12-0083

ENERGY STRATEGY REPORT

FOR

BACTON LOW RISE ESTATE REGENERATION

AT

LONDON BOROUGH OF CAMDEN, LONDON

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CONTENTS

EXECUTIVE SUMMARY

The Rolton Group, as part of the appointed design team for the proposed regeneration, have been requested to provide an updated energy strategy relating to the new housing development for the Bacton Low Rise Project. This document aims to provide details of the direction the team are taking with respect to the requirements of the applicable adopted policies including the London Plan, GLA and London Borough of Camden policies, including CS13 and DP22/23 on energy and carbon dioxide emissions for the proposed regeneration.

The document incorporates all applicable information from the ongoing detailed design of phase 1 of the scheme as well as the changes necessary due to unforeseen restrictions in the provision of heat from off-site sources. Where applicable, this design detail has also been applied to phases 2 and 3 of the scheme to provide a projected view of the whole development

This document incorporates the Be Lean, Be Clean, Be Green hierarchy as defined in the London Plan. With Be Lean seeking to minimise energy use through passive measures, i.e. maximising insulation, natural ventilation, etc. Be Clean minimising the use of energy, i.e. by utilising energy efficient lighting etc, and Be Green relating to the utilisation of renewable technologies.

PASSIVE DESIGN

The project is targeting CfSH Level 4, in accordance with the various local policies and to help achieve the required energy reduction figures the various houses, apartments/ flats and have and will be designed to achieve the following U values and air permeability rate.

Wall	0.13 W/m^2K
Floor	0.09 W/m^2K
Windows	1.5 W/m^2K
Roof	0.18 W/m^2K
Door	1.6 W/m^2K
Air permeability	4 $m3/m^2hr$@50Pa

These measures have helped to ensure minimises energy use before Low Carbon technologies are integrated.

LOW CARBON AND RENEWABLE ENERGY SOURCES

The original energy strategy found that the most efficient method of minimising carbon emissions was by using a central district heating distribution system incorporating a high efficiency gas turbine Combined Heat and Power (CHP) unit. The original heating solution for the scheme was, therefore, to utilise heat from the Royal Free Hospital CHP district heating system to provide heating and hot water to the development.

In developing this intent into a final design, however, it became apparent that the Royal Free system currently has insufficient capacity to meet the needs of the new development. This was explained during a meeting with Camden Borough Council's sustainability team on 7th November 2013; it was also confirmed that there would not be sufficient capacity on this system for at least 10 years. To overcome this shortcoming, the new development shall continue to utilise a local district heating network, with heat now provided by a dedicated on-site CHP unit.

As per the original intent, the CHP unit(s) will be installed to offset 20% of the development's carbon emissions; with this forming part of the phase 2 central heating installation. (Phase 1 will use temporary boilers until this system is online, when these boilers will be relocated into phase 2 to form a back up to the new CHP system). These boilers will be installed within a custom built enclosure located north of the future phase 3. Due to the size of the development, a conventional CHP unit will be used, as a gas-turbine engine is not suitable of an installation of this size. This system will be supported and backed up using gas-fired boilers as per the original intent.

The connection to the Royal Free district heating network shall still be extended into the new development to provide an opportunity for the future connection to the Royal Free network should this become appropriate at later date. (As this is dependent upon external factors it does not form part of the current scheme.)

As again mentioned in the original report, it is intended that this CHP system will be of a sufficient size and efficiency to provide the energy savings required for Code Level 4 and in doing so remove the need for any additional renewable or low carbon technologies.

ENERGY PREDICTIONS

To determine the estimated energy usage a detailed assessment of the energy demands and emissions for the proposed regeneration has been undertaken based on the Building Regulations Part L1A SAP 2009 calculations as undertaken by the project SAP assessor CalfordSeaden.

This assessment highlights the improvement in emissions ratings the development is expected to obtain above and beyond the Target Emission Rating required by the Building Regulations. Although SAP information is only currently available for phase 1, these results have been used to predict the performance of the whole scheme in order to assess its the overall impact and the extent of the measures necessary to offset part of these emissions as detailed above. These figures are provided both with and without non-regulated emissions as per the requirements of the Code and planning authority respectively.

Below is a graphical representation of the carbon emission savings anticipated due to the inclusion of the proposed energy efficiency and CHP measures. The project is targeting Code for Sustainable Homes Level 4 which is an improvement over the 2010 Part L1A Building Regulations emission rate of 25%.

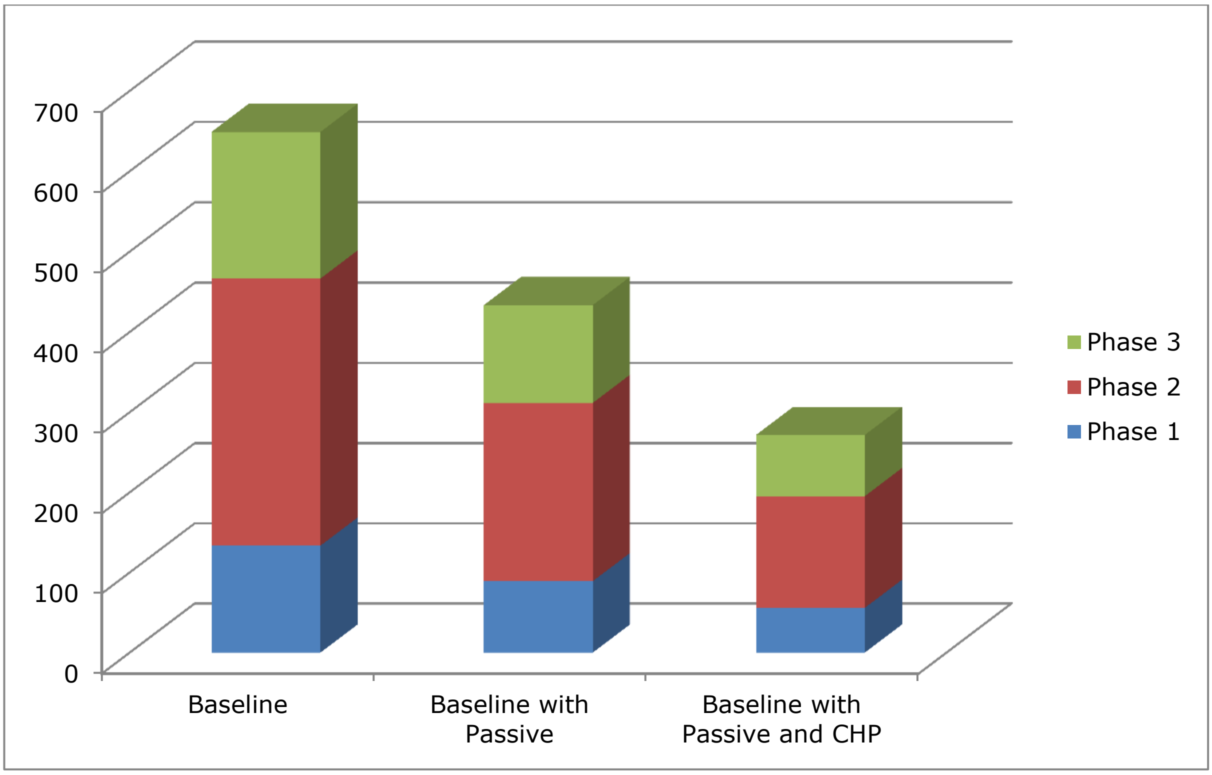


Chart 1 – CO_2 Emissions Showing Impact of Energy Saving (Excl. Non-Regulated Emissions)

