RIDGE

BICESTER MOTION – EXPERIENCE QUARTER
ENERGY AND SUSTAINABILITY
DESIGN STRATEGY
18 December 2020

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MOTION

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1. SUSTAINABLE DESIGN STRATEGY

Environmental responsibility and a sustainable design strategy are core considerations in construction projects. In the development any project, the design needs to facilitate occupant comfort whilst not being detrimental to the environment and ultimately be cost effective in operation. These three key components are integral to the success of any project. This document outlines the core design principles considered for the Bicester Motion Experience Quarter.

The document presented below outlines the preliminary low carbon design philosophy followed to develop an energy strategy for the proposed Experience Quarter of the Masterplan based on the relevant policies of Cherwell Local Plan. The following policies have been carefully considered and implemented to both deliver sustainable development and comply with local requirements.

1.1. Planning

Four sections of the Cherwell Local Plan pertain to the Experience Quarter. These have been extracted and presented below:

ESD 1: Mitigating and Adapting to Climate Change

"Measures will be taken to mitigate the impact of development within the District on climate change. At a strategic level, this will include:

- Designing developments to reduce carbon emissions and use resources more efficiently.
- Promoting the use of decentralised and renewable or low carbon energy where appropriate.

The incorporation of suitable adaptation measures in new development to ensure that development is more resilient to climate change impacts will include consideration of the following:

- Demonstration of design approaches that are resilient to climate change impacts including the use of passive solar design for heating and cooling".

ESD 2: Energy Hierarchy & Allowable solutions

"In seeking to achieve carbon emissions reductions, we will promote an energy hierarchy as follows:

- Reducing energy use using sustainable design and construction measures.
- Supplying energy efficiently and giving priority to de-centralised energy supply.
- Making use of renewable energy
- Making use of allowable solutions".

ESD 3: Sustainable Construction

"All new non-residential development will be expected to meet at least "BREEAM Very Good" with immediate effect, subject to review over the plan period to ensure the target remains relevant. The demonstration of the achievement of this standard should be set out in the Energy Statement.

All development proposals will be encouraged to reflect high quality design and high environmental standards, demonstrating sustainable construction methods including but not limited to:

- Minimising both energy demand and energy loss.
- Maximising passive solar lighting and natural ventilation".

ESD 4: Decentralised Energy Systems

"A feasibility assessment for District Heating / Combined Heat and Power, including consideration of biomass fuelled CHP, will be required for:
- All applications for non-domestic developments above 1000m² floorspace".

1.2. CO_2 and energy reduction through Energy Hierarchy

Bicester Motion has instructed Ridge and Partners to provide an early design stage energy advice for the Experience Quarter of their proposed Masterplan development. To reduce energy consumption and develop a sustainable and holistic strategy for the site design, Ridge has developed an approach following the Lean, Clean and Green methodology outlined in the London Plan[1]. The London plan is considered a leading piece of guidance which historically has been adopted throughout the country by local councils to minimise carbon emissions is a measured and strategic manor.

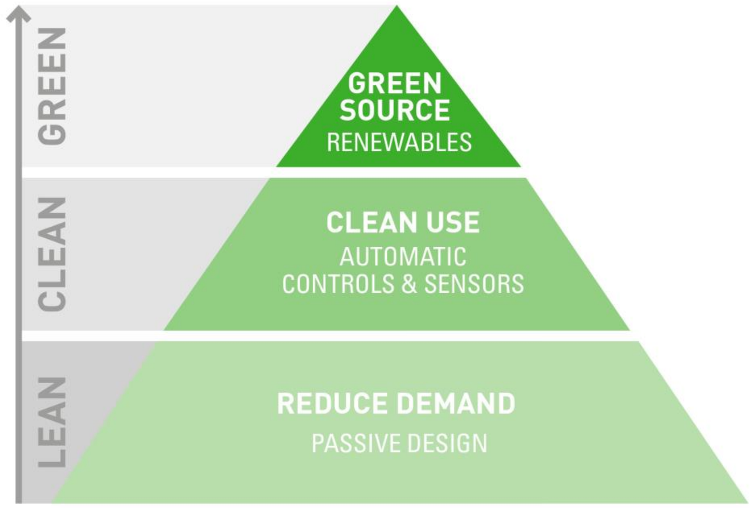

Figure 1 - Energy Hierarchy [Source: GLA London Plan]

This approach follows a three-step process to a sustainable design;

Lean

Reduce the energy requirement of the building through passive design measures.

