



Energy Strategy Statement

Gas Holder Site, Reading

Danescroft (Kenavon Drive Project Management) LLP

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Version 3

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Executive Summary

Danescroft (Kenavon Drive Project Management) LLP has instructed Briary Energy to prepare this document, which examines the feasibility of suitable LZC (Low to Zero Carbon) sources, high-efficiency alternative systems, and low carbon energy efficiency measures.

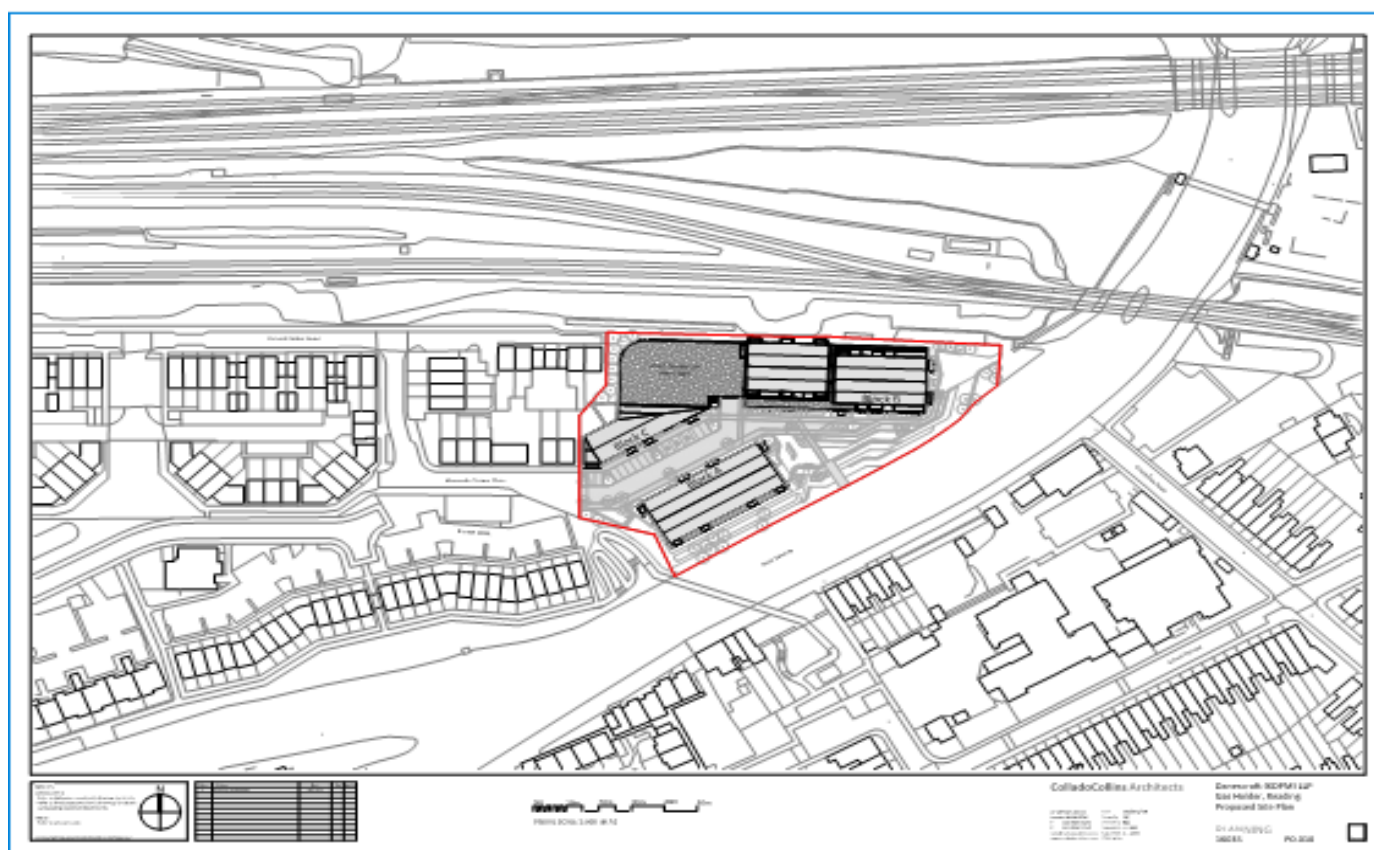
The Gas Holder Site, Reading development will comprise of 130 dwellings. The developer will meet a compliance level in excess of the Building Regulations reduction in emissions across all dwellings relative to a 2013 Part L1A Building Regulations baseline, which will be achieved solely through the use of improved energy efficiency measures such as improved thermal fabric efficiency, MVHR, air tightness and effective heating controls.

The energy consumption figures for the development are based on benchmark figures for each building type from CIBSE for non-domestic buildings or based on SAP 2012 for domestic buildings, and include regulated and non-regulated emissions.

Reading Borough Council Local Plan, Emerging Policy Local Plan November 2017 states –

Policy H5 – Standards for new housing

(c) All major new-build residential development should be designed to achieve zero carbon homes; as a minimum a 35% improvement over the 2013 Building Regulations⁸¹ plus a contribution of £1,800 per tonne towards carbon offsetting within Reading (calculated as £60 per tonne over a 30 year period)



The strategy calculates the total CO₂ arising from the dwellings and demonstrates that a reduction equating to 35% Carbon can be achieved through Showersave Waste Water Heat Recovery (WWHR) MVHR and improved fabric efficiency measures.

National Planning Policy Framework (NPPF)

The latest National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these are expected to be applied. At the heart of the NPPF is a presumption in favour of planning for climate change as noted in the following relevant clause numbers:

Achieving a sustainable development

7. The purpose of the planning system is to contribute to the achievement of sustainable development. At a very high level, the objective of sustainable development can be summarised as meeting the needs of the present without compromising the ability of future generations to meet their own needs.

Planning for climate change

150. New development should be planned for in ways that:

- a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and
- b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

151. To help increase the use and supply of renewable and low carbon energy and heat, plans should:

- a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);
- b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and
- c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for collocating potential heat customers and suppliers.

152. Local planning authorities should support community-led initiatives for renewable and low carbon energy, including developments outside areas identified in local plans or other strategic policies that are being taken forward through neighbourhood planning.

Paragraph 154 sets out what is expected from local authorities when considering strategies to mitigate and adapt to climate change:

154. When determining planning applications for renewable and low carbon development, local planning authorities should:

- a) not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and
- b) approve the application if its impacts are (or can be made) acceptable*. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas.

Local Policy and/or Planning Conditions

Reading Borough Council Local Plan, Emerging Policy Local Plan November 2017 states –

Policy H5 – Standards for new housing

(c) All major new-build residential development should be designed to achieve zero carbon homes; as a minimum a 35% improvement over the 2013 Building Regulations⁸¹ plus a contribution of £1,800 per tonne towards carbon offsetting within Reading (calculated as £60 per tonne over a 30 year period)

Changes to National Policy

Significant changes to both Building Regulations standards and national policy have occurred, since 2010.

Reductions in CO2 emissions from new development have been mandated through changes to Part L England and Wales. Updates in 2010 and 2013 required CO2 reductions from residential development cumulatively equating to approximately 30% better than Part L 2006, when the minimum standards for CO2 emissions were first introduced. Further changes to national policy impact on the application of local planning policy, as expressed by the guiding principle within the National Planning Policy Framework published in March 2012 which states that local policy should, “when setting any local requirement for a building’s sustainability, do so in a way consistent with the Government’s zero carbon buildings policy.”

