mansfield bowling club

energy report - january 2015

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issue information...

CURRENT ISSUE

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contents...

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OBJECTIVE

This report has been prepared on behalf of Generator Group to provide a commentary on energy performance and Carbon emission reductions for the proposed development at Mansfield Bowling Club, explaining how principles incorporated in the design contribute to ensuring energy performance is optimised.

The report intends to demonstrate that the London Borough of Camden and the Greater London Authority's Planning Policies, relevant to energy and Carbon emissions, have been addressed in a structured and comprehensive manner by the proposals in the Planning Application. The energy strategy for the development has been developed in line with the expectations of the London Plan. Relevant policy background is reviewed in **appendix a.**

PROJECT BACKGROUND

The proposals comprise the redevelopment of the indoor bowling club to provide 21 residential homes through a combination of houses and flats. In addition, a community tennis club will be retained and improved and publicly accessible open space will be provided.

Architects Indicative Plan of the Proposed Mansfield Bowling Club Redevelopment

ENERGY STRATEGY

Methodology

A thorough review has been undertaken of the energy technology options for the site to ensure the most appropriate energy strategy is implemented. This energy strategy has been developed in accordance with the requirements of the London Plan and specifically the GLA Energy Team's Guidance Note 'Guidance on Preparing Energy Assessments April 2014'.

Accordingly, the Mayor's Energy Hierarchy (Use Less Energy - 'Be Lean', Supply Energy Efficiently - 'Be Clean' and Use Renewable Energy - 'Be Green') has been applied to energy considerations for the site, starting with a robust 'baseline' energy demand assessment.

Baseline Energy Demand Assessment

Before energy efficiency measures are investigated, it is important to establish the baseline energy consumption of the scheme, for comparison and evaluation of energy proposals for the proposed redevelopment.

The dwellings at Mansfield Bowling Club must comply with the requirements of the Building Regulations Part L1A 2013 'Conservation of fuel and power in new dwellings'.

The Standard Assessment Procedure (SAP) 2012 has been used to assess anticipated energy consumption and Carbon emissions of the proposed dwellings. Full SAP calculations have been carried out for a representative sample and the results have been averaged.

The required case against which to assess potential Carbon savings of the development is the Target Emission Rate (TER). This is based on a notional building that will form the Part L Building Regulations baseline.

Appropriate 'unregulated' loads have also been incorporated within the assessment.

Energy Hierarchy Step 1 - 'Be Lean' - Reduce Energy Demand

The first step in pursuing an energy efficient and low-carbon design under the Energy Hierarchy is to minimise the development's energy demand. This is achieved both by passive measures and the introduction of more energy efficient plant and services.

The services strategy at 'Be Lean' stage for the dwellings consists of: mechanical ventilation with heat recovery (MVHR), individual gas boilers to provide heating (via underfloor for the private units and radiators for the affordable), DHW with a cylinder in the dwelling and energy efficient lighting throughout the development.

Further details of the SAP calculation parameters are given in **appendix b.**

Energy Hierarchy Step 2 - 'Be Clean' - Supply Energy Efficiently

In line with the London Plan requirements for Decentralised Energy: Heating, Cooling and Power, the opportunity to extend the scheme beyond the site boundary to adjacent areas has been considered. However, it was found that there are no available distribution networks near to the site.

Following the hierarchy, the use of a community heating system using gas-fired CHP has been considered, but, although there is a year-round hot water demand, it is not enough for a technically viable and economically sensible CHP installation. This is because community heating with CHP lends itself to medium to large-scale developments, which have a large heating and hot water demand. The total annual heat demand for the dwellings is low and would not provide a sufficient base load to allow a CHP unit to operate efficiently.

Energy Hierarchy Step 3 - 'Be Green' - Renewable Energy

The Renewables Toolkit published by the London Energy Partnership has been used to provide a robust methodology for the selection and sizing of renewable energy technologies, as shown in **appendix c**. The technologies reviewed were biomass heating, biomass CHP, combined heat & power, air and ground source heat pumps, photovoltaics, solar thermal panels and wind power.

For each viable technology, a review of its' performance with respect to payback, land use, local planning criteria, noise, feasibility of exporting heat/ electricity from the system and life cycle cost/impact has been undertaken.

From the analysis set out in **appendix c**, it is clear that the most appropriate renewable energy technology for integration on the site is photovoltaic (PV) panels.

It is proposed to allocate roof space in the affordable element, for an approximate effective PV area of 80 m^2, with the panels positioned horizontally, to provide an approximate output of ≥ 9,200 kWh/year. In the private element an effective PV area of approximately 120 m^2, with the panels in the same position will provide an approximate output of ≥ 13,900 kWh/year.

COMMENTARY

The cumulative effect of the final measures implemented in accordance with the GLA's energy hierarchy achieve a total carbon emissions reduction of **26.15%** below the Target Emission Rate (TER) in accordance with Building Regulations Part L 2013.

Compliance with the new Target Fabric Energy Efficiency requirements set in the new Building Regulations 2013 Part L1A is exceeded by 3.19%, proving that the energy demand of the dwellings has been minimised through the use of optimised building fabric.

This overall reduction demonstrates a significant commitment towards reducing the Carbon emissions of the development through the incorporation of passive measures, efficient services and PV.

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SUMMARY TABLES - CARBON EMISSIONS AT END OF 'BE GREEN' STAGE

	Carbon Dioxide Emissions		
	Regulated	Unregulated	Total
Building Regulations Part L 2013 Baseline	45,675	80,255	125,930
Be Lean	45,611	80,255	125,866
Be Clean	45,611	80,255	125,866
Be Green	33,733	80,255	113,987

Carbon Dioxide Emissions after each stage of the Energy Hierarchy

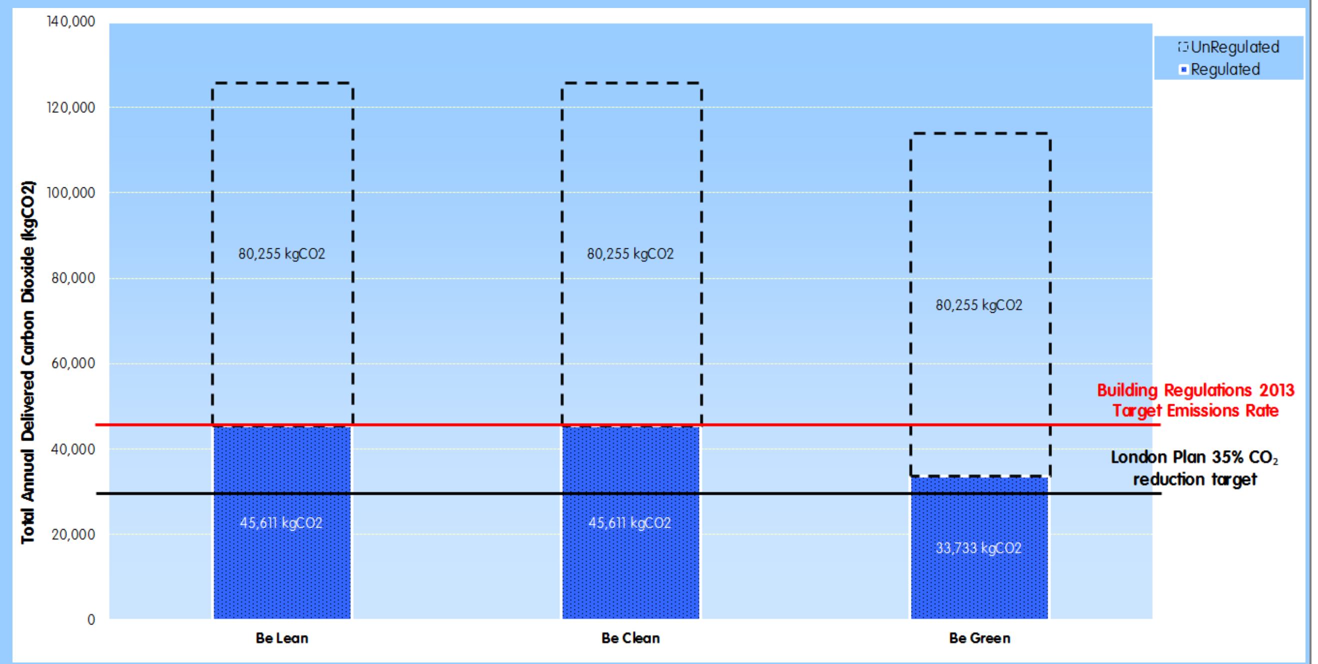
		Carbon Dioxide Savings			
		Kg CO_2 / year		%	
		Regulated	Total	Regulated	Total
Be Lean	**Savings from Demand Energy Reduction**	64	64	0.14%	0.05%
Be Clean	**Savings from CHP/Community heating/Cooling**	0	0	0.00%	0.00%
Be Green	**Savings from Renewable Energy**	11,878	11,878	26.04%	9.44%
	Total Cumulative Savings	**11,942**	**11,942**	**26.15%**	**9.48%**

Carbon Dioxide Emissions savings from each stage of the Energy Hierarchy

This is a total saving of **11,942 kgCO_2/year** (**26.15%** of regulated emissions) under the Target Emission Rate (TER).

The graph opposite indicates the progressive reduction of carbon emissions at each stage of the Energy Hierarchy.

SUMMARY GRAPH - CARBON EMISSIONS AT END OF 'BE GREEN' STAGE



The Energy Hierarchy applied at Mansfield Bowling Club

executive summary…

1.0 project background…

SITE BACKGROUND

This document has been prepared to review the energy issues associated with the proposed redevelopment of the site known as Mansfield Bowling Club, Croftdown Road, London NW5 1EP. The site local planning authority is the London Borough of Camden.