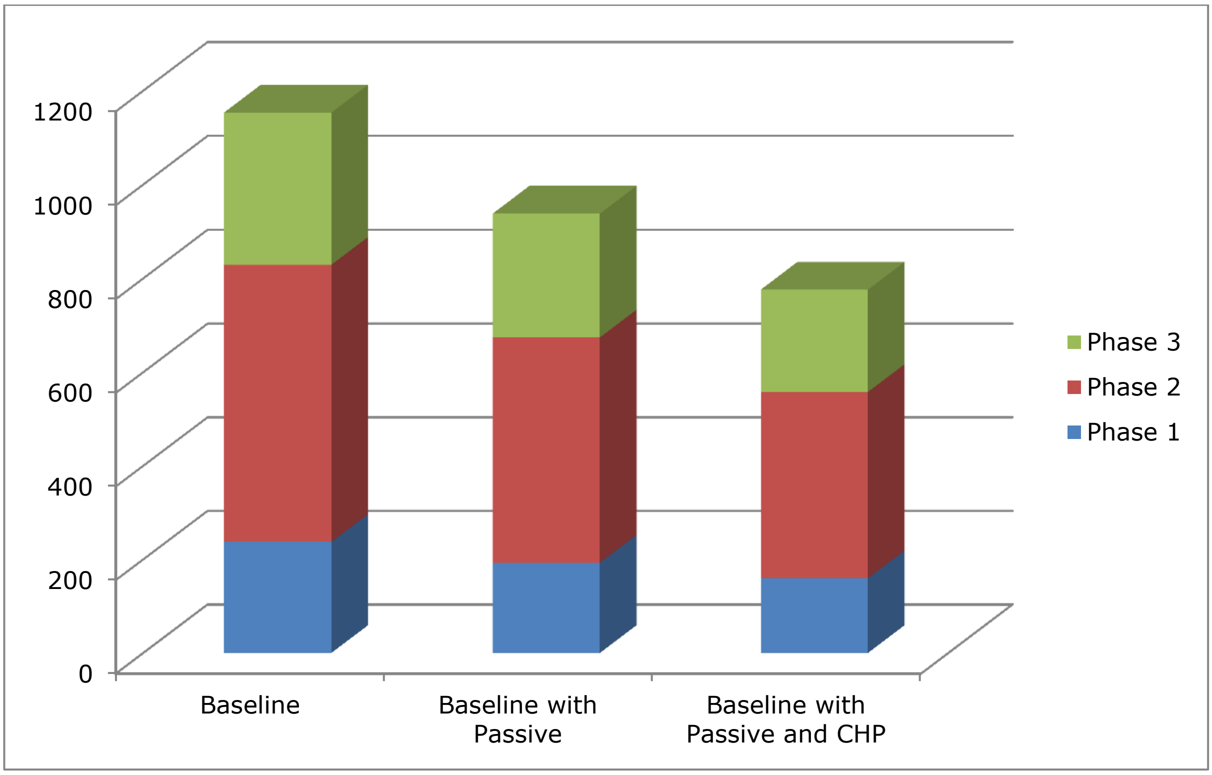


Chart 2 – CO_2 Emissions Showing Impact of Energy Saving (Incl. Non-Regulated Emissions)

THE BRIEF

The Rolton Group, as part of the appointed design team for the proposed regeneration, have been requested to provide a revised energy strategy relating to the new housing development for the Bacton Low Rise Project. This document aims to provide an updated view of the direction the team are taking with respect to the requirements of the applicable adopted policies including the London Plan, GLA and London Borough of Camden policies, including CS13 and DP22/23 on energy and carbon dioxide emissions for the proposed regeneration.

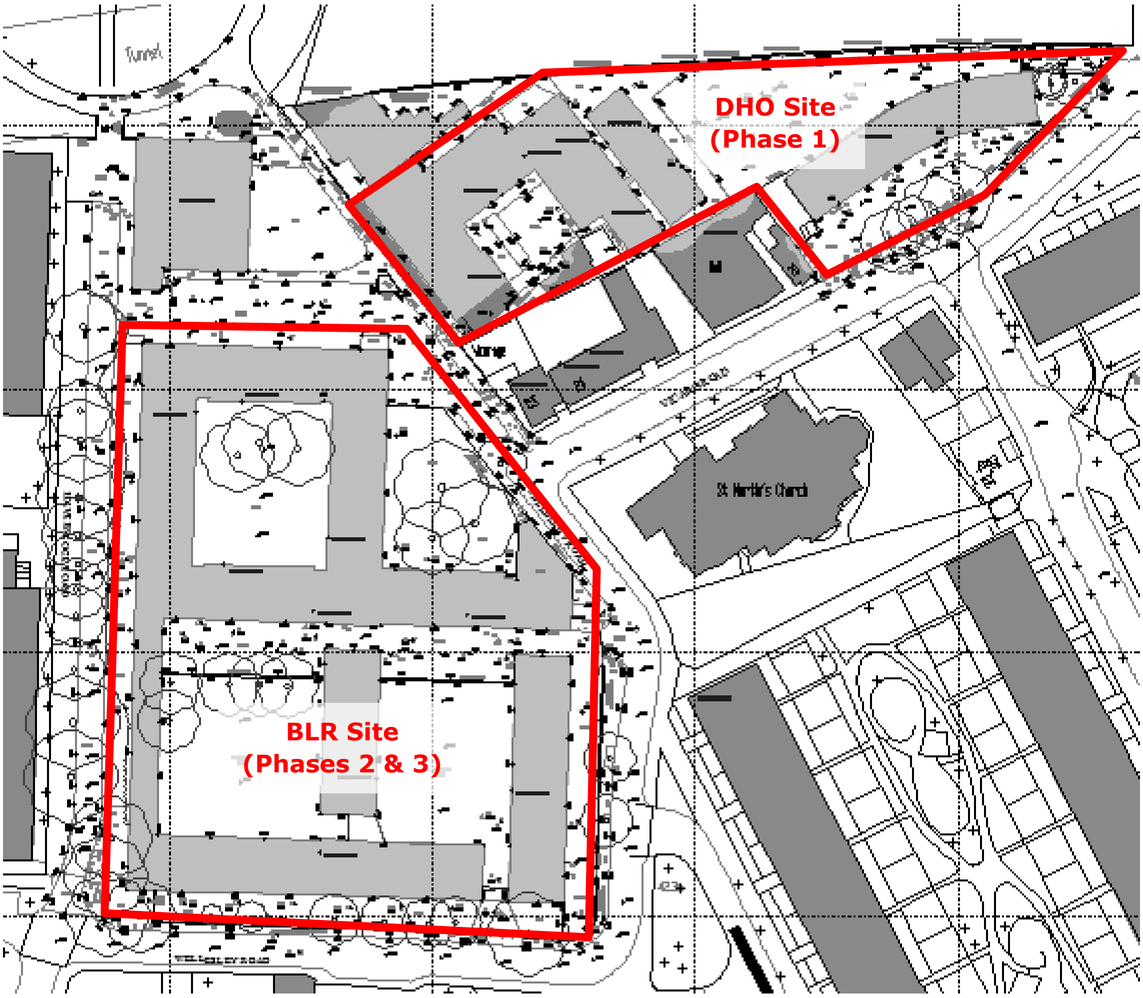
The areas that we have addressed within this document include the following:-

- Policy review
- Energy efficiency measures
- Incorporate combined heating and power system
- Provision of district heating
- Offset of CO_2 emissions with Renewables (CHP)

SITE DESCRIPTION

The proposed regeneration will require the demolition of existing residential, commercial and industrial buildings to provide 294 new residential units, with a development size of approximately 30,775 square metres (GIA). The development is divided into two sites (known as the DHO and BLR) with each containing social and market type houses, maisonette and apartments ranging from 1 to 4 bedrooms.

Design of phase 1 of the development is currently well underway, and these details have been used and expanded to provide energy and emissions information for the whole development.



POLICY REVIEW

A policy review has been carried out which includes in hierarchical order, national policy i.e. Planning Policy Guidance Notes and Planning Policy Statements, regional Policy i.e. the adopted London Plan SPG, and Core Strategy for the London Borough of Camden.

The London Borough of Camden Sustainability Camden Planning Guide (CPG3) has stated that the proposed regeneration shall be in accordance with the London Plan and the Supplementary Planning Document (SPD) Guide which is an additional "material consideration" in planning decisions. The Camden Planning document covers range of topics as well sustainability issues, the council is committed to reduce the Camden's carbon emissions by implementing large scale projects such as installing decentralised energy network alongside smaller scale measures such as improving the insulation and energy performance of the existing buildings.

Within the adopted London Plan and Camden Planning Guide there are identified various requirements which have been replicated below:-

CS13: Tackling Climate Change through promoting higher environmental standards

Core Strategy policy CS13 - *Tackling climate change through promoting higher environmental standards* encourages developments to meet the highest feasible environmental standards that are financially viable during construction and occupation. Paragraph 13.11 states that developments will be expected to achieve a 20% reduction in carbon dioxide emissions from on-site renewable energy generation unless it can be demonstrated that such provision is not feasible. The 20% reduction should only be attempted once stages 1 and 2 of the energy hierarchy have been applied.

WHAT DOES THE COUNCIL EXPECT?

All developments are to target at least a 20% reduction in carbon dioxide emissions through the installation of on-site renewable energy technologies. Special consideration will be given to heritage buildings and features to ensure that their historic and architectural features are preserved.