Clean

Improve the efficiency of fixed building services to provide the required energy as efficiently as possible.

Green

If suitable or required, support the remaining energy demands through low and zero carbon technologies (LZCTs).

The report presented below covered the following:

- Energy strategy methodology.
- Recommended design measures.
- Energy demand assessment.
- Low and Zero Carbon technology feasibility study.
- Conclusions and summary of recommendations.

[1] https://www.london.gov.uk/sites/default/files/the_london_plan_2016_jan_2017_fix.pdf

1.3. Estimated Energy Usage

To allow an accurate feasibility study to be conducted, it is important to understand the building's annual energy consumption. The table below shows our initial estimate of annual energy consumption based on an example of how the Experience Quarter may come forward. This is based on benchmark energy consumption data published in the BSRIA Rules of Thumb, 5th Edition;

Space Usage and Area	Area (m^2)	Benchmark Energy Use per m²		Experience Quarter Estimated Annual Energy Use	
		Electricity (kWh/m²yr)	Thermal (kWh/m²yr)	Electricity (kW.h/yr)	Thermal (kW.h/m²)
1 - Building	2,088	76	157	159,210	328,860
2 - Building	3,958	76	157	301,798	623,385
3 - Building	3,034	76	157	231,343	477,855
4 - Building	1,930	76	157	147,163	303,975
5 - Building	1,716	76	157	130,845	270,270
6 - Building	846	76	157	64,508	133,245
7 - Building	916	76	157	69,845	144,270
8 - Building	2,870	76	157	218,838	452,025
9 - Building	4,980	76	157	379,725	784,350
10 - Building	423	76	157	32,254	66,623
11 - Building	423	76	157	32,254	66,623
12 - Building	423	76	157	32,254	66,623
13 - Building	423	76	157	32,254	66,623
Totals:				1,832,288	3,784,725

Estimated Annual energy consumption

This analysis assumes that the buildings is built to average construction standards and with typical usages as highlighted above. This our starting point for consideration.

It can be seen above that it is predicted that the highest energy consumer for this part of the Masterplan will be from space heating at around **3.8 mWh**. Please note that these values and loads are dependent on the building types set out above. If these changes, the predicted energy usage (which is based on building type) will also change.

By focussing on the fabric first, the high energy consumption that is predicted for this area can be reduced before super-efficient heating options are explored.

2. ENERGY STRATEGY METHODOLOGY

This section presents a buildings first approach to reduce the energy demand of the Experience Quarter, with an effort to highlight those design measures that are best suited for the zone, the buildings, and Bicester Motion. The implications in relation to Part L 2013 (Approved document L2A) of the Building Regulations is explored, with reference to the technical and functional feasibility of various energy efficiency measures. Figure 2 illustrates the building and environmental considerations evaluated at this stage to develop the proposed energy strategy.

The low carbon design should be considered and implemented where applicable during the detailed design development of all buildings proposed on the Experience Quarter of the master plan at Bicester Motion.

