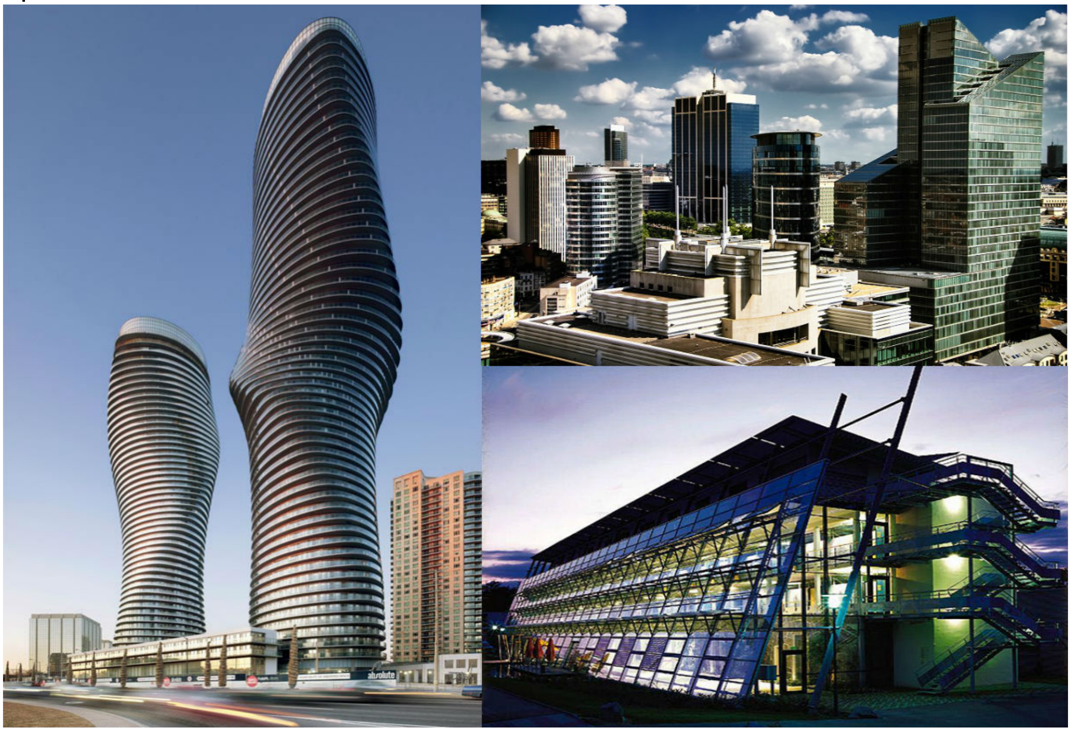
Medinbrand

New Compton Street

Application for planning consent

Energy Statement
April 2018



Prepared for:

Medinbrand

Revision Schedule

Energy statement
April 2018

Rev	Date	Details	Prepared by	Reviewed by	Approved by
01	Apr 2018	Final	Drs P Giesberg	Dr SJ Bamford	Drs. P. Giesberg
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1 EXECUTIVE SUMMARY

Introduction

Planning for Sustainability Ltd. has been commissioned to produce a report to identify the options available to enable the introduction of renewable energy technologies to a development at 45 New Compton Street, London, WC2H 8DF to deliver a 19% reduction in CO_2 output against Building Regulations 2013. The purpose of this report is to support the planning application for the proposed development. To do this, this report will consider the maximum potential of each technology to achieve these targets, examine cost, visual appearance and installer & end-user issues and conclude with recommendations for action.

In line with best practice and the requirements set out in the London Plan the approach to carbon reduction has been to use the hierarchy:

- Be lean
- Be Clean
- Be Green

In order to reduce the energy demand of the building in the first place (Be lean), higher levels of insulation, improved air tightness and reduction of energy loss at construction junctions by specifying accredited details have been proposed. Table 1 gives an overview of the baseline building regulations specification details and the proposed specification for the current development.

Table 1: Overview of building fabric parameters

Element	Baseline	Proposed building
External walls	0.18	0.14
Ground floor	0.13	0.11
Roof	0.13	0.1
Windows	1.4	1.0
Ext. opaque doors	1.0	1.0
Ext glazed doors	1.2	1.2
Air tightness	5	4
Psi	acr details	act details
efficient lighting	100%	100%
Thermal mass	250	250

In order to be clean the development should be connected to district heat network or install a combined heat and power installation. The development is not in the vicinity of a district heat area. The characteristics of the current development (limited number of units and spatial separation of the proposed units) make the installation of CHP technology not viable. Clean technology is therefore not implemented within the current development.

The final stage in designing an energy strategy is the consideration of renewable energy. There are a number of different technologies available for installation in residential development projects. An option study was carried out and it is proposed to install 4kWp of photovoltaics on the roof of the development.

Table 2 shows the amount of CO_2 emissions for the various scenarios as well as the total reduction compared to the baseline scenario.

Table 2. The energy hierarchy and carbon reductions

Scenario	CO_2 (tonnes/year)	Reduction	Cumulative reduction
Baseline	12.8		
Be lean	11.9	6.5%	6.5%
Be clean	11.9	0%	6.5%
Be green	10.2	13.4 %	19.9%

2 Introduction

The author has been providing advice and guidance on reducing carbon output and methods of generating energy at a local level for 10 years. He has reviewed over 160 existing properties and hundreds of new build properties. As such, the author is well placed to analyse and assess local energy and carbon reduction requirements relating to planning conditions.