When assessing the feasibility and viability of renewable energy technology, the Council will consider the overall cost of all the measures proposed and resulting carbon savings to ensure that the most cost-effective carbon reduction technologies are implemented in line with the energy hierarchy.

The section 3 "A Sustainable and attractive Camden – Tackling climate change document refers to policy DP22 Promoting Sustainable Design and Construction,

DP 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) adopting the government target that all new build housing will be zero carbon by 2016 (Code for Sustainable Homes Level 6), along with the stepped targets of Code 3 by 2010 and Code 4 by 2013;

d) expecting developments (except new build) of 500sqm of residential floorspace or above or 5 or more dwellings to achieve 'excellent' in EcoHomes assessments from 2013 and at least 'very good' prior to 2013;

e) expecting non-domestic developments of 500sqm of floorspace or above to achieve 'very good' in BREEAM assessments, with the aim of increasing the target to a rating of at least 'excellent' in 2016, if feasible, and zero carbon from 2019, in line with the government's ambitions.

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.

According to the London Plan Spatial Development Strategy for Greater London the tackling climate change section states,

Policy 4A.1 Tackling climate change

The Mayor will, and boroughs should, in their DPDs require developments to make the fullest contribution to the mitigation of and adaptation to climate change and to minimise emissions of carbon dioxide.

The following hierarchy will be used to assess applications:

- using less energy, in particular by adopting sustainable design and construction measures (Policy 4A.3)
- supplying energy efficiently, in particular by prioritising decentralised energy generation (Policy 4A.6), and
- using renewable energy (Policy 4A.7).

The Camden Planning Guidance Sustainability CPG states the following energy hierarchy for sustainable building,

THE ENERGY HIERARCHY:

1. use less energy
2. supply energy efficiently
3. use renewable energy

The Camden Planning Guidance Sustainability CPG states the following energy hierarchy for sustainable building,

Within this document we have addressed the Be Lean, Be Clean, Be Green strategy as defined within the London Plan and Camden Strategy which targets in hierarchical order the most appropriate methods of minimising energy use.

Policy 4A.2 Mitigating climate change

The Mayor will work towards the long-term reduction of carbon dioxide emissions by 60 per cent by 2050. The Mayor will and boroughs and other agencies should seek to achieve the following minimum reduction targets for London against a 1990 base; these will be monitored and kept under review:

- 15% by 2010
- 20% by 2015
- 25% by 2020
- 30% by 2025.

The London Plan also states the above and within this document we have targeted a reduction in energy use by utilisation of the Code for Sustainable homes of which we will be targeting Code Level 4 for the residential development. Code Level 4 provides a 25% improvement compared to the requirements of the Building Regulations 2010 Part L1A which will be in excess of the London Plan.

Policy 4A.7 Renewable Energy

The Mayor will, and boroughs should, in their DPDs adopt a presumption that developments will achieve a reduction in carbon dioxide emissions of 20% from on site renewable energy generation (which can include sources of decentralised renewable energy) unless it can be demonstrated that such provision is not feasible. This will support the Mayor's Climate Change Mitigation and Energy Strategy and its objectives of increasing the proportion of energy used generated from renewable sources by:

- requiring the inclusion of renewable energy technology and design, including: biomass fuelled heating, cooling and electricity generating plant, biomass heating, renewable energy from waste (Policy 4A.21) photovoltaics, solar water heating, wind, hydrogen fuel cells, and ground-coupled heating and cooling in new developments wherever feasible
- facilitating and encouraging the use of all forms of renewable energy where appropriate, and giving consideration to the impact of new development on existing renewable energy schemes.

The policies above relates to the targeted renewables reduction and within this energy strategy document we outline the renewable technologies that have been considered and how renewable technologies will be utilised within the proposed regeneration to meet the Code requirements.

Policy 4A.9 Adaptation to Climate Change

The Mayor will, and other agencies should, promote and support the most effective adaptation to climate change, including:

- minimising overheating and contribution to heat island effects (Policy 4A.10)
- minimising solar gain in summer (Policy 4A.10)

With regards to the London Borough of Camden Planning Brief CPG3 we have paid attention to this document, in particular the sections relating to Decentralised Energy network and Combine Heat & Power under chapter 5 it states the following:-

Core Strategy policy CS13:-

5.2 The Mayor of London has set a target that 25 per cent of the heat and power used in London is to be generated through the use of localised decentralised energy systems by 2025. In order to achieve this target the Mayor prioritises the development of decentralised heating and cooling networks at the development and area wide level, as well as larger scale heat transmission networks.

5.3 We will expect developments to connect to a decentralised energy network and use the heat unless developers can demonstrate it is not technically feasible or financially viable.

What are developments expected to do?

5.11 Once a development has been designed to be as energy efficient as possible (Energy hierarchy - Stage 1), developments will be required to consider the following steps, in the order listed, to ensure energy from an efficient source is used, where possible:

1. investigating the potential for connecting into an existing or planned decentralised energy scheme and using heat
2. installing a Combined (Cooling) Heat and Power Plant (CHP or CCHP), including exporting heat, where appropriate
3. providing a contribution for the expansion of decentralised energy networks
4. strategic sites are to allow sufficient accessible space for plant equipment to support a decentralised energy network
5. designing the development to enable its connection to a decentralised energy network in the future

To cater the above the proposed CHP system utilised the waste heat from the Royal Free Hospital CHP gas turbines and provides the heating to all the dwelling at the proposed Bacton Low Rise. The details of the above have been provided within the district heating system section of this report.

The Camden Planning Guidance document also highlighted the fact that all the developments are to be target to reduce the amount of overall Carbon dioxide emissions arises to and from the proposed development, under chapter 6 Renewable Energy it states,

WHAT DOES THE COUNCIL EXPECT?

All developments are to target at least a 20% reduction in carbon dioxide emissions through the installation of on-site renewable energy technologies. Special consideration will be given to heritage buildings and features to ensure that their historic and architectural features are preserved.

When assessing the feasibility and viability of renewable energy technology, the Council will consider the overall cost of all the measures proposed and resulting carbon savings to ensure that the most cost-effective carbon reduction technologies are implemented in line with the energy hierarchy.

To address the above, calculations have been carried out to demonstrate the overall CO_2 emissions reduction from the targeted emissions and the results shows the over 20% required target would be achievable through the proposed technology. The predicted site energy section of this report will address the above policy.

PASSIVE DESIGN OVEREHATING AND COOLING REQUIREMENT

With regards to 'Passive Design', this is the process of best employing the conventional elements of construction to both reduce energy consumption and to make best use of the natural elements such as daylight, sunlight and natural ventilation, this will also take into consideration the minimisation of overheating which, in well insulated dwellings, becomes as significant in comfort as the energy reduction measures.

This can include the following:-

- The improvement of building fabric U-values
- The improvement of the air permeability of the building
- The use of the shape of the building to limit heat loss and optimise useful solar heat gain
- The optimisation of daylight to reduce the need for artificial lighting
- The use of natural screening of sources of glare or noise
- The use of natural ventilation and cross ventilation

The passive measures that are being employed for this project include where appropriate:-

- Reducing U-values below the levels required to achieve compliance
- Reducing air permeability below the level required to achieve compliance
- Using the shape of the building to limit heat loss and optimise useful solar heat gain. This can be achieved by:-
    - having occupied spaces facing within 30° of due south
    - reducing heat losses through the use of courtyards
- Optimising daylight by:-
    - appropriate use (size and position) of windows in occupied areas
    - using courtyards or atria to introduce daylight to 'deep plan' areas
- The use of natural ventilation through the use of:-
    - openable windows
    - courtyards to provide cross flow ventilation (with the possibility of utilising stack effect ventilation) whilst limiting the effects of direct wind force through the residences

DWELLINGS

For the Bacton Low Rise regeneration an initial assessment of the use of overhangs, natural shading, thermal mass, natural ventilation and, where available, cross ventilation helped formulate the original design and has minimised the possibility of overheating. The worst case scenarios of the various dwelling types was modelled in TAS modelling software and the likelihood of high internal temperatures during summer analysed using the SAP calculation programme which is the Building Regulations method of assessment for overheating, further checks were carried out utilising the TAS simulation program for typical units including each different type of dwelling (one Bedroom, Two Bedroom & Three Bedroom apartments and four Bedroom Maisonette).

The results indicated that with the option of fully opening windows the likelihood of overheating is 'not significant', however it is recognised that due to security and other issues, it may not be feasible to have windows fully open, in particular on lower storeys.