LOCATION

The surrounding area consists of primarily residential dwellings which are well screened by established landscaping and shrubbery. Specifically, the boundaries of the site sit adjacent to the rear gardens of properties on Croftdown Road, Regency Lawn, Dartmouth Park Avenue, Laurier Road and York Rise.

'The site is accessed via Croftdown Road and has a Public Transport Accessibility Level rating of 3. (moderate) although neighbouring properties have a PTAL rating of 4. The nearest underground station is Tufnell Park, located approximately 750m away.

Aerial View of the Existing Site

Site Location Map

1.0 project background…

…sustainable building services solutions

EXISTING MANSFIELD BOWLING CLUB SITE DESCRIPTION

The application site comprises a vacant indoor bowling facility which consisted of a six rink indoor bowling green, part 2/part 3 storey clubhouse with associated changing rooms and function room (Class D2).

Two ancillary residential flats (Class C3) are also accommodated in the building. The remainder of the site is made up of associated car parking and hardstanding for the aforementioned vacant building, areas of open space, an outdoor bowling green, two tennis courts and associated clubhouse, and a small allotment area.

The existing site area is approximately 0.85 hectares (ha) or 8,500 square metres.

Photograph of the Existing Mansfield Bowling Clubhouse

PROPOSED MANSFIELD BOWLING CLUB DEVELOPMENT DESCRIPTION

The application is formally for the Creation of a new publicly accessible open space; enhanced tennis facilities including the reconfiguration and extension of the courts to provide an additional court and increased playing area to accord with LTA requirements; the provision of a new ancillary pavilion (Class D2) to replace existing ancillary buildings and structures providing community and leisure space; a new community garden; and the demolition and replacement of the existing bowling club building with a new part three storey, part 2 storey building providing 21 residential dwellings (Class C3) with associated access, parking and landscaping.'

Architects Indicative View of the Proposed Mansfield Bowling Club Redevelopment

1.0 project background…

2.0 energy strategy…

ENERGY STRATEGY

General Methodology

The energy strategy for Mansfield Bowling Club has been produced following guidance from the London Borough of Camden and meets the requirements of the London Plan (and specifically the GLA Energy Team's guidance note 'Guidance on Preparing Energy Assessments April 2014'). After establishing the baseline energy demand and profile for the site, the strategy for the project follows the Mayor's Energy Hierarchy (Use Less Energy - 'Be Lean', Supply Energy Efficiently - 'Be Clean' and Use Renewable Energy - 'Be Green') in appraising appropriate measures to reduce Carbon emissions and other climate impacts from the development.

Policies within Chapter 5 of the London Plan (July 2011) set out the relevant design and climate change adaptation policies for such strategies, and establish expectations for applicant's commitments in terms of CO_2 savings and measures proposed. For non-referable applications, Boroughs are encouraged to apply the same standards and it is understood that this is the expectation of the London Borough of Camden.

Within the London Plan, the energy hierarchy defines a strategy that firstly requires the baseline energy use of the proposed scheme to be established and then applies potential energy measures within the structure of the 'Energy Hierarchy'. The stages of the hierarchy are defined as follows:

Energy Hierarchy Stage	Typical Measures to be Investigated
Use Less Energy - 'Be Lean'	Reduce use through behaviour change. Incorporate passive heating and cooling and reduce cooling loads via the 'Cooling Hierarchy'. Install Energy Efficient lighting and appliances.
Supply Energy Efficiently - 'Be Clean'	Use Combined Heat and Power (CHP/CCHP). Use existing heating and cooling networks. Facilitate future use of proposed community heating and cooling networks. Use site-wide heating networks.
Use Renewable Energy - 'Be Green'	Install renewable energy technologies on site. Import renewable energy from off-site.

The following sections of the report provide more details on each of the steps of the Energy Strategy following the London Plan's Energy Hierarchy.

2.0 energy strategy…

BASELINE ENERGY ASSESSMENT

Objective

Before energy efficiency measures are investigated, it is important to establish the baseline energy consumption of the scheme, for comparison and evaluation of energy proposals of the development.

The dwellings at Mansfield Bowling Club must comply with the requirements of the Building Regulations Part L1A 2013 'Conservation of fuel and power in new dwellings'.

Scope

All energy uses, not just the conventional building services loads (lighting, heating, cooling and ventilation), have been considered in the establishment of the energy profile. This also includes energy loads associated with the operation of the site, to ensure the optimal selection of a building services strategy and any renewable energy technology.

The following 'regulated' energy uses are considered in the baseline energy analysis:

- Space heating
- Water heating
- Cooling
- Fans and pumps
- Lighting

The regulated energy uses can be established using the robust and well-established methodology of Part L of the Building Regulations. However, energy and Carbon emissions calculated for Part L do not consider all energy demands and omit assessment of:

- Appliances
- Cooking
- External lighting

APPROACH AT MANSFIELD BOWLING CLUB

OVERVIEW

The Standard Assessment Procedure (SAP) 2012 has been used to assess anticipated energy consumption and Carbon emissions of the proposed dwellings. Full SAP calculations have been carried out for a representative sample and the results have been averaged.

REGULATED LOADS - TARGET EMISSION RATE (TER)

The required case against which to assess potential Carbon savings of the development is the Target Emission Rate (TER). This is based on a notional building that will form the Part L Building Regulations baseline.

The notional building has been assessed using a Department of Communities and Local Government approved calculation tool in accordance with the National Calculation Methodology (NCM) and its Modelling Guide. The notional building is created automatically by the same size shape, function and operating hours as the actual building, but set parameters for building fabric standards and plant efficiencies.

UNREGULATED LOADS

As the majority of the unregulated loads arise from the use of the building by the incoming residential tenants, the developer has limited scope to reduce the associated energy consumption and CO_2 emissions.

Emissions associated with non-regulated loads for the dwellings (i.e. cooking and appliances) have been calculated using the methodology set out in SAP Section 16. This figure is used throughout the analysis.

Unregulated emissions associated with external lighting have also been included in the assessment.

2.0 energy strategy…

BE LEAN

Objective

The first step in pursuing an energy efficient and low-carbon design under the Energy Hierarchy is to minimise the development's energy demand. This is achieved both by passive measures and the introduction of more energy efficient plant and services. Any measures achieved at this stage will reduce the extent of measures or size of plant needed to address the subsequent 'be clean' and 'be green' stages.

In addition to satisfying the need to minimise Carbon emissions, the building services strategy has been developed to respond to the following drivers for the project:

- maximising the potential of the building to satisfy market expectations (balancing of scope of works with value to create the optimal specification)
- achieving environmental comfort condition and occupant well-being, buildability, and avoiding unnecessary costs of construction
- achieving appropriate sustainability targets.

Methodology

In establishing the proposed energy strategy and services strategy for the development, the requirement to minimise energy consumption through available building fabric and building services measures has been considered a priority.

As part of this assessment the London Plan's 'Cooling Hierarchy' has been considered in the design process, to reduce or eliminate (where possible) the extent and installed capacity of cooling plant.

Building Services Strategy for the 'Be Lean' Assessment

REGULATED LOADS - BUILDING FABRIC

Passive measures have been maximised through the introduction of enhanced building fabric, including the incorporation of triple glazing in the private element. The thermal properties of all the building elements are to meet the requirements set in the Building Regulations Part L1A 2013.

BUILDING SERVICES STRATEGY

The services strategy at 'Be Lean' stage for the dwellings consists of: mechanical ventilation with heat recovery (MVHR), individual gas boilers to provide heating (via underfloor for the private units and radiators for the affordable) and DHW with a cylinder in dwelling and energy efficient lighting.

Further details of the SAP calculation parameters are given in **appendix b**.

UNREGULATED LOADS

The non-regulated loads have been calculated a per the baseline assessment. This figure is used throughout the analysis.

Cooling Hierarchy

The design of the development has followed the 'cooling hierarchy' set out in the London Plan, incorporating the following design and technology features:

MINIMISE INTERNAL HEAT GAINS THROUGH EFFICIENT LIGHTING DESIGN

Improved lighting efficiency means less of the energy required for lighting is wasted as heat. It is proposed to incorporate 100% energy efficient lighting with an efficiency of over 45 lamp lumens per circuit-watt for all the apartments.

REDUCE SOLAR GAINS THROUGH OPTIMISED DESIGN

Windows, glass doors, panels and skylights play a crucial role in admitting heat and light, and can have a significant impact on energy consumption. Windows will be specified to get the most benefit from winter sun while avoiding overheating in summer and heat loss in winter.

Overheating will be minimised through good passive design. Solar glazing will be provided to South elevation to prevent overheating and to adapt to climate change impacts on predicted raising temperatures. Internal blinds are also to be incorporated.

EFFICIENT NATURAL VENTILATION DESIGN

Mechanical Ventilation with Heat Recovery (MVHR) will ensure adequate ventilation rates and openable windows will be provided to allow effective purge ventilation.

2.0 energy strategy…

BE CLEAN

Objective

The next step in the Energy Hierarchy is the 'Be Clean' strategy of supplying the required heating and hot water using shared infrastructure, after all possible passive energy efficiency measures have been incorporated.

Scope

Potential approaches include connecting the scheme to existing CHP-led district energy networks, or if no existing schemes exist, investigating whether such networks are planned in the area and designing systems with the flexibility to connect to these in the future.

Opportunities to provide a communal heating system across buildings/uses within a multiple building scheme should also be pursued. With or without a communal system, the feasibility of CHP (combined heat and power) including the provision of cooling using the CHP waste heat should be reviewed.