With respect to ‘zero carbon’, the implementation timescale and meaning of ‘zero carbon’ buildings has been under review and consultation in recent years. ‘Zero carbon homes’ was originally planned for introduction in 2016, with non-residential development to follow in 2019, however a policy announcement presented by HM Treasury as part of the July 2015 productivity plan “Fixing the Foundations” advised that the government is not intending to proceed with zero carbon policy at this time, commenting that energy efficiency standards introduced through the 2013 amendment to Part L ‘need time to become established’ and will therefore persist until further notice

Energy Standards

The March 2015 ministerial statement additionally stated:

“For the specific issue of energy performance, local authorities will continue to be able to set and apply policies in their Local Plans which require compliance with energy performance standards that exceed the energy requirements of Building Regulations until commencement of amendments to the Planning and Energy Act 2008... Until the amendment is commenced, we would expect local planning authorities to take the government’s intention into account in applying existing policies and not set conditions with requirements above a Code Level 4 equivalent”.

Proposed LPA Policy Response

The strategy calculates the total CO2 arising from the dwellings and demonstrates that a reduction equating to 35% Carbon can be achieved through Showersave Waste Water Heat Recovery (WWHR) MVHR and improved fabric efficiency measures.

Energy hierarchy through design

The Gas Holder Site, Reading development will be developed with the aim to reduce annual energy consumption, whilst providing energy in the most environmentally friendly way to reduce the annual CO₂ footprint.

This outline strategy has been developed using established methodology (as recommended by Cibse and the London Plan). It has three priorities, seeking to reduce energy use through the cleanest possible solutions. Reducing the demand for energy in the first place means our priority is always to use a fabric first approach: -

Be Lean - Reducing energy needs through improved design and construction.

Be Clean - Supply energy efficiently through the use of decentralised energy where feasible.

Be Green - Further reduce CO₂ emissions through the use of on-site renewable sources, where practical.

As this hierarchy demonstrates, designing out energy use is weighted more than the generation of low-carbon or renewable energy to offset unnecessary demand. Applied to the development of new housing, this approach is referred to as 'fabric first' and concentrates finance and efforts on improving U-values, reducing thermal bridging, improving airtightness and installing energy efficient ventilation and heating services.

This approach has been widely supported by industry and government for some time, with previous reports from Zero Carbon Hub [1] and Energy Saving Trust [2] having both stressed the importance of prioritising energy demand as a key factor in delivering resilient, low energy homes.

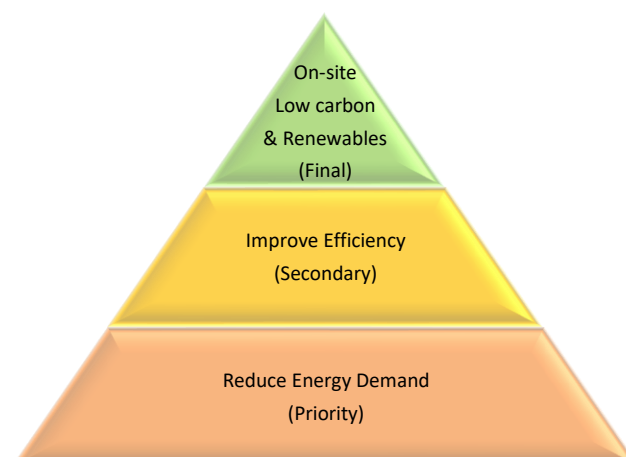
Further to the above methodology, we have also looked at other steps towards achieving a low carbon solution, including:

- The incorporation of passive design solutions by considering the dwellings orientation and layout solutions;
- The incorporation of energy efficiency measures through the design of services and improved fabric performance;
- Calculation of the predicted design energy consumption rates and associated annual CO₂ emissions in comparison with a 'baseline' building (using Part L Regulations compliance standards) to include both regulated and un-regulated energy use; and
- Assessment of the viability of incorporating low and zero carbon energy sources.

Benefits of the Fabric First Approach	Fabric Energy Efficiency Measures	Bolt on renewable energy technologies
Energy/CO ₂ /fuel bill savings applied to all dwellings	✓	0
Savings built-in for life of dwelling	✓	0
Highly cost-effective	✓	0
Increases thermal comfort	✓	0
Potential to promote energy conservation	✓	✓
Minimal ongoing maintenance / replacement costs	✓	0
Minimal disruption to retrofit post occupation	✓	0

[1] Zero Carbon Hub, Zero Carbon Strategies for tomorrow's new homes, Feb 2013.

[2] Energy Saving Trust, Fabric first: Focus on fabric and services improvements to increase energy performance in new homes, 2010



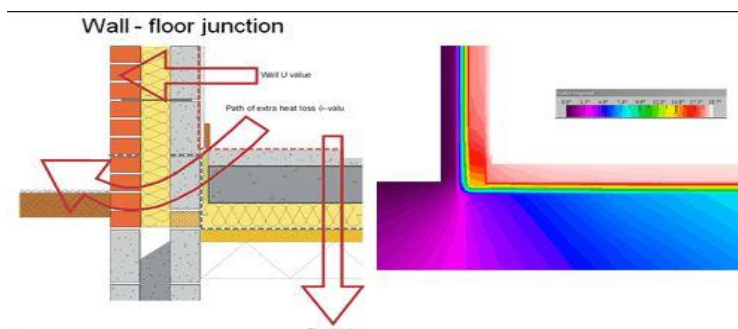
Be Lean – Energy efficient design measures

Enhancing the thermal performance of the building is usually more cost effective than providing renewable energy, with more reliable CO₂ savings for the long-term life cycle of the building, without the cost of replacing mechanical or electrical components on a continual basis. Adding renewable technology will then maximise these carbon reductions, reducing the quantity required.

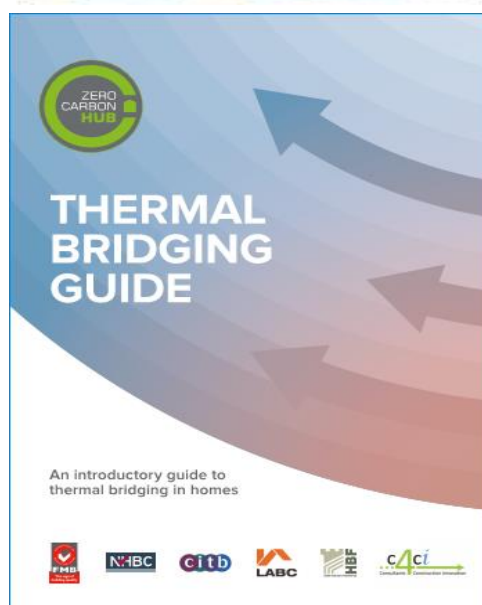
This development will achieve compliance with Part L1A of the Building Regulations (2013) without relying upon the contribution of renewable energy.

Element	Building Regulations	Proposed
Ground Floor	0.25 W/m ² k	0.11 W/m ² k
External Wall	0.30 W/m ² k	0.26 W/m ² k
Dormer	0.30 W/m ² k	0.1 W/m ² k
Flat Roof	0.20 W/m ² k	0.09 W/m ² k
Windows	2.00 W/m ² k	1.2 W/m ² k
Doors	2.00 W/m ² k	1.09 W/m ² k
Air Perm	10.00 m ³ /hm ² (@50 Pa)	1 m ³ /hm ² (@50 Pa)
Thermal Bridges	0.15 ≤ Y	Calculated Constructive Details

Improving the thermal bridge constructive details can have a great impact on the heat loss of the development, in some cases using enhanced details can make as much as a 27% improvement on fabric alone.



Additional improvements to thermal performance can be achieved by ensuring good practice airtightness targets are achieved. Simple measures like sealing around services (e.g. water, gas and cables), using proprietary seals and collars, ensuring blockwork is sealed and parging layer/plaster finish is applied to external walls before erecting studwork for internal partitions can all improve air tightness results.