A more detailed analysis was therefore undertaken to help inform the design as the detail progressed, this included an assessment of the amount of glass, blank panels, consideration and utilisation of solar glass, which will helped mitigate excessive solar gain, together with an assessment of the use of a whole house ventilation systems, these will have a positive impact on overheating which will be incorporated into the design, this would be above the requirements of Building Control but will help ensure that the dwellings remain comfortable.

U VALUES

With regards to the improvement of U-Values to minimise heating energy used we have tabulated out the two scenarios of U-Values, the first being the current benchmark with the second showing the targeted U-Values to help meet the code requirements subject to viability for the Bacton Project:-

U-Values *[W/m²/K]*

	UK Typical Common Practice	Proposed Standards
Wall Insulation	0.30	0.13
Roof	0.20	0.09
Floor	0.25	0.18
Glazing	2.00	1.5
Door	2.00	1.60

DISTRICT HEATING AND COMBINED HEAT AND POWER STRATEGY

Once the passive measures have been assessed, the adopted Camden Planning Guidance CPG3 looks to implement the decentralised energy network within a scheme to utilise CHP in conjunction with a site wide district heating main.

Due to the multi storey nature of the Bacton project, it is well suited to the connection of a district heating system. It is proposed to serve the various dwellings via the integrated CHP system and a piped distribution network. The benefit of this system will also enable the affordable, private dwellings, commercial properties and possible other future offsite users to be linked into the network and maximise the usage of the CHP installation.

Combined Heat and Power (CHP) involves the on-site generation of electricity and the effective use of the 'waste' heat from this process. The high efficiency of this system is due to the fact that more of the energy input to the process is utilised than with traditional (grid) electricity generation. The electrical transmission losses associated with grid electricity are also minimised.

Factors that will be considered in the detailed design of the system (as part of the phase 2 works) are as follows:

- Provision of a proportion of the site electrical load via the CHP system along with the provision of the subsequent 'free' hot water and heating.
- Gas technology is well proven and integrates well with traditional systems.
- Operates well with multi use sites. Integration from Royal Free Hospital will be re-evaluated by the project as the load profiles would benefit from a wider and more varied distribution increasing hours run and system size, and therefore increasing the efficiency of the system.
- These systems need to be carefully designed so as to accurately match the heat and power requirements of the site.
- Can provide cooling to adjacent developments or onsite by bringing the District heating pipe work into a suitable client plant room where an absorption chillers would produce chilled water from the heat generated.

A key target for the development is to meet the Code for Sustainable Homes Level 4 and have 20% of its CO2 demand served from low carbon sources through the installation of a suitably sized CHP system. A CHP system will be integrated into the scheme as the main low carbon energy technology as part of the phase 2 works.

ENERGY ASSESSMENT

APPROACH

The approach taken by this report is in accordance with London Borough of Camden adopted Bacton Low Rise Planning Brief Supplementary Planning Guidance document and the adopted London Plan Supplementary Planning Guide which follows the hierarchy:

- Be Lean, using less energy, in particular by adopting sustainable design and construction measures
- Be Clean, supplying energy efficiently, in particular by prioritising decentralised energy generation
- Be Green, using renewable energy

The Essential Standards highlighted in the adopted London Plan Supplementary Planning Guide have been used to focus the solutions to the most appropriate technologies and passive systems. We are targeting the required 20% figure for the Bacton Project:-

ENERGY PREDICTIONS

This report provides an assessment of the energy demands and emissions for the proposed regeneration highlighting the improvement over the benchmark emissions relating to the Target Emission Rating defined within the Building Regulations 2010, these figures are for the complete development and exclude non-regulated emissions.

To achieve the energy reduction figures detailed above we have utilised the results of the Building Regulations Part L1A SAP 2009 calculations as undertaken by the project SAP assessor CalfordSeaden. We have also included for the use of a central district heating distribution system that incorporates a suitably sized combined heat and power system.

Initially to understand the energy reductions required to meet the requirements of the Code for Sustainable Homes we have calculated the anticipated energy demand.

Based on the design team information, CalfordSeaden have undertaken the calculations set out in 'The Government's Standard Assessment Procedure for Energy Rating of Dwellings' (SAP 2009), which forms the basis of the calculations set out in The Code for Sustainable Homes 2010. These calculations have been undertaken for all dwellings within phase 1 of the development and the results used to assess the emissions resulting from this and all future phases.

When examining these results we were able to determine the extent of the improvement in carbon emissions the development achieved above the target in order to show the 25% energy reduction required by Level 4 of the Code for Sustainable Homes. In due course when more detailed information is available for the future phases, there will be a requirement for further checking and analysis to confirm our assumptions and tailor these buildings towards the optimal solution for each block/site.

RENEWABLE ENERGY OPPORTUNITIES

For the provision of Renewable Energy, a number of established renewable technologies have been looked into to reduce the use of fossil fuels and reduce overall onsite energy consumption.

With regards to the supplementation of the current passive measures the Bacton scheme will be utilising a combined Heat and Power system which fulfils the heating demands of the development. The current Building regulations Part L1A 2010 document sets out the carbon emission targets for all building developments within the UK. In 2010 Part L requirements were increased to achieve 25% better than the 2006 regulations, and calculations (based on the actual SAP calculations) were used to compare the scheme to a notional equivalent 2006 building. In 2010 these regulations were increased again by another 25%, which equates to 44% better than 2002 regulations. In 2013 it is intended to increase the improvement by a further 25%.

Experience gained from in undertaking Part L calculations indicates that the achieving Part L 2010 is very difficult if we just consider the building fabric and for that reason we would suggest the inclusion of renewable and/or low carbon technologies which can offset the 20% CO2 emissions target as governed by the Standard assessment procedure (SAP) calculations.

This section deals only with the selection of appropriate renewable and clean technologies which are suitable for the application. Please note that annual energy figures are used throughout this report to allow the comparison of non-linear energy uses such as heating systems etc.

Achieving CO_2 reduction

BE CLEAN

The following technologies come under the heading of 'Clean' as they are efficient ways of generating energy, or supplying energy in an efficient manner.

The following solutions have been assessed to provide the optimum level of energy that can be achieved for a level of investment acceptable to the client. Below, we have highlighted the most common 'Clean' technologies and commented on their appropriateness for the proposed development.

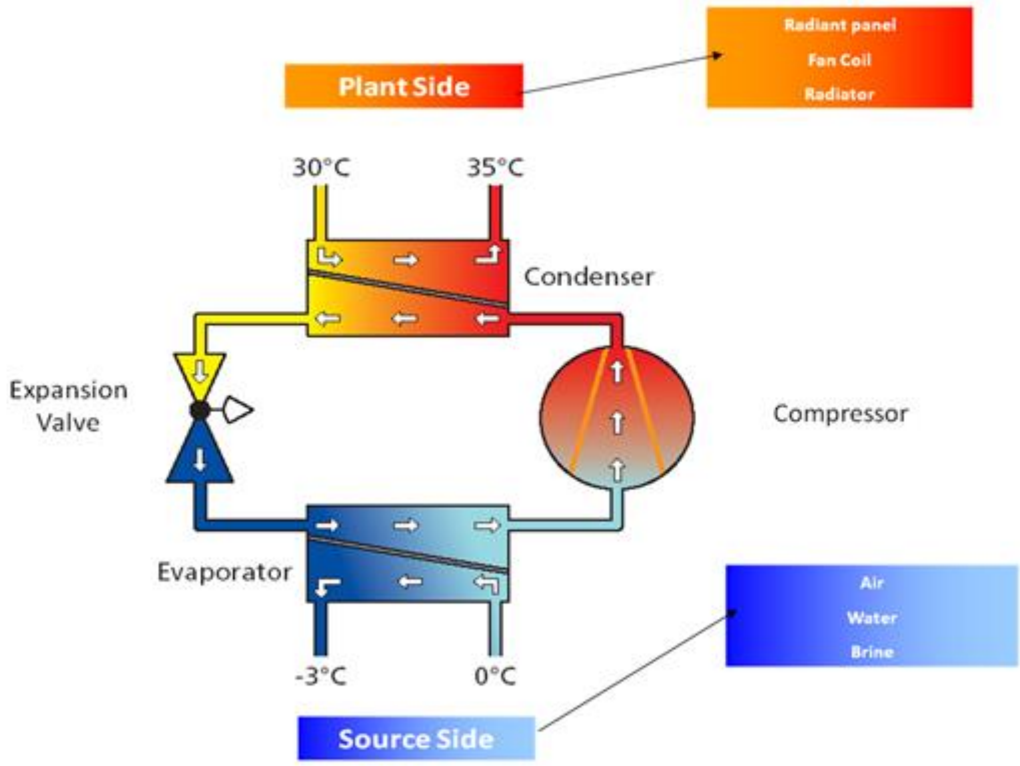
Biomass Heating

Biomass heating consists of a boiler that produces hot water from the combustion of wood chips or wood pellets. The location of the site needs to be within 25 miles of a biomass fuel source. A plant room area would be required and space for biomass and ash storage. High maintenance of the equipment and storage are often the main reasons for these types of facilities not being utilised. Such a system requires a high amount of input from the user, relative to a traditional gas fired installation, to work effectively. For our typical house model we would require a weather proof store of approximately 3m^2 to allow for a pellet fuel storage facility including automatic fuel feeding system.