Community Networks

Reference has been made to the London Heat Map to review the potential for connecting the scheme to an existing district energy network. On the basis of this review, it is not feasible to connect community heating and/or cooling networks in the vicinity of the site, however the site may be targeted in the future for local heat networks.

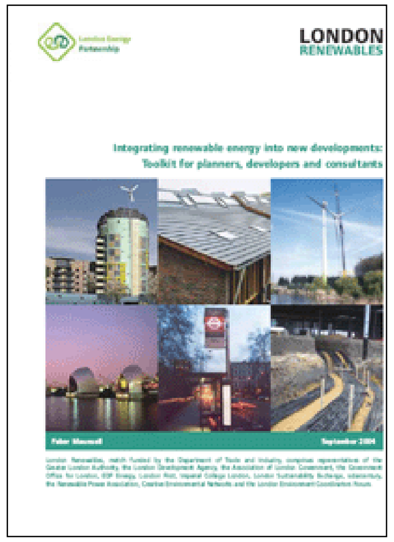
Image from London Heat Map

Community Heating

In line with the London Plan requirements for decentralised energy: heating, cooling and power, the opportunity to extend the scheme beyond the site boundary to adjacent areas has been considered. However, it was found that there are no available distribution networks near to the site.

Following the hierarchy, the use of a community heating system using gas-fired CHP has been considered but although there is a year-round hot water demand, it is not enough for a technically viable and economically sensible CHP installation. This is because community heating with CHP lends itself to medium to large-scale developments, which have a large heating and hot water demand. The total annual heat demand for the dwellings is low and would not provide a sufficient base load to allow a CHP unit to operate efficiently.

BE GREEN



Objective

The third and final stage of the energy hierarchy - 'Be Green' is addressed by reviewing the potential of a range of renewable energy systems to serve the energy requirements of the site and thereby offset CO_2 emissions.

Methodology

This assessment has been undertaken using the methods laid out in the London Energy Partnership's 'Integrating renewable energy into new developments: Toolkit for planners, developers and consultants' - the 'Renewables Toolkit' 2004.

Whereas some cost and yield figures for certain technologies set out in the Toolkit are considered outdated, the general principles set out remain applicable and the calculation methodologies for predicting system outputs are robust.

The Renewables Toolkit provides a method of evaluating Carbon savings from particular renewables technologies at the outline planning stage, before specific system sizing is possible.

For certain systems, such as air source heat pumps, the plant sizing and calculation of Carbon emission reduction are 'design-led' i.e. the system is sized to meet a proportion of the predicted demand in the building.

For other systems such as photovoltaics or wind turbines, the system sizing is discretionary, i.e. the size is at discretion of the developer and is otherwise limited only by system specific characteristics such as available turbine sizes and the availability of a suitable location. For these systems, a standard provision based on the area of the site has been used.

Technologies Considered

The following renewable energy technologies have been considered for application at the site as they were the technologies identified in the (former) London Plan policy 4A.7 (2008) as being potentially technically feasible (at the building level) for projects in London.

- Wind Power
- Photovoltaics
- Solar Water heating
- Air-Source Heat Pumps
- Ground Source Heating
- Biomass Heating

For each of these technologies, a commentary is provided in **appendix c** on the nature of the systems, their potential yield and compatibility with the building form, location and uses, including their compatibility with the 'be lean' measures already implemented in the first steps of the energy hierarchy.

Detailed Review

Please refer to **appendix c** for a detailed review of the potential to incorporate renewable energy measures into the scheme.

Conclusion

From the analysis set out in **appendix c**, it is clear that the most appropriate renewable energy technology for integration on the site is photovoltaic (PV) panels.

It is proposed to allocate roof space in the **affordable element**, for an approximate effective PV area of 80 m^2, with the panels positioned horizontally, to provide an approximate output of $\geq$ 9,200 kWh/year. In the **private element** an effective PV area of approximately 120 m^2, with the panels in the same position will provide an approximate output of $\geq$ 13,900 kWh/year.

Roof area for the PV location is to be shown in the architectural drawings.

2.0 energy strategy . . .

2.0 energy strategy…

SUMMARY ENERGY STATEMENT

The cumulative effect of the final measures implemented in accordance with the GLA's energy hierarchy achieve a total CO_2 emissions reduction of **26.15%** below the Target Emission Rate (TER) in accordance with Building Regulations Part L 2013.

Compliance with the new Target Fabric Energy Efficiency set in the new Building Regulations 2013 Part L1A is achieved by 3.19%, proving that the energy demand of the dwellings has been minimised through the use of optimised building fabric.

This overall reduction demonstrates a significant commitment towards reducing Carbon emissions for the development through the incorporation of passive measures, efficient services and PV.

Further details of the SAP calculation parameters are given in **appendix b**.

Overall Summary Tables

		Carbon Dioxide Emissions kg CO_2 /year		
		Regulated	**Unregulated**	**Total**
Building Regulations Part L 2013 Compliant Development		45,675	80,255	125,930
Be Lean	After Energy Demand Reduction	45,611	80,255	125,866
Be Clean	After CHP/Comm. Heating/Cooling	45,611	80,255	125,866
Be Green	After Renewable Energy Systems	33,733	80,255	113,987

Carbon Dioxide Emissions after each stage of the Energy Hierarchy

		Carbon Dioxide Savings kg CO_2 / year		**Carbon Dioxide Savings** %	
Stage	**Savings From**	**Regulated**	**Total**	**Regulated**	**Total**
Be Lean	Energy Demand Reduction	64	64	0.14%	0.05%
Be Clean	CHP/Community Heating/Cooling	0	0	0.00%	0.00%
Be Green	Renewable Energy Systems	11,878	11,878	26.04%	9.44%
Total	Total Cumulative Savings on 'Be Lean'	**11,942**	**11,942**	**26.15%**	**9.48%**

Carbon Dioxide Emissions savings from each stage of the Energy Hierarchy

This is a total saving of **11,942 kgCO_2/year** (**26.15%** of regulated emissions) under the Target Emission Rate (TER).

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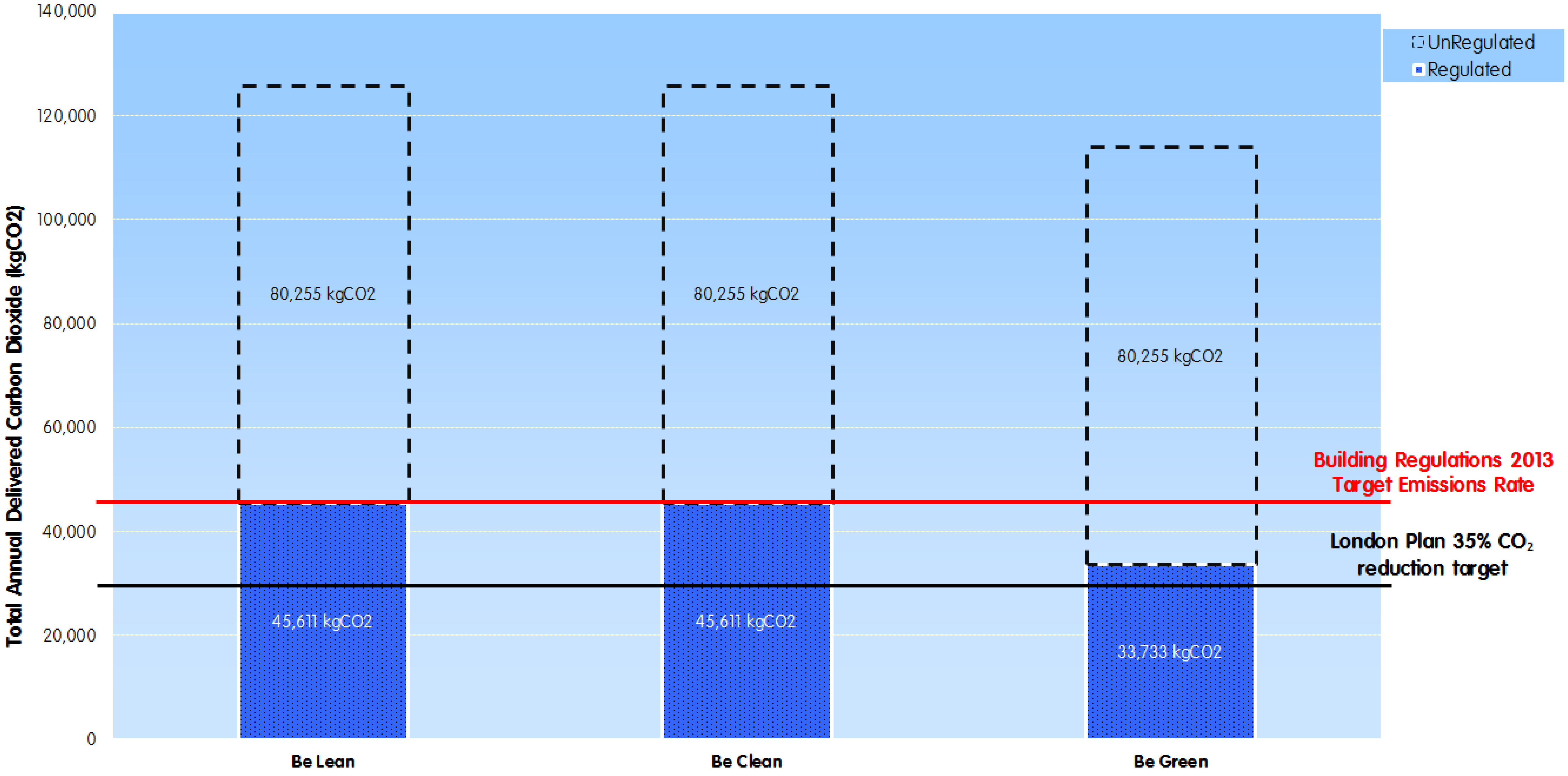
OVERALL SUMMARY GRAPH – THE ENERGY HIERARCHY APPLIED AT MANSFIELD BOWLING CLUB



OVERVIEW

Objective

The following section of this document provides background and commentary on the national, regional and local planning policy issues relevant to this project with respect to energy and sustainability.