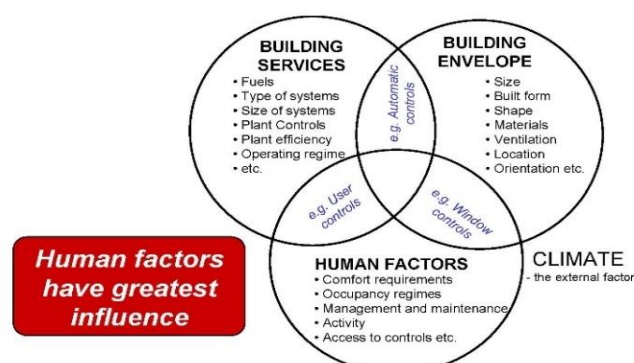


HOW IS FABRIC HEAT LOSS QUANTIFIED?



Be Clean – Energy efficient M & E systems

FACTORS THAT INFLUENCE ENERGY CONSUMPTION



Having reduced energy demand through the fabric first approach, we now look to specify mechanical and electrical systems with efficiencies that surpass the requirements of the Domestic and Non-domestic Building Services Compliance Guide (2013): –



The following energy efficient systems are proposed. This covers the clean mechanical and electrical systems, HVAC (heating, ventilation, air conditioning), hot water, lighting and efficient controls. Some renewable factors may be considered and included at this stage, i.e.: heat recovery, air source heat pumps or ground source heat pumps.

Element	Compliance	Proposed
Low energy lighting (efficacy $\geq 45\text{lm/W}$)	75%	100%
Ideal Logic ESP1 and System	88.00%	89.60%
Shower Save (WWHRS)	N/A	Yes
Hot water 250L cylinder	$\leq 2.56 \text{ kW/day}$	1.85 kWh/day
Heating controls	Programmer, TRV's & room stats	Time & Temp Zone controls
Advanced controls	N/A	delayed start
System 4 MVHR	0.3 l/W/s (SFP)	0.2 l/W/s (SFP)

Be Green – Decentralised/Low to Zero Carbon sources

Feasibility is based on location, cost, payback for both initial payment and ongoing maintenance and suitability. The following pages show each Low to Zero Carbon energy solution that has been considered. Further feasibility has been calculated and demonstrated for each, with a list below of all the technologies considered with in-depth information about each technology, regardless of whether it is proposed or not: –

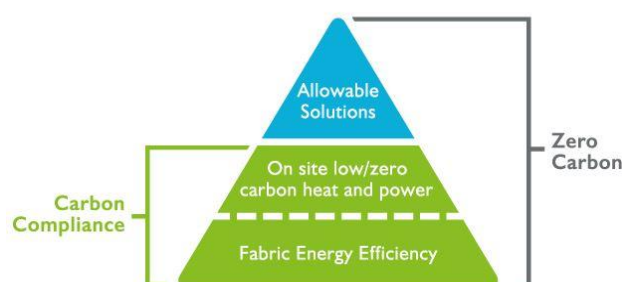
Zero carbon technologies

- Solar Hot Water;
- Solar Photovoltaic;
- Perovskite Photovoltaic;
- Wind Turbines; and
- Small Scale Hydro Power.

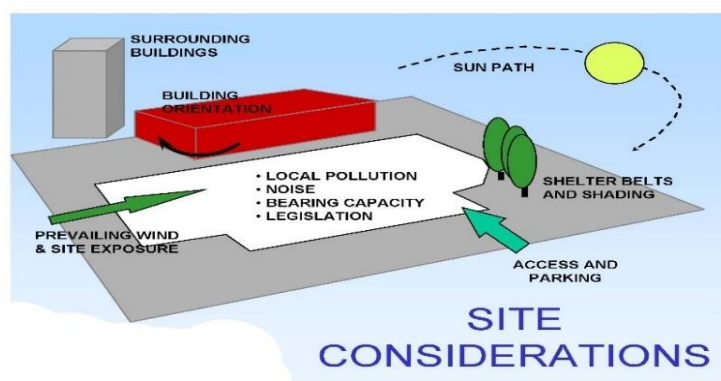
Low carbon technologies

- Biomass;
- District Heating and Combined Heat and Power (CHP);
- Heat pumps: Ground Source Heat Pumps, Geothermal Heating Systems, Air Source Heat Pump;
- Flue Gas Heat Recovery Systems (FGHRS); and
- Showersave / Waste Water Heat Recovery System (WWHRS).

Be Green – Continued



In order to satisfy the local planning requirements, a more detailed assessment of each of the following solutions will be explored. Each energy efficiency measure has been considered to give a greater understanding of which solutions could be implemented at the development to provide energy and CO₂ savings beyond current building regulations.



Considered technologies	
Solar hot water	No
Solar Photovoltaic	No
Wind Turbines	No
ASHP	No
GSHP	No
Flue Gas Heat Recovery	No
WWHR	Yes
Fabric Approach	Yes

District Heating

As part of planning, any major development proposal should evaluate energy systems in accordance with the following hierarchy: –

- Connection to existing heating and cooling networks;
- Site wide combined heat and power (CHP) network;
- Communal heating and cooling.

Over several years, building service engineers Max Fordham have studied the benefits and drawbacks of providing heat to buildings via hot water heat networks supplied from community scale heat sources, in particular combined heat and power (CHP). Government scenario planning includes predictions that by 2050 heat networks may supply about 20% of the UK's building heat demand [*D. o. E. & C. Change, "National Energy Efficiency Data-Framework (NEED) report: Summary of analysis 2013 Part 1," DECC, 2013.*]. It is clear that government policy is vigorously pursuing gas fired CHP with heat networks, but to what effect?

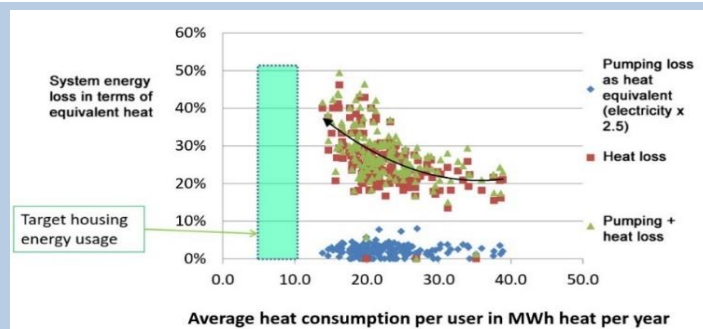
The issues are varied and complex, and include: consideration of the heat sources that may be in use in the future; the future strategy for national electricity generation; the difference between "as predicted" and "as measured"; the relationship to the intensity of heat demand; and the costs to the end users.

The most important aspect that Max Fordham concluded is that the heat network system heat losses are very large. They are much larger than the assumed values used in regulatory and system planning calculation methods (such as SAP).

An unfortunate feature of this (district heating) debate is that good quality data from a wide range of UK installations is not available or not publishable due to its commercially sensitive nature. Clearly this situation is not helping the UK develop a low carbon heat strategy.

However, data from the Danish District Heating Association shows that from analysis of about 100 installations the heat losses in the municipal distribution pipes ranged from 15% to 45% of the heat supplied. This is only the loss up to the building site boundaries. There will be additional losses inside the buildings too. The current UK average domestic heat demand is 14MWhr/dwelling/yr. [*D. o. E. a. C. Change, "National Energy Efficiency Data-Framework (NEED) Summary consumption statistics," DECC, 2011.*]. At this scale the Danish data shows that a heat loss of around 35%. If the heat demand from buildings is reduced to less than 10 MWh/yr. (which is desirable) then the heat losses might represent 50% of the heat supplied.