Currently, for the project there is a local suitable supply of biomass in the area but due to the working characteristics and high maintenance input from user the system will not be suitable for this development.

Heat pumps

Heat pumps are efficient clean sources of energy. A heat pump uses a refrigerant as a medium to exchange heat between the building and a heat source. There are two types of heat pump, an air source heat pump which exchanges the heat with the outside air and a ground source heat pump which exchanges heat with the ground via a bore hole or a coil of pipe within the ground (known as a slinky). A heat pump uses a compressor to change the thermodynamic state of the refrigerant with minimal energy input. This process changes the temperature of the refrigerant to a level where natural heat transfer occurs between the refrigerant and the air or ground. For example if we compress a fluid it becomes hot and we are able to transfer this heat between the heat pump and the building. This process reduces the temperature of the refrigerant, but if we allow it to expand it reduces the refrigerant temperature further. This state of the refrigerant can then be put through a heat exchanger to the outside air or ground where is can then gain the heat lost to the building back from the outside, before the process starts all over again. The following diagram shows this process.



Because of the natural heat transfer which occurs in the above system, we are able to transfer more heat into the building that the electrical energy used to power the compressor. For this reason we use the term coefficient of performance (COP) rather than efficiency.

Heat pumps can provide both heating and cooling with typical COPs of 4.0-6.0 for ground source and 2.5-3.0 for air source heat pumps. Although the efficiencies for ground source systems are better, the associated extra costs over air source systems tend to make them much less viable for small installations. Also large ground source heat only heat pumps are not viable as they extract so much heat from the ground that the ground will freeze and would not be able to recover.

A slinky ground source heat pump system for a dwelling would normally require approximately 200m of pipework buried at 1-2m. Current proposals are to provide make up ground at Deanshanger and this system may be able to be included within these proposals.

The air source heat pump technology includes an outdoor unit which allows for the heat transfer between the refrigerant and the outdoor air. It is therefore important to consider the positioning of the outdoor units as a good airflow is required to help with the heat transfer which in turn will help to maintain a high COP for the system. For clarity the 799 kWh/annum detailed in the table above is equivalent to 5.96m^2 of PV.

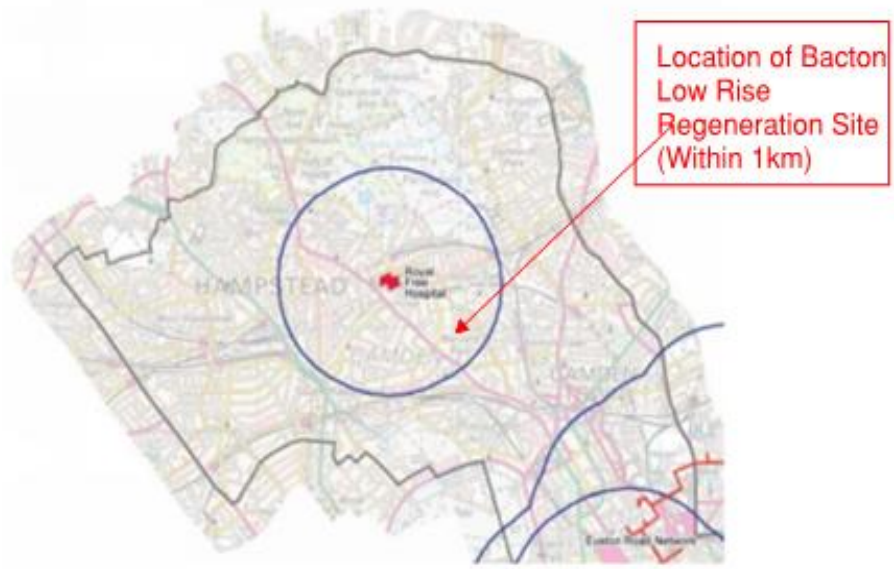
For the development, heat pump technology could be used to minimise energy use and CO_2 emissions, although at this stage of the development, the siting of external units would form a further space planning issue. For this reason, and the desire to use a central CHP solution, this technology has not been included for ongoing consideration.

Biomass/gas combined heat and power

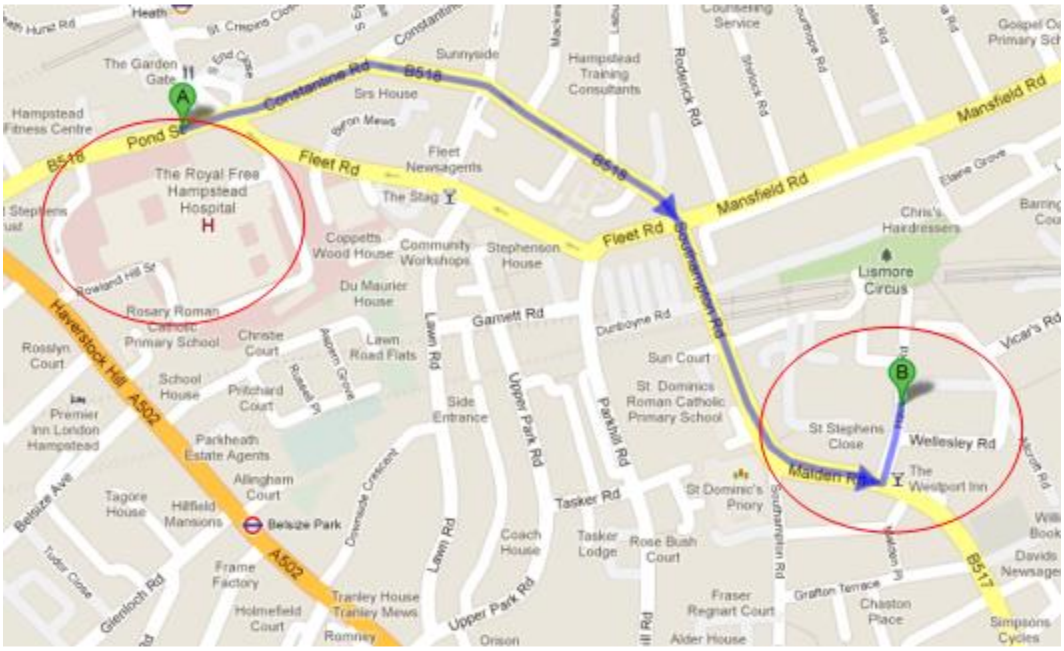
This is a very efficient system which can provide heating, cooling and electricity, but is only suitable for buildings with high periods of heating or hot water demand such as leisure centres and industrial buildings. When heat is not required by the heating system, it could be used to provide energy for the hot water generation. When electricity is not required on the site, then it can be exported to serve the surrounding facilities, assuming the heating/domestic load is not being met. These systems can also be integrated with absorption chillers to provide chilled water. Therefore the existing CHP system which has been installed at Royal Free Hospital will provide the access heat to facilitate the proposed Bacton development.

Potential for Communal Heating and CHP:

Below map has been taken from the Camden Planning Guidance Core Strategy document indicates the proximity of the proposed Bacton Low Rise Regeneration development and Royal Free Hospital (proposed heating CHP network). The proposed development is within 1km Close proximity to the Royal Free Hospital Combine Heat and Power scheme and can be benefitted from the existing system.



The above map is taken from map 4 of Camden Planning Guidance



The above map shows the distance from Royal Free Hospital to the proposed Bacton development

> The above confirms that the use of CHP will provide a feasible solution to the production of energy for this project enabling a reduction in the site energy demand. The detail design will take into consideration the base loads in conjunction with the use of a thermal store. This type of technology will be utilised for the development in conjunction with a district heating system.

BE GREEN

The following technologies come under the heading of 'Green' as they are renewable sources of energy only requiring the natural elements to provide energy.

Below, we have highlighted the most common 'Green' technologies and commented on their appropriateness for the proposed development.