Key Guidance for Mansfield Bowling Club

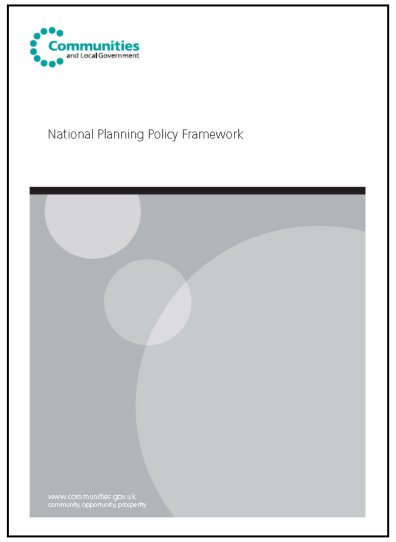
In compiling this report, consideration has been given to the latest applicable standards of sustainable design in the Borough of Camden as set out in the following documents:

- The London Plan: Spatial Development Strategy for Greater London (2011)
- London Borough of Camden's CPG3 – Sustainability.
- DP22 – Promoting Sustainable Design and Construction.
- CS13 – Tackling Climate Change through Promoting Higher Environmental Standards.

All aspects of the development have been designed to exceed the requirements of the Building Regulations Part L 2013.

In addition to the standards, targets and policies discussed above, the relevant British Standards; and CIBSE Guidelines have used to assist in determining the most appropriate building services strategy for the development.

NATIONAL POLICY



Published in March 2012, the National Planning Policy Framework (NPPF) sets out the Government planning policies for England and how these are expected to be applied. The NPPF has since replaced all Planning Policy Statements and Planning Policy Guidance notes.

It sets out the Government's requirements for the planning system only to the extent that it is relevant, proportionate and necessary to do so. It provides a framework within which local people and their Councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

The key section of the NPPF relevant to Mansfield Bowling Club is Core Planning Principle: **10. Meeting the Challenge of Climate Change, Flooding and Coastal Change**

Planning plays a key role in helping shape places to secure radical reductions in greenhouse gas emissions, minimising vulnerability and providing resilience to the impacts of climate change, and supporting the delivery of renewable and low Carbon energy and associated infrastructure. This is central to the economic, social and environmental dimensions of sustainable development.

Local planning authorities should adopt proactive strategies to mitigate and adapt to climate change, taking full account of flood risk, coastal change and water supply and demand considerations.

To support the move to a low Carbon future, local planning authorities should:

- plan for new development in locations and ways which reduce greenhouse gas emissions;
- actively support energy efficiency improvements to existing buildings; and
- when setting any local requirement for a building's sustainability, do so in a way consistent with the Government's zero Carbon buildings policy and adopt nationally described standards.

In determining planning applications, local planning authorities should expect new development to:

- Comply with adopted Local Plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

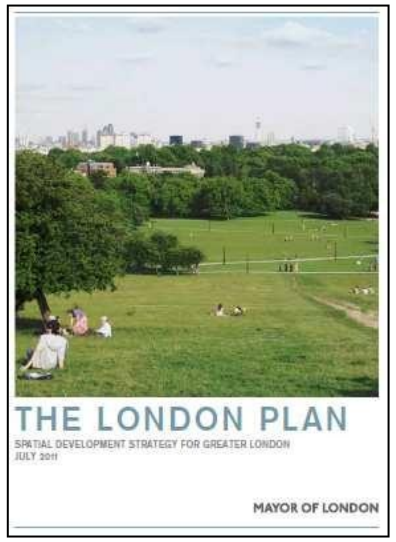
appendix a - policy background…

REGIONAL POLICY

Background

Regional Spatial Strategies (RSS) provide the statutory framework for sustainable development in the English regions. From April 2010, all RSS and Regional Economic Strategies (RES) were replaced by a single Regional Strategy (RS), except for London.

In London, the Mayor of London is responsible for producing a sustainable planning strategy - The London Plan. It was introduced in 2002 and replaced the previous strategic guidance (known as RPG3). The current document (London Plan 2011) was adopted in July 2011. Revised Early Minor Alterations to the London Plan (REMA) were published on October 2013 and Draft Further Alterations to the London Plan (FALP) were published on January 2014 for public consultation.



The London Plan

The London Plan promotes economic development, and the creation of wealth in Greater London, through embracing the principles of sustainable development and providing better integration between land use and transport planning.

The London Plan contains a number of policies directly related to energy and sustainability. In particular, Policy 5.3 'Sustainable design and construction' states that the highest standards of sustainable design should be sought, including measures to achieve other policies in the Plan and the following sustainable design principles:

- Minimising Carbon dioxide emissions across the site, including the building and services (such as heating and cooling systems);
- Avoiding internal overheating and contributing to the urban heat island effect
- Efficient use of natural resources (including water)
- Minimising pollution (including noise, air and urban run-off);
- Minimising the generation of waste and maximising reuse or recycling;
- Avoiding impacts from natural hazards(including flooding);
- Ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions;
- Securing sustainable procurement of materials, using local supplies where feasible;
- Promoting and protecting biodiversity and green infrastructure.

Key London Plan Guidance for Mansfield Bowling Club

The key guidance regional policy guidance referred to in the preparation of this document is:

- Greater London Authority Supplementary Planning Guidance on Sustainable Design and Construction (SPG), April 2014.
- Greater London Authority Energy Team's Guidance Note 'Guidance on Planning Energy Assessments April 2014.

appendix a - policy background…

GLA Energy Team Guidance on Preparing Energy Assessments, April 2014

OVERVIEW

This guidance note provides further detail on addressing the London Plan's energy hierarchy through the provision of an energy assessment to accompany strategic planning applications.

The purpose of an energy assessment is to demonstrate that climate change mitigation measures are integral to the scheme's design and evolution, and that they are appropriate to the context of the development.

THE ENERGY HIERARCHY

In delivering the Mayor's Energy Strategy an energy hierarchy has been developed to provide a guide to the approach that should be adopted by individuals and organisations in making London a leading city for sustainable energy. The stages of the hierarchy are set out in the guidance note as follows:

Use Less Energy/Reduce Demand- 'Be Lean'	• Reduce use through behaviour change • Improve insulation • Incorporate passive heating and cooling • Install energy efficient lighting and appliances
Supply Energy Efficiently - 'Be Clean'	• Use CHP and community heating and/or cooling • Cut transmission losses though local generation
Use Renewable Energy - 'Be Green'	• Install renewables on site • Import renewable energy

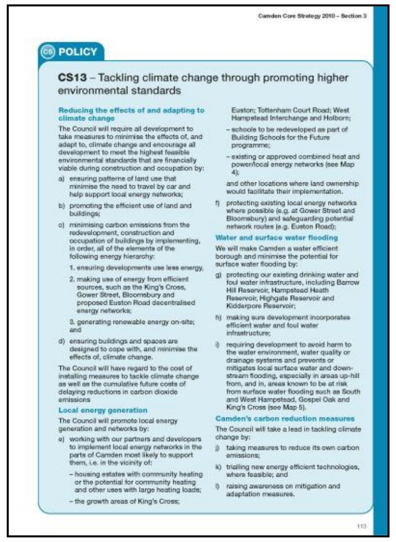
IMPLEMENTING THE ENERGY HIERARCHY

In order to meet the requirements of the London Plan, an energy assessment for a development must demonstrate how this energy hierarchy has been adhered to in order to meet the predicted energy demand.

The Guidance Note sets out a detailed process to enable sustainable energy to be addressed as follows:

- Carry out an energy demand assessment
- Maximise energy efficiency
- Demonstrate that consideration has been given to heating and where necessary, to cooling systems, passive design, solar water heating, CHP (or trigeneratation) preferably fuelled by renewables, community heating and cooling, heat pumps and gas condensing boilers.

LOCAL POLICY



Camden Core Strategy 2010 – Section 3

POLICY

CS13 – Tackling climate change through promoting higher environmental standards

Reducing the effects of and adapting to climate change

The Council will require all development to take measures to minimise the effects of, and adapt to, climate change and encourage all development to meet the highest feasible environmental standards that are financially viable during construction and occupation by:

a) ensuring patterns of land use that minimise the need to travel by car and help support local energy networks;

b) promoting the efficient use of land and buildings;

c) minimising carbon emissions from the redevelopment, construction and occupation of buildings by implementing, in order, all of the elements of the following energy hierarchy:

1. ensuring developments use less energy,
2. making use of energy from efficient sources, such as the King's Cross, Gower Street, Bloomsbury and proposed Euston Road decentralised energy networks;
3. generating renewable energy on-site; and

d) ensuring buildings and spaces are designed to cope with, and minimise the effects of, climate change.