District Heating - continued



Danish data of heat and pumping losses in district heating systems. Source: Birger Lauensten, International chef / Manager International Affairs, Dansk Fjernvarme / Danish District Heating Association

High system heat losses (and pumping demands) mean that in many cases, gas fired CHP with heat networks will not reduce, but increase carbon emissions. This is particularly true when compared to using individual gas boilers and electricity from the current national grid. It is clear that heat networks need to be reassessed (by the UK Government) taking into account the true extent of heat losses and/or the mitigation measures required to reduce them. If this is done, we may well see quite a change in national and local policies for heat networks, with or without CHP. Our preference has always been a much more vigorous pursuit of heat demand reduction, principally by insulating and draught proofing existing buildings. From our observations of district heating systems we believe that the very high losses can be reduced with improved components, improved design and improved care during installation. However, it is highly unlikely that the system losses could be reduced to the levels that have informed current government policy anytime soon.

The development will not connect to any existing district heating system, nor will a new system be considered, for the following reasons:

- the carbon reduction and energy efficiency requirements can be achieved at a lower cost, and at a greater benefit to the homeowner the 'fabric first' approach is proposed.
- the site is too far away from an existing District Heat networks, which have not been designed to extend by 130 dwellings - the network is at the far end of an adjacent site and serves just 2 blocks of apartments.
- the home owners would be tied to the same supplier, removing choice.
- The statement on the previous page outlines why CHP and district heating systems are generally more expensive to run, consume more energy and issue more CO₂ than an equivalent "conventional" systems.

Low to Zero Carbon Technology Reductions

A detailed assessment, which will include the practical implications of installing each technology and quantity to achieve the required mandatory improvement in DER over 2013 Building Regulations, will be discussed in more detail later in this report, should any of these technologies be considered economically viable for the Gas Holder Site, Reading development.

Technologies Not Considered

Fuel Cells: These are not yet fully commercially available.

Hydro: Small scale hydro would be inappropriate for integration into the proposed development due to the geographical location of the proposed site.

CHP, Biomass and Biogas District heating schemes have been discounted under the District Heating Scheme section

Low to Zero Carbon Technology Reductions – continued

Potentially viable energy strategies considered	Number of Dwellings Applied to	Energy Saved %	Carbon Saved %	Proposed?
Solar hot water	0	0%	0%	No
Solar Photovoltaic	0	0%	0%	No
Wind Turbines	0	0%	0%	No
ASHP	0	0%	0%	No
GSHP	0	0%	0%	No
Flue Gas Heat Recovery	0	0%	0%	No
Waste Water Heat Recovery	123	23.6%	14.6%	Yes
Fabric Approach	130	49.9%	29.2%	Yes

Solar Hot Water

Solar water heating systems use heat from the sun to work alongside conventional primary water heaters. The technology is well developed with a large choice of equipment to suit many applications. For domestic hot water there are three main components Solar panels or collectors- are fitted to the roof. They collect heat from the sun's radiation. There are 2 main types of collector:

- Flat plate systems- which are comprised of an absorber plate with a transparent cover to collect the sun's heat, or
- Evacuated tube systems- which are comprised of a row of glass tubes that each contains an absorber plate feeding into a manifold which transports the heated fluid. A heat transfer system- uses the collected heat to heat water;

Hot water cylinder- stores the hot water that is heated during the day and supplies it for use later. All savings are approximate and are based on the hot water heating requirements of a 3 bed semi detached home. Solar water heating can be used in the home or for larger applications, such as swimming pools. For a domestic system you will need 3-4 square metres of southeast to southwest facing roof receiving direct sunlight for the main part of the day, a space to locate an additional water cylinder if required. Solar water heating systems tend to require little maintenance Installation and maintenance costs.

The typical installation cost for a domestic system is £3,000- £5,000. Evacuated tube systems are more advanced in design than flat plate, and so tend to be more expensive. Solar water heating systems generally come with a 5-10 year warranty and require little maintenance. A yearly check by the householder and a more detailed check by a professional installer every 3-5 years should be sufficient.

Proposed for this development?

No



Solar Thermal Calculation

Number of plots with panels	0
Size of Panel	4.5
Number of Panels per plot	1
Total m ²	0
Average kWh/m ²	294
Energy produced by panels	0
Energy% Saved From Panels	0.0%
CO ₂ % Saved From Panels	0.0%

Not Proposed for this development because...

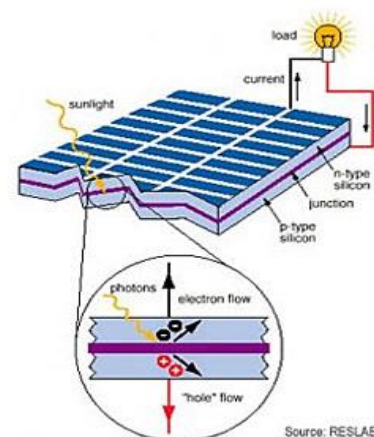
- Solar Thermal relies on energy from the sun, therefore producing hot water only during daylight hours.- Poor servicing and badly programmed controls can make this technology operate less efficiently than a standard boiler.
- Hot water storage has a heat loss linked to it, which can contribute to summer over heating and reduced efficiency.
- This is not a 'fit and forget' technology, it requires regular servicing, replacement parts and optimizing of controls.
- This is not suitable for poorly orientated dwellings.
- Solar thermal is predominantly not feasible for dwellings with combination boilers.

Photovoltaic Collectors (PV)

Solar PV (photovoltaic) creates electricity to run appliances and lighting from natural daylight (direct sunlight is not required) to generate electricity.

How it works

Photovoltaic systems use cells to convert solar radiation into electricity. The PV cell consists of one or two layers of a semi conducting material, usually silicon. When light shines on the cell it creates an electric field across the layers, causing electricity to flow. The greater the intensity of the light, the greater the flow of electricity. PV systems generate no greenhouse gases, saving approximately 325kg of carbon dioxide emissions per year- adding up to about 8 tonnes over a system's lifetime- for each kilowatt peak (kWp - PV cells are referred to in terms of the amount of energy they generate in full sun light).



Source: RESLAB

PV arrays now come in a variety of shapes and colours, ranging from grey 'solar tiles' that look like roof tiles, to panels and transparent cells that you can use on conservatories and glass to provide shading as well as generating electricity. As well as enabling you to generate free electricity they can provide an interesting alternative to conventional roof tiles.

PV systems for a building with a roof or wall that faces within 90 degrees of south, as long as no other buildings or large trees overshadow it. If the roof surface is in shadow for parts of the day, the output of the system decreases. Solar panels are not light and the roof must be strong enough to take their weight, especially if the panel is placed on top of existing tiles. Solar PV installations should always be carried out by a trained and experienced installer. The area of PV required to generate 1kw hour peak varies but generally 6-8m² for M6n crystalline or 102 for polycrystalline modules of PV will produce 1Kw peak of electricity.

In order to meet energy demand improvements using Solar Photovoltaics, this site would require 0kWp to be shared amongst approximately 0 dwellings. Carbon emissions could be reduced by 0.% compared with Part L 2013 Target Emission Rate, and energy demand reduced by a further 0.%.

Cost and maintenance

Prices for PV systems vary, depending on the size of the system to be installed, type of PV cell used and the nature of the actual building on which the PV is mounted. The size of the system is dictated by the amount of electricity required. For the average domestic system, costs can be around £1250-£2000 per kWp installed (energy saving trust 2017), with most domestic systems usually between 1.5 and 2 kWp. Solar tiles cost more than conventional panels, and panels that are integrated into a roof are more expensive than those that sit on top. Grid connected systems require very little maintenance, generally limited to ensuring that the panels are kept relatively clean and that shade from trees has not become a problem.