Solar water heating

The utilisation of evacuated tubes or solar panels mounted on the roof can save up to 50-60% of annual energy requirement for domestic hot water. However, there is still a requirement for domestic water generation equipment to cover cloudy days and to top up the energy that the solar heaters cannot provide. These installations are available for domestic installation but will need a hot water storage facility to be provided. Although these items are particularly suited to high hot water load buildings such as kitchens and sports facilities, modern dwellings can also benefit.

Typically solar hot water generators in the UK are able to provide approximately 450kWh per annum per m^2 of collector, and studies from the Energy Saving Trust have shown that savings in the region £55/year on average are achieved over heating the hot water with gas.

Note: Solar hot water systems are not sized in peak kilowatts as this figure is dependent on the solar radiation and the flow rate of the water within the system. The flow rate of water within the system should be designed such that the system won't overheat, i.e. the water temperature shouldn't reach more than 90 degrees Celsius.

> The use of solar water heating is not complementary with these technologies due to the requirement of the CHP system targeting the provision of energy for the base demand, any Solar thermal system employed would therefore reduce this base demand and the overall size of the CHP system which is contrary to the design intent of this type of system, and we have therefore discounted this at this stage.

Wind turbine

The main advantage of wind turbines is that the energy is free and with modern technology it can be captured efficiently. It is therefore a fully renewable source of energy and produces no pollution (apart from the pollution from manufacturing). However, wind turbines do not produce the same amount of electricity all the time and there will be periods when they produce no electricity at all.

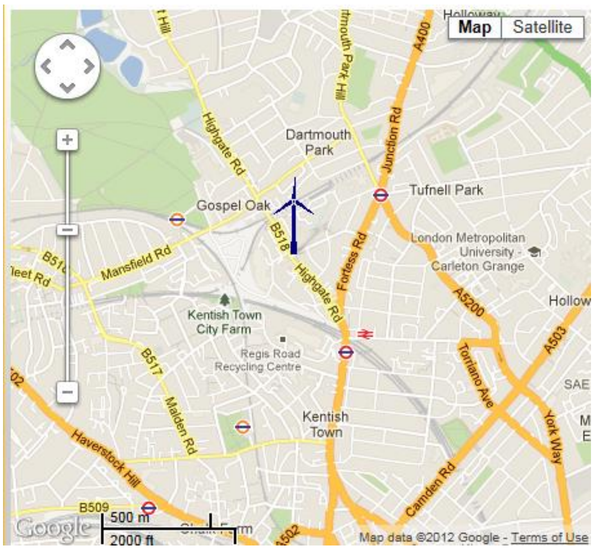
When in operation, they can also disturb local bird populations and cause death to those venturing too close to the rotating blades. However the RSPB states that this is insignificant in comparison to the problems that will be caused to birds if Global warming is left unchecked. Wind turbines can be column mounted or building mounted. The more efficient of these is the column type of up to 150m, which can produce a peak output of 3MW each.

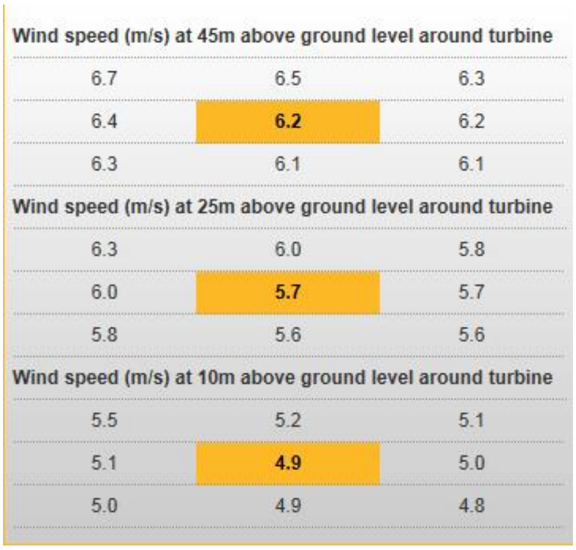
Unfortunately, wind turbines are not suitable for sites of a restricted size and limited network connectivity. For this type of site we would suggest that pole mounted devices of typically 6-11m in height would be more suitable. These can cause an aesthetic issue which would need to be addressed and turbulence from adjacent buildings and trees may make the solution unviable. These units can increase ambient noise levels which may prove problematic with the neighbours.

A typical installation for a domestic wind turbine would be a Kingspan wind 3kw unit on a 6.5-11m pole. This will have a rotor diameter of 3.9m and in average wind speed areas of 5m/s could produce up to 4500 kWh per annum.

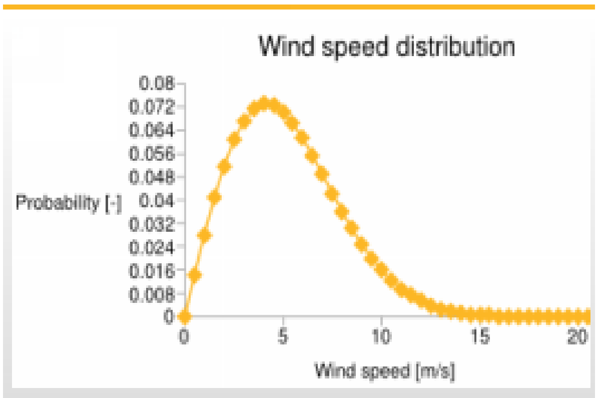
Alternatively building mounted turbine can be provided, such as the 1.5kW 'Swift' manufactured by Renewable devices, which includes an immersion heating so that any electrical energy not being used is transferred to heat the hot water in the dwelling. With average wind speed of 5.5m/s this type of turbine could produce up to 1753 kWh per annum.

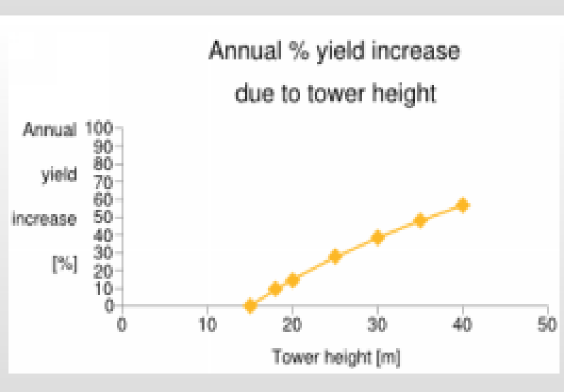
The following was extracted from the DTI wind speed database and shows the annual mean wind speed for the site and its relevant grid in the yellow box, this varies for differing heights of turbines.





Wind speed (m/s) at 45m above ground level around turbine		
6.7	6.5	6.3
6.4	6.2	6.2
6.3	6.1	6.1
Wind speed (m/s) at 25m above ground level around turbine		
6.3	6.0	5.8
6.0	5.7	5.7
5.8	5.6	5.6
Wind speed (m/s) at 10m above ground level around turbine		
5.5	5.2	5.1
5.1	4.9	5.0
5.0	4.9	4.8





With the above calculated yield the occupier would be able to save up to £354.48 on their energy bill depending on the utilisation of the available energy, but would also be eligible for 10.4p per kWh generated from the governments feed in tariff, however the Feed in Tariff is now linked to index and the above figure would be different at the time of application.

These systems typically need a minimum average wind speed of 5m/s with an average of 7m/s to work effectively. The figures for this site are less than the minimum average speed requirement at 10m. We would therefore suggest this technology is not utilised for this site.

Photovoltaic

The utilisation of PV in the UK is currently at a fairly low level due to the lack of good external light levels along with expensive equipment compared to other renewable technologies. The photovoltaic cells absorb direct sunlight and with use of semiconductors change this directly into electrical current. In the UK they are particularly suited to powering remotely located items of electrical equipment with low electrical loads such as parking meters, and illuminated road signs, as the cost for cabling and power lost in transfer make it more economic. Some street light manufacturers have introduced LED luminaries with built in PV's which is an ideal packaged solution.

As the technology develops and as integrated roof solutions become readily available which reduce the cost by implementing the PV panels as the roof covering, then the feasibility of this type of system increases.

The main draw back with PV generated electricity is that the profile of generation is usually not matched by the load profile of the building. It is obviously much simpler to use the energy generated directly, as any type of power storage reduces the efficiency of the system, but matching the supply and demand profiles is out of the control of the consumer.

We would therefore suggest that PVC's are looked at and utilised for the provision of some of the remote external lighting requirement for this site such as bin stores etc. This will also provide minimisation of external cabling to the lighting which has a significant benefit in cost and energies expended for the excavation and cable installation.