The Council will have regard to the cost of installing measures to tackle climate change as well as the cumulative future costs of delaying reductions in carbon dioxide emissions

Local energy generation

The Council will promote local energy generation and networks by:

e) working with our partners and developers to implement local energy networks in the parts of Camden most likely to support them, i.e. in the vicinity of:

– housing estates with community heating or the potential for community heating and other uses with large heating loads;

– the growth areas of King's Cross; Euston; Tottenham Court Road; West Hampstead Interchange and Holborn;

– schools to be redeveloped as part of Building Schools for the Future programme;

– existing or approved combined heat and power/local energy networks (see Map 4);

and other locations where land ownership would facilitate their implementation.

f) protecting existing local energy networks where possible (e.g. at Gower Street and Bloomsbury) and safeguarding potential network routes (e.g. Euston Road);

Water and surface water flooding

We will make Camden a water efficient borough and minimise the potential for surface water flooding by:

g) protecting our existing drinking water and foul water infrastructure, including Barrow Hill Reservoir, Hampstead Heath Reservoir, Highgate Reservoir and Kidderpore Reservoir;

h) making sure development incorporates efficient water and foul water infrastructure;

i) requiring development to avoid harm to the water environment, water quality or drainage systems and prevents or mitigates local surface water and down-stream flooding, especially in areas up-hill from, and in, areas known to be at risk from surface water flooding such as South and West Hampstead, Gospel Oak and King's Cross (see Map 5).

Camden's carbon reduction measures

The Council will take a lead in tackling climate change by:

j) taking measures to reduce its own carbon emissions;

k) trialling new energy efficient technologies, where feasible; and

l) raising awareness on mitigation and adaptation measures.

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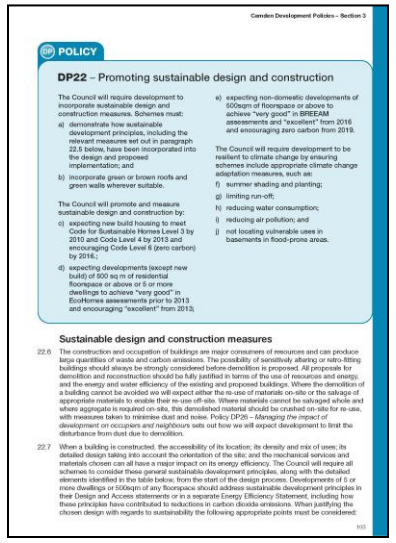
CS13 – Tackling Climate Change through Promoting Higher Environmental Standards

This policy ensures the London Borough of Camden is committed to reducing CO_2 emissions and minimising the effect of the Borough on the environment through responsible construction.

It is also a priority of the Council to ensure the Borough becomes more adaptable to climate change through redevelopment.

The policy gives close consideration to energy, water and flooding in reducing and adapting to climate change. The strategy for achieving the targets set for individual developments and the Borough as a whole are consistent with the London Plan, particularly with regard to the Mayor's Energy Hierarchy.



Camden Development Policies – Section 3

POLICY

DP22 – Promoting sustainable design and construction

The Council will require development to incorporate sustainable design and construction measures. Schemes must:

a) demonstrate how sustainable development principles, including the relevant measures set out in paragraph 22.5 below, have been incorporated into the design and proposed implementation; and

b) incorporate green or brown roofs and green walls wherever suitable.

The Council will promote and measure sustainable design and construction by:

c) expecting new build housing to meet Code for Sustainable Homes Level 3 by 2010 and Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016.;

d) expecting developments (except new build) of 500 sq m of residential floorspace or above or 5 or more dwellings to achieve "very good" in EcoHomes assessments prior to 2013 and encouraging "excellent" from 2013;

e) expecting non-domestic developments of 500sqm of floorspace or above to achieve "very good" in BREEAM assessments and "excellent" from 2016 and encouraging zero carbon from 2019.

The Council will require development to be resilient to climate change by ensuring schemes include appropriate climate change adaptation measures, such as:

f) summer shading and planting;

g) limiting run-off;

h) reducing water consumption;

i) reducing air pollution; and

j) not locating vulnerable uses in basements in flood-prone areas.

Sustainable design and construction measures

22.6 The construction and occupation of buildings are major consumers of resources and can produce large quantities of waste and carbon emissions. The possibility of sensitively altering or retro-fitting buildings should always be strongly considered before demolition is proposed. All proposals for demolition and reconstruction should be fully justified in terms of the use of resources and energy, and the energy and water efficiency of the existing and proposed buildings. Where the demolition of a building cannot be avoided we will expect either the re-use of materials on-site or the salvage of appropriate materials to enable their re-use off-site. Where materials cannot be salvaged whole and where aggregate is required on-site, this demolished material should be crushed on-site for re-use, with measures taken to minimise dust and noise. Policy DP26 – *Managing the impact of development on occupiers and neighbours* sets out how we will expect development to limit the disturbance from dust due to demolition.

22.7 When a building is constructed, the accessibility of its location; its density and mix of uses; its detailed design taking into account the orientation of the site; and the mechanical services and materials chosen can all have a major impact on its energy efficiency. The Council will require all schemes to consider these general sustainable development principles, along with the detailed elements identified in the table below, from the start of the design process. Developments of 5 or more dwellings or 500sqm of any floorspace should address sustainable development principles in their Design and Access statements or in a separate Energy Efficiency Statement, including how these principles have contributed to reductions in carbon dioxide emissions. When justifying the chosen design with regards to sustainability the following appropriate points must be considered:

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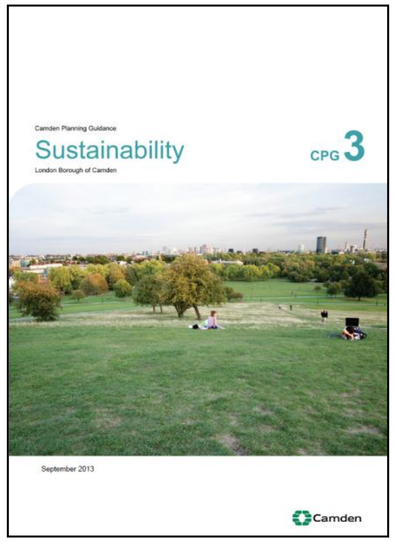
DP22 – Promoting Sustainable Design and Construction

This policy ensures developments within the London Borough of Camden are encouraged to incorporate sustainable design and construction practices.

As a measure of the levels of sustainable development reached, the Council require independent environmental assessments to be undertaken: BREEAM, Code for Sustainable Homes and EcoHomes.

It is the Council's expectation that the appropriate assessment tool is used; the minimum ratings required for each tool are detailed within this policy.



London Borough of Camden CPG3 - Sustainability

The London Borough of Camden CPG3 has been compiled in order to support the policies in the Borough's Local Development Framework (LDF), which provides a long-term strategic plan for land and building use, new developments and conservation within the London Borough of Camden.

In particular, this document was produced to provide additional guidance with regard to the adjacent policies - DP22 and CS13.

Planning permissions are made in accordance with the policies set out in the LDF and they set out the general direction in which change will be encouraged or resisted. Camden Planning Guidance is consistent with the Core Strategy and the Development Policies, and forms a Supplementary Planning Document (SPD) which is an additional "material consideration" in planning decisions. This document was updated on 4 September 2013.

The LDF contains a wide range of policies for the growth and development of the London Borough of Camden. Included are policies on housing, the environment, transport, leisure, retail and community uses. Along with other development plan documents and council strategies, the LDF aims to improve and create a better borough for those who live, work and visit.

Relationship to London Plan

The London Borough of Camden takes the London Plan as the primary reference with respect to energy and sustainability issues at planning.

Accordingly, within this Energy Report the primary reference is to London Plan policies.

appendix b – SAP inputs…

SAP INPUTS

	Parameter	Unit	Be Lean	Be Clean	Be Green
Building Fabric	Floor U-Value	W/m^2.K	0.12	As 'Be Lean'	As 'Be Clean'
	Roof U-Value	W/m^2.K	0.12	As 'Be Lean'	As 'Be Clean'
	External Wall U-Value	W/m^2.K	0.15	As 'Be Lean'	As 'Be Clean'
	Party Wall U-Value	W/m^2.K	0 (Fully filled cavity and sealed edges)	As 'Be Lean'	As 'Be Clean'
	Walls to corridor U-Value	W/m^2.K	Heated / no loss (Fully filled cavity and sealed edges)	As 'Be Lean'	As 'Be Clean'
	Walls to unheated spaces U-Value	W/m^2.K	0.15	As 'Be Lean'	As 'Be Clean'
	Glazing proportion		As per architectural drawings	As 'Be Lean'	As 'Be Clean'
	Windows and Skylights (glazing + frame) U-Value	W/m^2.K	Private (TG) = 1 Affordable (DG) = 1.4	As 'Be Lean'	As 'Be Clean'
	(To North, East & West) Glass g-Value and Light Transmittance		Private: g = 0.53 ; LT = 71% Affordable: g = 0.63 ; LT = 77%	As 'Be Lean'	As 'Be Clean'
	(To South) Glass g-Value and Light Transmittance		Private: g = 0.36 ; LT = 61% Affordable: g = 0.41 ; LT = 67%	As 'Be Lean'	As 'Be Clean'
	(Skylight) Glass g-Value and Light Transmittance		Private: g = 0.36 ; LT = 61% Affordable: g = 0.41 ; LT = 67%		
	Doors U-Value	W/m^2.K	1.5	As 'Be Lean'	As 'Be Clean'
	y-Value	W/m^2.K	Default = 0.15	As 'Be Lean'	As 'Be Clean'
	Shading devices		External shading as per architectural drawings and internal blinds	As 'Be Lean'	As 'Be Clean'
	Air Permeability	m^3/m^2.hr at 50 Pa	3	As 'Be Lean'	As 'Be Clean'
Building Services	M&E Standards Limits		Enhanced values on DBSCG 2013 limits	As 'Be Lean'	As 'Be Clean'
	Ventilation	% & W/l/s	MVHR - Sentinel Kinetic Plus or similar K + 1 WC: HR 92% - SFP = 0.52 K + 2 WC: HR 92% - SFP = 0.55 K + 3 WC: HR 90% - SFP = 0.63	As 'Be Lean'	As 'Be Clean'
	Space Heating and DHW		Gas boiler	As 'Be Lean'	As 'Be Clean'
	Space Heating and DHW eff.		88%	As 'Be Lean'	As 'Be Clean'
	DHW Storage		Cylinder :150 litres (1bed) - 200 litres (2bed) - 300 litres (3bed)	As 'Be Lean'	As 'Be Clean'
	Controls		Time and temperature zone control	As 'Be Lean'	As 'Be Clean'
	Space Heating Emitter		Private: Underfloor ; Affordable: Radiators	As 'Be Lean'	As 'Be Clean'
	Cooling		Private: Yes ; Affordable: n/a	As 'Be Lean'	As 'Be Clean'
	Cooling efficiency		A rated - SEER = 4	As 'Be Lean'	As 'Be Clean'
	% Low energy lighting		100%	As 'Be Lean'	As 'Be Clean'
	Renewables		n/a	As 'Be Lean'	PV (positioned horizontally) to serve: Affordable element: approx. 80 m² to provide ≥ 9,200 kWh/y Private element: approx. 120 m² to provide ≥ 13,900 kWh/y