The wiring and components of the system should however be checked regularly by a qualified technician. Stand-alone systems, i.e. those not connected to the grid, need maintenance on other system components, such as batteries.



Photovoltaic Collectors (PV) – continued

Proposed for this development?

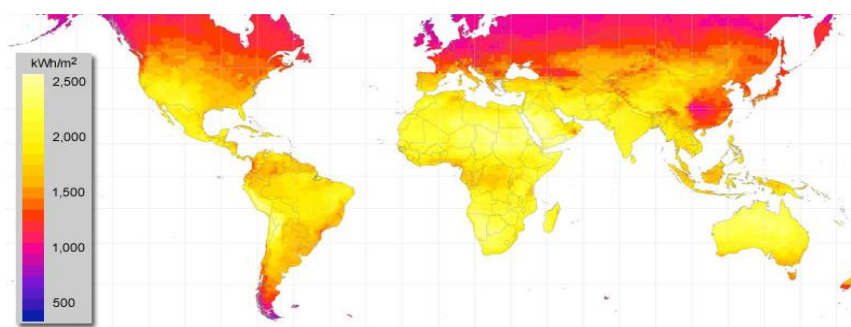
No

In calculating the feasibility of Solar PV, we will use a global formula $E = A \times r \times H \times PR$ to calculate the energy generated by the proposed PV to be placed on the development.

Losses details (depend of site, technology, and sizing of the system)

Inverter losses	4%
Temperature losses	3%
DC cables losses	1%
AC cables losses	1%
Shadings	0%
Losses weak irradiation	1%
Losses due to dust, snow	1%
Other Losses	0%

Yearly sum of global irradiance

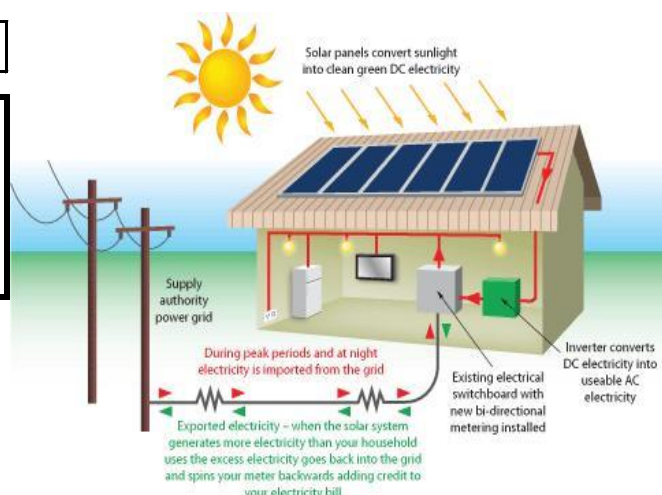


	Total site kWp	PR = Perf Ratio	H = Annual irradiation	r=panel yield(%)	A=Panel Area(m²)	E=Energy (kWh)
South	0	0.89	1054	20%	0	0.00
SE/SW	0	0.89	997	20%	0	0.00
East/West	0	0.89	854	20%	0	0.00
NE/NW	0	0.89	686	20%	0	0.00
North	0	0.89	640	20%	0	0.00
	0				Total Energy kWh	0.00

Amount of PV Panels to meet 0kWp Requirement

240w Panels
0 Panels Required
250w Panels
0 Panels Required
270w Panels
0 Panels Required

The panels will be applied to some of the detached south, south east and south west dwellings



Not Proposed for this development because...

On the face of it, PV panels would be considered technically feasible for all buildings with suitable roof orientations. However, for the following reasons, PV is not considered to be viable for this site: -

- Poor design and installation can lead to lower than expected yields (e.g. from shaded locations);
- Installation is restricted to favourable orientations;
- Feed in Tariff scheme no longer offered by government;
- Safe access must be considered for maintenance and service checks, meaning gantries installed on high rise blocks
- Inverters need replacing an average of every seven years;
- Visual impact may be a concern in special landscape designations (e.g. AONB), reflected light may be a concern in some locations.

Micro wind turbine

Proposed for this development?

No

Wind turbines use the wind's lift forces to rotate aerodynamic blades that turn a rotor which creates electricity. In the UK we have 40% of Europe's total wind energy. But it is still largely untapped and only 0.5% of our electricity requirements are currently generated by wind power.

How does it work? Most small wind turbines generate direct current (DC) electricity. Systems that are not connected to the national grid require battery storage and an inverter to convert DC electricity to AC (alternating current-mains electricity). Wind systems can also be connected to the national electricity grid. A special inverter and controller convert DC electricity to AC at a quality and standard acceptable to the grid. No battery storage is required. Any unused or excess electricity may be able to be exported to the grid and sold to the local electricity supply company.

There are two types of wind turbines: -

- Mast mounted- which are free standing and located near the building(s) that will be using the electricity.
- Roof mounted- which can be installed on house roofs and other buildings.



Potential Benefits

Wind power is a clean, renewable source of energy which produces no carbon dioxide emissions or waste products. Individual turbines vary in size and power output from a few hundred watts to two or three megawatts (as a guide, a typical domestic system would be 1- 6 kilowatts). Uses range from very small turbines supplying energy for battery charging systems (e.g. on boats or in homes), to turbines on wind farms supplying electricity to the grid.

Not Proposed for this development because...

The Government wind speed database predicts local wind speeds at Gas Holder Site, Reading to be 4.7 m/s at 10m above ground level, 5.4 m/s at 25m above ground level and 5.9 m/s at 45m above ground level. This is below the level generally required for commercial investment in large wind turbines and in addition the land take, potential for noise and signal interference make a large wind turbine unsuitable for this development.

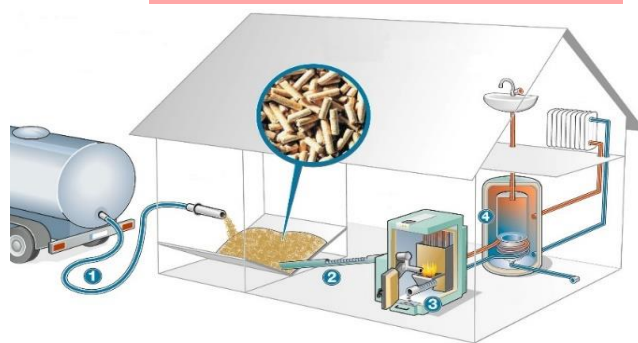
- Horizontal axis micro-wind turbines only reduce carbon emissions by a small amount. In high winds they need to be static due to fundamental design issues.
- Health and safety is also a factor, with high speed moving parts mechanical failure can be catastrophic to human life, birds and wildlife.
- Flicker means that the turbine needs to be at least 400 mtrs from the nearest dwelling and computer controlled to take into account the position of the sun.

Bio Mass

Biomass is produced from organic materials, either directly from plants or indirectly from industrial, commercial, domestic or agricultural products. It is often called 'bio energy' or 'bio fuels'. It does not include fossil fuels, which have taken millions of years to be created.

Biomass falls into two main categories: -

- Woody biomass includes forest products, untreated wood products, energy crops and short rotation coppice (SRC), which are quick-growing trees like willow.
- Non-woody biomass includes animal waste, industrial and biodegradable municipal products from food processing and high energy crops. Examples are rape, sugar cane, maize.



Planning

If the building is listed or in an area of outstanding natural beauty (AONB), then you will need to check with your Local Authority Planning Department before a flue is fitted.