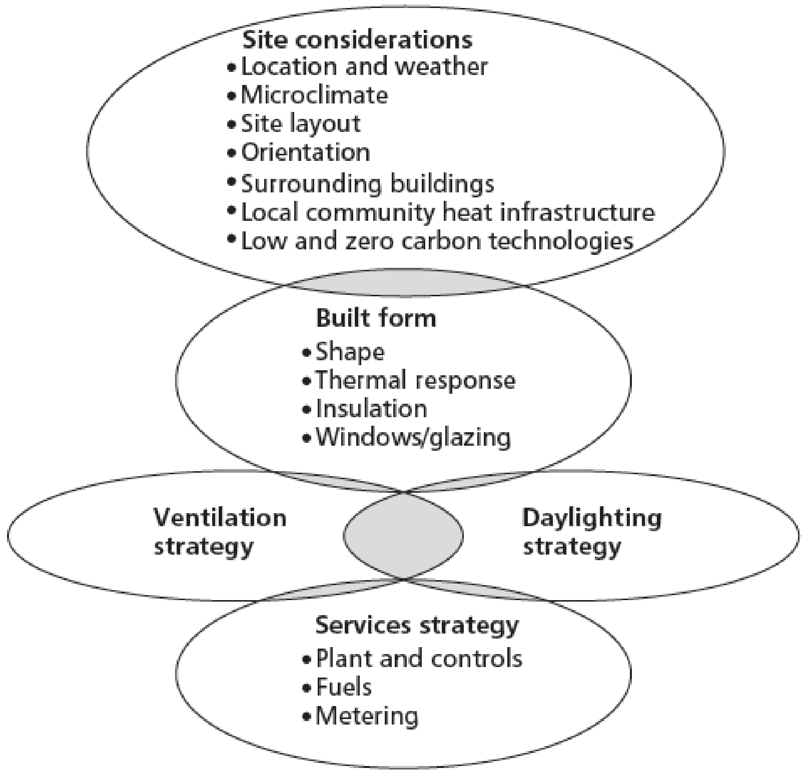

Figure 2 – CIBSE Guide F – Concept Design [Source: CIBSE Guide F 2012]

2.1. Lean Measures

Passive design measures help to reduce the future energy consumption of the building by optimising the building form, position and construction. The following passive measures have been considered and proposed for the Experience Quarter:

- Building Layout/ Form
- Building Orientation
- Reducing Heating Demand
- Natural Day Lighting

Building layout and form

Designers are to consider the building layout and form. Figure 3 below illustrates the key layout and form principles directly related to energy use and potential to naturally ventilate the buildings.

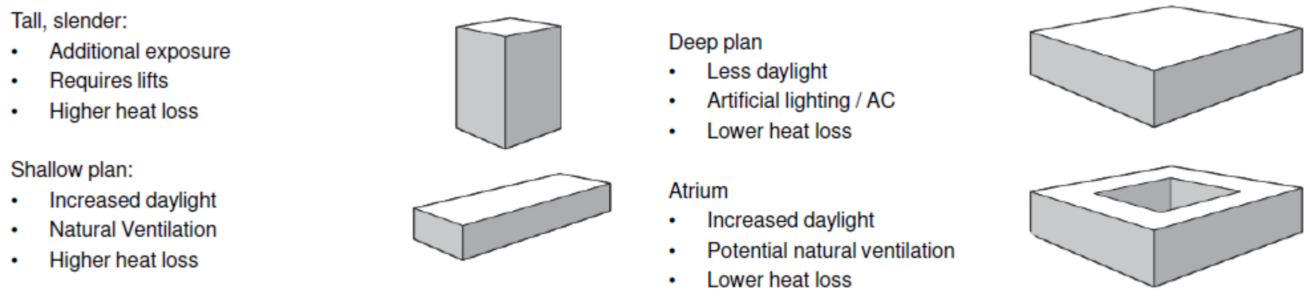

Figure 3 - Build form low carbon design considerations (From CIBSE Guide F 2012)

Orientation

Adequate orientation would enable buildings to either utilise useful energy from the sun or shelter the building from the sun's negative effects (i.e. overheating). The sun path analysis in Figure 4 illustrates the seasonal effects that a building could experience. Designers are encouraged to carefully consider each building's orientation to minimise unwanted solar gain whilst also providing adequate natural light.

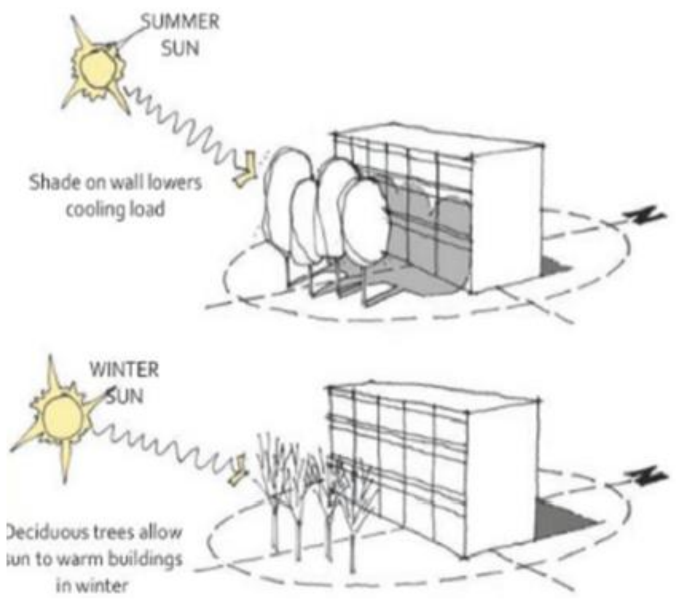

Figure 4 – Orientation principles (From CIBSE Guide F 2012)