appendix c – 'be green' – renewable energy…

AIR SOURCE HEAT PUMPS - HEATING ONLY

Technology Background

Air source heat pumps work by converting the energy of the outside air into heat, creating a comfortable temperature inside the building as well as supplying energy for the hot water system. As with all heat pumps, air source models are most efficient when supplying low temperature systems such as underfloor heating.

An air source heat pump extracts heat from the outside air in the same way that a fridge extracts heat from its inside. It can extract heat from the air even when the outside temperature is as low as minus 15° C. Cold water or another fluid is circulated through pipes, picking up the ambient temperature and then passing through the heat exchanger (the evaporator) in the heat pump unit.

The heat exchanger extracts heat from the fluid, using a refrigerant compression cycle to upgrade the heat to a usable temperature (+55°C). This heat is then transferred to the heating system via another heat exchanger, the condenser of the heat pump.

Accordingly ASHP heating systems generally run at a lower temperature than conventional heating systems.

There are two main types of air source heat pumps. An air-to-water system uses the heat to warm water. Heat pumps heat water to a lower temperature than a standard boiler system would, so they are better suited to underfloor heating systems than radiator systems. An air-to-air system produces warm air, which is circulated by fans to heat the building.

Whilst heat pumps are not a wholly renewable energy source due to use of electricity, the renewable component is considered as the heat extracted from the air. It is measured as the difference between heat outputs, less the primary electrical energy input.

Using this heat, for every Watt of electrical energy supplied to the system, 4 Watts or more of heating energy can be supplied to a heating system. This 'Coefficient of Performance' (CoP) of 4 is effectively an 'efficiency' of 400% for the system and compares very favourably with even the best gas condensing boiler's efficiency of around 85%.

The smaller the temperature difference between the source and the output temperature of the heat pump (i.e. the temperature of the distribution system) the higher the heat pump's CoP.

Benefits

Unlike boilers, there is no pollution on-site and as the mix of power stations used to supply the electricity grid gets 'cleaner', with more renewable electricity generation being brought on line, so the Carbon emissions from the heat pumps system will decrease even further.

The key operational benefit of air source heat pumps for the user is the reduction in fuel bills. In addition, space savings can be made over other plant types as an air source heat pump unit is compact, and requires no storage space for fuel.

Technical Considerations

Since air source heat pumps produce less heat than traditional boilers, it is essential that the building where the air source heat pump is proposed is well insulated and draught proofed for the heating system to be effective.

Fans and compressors integral to the air source heat pump unit generate some noise, but this is generally acceptable especially where outdoor units can be located away from windows and adjacent buildings. By selecting a heat pump with an outdoor sound rating of 76 dB or lower and mounting the unit on a noise-absorbing base these issues can be resolved for the site.

Economic Considerations

Costs for installing a typical system vary but they are considerably more economical to install than an equivalent capacity ground source heat system and can produce similar levels of energy and carbon savings.

Actual running costs and savings for space heating will vary depending on a number of factors - including the size and use pattern of the building and how well insulated it is.

Application at Mansfield Bowling Club

Gas boilers will provide space heating and domestic hot water to the residential element. This is a proven technology with a low Carbon dioxide emission impact.

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appendix c – 'be green' – renewable energy…

GROUND SOURCE HEATING

Technology Background

Heat pumps take in heat at a certain temperature and release it at a higher temperature to provide space and water heating, using a similar process to a refrigerator. Conversely the use of a reverse cycle heat pump can provide cooling capability within the same equipment. Heat pumps offer the lowest-carbon emission method of heating any building.

This technology is now in common use for installations up to 2-4MW capability. Preliminary investigations indicate the system has potential as the cooling and heating source to the scheme.

Ground Source Heat Pumps (GSHPs) extract heat from the ground to provide space and water heating for buildings. As the ground stays at a fairly constant temperature throughout the year heat pumps can use the ground as the source of heat. The ground temperature is not necessarily higher than ambient air temperature in winter but this temperature is more stable whereas air has a wide temperature range.

Benefits

Whilst a GSHP is not a wholly renewable energy source as it uses electricity, the renewable component is considered as the heat extracted from the ground, measured as the difference between heat outputs, less the primary electrical energy input.

Using this geothermal heat, for every Watt of electrical energy supplied to the system, 4 Watts or more of heating energy can be supplied to a heating system. This 'Coefficient of Performance' (CoP) of 4 is effectively an 'efficiency' of 400% for the system and compares very favourably with even the best gas condensing boiler's efficiency of around 85%.

Unlike boilers, there is no pollution on-site and as the mix of power stations used to supply the electricity grid gets 'cleaner', with more renewable electricity generation being brought on line, so the carbon emissions from the heat pumps system will decrease even further.

Technical Considerations

In a GSHP system cold water (or another fluid) is circulated through pipes buried in the ground (the 'ground loop') picking up temperature (from, say, -5°C to + 2°C) as it does so and then passing through the heat exchanger (the evaporator) in the heat pump unit.

There are two methods of extracting the heat from the ground – 'ground loop' or 'borehole'. With the ground loop system, lengths of plastic pipe are buried in the ground in a horizontal trench, usually approximately 1 to 2 metres below ground level. With the borehole system, the pipework is installed in relatively small diameter (150mm diameter) holes drilled anything between 15 to 100 metres into the ground depending on ground type and conditions. With both systems the pipe is a closed loop filled with a water/antifreeze mixture. This mixture circulates in the pipe, absorbing heat from the ground.

The heat exchanger extracts heat from the fluid, using a refrigerant compression cycle to upgrade the heat to a usable temperature (from say +2°C to +55°C) This heat is transferred to the heating (and sometimes the hot water) system via another heat exchanger, the condenser of the heat pump.

The smaller the temperature difference between the source and the output temperature of the heat pump (i.e. the temperature of the distribution system) the higher the heat pump Coefficient of Performance.

Accordingly GSHP heating systems generally run at a lower temperature than conventional heating systems. In GSHP systems serving heating loads, water heating provides a year-round load and can improve the load factor for the heat pump. Hot water is usually required to be delivered from the tap at temperatures in the range 35°C to 45°C, which is within the thermal power output of a heat pump system.

Applicability at Mansfield Bowling Club

DISCUSSION

Technical feasibility for a site generally depends on the ground loop with the ground conditions affecting both the ease of construction and performance of the system, with a need for appropriate soil and ground water conditions for the site. Geothermal heating systems are more expensive to install initially than traditional boiler or electric heating systems. However, as previously discussed they are significantly cheaper to run and maintain against traditional boiler solutions if the ground conditions are correct. As electrically run heat pumps, if the reservoir of energy in the ground requires excessive pumping to access, the energy and carbon emissions from the system rise significantly.

With the ground geology and site restrictions, it is considered that this technology presents a significant risk to the developer in respect of the need to pursue an open loop system. The location of the boreholes would compromise the site boundary and provide difficulty in installation with the buildings' basement.

These problems, along with the uncertain yield from the borehole, mean that the risk and large capital costs outweigh the advantages of ground source heat pumps.

DECISION TABLES

General Considerations

Issue	Consideration	Response for Mansfield Bowling Club
Heat Demand	Is there a year-round heat demand?	**NO**
Heat Distribution System	Is it possible to incorporate a low-grade distribution system e.g. under floor heating?	**NO**
Cooling Distribution System	Is it compatible with the proposed cooling system?	**YES**

Ground-Source Heat Pumps

Issue	Consideration	Response for Mansfield Bowling Club
Ground Conditions	Has a basic ground study concluded that the site is suitable for GSHP?	**TBC**
Horizontal Piping	Is there a large area of open land where horizontal piping could be installed?	**NO**
Vertical Piping	Is the ground suitable for vertical piping?	**NO**
	Can underground obstacles be avoided?	**NO**
Plant Room	Is there space allowance for a GSHP and associated auxiliary equipment?	**YES**

Water-Source Heat Pumps

Issue	Consideration	Response for Mansfield Bowling Club
Resource	Is an appropriate water source available close to the site?	**NO**

Air Source Heat Pumps

Issue	Consideration	Response for Mansfield Bowling Club
Roof Space	Is there sufficient roof space for air-source heat pumps?	**YES**

RECOMMENDATION

Due to the number of negative or undetermined responses in the Decision Tables and the proposed development's limited heating demand (Heat Pumps (Ground/Water/Air/Geothermal) not recommended for Mansfield Bowling Club.