Costs and savings

Stand alone room heaters generally cost £2,000 to £4,000 installed. Savings will depend on how much they are used and which fuel you are replacing. A biomass stove which provides a detached home with 10% of annual space heating requirements could save around 840kg of carbon dioxide when installed in an electrically heated home. Due to the higher cost of biomass pellets compared with other traditional heating fuels, and the relatively low efficiency of the stove compared to a central heating system it will cost more to run. The cost for boilers varies depending on the system choice; a typical 15kW (average size required for a three bedroom semi detached house) pellet boiler would cost around £5,000- £14,000 installed, including the cost of the flue and commissioning. A manual log feed system of the same size would be slightly cheaper. A wood pellet boiler could save around £750 a year in energy bills and around 6 tonnes of CO₂ per year when installed in an electrically heated home.

Not Proposed for this development because...

Biomass boilers, wood burning stoves and CHP engines all create a large amount of pollution and carbon emissions. Although it is considered that Biomass is a carbon neutral technology thanks to the CO₂ being absorbed by growing new trees, It is not viable at the Gas Holder Site, Reading development.

- With pollution levels consistently increasing, particulate levels in burning biomass mean is not a clean technology;
- Wood is a major source of biomass energy. Producing biomass fuel on a large scale can lead to deforestation;
- Delivering the fuel can lead to more traffic causing pollution and delays, supply needs to be within a 40 mile radius;
- By developing crops to produce fuel for biomass energy, we are utilizing land that may have been used for food sources.

Heat Pumps (ASHP & GSHP)

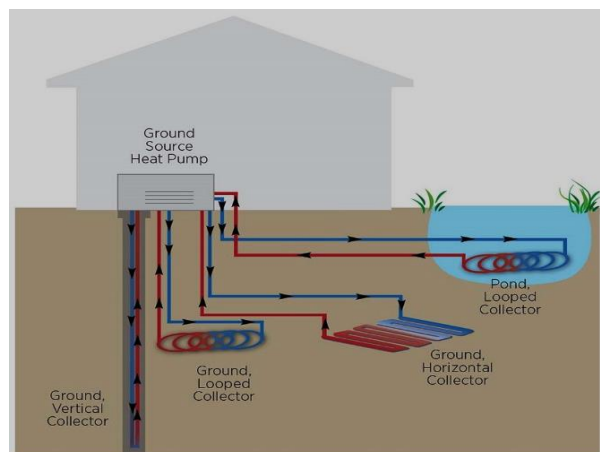
Proposed for this development?

No

There are two types of heat pumps, ground source and air source. Heat pumps work in a similar way to fridges and air conditioners and absorb heat from the ground or from the air. Ground or air source heat pumps are mainly designed to work with under floor heating systems because of the lower design temperatures of under floor systems. Efficiencies of ground source heat pumps are between 350%-550% and air source between 250%-450%. Heat pumps are a viable alternative to electric, LPG and oil fuel boilers, but are not considered as an alternative to natural gas.

Generally speaking, the ground source heat pump is considered the best for use in cold weather as the ground has a natural supply of warmth. Typically, the piping is buried far enough down that the frost and cold weather will not be able to reach it, and so is prevented from freezing by the natural warmth that surrounds it. This also means that it does not lose efficiency at any point in the year. This is in contrast to the air source heat pump, which is installed outside.

Commercial buildings and some dwellings can benefit from variable refrigerant flow systems (VRF), which are large-scale ductless HVAC systems that can perform at a high capacity. VRF systems can either be heat pump or heat recovery systems, which provides simultaneous heating and cooling. These systems function in a similar way to ASHP, when designed correctly they can produce far greater efficiencies, in some circumstances outperforming GSHP. A VRF HVAC system can heat and cool different zones or rooms within a building simultaneously. If the appropriate VRF system is selected, building occupants have the ability to customize the temperature settings to their personal preferences. These systems are advantageous in buildings with plenty of glass on several orientations, helping to reduce the risk of over heating and producing adequate heat whilst maintaining a lower energy demand.



Not Proposed for this development because...

GSHP - the area of land required for individual systems means GSHP systems are not viable on this development and bore holes would need extensive survey work in relation to the sewers and Underground service networks.

ASHP - while they are viable, there is a reduction on CO₂ but an increase in energy demand as they are powered by electricity. There is a question of efficiency in areas where the temperature in winter regularly drops below -1.5°C. The CoP can drop below that of a gas boiler increasing running costs significantly. Meeting hot water demand solely from ASHP is an issue as they are a low temperature system, topping the heat up using the immersion element can create a high energy demand.

- Lower heat supply compared to oil and gas boilers, so larger radiators would be needed; they perform better with underfloor heating or warm air heating and work more efficiently when coupled with larger radiators.
- A highly insulated development is required to take advantage of maximum energy demand reductions;
- Heat pumps need to run constantly during the winter, with similar noise to an air conditioning unit and a constant energy demand;
- The cost of installing an air source heat pump is usually between £3,000-£11,000.

Flue Gas Heat Recovery Systems

FGHRS provides a good reduction in CO₂ emissions compared to some technologies that are classified and listed as LZC technologies yet do not provide a reduction in CO₂ emissions when compared to a Natural Gas energy model.



Flue Gas Heat Recovery Systems takes advantage of the heat within the waste flue gasses resulting from the combustion of gas in the boiler. This recovered heat is used to preheat the cold water entering the boiler, thereby lowering the amount of energy needed to warm the water up to the required temperature.

It can be applied to mains gas, LPG or oil condensing boilers.

The flue gas heat recovery system requires very little maintenance, with no need for mains electricity. These systems should be planned in early as there are additional space requirements for the FGHRS. Some boilers have the system built in, and in others it takes the form of a "top box". It is important that the specific boiler and FGHRS are compatible so check this with the manufacturer or seek further advice

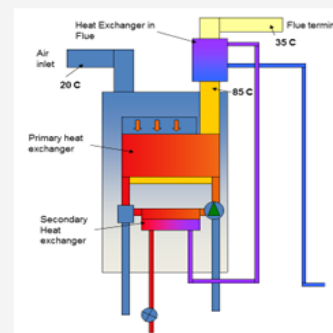
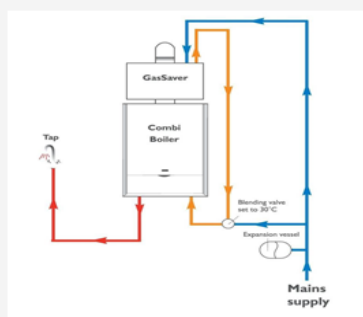
Land use

FGHRS requires no specific land use requirements.

Planning

FGHRS require no additional planning requirements.

Systems can be either a "wet" or "dry" version



Not Proposed for this development because...

Flue Gas Heat Recovery Systems are not the most efficient carbon reducing technology for the Gas Holder Site, Reading development. They are better suited to small dwellings with no more than five occupants and two bathrooms, although there are some devices that are capable of providing hot water or central heating to larger dwellings and even non-domestic buildings. These types are less efficient and can often require continual servicing and calibration.

Waste Water Heat Recovery Systems

Shower Save (Figures 1 & 2) Waste Water Heat Recovery Systems (WWHRS) is a Dutch technology, where in The Netherlands, they are fitted to 20% of new dwellings. Although generically classified as a WWHRS, the Shower-Save device is primarily applicable to heat recovery from warm shower waste water.