Reducing Heating Demand

The largest predicted energy usage of the building will be the heating demand. To help reduce this requirement, it is proposed that reduced material U-values and air permeability are developed based on the Part L limits stated below.

BUILDING ELEMENT	PART L MINIMUM REQUIREMENT
External Walls	0.35 W/m²K
Ground Floor	0.25 W/m²K
Roof	0.25 W/m²K
External Glazing	2.2 W/m²K
Roof Lights	2.2 W/m²K
Doors (People/ Vehicle Access)	2.2/1.5 W/m²K
Air Permeability	10.0 m³/h.m² at 50 Pa

Targeted building fabric performance

Natural Daylighting

To help avoid high levels of artificial lighting use, the buildings should prioritise natural daylight wherever possible. This can take the form of windows and roof lights positioned to maximise their daylight potential.

Increasing daylight into the building also allows more solar heat gains into the building. For this reason, the solar transmittance of all glazing units (G-value) needs to be carefully considered to help reduce overheating risk. The following are being explored at this stage.

ELEMENT	U-VALUE	G-VALUE
Glazed elements facing Southeast and Southwest	1.60 W/m²K	0.4
Glazed elements facing Northeast and Northwest	1.60 W/m²K	0.6

Targeted glazing performance

2.2. Clean Measures

After reducing the demand of energy through passive design principles, the next step is to evaluate the active design principles. This focusses on meeting the reduced demand through the most energy efficient mechanical and electrical services. The following active design measures are under consideration:

- Automatic controls to optimise natural ventilation.
- Improved lighting design efficiency – LED Lighting
- Included natural daylight photoelectric sensing controls.
- Occupant sensing to control absence automatically.
- Occupant sensing for the toilet extract ventilation system.
- Improved heat recovery efficiency on mechanical ventilation.
- Incorporated variable speed motors on fixed building services.
- Incorporated improved system efficiencies for the space heating and domestic hot water services.

District Heating Options

District Heating (DH) is a system that provides heating from a central location to several outlets (buildings) through a network of insulated pipes. Due to the centralised nature of the system, the DH network benefits from efficiencies of scale and limits plant related nuisances such as noise to a single area. The layout of the Experience Quarter with a cluster of mixed use-buildings to the west and the trackside pavilions to the east enables the opportunity for a DH system to be explored, the suitability and appropriateness of this will be subject to a further study when the development plan and building occupiers and known.

Consideration has been made for potential district heating technologies which are presented to the right. The table highlights the rough CO_2 benefit and cost associated with each technology.

HEAT GENERATION	CO2 BENEFIT	COST
Condensing [Natural Gas] Fired Boilers	Low	Low
Mixture of Boilers and CHP	Medium	Medium
Heat Pump Preheated – Gas Boiler Top UP	High	High
▪ Air Source Heat Pump		
▪ Ground Source Heat Pump		
▪ Water Source Heat Pump		
Biomass Boilers [Gas Boiler Backup]	High	High
Biomass CHP [Gas Boiler Backup]	High	High

Figure 5 - District Heating Comparison

Special considerations:

- Heating will vary by zone depending on building type and use and separate heating plant zones can be tailored to suit that need.
- Diversity
- Ground surveys will still be required but will not need to be extensive.
- Localised distribution pipe network may not be very extensive.
- Heat generation technologies
  - Natural gas condensing boilers.
  - Natural gas fired CHP.
  - Heat pumps.
  - Suitability in consideration of development phasing and building ownership.

Non-District Heating Options

Should district heating not be feasible for the Experience Quarter, typical heating methods are suitable. At this stage, the heating technologies available do not vary greatly from the DH heating technologies outlined above and the pros and cons remain largely the same. As stated above, by providing each building with its own heating system there will be a loss of floor lettable area and there will not be the efficiencies of scale benefit. Even with these drawbacks, local heating systems may be a more efficient means of heating the proposed buildings as the design develops.