…sustainable building services solutions

BIOMASS HEATING

Technical Considerations

Wood chips / pellets would require a large number of deliveries and significant storage space, not compatible with a city centre location. Delivery logistics for liquid biofuel would pose similar issues, and require careful consideration;

Operational Considerations

Biomass systems typically require more frequent maintenance and greater operator attention than conventional systems. As a result, the degree of operator dedication to the system is critical to its success. They often require special attention to fire insurance premiums, air quality standards, ash disposal options and general safety issues.

Application at Mansfield Bowling Club

DISCUSSION

The local sourcing of fuel for the heating system poses a challenge due to the site's location. With the location of the site, sourcing wood pellets/chips would have to occur from suppliers over 30km from the site.

DECISION TABLE

Woody Biomass

Issue	Consideration	Response for Mansfield Bowling Club
Heat Demand	Is there a year round heat demand?	NO
Supply Chain	Is there an established supply chain in the local area?	NO
Delivery Logistics	Is the site accessible for deliveries?	NO
Storage	Is there sufficient space for a supply vehicle to access a biomass storage hopper?	NO
	Is there sufficient space for fuel storage to allow a reasonable number of deliveries?	NO
Plant Room	Is there sufficient space for a biofuel boiler and associated auxiliary equipment?	YES
Flue	Can a flue be designed to meet air quality and dispersion requirements?	YES

Liquid Biofuel

Issue	Consideration	Response for Mansfield Bowling Club
Heat Demand	Is there a year round heat demand?	NO
Supply Chain	Is there an established supply chain in the local area?	NO
Security of Supply	Is the future supply of biofuel guaranteed?	NO
Delivery Logistics	Is the site accessible for deliveries?	NO
	Is there sufficient space for a supply vehicle to access a biofuel storage tank?	NO
Storage	Is there sufficient space for fuel storage to allow a reasonable number of deliveries?	NO
Running Costs	Are the high running costs acceptable?	NO

RECOMMENDATION

It is not considered that a biomass boiler would be a suitable renewable option at the development for the following reasons:

The local sourcing of fuel for the development poses an issue due to the urban location of the site. Being situated in Central London it is thought a Carbon burden would be added to the site as fuel suppliers sourcing wood pellets/chips from supplies would not have been sourced within 30 km of the site.

Air quality issues arising from exhaust emissions and transportation are also an issue for the application of biomass in this central London location.

PHOTOVOLTAICS

Overview

Solar photovoltaic (PV) technology is a semi-conductor based technology that converts the energy in sunlight into electricity. A PV system comprises the PV panel (generator) and the associated wiring and electronics or 'balance of system'. If the energy in the daylight is sufficient, it causes a flow of electrons across the junction of the semi-conductor: electricity is generated. A solar panel is made of cells, which are connected together in different configurations to give different voltage and current outputs.

The PV panel should be orientated between southeast and southwest (optimally south). The optimal tilt angle (inclination of panel from horizontal) should be calculated to ensure the best possible output of the system during the year. In the UK, the angles of most pitched roofs are suitable for mounting PV panels. Panels can also be mounted on A-frames on flat-roofed buildings. PV technology comes in a range of forms: PV panels that can be retrofitted to the roof of an existing building or equally, sunk to fit flush with the roof line; PV cells that are 'laminated' between sheets of glass to provide shading in a glazed area, and PV cladding.

PV systems are low maintenance as they have no moving parts and panels generally have 25-year warranties, although the lifetime of the panel can be expected to be beyond this time.

Technical Considerations

The PV systems should not be shaded. Shading caused by other buildings, greenery and roof 'furniture' such as chimneys or satellite dishes, even over a small area of the panel, can significantly reduce performance. Excess energy can be exported to the grid. Although the feed-in tariffs are generally not high, exporters can negotiate with their utility company.

Feasibility of PV is typically dependent on the availability of unshaded, south- facing locations for mounting an array of panels. In the London area there is an annual average solar energy availability of 1 MWh/m^2 at the optimum (south facing) angle of 30° from the horizontal plane. The amount of this energy that can be utilised is dependent upon the availability of un-shaded roof space and efficiency of the solar panels considered. Aesthetic, access and structural implications need to be considered in identifying panel locations.

Economic Considerations

Payback times for this technology are usually in excess of twenty years; but this is reducing year on year as the technology matures and are set to reduce further as fuel prices increase. Integrating PV into a building and replacing other building materials can further offset the cost.

Application at Mansfield Bowling Club

DISCUSSION

The upper roof of the proposed building accommodates some plant and lift overrun accommodation, but the majority of the area is accessible for maintenance and has minimal shading from surrounding buildings over the year. This location is therefore considered suitable for the implementation of PV arrays, and opportunity to integrate PV into the roof layout shall be pursued.

DECISION TABLE

Issue	Consideration	Response for Mansfield Bowling Club
Roof Orientation	Are available roofs facing south-west to south- east (through south), or flat?	**YES**
Roof Layout	Is there sufficient un-shaded roof area?	**YES**
Electrical Demand	Is there an electrical demand on site?	**YES**

RECOMMENDATION

It is proposed to allocate roof space in the affordable element, for an approximate effective PV area of 80 m^2, with the panels positioned horizontally, to provide an approximate output of ≥ 9,200 kWh/year. In the private element an effective PV area of approximately 120 m^2, with the panels in the same position will provide an approximate output of ≥ 13,900 kWh/year.

…sustainable building services solutions

SOLAR WATER HEATING

Overview

Solar water heating systems use the energy from the sun to heat water, most commonly in the UK for domestic hot water needs. The systems use a heat collector, generally mounted on the roof in which a fluid is heated by the sun. This fluid is used to heat up water that is stored in either a separate hot water cylinder or a twin coil hot water cylinder inside the building.

The heated carrier fluid circulates around the system, with a pump in an active system or by natural convection in a passive system, to the hot water cylinder, which ideally should be a twin coil cylinder.

Two types of collector exist: flat plate and evacuated tube. Flat plate collector can be mounted on or flush with the roof. The air in the collection tubes can be evacuated to reduce heat losses within the frame by convection. Evacuated tube collectors need to be re-evacuated every few years. They are more difficult to install but are more efficient and allow higher temperature heating.

Technical Considerations

Solar thermal systems should be sized to the hot water requirements of the user since any excess heat that is generated cannot be exported elsewhere. The optimal angle for mounting depends on when the water demand is greatest. Ideally, the collectors should be mounted onto a non-shaded, south-facing roof.

Solar thermal collectors offer a good price-performance ratio. Solar hot water systems are best suited to developments with high hot water requirements, such as hotels, care homes and leisure centres. Many systems have been installed in the UK and they work well, even without direct sunlight.

Economic Considerations

Solar thermal technology is a cost effective way to reduce Carbon emissions, especially if it is replacing electric water heating.

Application at Mansfield Bowling Club

DISCUSSION

As discussed in the photovoltaic panels review, the upper roof area is accessible for maintenance, and has minimal shading.

DECISION TABLE

Issue	Consideration	Response for Mansfield Bowling Club
Roof Orientation	Are available roofs facing south-west to south- east (through south), or flat?	**YES**
Roof Layout	Is there sufficient un-shaded roof area?	**YES**
Hot Water Demand	Is there a year round hot water demand?	**YES**
Hot Water Storage	Is there space allowance for a hot water storage vessel?	**YES**
Conflicts/Compatibility With Other Systems	Will solar thermal conflict with other systems (e.g. CHP) which are higher up the energy hierarchy?	**YES**
	Would a solar thermal collector be compatible with the proposed heating system?	**YES**

RECOMMENDATION

As the upper roof area is considered suitable for the implementation of PV arrays, the opportunity to place solar thermal panels into the roof layout here is not available. Solar thermal panels are not considered appropriate for the site due to the need for hot water distribution pipework to and from the roof.

Since the available roof space will be taken up by the installation of PV, the use of solar water heating has not been considered further.

appendix c – 'be green' – renewable energy…

WIND TURBINES

Technology Background

Wind power generation is the conversion of the kinetic energy in the wind to mechanical energy, which in turn is used to generate electricity.

The energy in the wind is captured by the blades of a wind turbine, which are normally mounted on a horizontal shaft (although vertical axis turbines also exist). The wind causes the shaft to turn, which drives the electrical generator.

The size of wind turbines varies greatly, from a few hundred watts to 3MW. Wind turbines are sized according to their rated power, that is the power output at a given wind speed, usually 12 m/s.

The relation between wind speed and power output is not linear. The energy content of the wind varies with the cube of the wind speed - twice the wind speed would give eight times as much energy. The speed of the wind increases with height above the ground, so it is therefore important to have a good understanding of local wind conditions before specifying a turbine. For larger turbines, an anemometer will have to be mounted on a mast at the site of the proposed turbine in order to have reliable wind speed and direction data over the course of a year.

On average, a wind turbine generates electricity for 70-85% of the time, although not always at the rated power. Its load factor, the proportion of a turbine's theoretical energy output over a year, is around 30%, compared to 50% for a conventional power station.

Benefits

Wind power is one of the more cost effective renewable energy technologies. For grid-connected systems, any excess electricity that is produced can be sold back to the grid. If the site is well chosen, wind power can be a reliable source of power.

Technical Considerations

Most wind turbines start operating ('cut in') at around 3-4 m/s. Larger wind turbines are viable where the average wind speed is 6-7 m/s. Smaller turbines can still produce useful amounts of electricity at an average wind speed of 4 m/s.

Turbines should be sited away from obstacles that could disrupt the wind pattern e.g. buildings, trees etc. The wind regime in urban areas is also an area of concern due to the likelihood of high wind turbulence, which will potentially reduce electricity output.

Although there is some scope for the addition of larger wind generators in some urban sites, turbines of a capacity between 1kW and 500kW are best suited to these locations.