The most common configuration known as QB-21 (Figure 1), is applicable to upstairs showers, whilst the Linear Drain (Figure 2) can be used in apartments, bungalows or other single storey properties. The principle of heat recovery is the same in both cases: -

- Warm shower water passes through the 'grey' water side of a copper counter-flow heat exchanger
- Mains pressure water simultaneously passes through the fresh water side of the heat exchanger, where it is pre-heated before passing into both the 'cold' inlet of the mixer shower and the 'cold' inlet to the hot water cylinder, combi boiler or other water heater.
- The use of pre-heated water (orange line in Figures 1 and 2) reduces the total volume of hot water required per shower, whilst also pre-heating the cold feed to the hot water heater which increases potential flow rates for combi or shortens the re-heat time of cylinders. The energy saving applies to whichever fuel is used for water heating, which is therefore not limited solely to gas boilers. Whilst technically applicable to instantaneous electric showers, these ARE NOT currently modelled by SAP, so it is not possible to apply in Appendix Q either. WWHRS does not save energy from baths, in which hot water use is in advance of grey water disposal, but it is applicable to the shower over a bath.

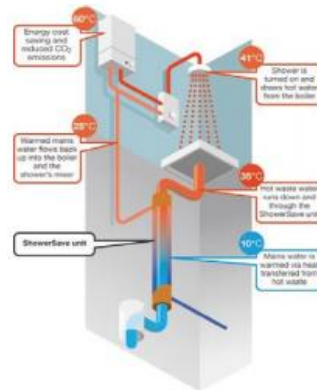


Figure 1

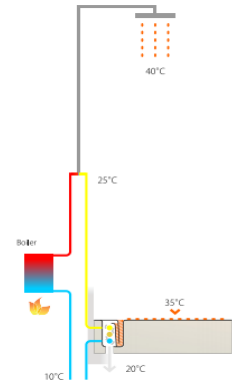


Figure 2

DIRECTIVE (EU) 2018/2001 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2018

on the promotion of the use of energy from renewable sources states: " 'ambient energy' means naturally occurring thermal energy and energy accumulated in the environment with constrained boundaries, which can be stored in the ambient air, excluding in exhaust air, or in surface or sewage water"

WWHR is therefore now classed as renewable.



System A set ups are now feasible for apartment projects, yielding efficiencies as high as 65.2% when installed effectively, using a shared soil stack for every apartment above 1st floor height. The solution being the to use an in-line tray system for the ground floor apartment.



Proposed for this development because...

In order to meet energy demand improvements using WWHRS, it would need to be applied to 123 dwellings, site wide. By doing this, carbon emissions will be reduced by 14.62% compared with part L 2013, and energy demand will be reduced by a further 23.58%. We recommend WWHRS on shower/bath drains because: -

- Shower recuperation of heat is the most efficient source of heat recovery
- The use coincides well with the flow of hot water
- In best case scenario the hot water demand can be reduced by as much as 8%
- Waste Water Heat Recovery is a renewable

Mechanical Ventilation with Heat Recovery Systems

Mechanical Ventilation with Heat Recovery, otherwise called Heat Recovery Ventilation (MVHR) is the only form of ventilation that cuts out almost all of the ventilation heat losses, which make up to 30% of the heating demand of a dwelling. No other ventilation method is as predictable and consistent in providing the required amount of fresh air into each room, as well in extracting stale and polluted air where needed.

MVHR uses very little energy, compared to conventional Air Conditioning Systems. It goes hand in hand with the fabric first approach, based on passive design criteria, which is becoming increasingly more common as people's awareness and understanding of its advantages rise. Compared with any other renewable technology, it has potentially the greatest impact on the primary energy use, CO₂ footprint and heating costs.



An efficient MVHR system will reduce the heating demand from 35kWh/(m²a) to 15kWh/(m²a) at equal ventilation rates – compared with natural ventilation.

From this, it can be seen that the process of recovering heat from stale, used air and transferring it to fresh yet cold air, has a major influence on energy and emission savings.

*Continuous supply of fresh air to provide good indoor air quality

*No drastic CO₂ peaks

*No build up of air pollution, e.g. from carpets and furniture or radioactive radon

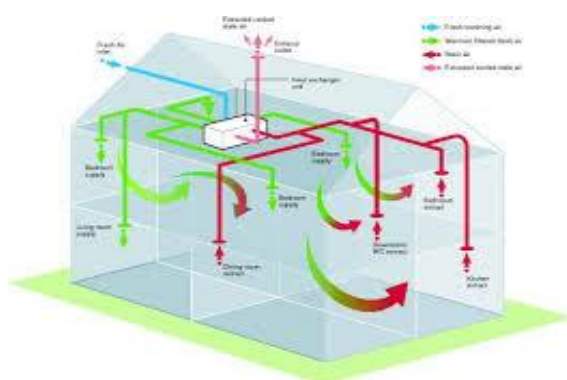
*Elimination of bad odours

*Filtered air: pollen filter are a great advantage for allergic people

*A controlled air flow path throughout the building, rather than random 'by-chance' ventilation.

*Most systems can be controlled by the user.

*Some systems provide a monitoring function to check the air quality and humidity.



The information has been taken from Collado Collins Architects drawings 16035 P0-100, 16035 P0-101, 16035 P0-102, 16035 P0-103, 16035 P0-104 (all dated 28/03/2019) and is presented below:

MVHR clean air requirements to the following apartments has been input into this assessment as recommended by the Stuart Michael Associates Noise Assessment 15/03/2019.

Ground floor, first floor and second floor of Block C (total of 10 units); Ground floor and first floor of Block B (total of 10 units); Second floor of Block B (total of 11 units); Third floor of Block B (total of 11 units); Fourth floor of Block B (total of 11 units); and All floors in Block A (total of 34 units).

Baseline Energy Calculations

A baseline total energy demand has been established for the development. Reductions in demand due to energy conservation measures are considered and form the basis of the renewable energy strategy which follows. Floor areas for the Gas Holder Site, Reading development have been used in conjunction with building specifications to prepare preliminary SAP Calculations. SAP calculations have been carried out to Part L1A 2013.

Total Energy Demand is used in the final analysis to determine the contribution that renewable energy technology makes to total energy requirements for the development once energy conservation measures have been considered.

Energy savings are measured in terms of a reduction in CO₂ emissions and kWh, which are calculated from their association with a particular fuel source. CO₂ conversion factors have been taken from the approved DEFRA Carbon Factors 2017 DECC conversion (cF)¹.



Activity	Fuel	Unit	Energy - Gross CV	
Electricity Generated	Electricity	kWh	0.35156	kg CO ₂ e
Gaseous Fuels	Natural Gas	kWh	0.18416	kg CO ₂ e
Biomass	Wood Pellets	kWh	0.01270	kg CO ₂ e

Baseline Energy Calculations- Continued

Predicted Carbon Emissions: Part L1A (2013) TER, Before Fabric Improvements

	Space Heating Demand	Hot Water Demand	Energy From Pumps and Fans	Energy from Lighting		Totals
Part L1A Plots (kWh/a)	329,725	305,461	9,750	47,867		692,803
CO ₂ Associated with total Energy Demand (kg/a)	60,722	56,254	3,428	16,828		137,232

Predicted Carbon Emissions: Part L1A (2013) DER, with improved fabric, controls and heating system

	Space Heating Demand	Hot Water Demand	Energy From Pumps and Fans	Energy from Lighting		Totals
Part L1A Plots (kWh/a)	154,269	236,203	23,914	47,867		462,253
CO ₂ Associated with total Energy Demand (kg/a)	28,410	43,499	8,407	16,828		97,145