At this stage, the following heating options are under consideration. These have been broken down by building type and potential area type as usage has a significant effect on heating suitability.

BUILDING TYPE	ROOM TYPE	SUITABILITY OF TECHNOLOGY			
		Condensing Boilers (Gas)	Radiant Heaters (Gas)	Heat Pumps (Electric)	ELECTRIC RESISTANCE
Trackside Pavilions	Retail	✓		✓	
	Workshop		✓		
	Office	✓		✓	✓
	Ancillary Spaces	✓		✓	✓
Experience Quarter	Office	✓		✓	✓
	Retail	✓		✓	
	Ancillary Spaces	✓		✓	✓

As electricity is currently a less carbon intensive method for heating, it is recommended that heating technologies that are electrically based be selected where feasible. The suitability of technologies outlined above will change as the design develops so no technology should be taken off the table or selected until a more detailed design is available.

2.3. Green Measures

The Lean and Clean measures outlined above help to reduce the overall energy consumption of the buildings. The remaining energy demand should be met as efficiently as possible. The following assessment reviews the available LZC technologies against the anticipated building energy demands. This places a high priority on the technologies that can support the heating requirement of the building.

Heat Pumps

At this stage, two types of heat pumps are under consideration as potential systems at this location: air source and ground source. Air source systems could work well with the decentralised nature of the zone with separate units serving each building. Ground source heat pumps could also work in a zonal district heating option but will require a land use assessment as the technology needs significant ground contact to collect heat.

Solar Air

Solar air collectors are also under consideration as a potential system for these buildings as they are likely to have an exposed south façade which could be capable of heating air to deliver to the conditioned space. Care should be taken however with regards to shading from adjacent plantings and the internal layouts of the buildings and should be reassessed as the design develops.

Photo Voltaic (PV) Panels

Photovoltaic panels are under consideration as a potential technology for this zone, especially when paired with a heat pump. The roof space available on most of these buildings is suitably oriented with sufficient space to put PV panels, but careful consideration needs to be given as it is in close proximity to an airfield and glare on incoming planes is a concern.

Renewable energy technologies excluded at this point include;

Combined Heat and Power (CHP) System

CHP has been discounted as a potential option for this building because there is not a consistent heating demand in the building. At this point this technology is under consideration.

Wind Turbines

Based on the masterplan layout and all zones being within relative proximity to the aviation area, wind turbines have been deemed unfeasible for the site.

LZC Conclusion

The above section outlines the feasible renewable energy options for the Experience Quarter. As the design develops, the feasibility of the proposed technologies may change, and other technologies may be able to deliver more efficient lower carbon heat. It is recommended that as work on the Experience Quarter continues, this feasibility study be revisited to make sure that it is still meeting the requirements of Bicester Motion and utilizing the best technology to serve that requirement.

3. CONCLUSIONS AND RECOMMENDATIONS

To adhere to the overarching energy efficient and sustainable objectives of this development, this report has highlighted a series of design considerations to minimise energy use and carbon emissions on site. A Lean, Clean, Green methodology was adopted and from this the following recommendations were derived:

Lean

Minimise energy loss through the building envelope by targeting high fabric thermal performances, consider the inclusion of thermally massive building components, careful consideration of the buildings form and layout and determining the optimal building orientation.

Clean

Local district heating is being considered at this stage with an aim to serve several buildings off a central system. Additionally, efficient controls and plant equipment have been proposed.

Green

The low and zero carbon feasibility study has highlighted appropriate technologies being considered for the Experience Quarter based on predicted energy use, location, and proximity to resources. From this study it was determined that ASHPs are a suitable technology for the proposal at the time of writing. It should be mentioned that as the design changes, the feasibility of the ASHPs to deliver all the heating may change and as such, other technologies or a mixture of technologies may be better suited for the situation.

The recommendations highlighted in this report aim to deliver a low carbon energy efficient development that follows the clients design requirements whilst not causing undue harm to the natural world and environment. Please note that at this early stage, the recommendations in this report cannot and should not be set as mandatory but rather viewed as guidance to achieve a low energy and low carbon development.

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