Local Considerations

Planning consent is required for the installation of a wind turbine. It is important to involve the public in the consultation process. The noise levels vary from machine to machine but roof-mounted turbines, which have been specially developed to operate at low noise levels and with low vibration are now available.

In a building integrated or building mounted wind turbine system, the turbine is connected through appropriate electrical switchgear to the building's electrical system and both of these are connected to the electricity grid such that all generated energy can be used regardless of the building demand fluctuations.

Turbines rely on a minimum wind speed to 'cut in' and start generating power, but from this minimum upwards, the output increases as a cube function of the wind speed. In periods of above average wind speed, the power generated increases significantly. Since wind resource varies all the time, it is difficult to make precise calculations of the power output of a turbine. However, average figures indicate that in reasonably windy areas (average wind speed of 6 m/s or higher - this figure being generally accepted as the minimum average local wind speed to make turbines feasible) the expected output from each 1kW installed turbine capacity is about 2500kWh annually.

To investigate the potential of using wind turbines to provide an on-site renewable energy supply, the DECC/NOABL online wind speed tool has been used to determine the average wind speed at various heights above ground level at the site.

Although the data suggests that appropriate average wind-speeds may exist onsite, accurately predicting mean wind-speeds in urban locations is rarely possible without extensive on-site testing. Urban conditions are not ideal for energy generation from turbines which usually need to operate within both minimum and maximum wind speeds and far from sources of turbulence.

Additional issues which would require investigation include structural vibration and the risk of visual discomfort to neighbours and occupants through flicker.

appendix c – 'be green' – renewable energy…

…sustainable building services solutions

Application at Mansfield Bowling Club

DISCUSSION

Wind turbines are not specified where average wind speeds are less than 6m/s. Data from the DTI's NOABL wind speed database shows that this speed is just likely to be present on or around the site, with 4.9m/s 5.6m/s and 6.1m/s wind speeds predicted for 10m, 25m and 45m from the ground respectively.

DECISION TABLE

Issue	Consideration	Response for Mansfield Bowling Club
Wind Speed	Is the average wind speed greater than 6 m/s at hub height?	**YES**
Clear Air Flow to Turbine	Is the area free from obstructions or topography that may cause turbulence?	**NO**
Open Land Around Proposed Site	Is there sufficient open land for a turbine to be installed?	**NO**
Distance To Nearest Property	Are surrounding properties far away enough to avoid noise disturbance?	**NO**

RECOMMENDATION

Since there are low wind speeds recorded at the site at heights of 10 m and 25 m above ground and the installation of a wind turbine may face significant opposition on grounds of its aesthetically intrusive nature, wind turbines are not considered appropriate.

appendix c – 'be green'…

…sustainable building services solutions

COMPARISON TABLE

Technology	B. Payback (see 'Economic Considerations' above)	C. Land Use (see 'Local Considerations' above)	D. Local Planning Criteria (see 'Local Considerations' above)	E. Noise (see 'Local Considerations' above)	F. Feasibility Of Exporting Heat/ Electricity From The System (see 'Economic Considerations' above)	G. Life Cycle Cost/Impact (see 'Economic Considerations' above)	H. Available Grants (see 'Economic Considerations' above)
Biomass Heating	**Variable** More expensive than conventional boilers in capital cost and ongoing fuel costs. There is no payback applicable to biomass boilers versus conventional natural gas fired boilers.	**Medium** Direct combustion systems can replace gas/oil fired boilers. Requires large fuel storage facility	**Medium** While Planning Permission is not required for a boiler, it may be required for a boiler house, fuel silo and flue (chimney). It may also be required for any aspect of an installation where historic buildings are involved or in sensitive locations. If there is likely to be an increase in the number of large vehicle movements for fuel delivery, or fuel delivery is likely to be noisy, e.g. when blowing woodchips, Planning permission may be required.	**Medium** Noise associated with large vehicle access for the wood pellet deliveries.	**Good** Heat can directly be used in the building.	**Good** Neutral CO_2 emission impact. However as the site is in central London, the wood pellets will need to be delivered which will cost CO_2 emissions in term of transport.	The Renewable Heat Incentive. Under this scheme it is proposed that, like Renewable Obligation Certificates (ROCs) and the Feed In Tariff (FIT) for renewable electricity generation, a payment will be made per kilowatt hour (kWh) of heat produced.
Biomass CHP	**Variable** Payback will vary depending on the size of the CHP and fuel availability.	**Medium** Direct combustion systems can replace gas/oil fired boilers. Requires large fuel storage facility.	**Medium** While Planning Permission is not required for a boiler, it may be required for a boiler house, fuel silo and flue (chimney). It may also be required for any aspect of an installation where historic buildings are involved or in sensitive locations. If there is likely to be an increase in the number of large vehicle movements for fuel delivery, or fuel delivery is likely to be noisy, e.g. when blowing woodchips, Planning permission may be required.	**Medium** Noise associated with large vehicle access for the wood pellet deliveries.	**Good** Heat can directly be used in the building.	**Good** Neutral CO_2 emission impact. However as the site is in central London, the wood pellets will need to be delivered which will cost CO_2 emissions in term of transport.	The Renewable Heat Incentive. Under this scheme it is proposed that, like Renewable Obligation Certificates (ROCs) and the Feed In Tariff (FIT) for renewable electricity generation, a payment will be made per kilowatt hour (kWh) of heat produced and also per kilowatt of electricity produced.
Combined Heat & Power	**Variable** Payback will vary depending on the size of the CHP unit, for the smallest micro-CHP it can be up to 30 years, for bigger systems it will be about 5 years.	**Low** Packaged CHP will fit into the existing boiler room in the case of retrofitting. However, it is necessary to ensure that there is room for additional equipment and pipework. In the case of new build projects, site layout needs to incorporate approximately 40m2 for the boiler house (based on a 60kW system). Packaged CHP can also come in a shipping container	**Low** No planning approval required	**Low** Unit is attenuated and silenced to meet statutory levels.	**Good** Heat and electricity can directly be used on site or exported to the grid	**Good** Low carbon technology that provides a good payback in the region of five years.	None at present.

appendix c – 'be green' – renewable energy…

Technology	B. Payback (see 'Economic Considerations' above)	C. Land Use (see 'Local Considerations' above)	D. Local Planning Criteria (see 'Local Considerations' above)	E. Noise (see 'Local Considerations' above)	F. Feasibility Of Exporting Heat/ Electricity From The System (see 'Economic Considerations' above)	G. Life Cycle Cost/Impact (see 'Economic Considerations' above)	H. Available Grants (see 'Economic Considerations' above)
Ground Source Heat Pumps	**Medium to Poor** 14 years with RHI, 47 years without RHI	**High** Large site area required for horizontal or vertical closed loop pipework installation which is impractical for refurbished buildings. Open loop systems require the right geology and carry a high risk when considering yield. They also need to have 80m separation between boreholes, impossible on a constrained site. .	**Medium** The installation of a ground source heat pump or a water source heat pump is usually considered to be permitted development, not needing an application for planning permission. If you live in a listed building or a conservation area you should contact your council to check on local requirements	**Low** Heat Pumps make a slight humming noise much like refrigerator and so they are best located within a basement/utility room or away from occupants. Not a significant issue. Noise can be mitigated.	**Medium** Low temperature space heating system required.	**Average** High CoPs are dependent on relatively low supply temperatures in heating mode.	The Renewable Heat Incentive. Under this scheme it is proposed that, like Renewable Obligation Certificates (ROCs) and the Feed In Tariff (FIT) for renewable electricity generation, a payment will be made per kilowatt hour (kWh) of heat produced.
Photovoltaics	**Medium to Poor** On average 8 years with feed in tariffs, 25 years without.	**Low** Installed on roof or façade areas.	**Low** No planning permission required.	**Low** No noise associated	**Good** Electricity can be used on site and/ or exported to the grid.	**Good** It will on average take 8 years for PV to pay back their initial cost, assuming the Feed In Tariff applies at the time of installation. Considering that PVs have a life expectancy of 25 years, they could pay back the capital cost several times during their life span.	Feed In Tariff. This is assumed to remain in existence, however it is time limited.
Solar Thermal Panels	**Medium** On average 10 years	**Low** Installed on roof or façade areas.	**Low** No planning permission required.	**Low** No noise associated	**Low** Heat can directly be used by the existing/ new heating system.	**Good** The energy and emissions cost of a SHW system forms a small part of the life cycle cost and can be recovered fairly rapidly during use of the equipment. Their environmental impacts can be reduced further by sustainable materials sourcing, using non-mains circulation, by reusing existing hot water stores and, in cold climates, by eliminating antifreeze replacement visits.	The Renewable Heat Incentive. Under this scheme it is proposed that, like Renewable Obligation Certificates (ROCs) and the Feed In Tariff (FIT) for renewable electricity generation, a payment will be made per kilowatt hour (kWh) of heat produced.
Wind	**Good to Poor** The payback time will depend on the size of the wind turbine. For building mounted micro wind turbines, the turbine may not be paid back within its life time. Medium wind turbines (100-850kW) will have a payback of around 7 years and large wind turbines (1MW-2.5 MW) have a pay back of around 4 years.	**Variable** Best performance in open, non-urban locations. Can be installed on, or integrated into, a building.	**Variable** Doesn't require planning approval providing that conditions as set up in the planning portal are met.	**Medium** The average wind turbine is very quiet, with indicative noise levels set at around 35-45 dB from 350m, about the same as a road 5 km away. Noise from wind in trees is louder than wind turbines at 300m.	**Medium** Electricity can be used on site and/ or exported to the grid.	**Good** The wind turbine will payback its energy cost several times within its lifetime.	Feed In Tariff.