Fabric First Results

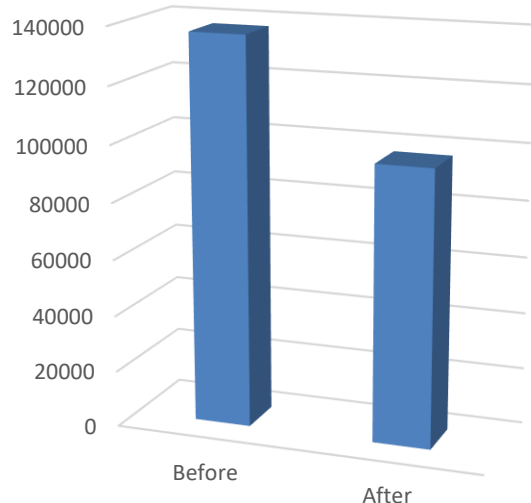
When compared against Part L1A 2013 Building Regulations: -

Total CO₂ demand for the residential units at Gas Holder Site, Reading is calculated to be 97145 kg per annum. This represents a saving of 29% over the Part L1A 2013 compliant figure of 137232 kg per annum

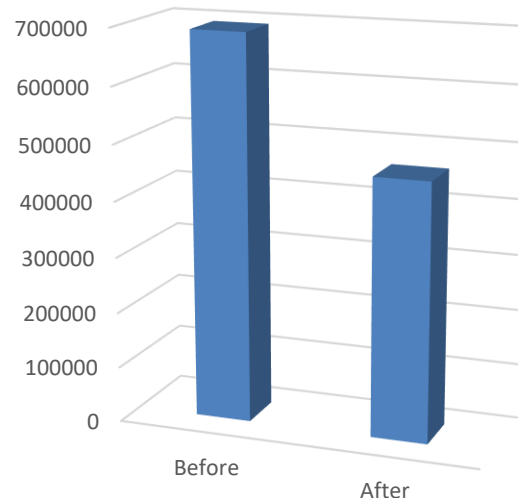
Total energy demand for the residential units at Gas Holder Site, Reading is calculated to be 462253 kWh per annum. This represents a saving of 33% over the Part L1A 2013 compliant figure of 692803 kWh per annum

Baseline Energy Calculations – Continued

Carbon CO₂



Energy kWh



Energy and Carbon Reduction Summary

This Energy statement has been prepared in support of the development of the site at Gas Holder Site, Reading. Local Planning Policy for the development requires that demand reduction measures are implemented to achieve an improvement of 35% Carbon, over Part L 2013 standards. Analysis based on a provisional SAP assessment of the house types proposed demonstrates that Part L compliant emissions equate to a site-wide calculated 137232 kg CO₂/year and energy demand of 692803 kWh/year

The dwellings are to be constructed to meet the requirements of Part L 2013, which requires CO₂ emissions to be reduced by approximately 30% beyond Part L 2006 standards. From this baseline, further energy demand reduction has been prioritised as part of the widely supported 'fabric first' approach. The benefits to the resident of this approach have been discussed in detail, which include an improvement in thermal comfort, lower energy bills, reducing the risk of fuel poverty and minimal maintenance requirements. These benefits are realised alongside the crucial aspect of the long-term reduction in energy demand that is built into the lifetime of the dwellings.

Through a combination of the fabric specification proposed, detailing to avoid thermal bridging, reducing air leakage and employing passive and active design measures, the dwellings will secure a saving in CO₂ emissions of 40087 kgCO₂/year, equating to an energy demand reduction of 230550 kWh/year.

In order to meet the 35% Carbon requirement, a further 7944 kg CO₂ will need to be offset.

A full assessment of appropriate technologies has been undertaken, concluding Showersave Waste Water Heat Recovery (WWHR) the most suitable for this development, providing a 108978kWh energy and 20069 kgCO₂ carbon reduction.

The final calculations demonstrate that the overall CO₂ reductions would equate to a 43.84% reduction over a development built to comply with the CO₂ targets under the latest revision of the Building Regulations, Part L1A 2013. This also represents a 73.45% reduction in the energy requirements of the site.

Carbon tonnage per year calculation

Regulated and unregulated Predicted Carbon Emissions:

	Space Heating Demand - Gas	Hot Water Demand - Gas	Pumps and Fans - Electricity	Lighting - Electricity	WWHR	Totals kg/co2/year
CO ₂ Associated with total Energy Demand (kg/a)	28,410	43,499	8,407	16,828		97,145
CO ₂ saved from WWHR					20,069	-20,069
CO ₂ tonnes per year						77
Payment to Reading Carbon Offset					£1800 per carbon Tonne	£138,736.80

The latest DEFRA Carbon Factors 2017 have been used in these calculations.

Gas - 0.18416

Electricity - 0.35156

Water Conservation

Performance target:

110 ltrs pp/d

Installation type	Unit of measure		Capacity/ flow rate		Use Factor		Fixed Use	Litres/ person/day
WC (dual flush)	Full flush volume		4		1.46		0	5.84
	Part flush volume		2.6		2.96		0	7.70
Taps (excluding kitchen/utility room taps)	Flow rate (l/min)		4		1.58		1.58	7.90
Bath (where shower also present)	Capacity to overflow		170		0.11		0	18.70
Shower (where bath also present)	Flow rate (l/min)		9		4.37		0	39.33
Bath Only	Capacity to overflow		N/A		0.5		0	0.00
Shower only	Flow rate (l/min)		N/A		5.6		0	0.00
Kitchen/utility room sink taps	Flow rate (l/min)		5		0.44		10.36	12.56
Washing machine	Litres/kg dry load		9.1		2.1		0	19.11
Dishwasher	Litres/place setting		1		3.6		0	3.60
Waste disposal unit	Litres/use		N/A		3.08		0	0.00
Water softener	Ltrs/person/day		N/A		0		0	0.00
Greywater Contribution	N/A	Rainwater Contribution	N/A	Normalisation factor	0.91	Total calculated use		114.74
Normalised total water consumption				104.41			Total Water Consumption	109.41
External water use		5.00						
The calculation methodology is to be used to assess compliance against the water performance targets in Regulation 36. It is not a design tool for water supply and drainage systems. It is also not capable of calculating the actual potable water consumption of a new dwelling. Behaviour and changing behaviour can also have an effect on the amount of potable water used throughout a home						Part G 17.K Compliance?		Yes
						Performance Target Met		Yes

The calculation methodology uses the water consumption figures provided from manufacturers' product details. Where details have not been provided, figures have been used to achieve compliance. These must be met in order to satisfy the Part G Calculation.

Policy H5 Requirements - Response

New build housing should be built to the following standards, unless it can be clearly demonstrated that this would render a development unviable:

- a. All new build housing outside the Central Area as defined on the Proposals Map will comply with the nationally-described space standard. - [All Units on this development have been designed in line with NDSS](#)
- b. All new build housing will be built to the higher water efficiency standard under Regulation 36(3) of the Building Regulations. - [Water Efficiency Calculator is on page 22 of this report](#)
- c. All major new-build residential development should be designed to achieve zero carbon homes - [Details are in this report in the previous pages](#)
- d. All other new build housing will achieve at a minimum a 19% improvement in the dwelling emission rate over the target emission rate, as defined in the 2013 Building Regulations. - [No applicable to this application](#)
- e. All new build housing will be accessible and adaptable in line with M4(2) of the Building Regulations where it is viable, unless it is built in line with M4(3) (see below). - [all units are designed in line with M4\(2\) except Block C \(no lift, therefore no step free access\) and M4\(3\) for wheelchair units](#)
- f. On developments of 20 or more new build dwellings, at least 5% of dwellings will be wheelchair user dwellings in line with M4(3) of the Building Regulations. Any market homes provided to meet this requirement will be 'wheelchair adaptable' as defined in part M, whilst homes where the Council is responsible for allocating or nominating an individual may be 'wheelchair accessible'. - [There are 5.4% wheelchair adaptable/accessible dwellings in line with M4\(3\)](#)