PV supplied external lighting could be utilised in the development to generate electricity, and whilst it does not form part of the current design, could be incorporated into future phases

Rainwater and greywater harvesting

A rainwater harvesting system is where the rainwater drainage system on a property is used to capture water in a storage facility such as a water butt or a water storage tank. This water is then used irrigate the garden or even to flush the toilet within the house. A greywater system takes the waste water drainage within the house including the sinks and bath (but not the toilet), filters it to remove soap etc. is sterilised so it is suitable for storage and then stored for later use for flushing the toilet.

Within the UK, the provision of water from the local authorities generally uses 1kWh per m^3 to clean and pressurise the supply to the point of use. By introducing a rainwater or greywater harvesting system not only are we able to reduce water usage which also saves the consumer money, we are able to reduce the energy usage and carbon emissions from the water supplier.

It should be noted that although technically we can save energy and carbon through using rain water harvesting, it is not taken into account within the Part-L calculations as it is not a energy saving directly associated with the development.

Having said that there are credits available within the Code for sustainable homes for including a rainwater or greywater system within the development.

A study by the Environment agency in a property which collected water from house similar to our standard model they were able to save 53% of their potable water. With an approximate water usage of 164 m^3 for our standard model this could equate to an annual saving of £96.48 on the water and drainage bill.

It is understood that water retention is required on site; therefore it should be easy to integrate this requirement into the development.

A rainwater recycling system could be provided which will capture rainwater, before pumping it to supply any external irrigation requirements. Basic rainwater collection systems are incorporated into phase 1 (water butts), and whilst not currently considered, a full rainwater harvesting system could be incorporated into future phases.

PREDICTED SITE ENERGY RESULTS

The following assessment is based on Building Regulations Part L1A SAP 2009 calculations as undertaken by the project SAP assessor CalfordSeaden for all dwellings forming phase 1. Where appropriate, these results have been increased (pro-rata based on floor area) to enable the assessment of the future phases.

This assessment is therefore based on the following:

- Modelling of selected one, two, three and four bedrooms flats and maisonette
- Calculation of Baseline (2010) emissions (Taken as the calculated Target Emission Rate)
- Improvements above 2010 regulations as detailed within this report
- Team target to meet Code for Sustainable Homes Level 4

Energy Efficiency

To reduce the energy use below the 2010 regulations, materials with the following properties have been used for the building design. As shown, these are significantly better the required Part L1A 2010:-

Element	**Area weighted average U-values required by Part L [W/(m^2 K)]**	**Calculated area weighted U-values for actual building [W/(m^2 K)]**
Wall	0.30	**0.13**
Floor	0.25	**0.09**
Roof	0.20	**0.18**
Door	2.00	**1.6**
Window	2.00	**1.5**

We have also improved a number of other items including the following:-

- Improved Systems and Lighting Efficiencies by proposing 100% low energy internal lighting
- Whole house ventilation system with heat recovery system
- Air pressurisation to Q_{50} = 4 m^3/hr m^2

The results of the Standard Assessment Procedure (SAP) 2009 calculations are shown below:

Unit	Actual	Target
	kgCO2/m²/year	
A-1	10.87	20.17
A-2	8.96	17.98
A-3	10.10	17.85
A-4	9.00	15.91
A-5	10.78	16.23
A-6	8.09	15.40
A-7	8.48	14.74
A-8	9.66	15.95
A-9	10.78	16.23
A-10	9.59	18.57
A-11	8.12	14.40
A-12	8.48	14.74
A-13	9.66	15.95
A-14	10.78	16.23
A-15	8.84	16.71
A-16	8.12	14.40
A-17	8.48	14.74
A-18	10.54	16.86
A-19	13.15	18.53
A-20	10.54	18.43
A-21	10.67	17.79
A-22	10.88	17.09

Unit	Actual	Target
	kgCO2/m²/year	
B1-01	8.82	17.21
B1-02	7.91	16.00
B1-03	7.91	16.00
B1-04	7.91	16.00
B1-05	7.91	16.00
B1-06	7.15	13.37
B1-07	7.15	13.34
B1-08	7.15	13.34
B1-09	7.15	13.34
B1-10	7.61	15.42
B1-11	7.61	15.42
B1-12	7.61	15.42
B1-13	8.87	17.32
B1-14	9.33	17.13
B1-15	8.23	15.46
B1-16	8.23	15.46
B1-17	8.23	15.46
B1-18	8.59	16.25
B1-19	8.57	16.18
B1-20	8.32	15.60
B1-21	8.32	15.60
B1-22	9.57	17.32
B2-01	9.86	17.19
B2-02	9.86	17.19

Unit	Actual	Target
	kgCO2/m²/year	
C-01	11.04	20.49
C-02	10.95	21.35
C-03	9.59	16.99
C-04	8.87	16.47
C-05	11.45	19.34
C-06	11.89	19.06
C-07	10.52	19.16
C-08	8.38	15.43
C-09	9.76	15.92
C-10	11.89	19.06
C-11	10.05	18.00
C-12	8.38	15.43
C-13	9.76	15.92
C-14	11.89	19.06
C-15	10.05	18.00
C-16	10.45	17.75
C-17	12.15	18.23
C-18	11.89	19.06
C-19	12.67	21.26
C-20	12.00	18.61
C-21	9.00	15.91

The above tables demonstrate the significant improvements have been achieved with regards to carbon emissions resulting from the passive measure introduced and the introduction of community district heating Combined Heat and Power (CHP).

The above analysis shows the overall emission reductions from phase 1 of the development. These results have been applied to the whole development (pro rata based on floor area) and the tables show the effect of each emission reducing measure included for each part of the development:

Scenario	**Carbon Dioxide tCO_2 per annum**	**Saving [tCO2/year]**	**Scenario Saving (excl. Appliances)**	**Total Saving (excl. Appliances)**
Building Regulation (Baseline)	133.44	-	-	-
Baseline with Passive	89.14	44.30	33%	33%
Baseline with passive and CHP	55.85	33.29	37%	58%

Table 1: Phase 1

Scenario	Carbon Dioxide tCO2 per annum	Saving [kgCO2/year]	Scenario Saving (excl. Appliances)	Total Saving (excl. Appliances)
Building Regulation (Baseline)	333.02	-	-	-
Baseline with Passive	222.46	110.56	33%	33%
Baseline with passive and CHP	139.39	83.08	37%	58%

Table 2: Phase 2

Scenario	Carbon Dioxide tCO2 per annum	Saving [kgCO2/year]	Scenario Saving (excl. Appliances)	Total Saving (excl. Appliances)
Building Regulation (Baseline)	182.42	-	-	-
Baseline with Passive	121.86	60.56	33%	33%
Baseline with passive and CHP	76.35	45.51	37%	58%

Table 3: Phase 3

Scenario	Carbon Dioxide tCO2 per annum	Saving [kgCO2/year]	Scenario Saving (excl. Appliances)	Total Saving (excl. Appliances)
Building Regulation (Baseline)	648.88	-	-	-
Baseline with Passive	433.46	215.42	33%	33%
Baseline with passive and CHP	271.59	161.87	37%	58%

