving scheme.		-	
Be Lean	Optimised glazing/facade	A key passive measure in the design has been the departure from a typical fully glazed façade solution. The glazing solution with various spandrel sizes depending on façade orientation allows for better daylight performance, reduced lighting load, enhanced thermal comfort and reduced heating load.	**10%**	**15-25%**
	Lighting	High light transmittance glazing in façade; Energy efficient lighting systems; Photocell control dimming in office perimeter areas. Presence detection on lighting controls in common areas.		
	HVAC plant	Mechanical ventilation with heat recovery Air Source Heat Pumps for heating, cooling and DHW with heat recovery Variable speed air handling units with efficient fan powers High efficiency central air-cooled chillers provide cooling		
Be Clean	None	No schemes proposed currently	**0%**	**10-15%**
Be Green	Heat Pumps PV Panels	Water to water source heat pumps will be specified in conjunction with the air Source Heat pump design A roof mounted PV array of 214 panels is currently proposed for the scheme High-efficiency air source heat pumps with heat recovery during mid-season will be applied across the scheme.	**32%**	
Total Energy Hierarchy			**Up to 42%**	**Up to 35%**