Table 4: Whole Development

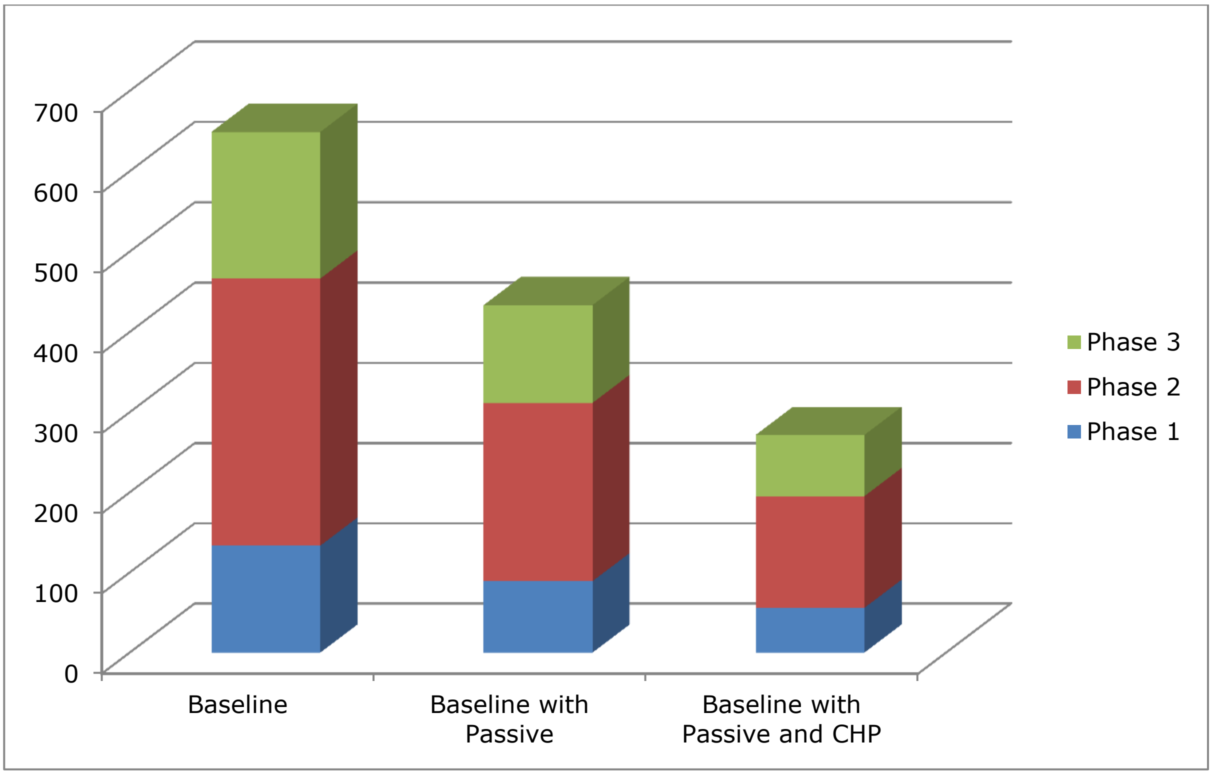


Chart 1 – CO_2 Emissions Showing Impact of Energy Saving (Excl. Non-Regulated Emissions)

The above graph and the tables show the impact of the passive improvements and CHP inclusion (from a base scenario) on the 'regulated' CO_2 emissions from the development.

SUMMARY

From the comparison to the 2010 base level emission values, the calculations carried out for the development show that the passive measures create a 33% reduction in CO2 emission for the proposed development.

The integration of the CHP is then shown to provide a further 37% reduction (58% total), which exceeds the 25% reduction requirements of Code Level 4. For the code calculation appliances and cooking is not taken into consideration.

SITE WIDE ENERGY ASSESSMENT INCLUDING NON REGULATED LOADS

The calculation process used above defines the relevant energy use of the site. This has been carried out in line with the Government's Standard Assessment Procedure for Energy Rating of Dwellings, 2009 version 9.90 (SAP). This assessment procedure also provides the energy improvement target for The Code for Sustainable Homes, this is by default the standard method for measurement as defined in the Building Regulations and currently the project is targeting Code Level 4.

We understand that the adopted London Plan SPG and Camden Planning Guide CPG3 requests calculations to be carried out integrating the cooking and appliance loads into the process and whilst this is not required for the Code for Sustainable Homes assessment below Code Level 6 therefore we have further calculated the impact of non-regulated emissions (i.e. cooking and appliances) and listed in the table below, again as provided in the SAP calculations:

Scenario	Carbon Dioxide [kgCO2/year]	Saving [kgCO2/year]	Scenario Saving (inc. Appliances)	Total Saving (inc. Appliances)
Baseline with Appliances	237.13	-	-	-
Baseline with Appliances and Passive Measures	192.83	44.30	18%	18%
Baseline with Appliances Passive Measures and CHP	159.55	33.29	17%	32%

Table 1: Phase 1

Scenario	Carbon Dioxide [kgCO2/year]	Saving [kgCO2/year]	Scenario Saving (inc. Appliances)	Total Saving (inc. Appliances)
Baseline with Appliances	591.82	-	-	-
Baseline with Appliances and Passive Measures	481.26	110.56	18%	18%
Baseline with Appliances Passive Measures and CHP	398.19	83.08	17%	32%

Table 2: Phase 2

Scenario	Carbon Dioxide [kgCO2/year]	Saving [kgCO2/year]	Scenario Saving (inc. Appliances)	Total Saving (inc. Appliances)
Baseline with Appliances	324.18	-	-	-
Baseline with Appliances and Passive Measures	263.62	60.56	18%	18%
Baseline with Appliances Passive Measures and CHP	218.12	45.51	17%	32%

Table 3: Phase 3

Scenario	**Carbon Dioxide [kgCO2/year]**	**Saving [kgCO2/year]**	**Scenario Saving (inc. Appliances)**	**Total Saving (inc. Appliances)**
Baseline with Appliances	1153.13	-	-	-
Baseline with Appliances and Passive Measures	937.72	215.42	18%	18%
Baseline with Appliances Passive Measures and CHP	775.85	161.87	17%	32%

Table 4: Whole Development

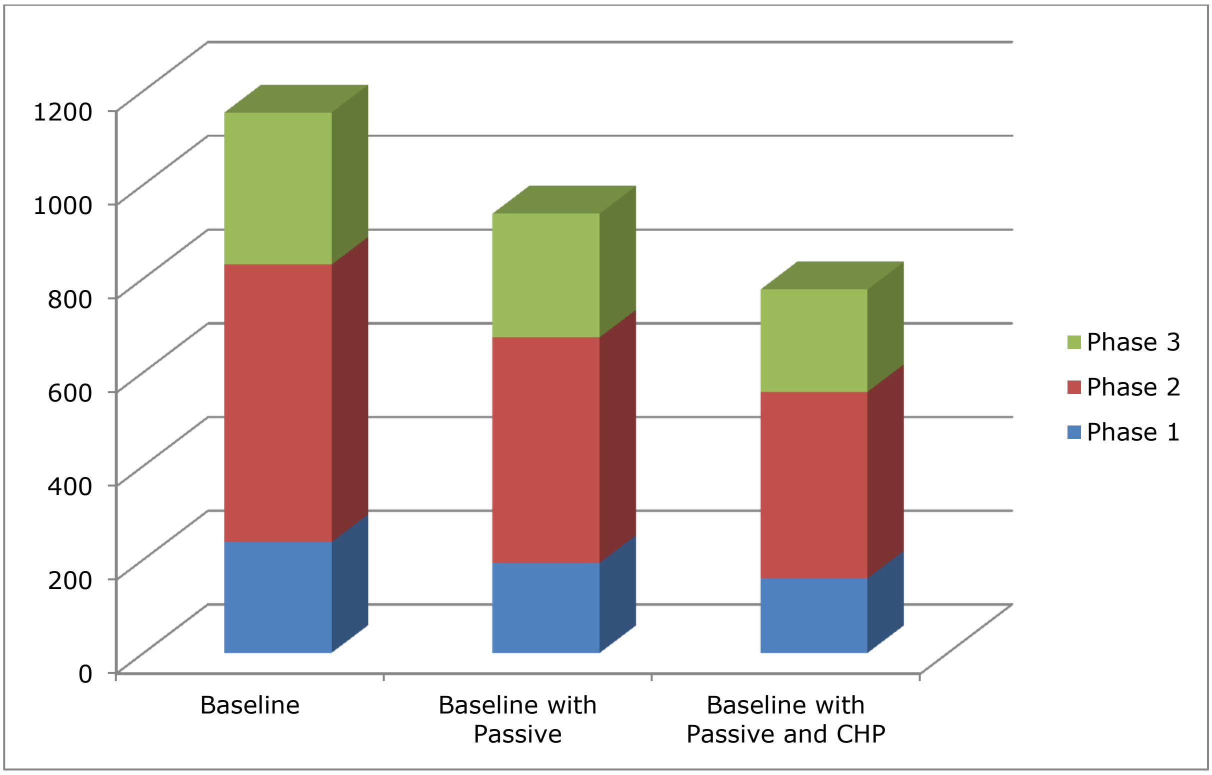


Chart 2 – CO_2 Emissions Showing Impact of Energy Saving (Incl. Non-Regulated Emissions)

SUMMARY

From the comparison to the 2010 base level emission values, the calculations carried out for the development show that the passive measures create a 18% reduction in CO2 emission for the proposed development.

The integration of the CHP is then shown to provide a further 17% reduction (32% total), which exceeds the 20% reduction requirements of the planning authority. For these calculation appliances and cooking are taken into consideration.

APPENDIX A

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ENQUIRIES

Any enquiries regarding this document and its content should be directed to Rolton Group: Tel: +44 (0)870 726 0000 E Mail: enquiries@rolton.com.