This report will assess the expected annual energy demand and carbon output of this development and investigate the various options available to the developers to achieve a 18% reduction in CO_2 output for the site. This proposed development consists of 9 new residential units created in and around the existing building of 45 New Compton Street. The development comprises:

- 1 semi-detached single storey annex to the south of the existing building
- 5 newly constructed flats on the ground floor parking area of the building
- 3 newly constructed flats on the existing roof as a fifth floor

The outline energy demand of the site has been estimated using 2013 SAP calculations, based on standardised UK dwelling occupancy usage patterns. All figures are estimates and the finalised designs/constructions usually perform better than those stated here. The calculations have been carried out by considering 7 distinct building types.

The LZC technologies will be assessed with regard to their suitability for this type of development; their energy offset potential and their capital and running costs.

The following technologies are considered:

- District heating
- Community heating
- Biomass heating (BIO)
- Ground Source Heat Pumps (GSHP)
- Air Source Heat Pumps (ASHP)
- Solar photovoltaics (PV)
- Solar thermal (ST)
- Wind turbines (WT)
- Combined Heat and Power (CHP)

3 Energy and Carbon Dioxide

Energy demand

The energy demand for the property has been estimated using 2013 SAP calculations for sample houses, as fully modelled SAP energy data for this specific property is not available.

The energy data is broken down into what are considered to be the four main areas of domestic usage, space heating, water heating, lights and Equipment. It should be noted that cooking and general electrical appliances do not feature under Part L1A of the Building Regulations and this has therefore not been considered as part of this report.

Table 3: Initial Assessment of Site Energy Demand (kWh/yr)

Type	Heating	DHW	Lighting	Equipment	Total
A	3,357.40	2,247.17	311.23	75.00	5,990.80
B	4,859.40	2,614.76	466.64	75.00	8,015.80
C (3 units)	3,294.85	2,568.54	406.85	75.00	19,035.72
D	3,466.91	2,553.87	401.00	75.00	6,496.78
E	2,530.67	2,387.41	340.55	75.00	5,333.63
F	1,335.40	2,202.77	231.08	84.00	3,853.25
G	2,463.31	2,250.68	280.48	75.00	5,069.47
Total	27,897.64	21,962.28	3,251.53	684.00	53,795.45

The total estimated energy consumption for the development is 53795 kWh/yr made up of 27,898 kWh for space heating, 21,962kWh for water heating, 3,252 kWh for lights and 684kWh for equipment. The figures above represent the properties just passing regulations.

Carbon Dioxide Emissions

This report uses the data from SAP 2013 calculations. Following extrapolation for the respective floor areas, table 4 below shows the total CO_2 emissions for the site. The following sections explore how this can be achieved

Table 4: Initial CO_2 emissions for the site in kgCO_2/year with SAP calculation

Unit	Heating	DHW	Lighting	Equipment	Total
A	725.20	485.39	161.53	38.93	1,411.05
B	1,049.63	564.79	242.19	38.93	1,895.53
C (3 units)	711.69	554.80	211.16	38.93	4,549.72
D	748.85	551.64	208.12	38.93	1,547.53
E	546.62	515.68	176.75	38.93	1,277.98
F	288.45	475.80	119.93	43.60	927.77
G	532.07	486.15	145.57	38.93	1,202.72
Total	6,025.89	4,743.85	1,687.54	355.00	12,812.28

The target for reduction of 19% CO_2 is based on the regulated energy as shown in table 4. This requires a saving of 2,434 kg CO_2/yr. The following sections explore how this can be achieved.

4 Be lean – reducing the energy demand

In order to reduce the energy demand of the building in the first place (Be lean), higher levels of insulation, improved air tightness and reduction of energy loss at construction junctions by specifying accredited details have been proposed. Table 5 gives an overview of the baseline building regulations specification details and the proposed specification for the current development.

Table 5: Overview of building fabric parameters

Element	Baseline	Proposed building
External walls	0.18	0.14
Ground floor	0.13	0.11
Roof	0.13	0.1
Windows	1.4	1.0
Ext. opaque doors	1.0	1.0
Ext glazed doors	1.2	1.2
Air tightness	5	4
Psi	acr details	act details
efficient lighting	100%	100%
Thermal mass	250	250

Using these parameters, the building can achieve 0.9 tonnes reduction in CO_2, which amounts to 6.5%.

5 Be clean - Centralised heating systems

District Heating

A district heating system would consist of an industrial unit that generates a large amount of surplus heat, such as an incinerator plant. This waste heat is converted in to high temperature water or steam and sent to the houses / flats / offices by pipe.

There is a charging system for each house / unit that measures the amount of hot water they take. At the local level – house for example – the very hot water or steam is passed through a heat exchanger to heat the local water in the house. This is then used internally just like a normal boiler based hot water system would be.

There are no district heating systems available in the locality.

Community heating

A community heating system is made up of a large boiler and hot water store in a central location. This generates hot water, which is passed through heat mains pipe work to each unit.

At the house level, the water will pass through a meter directly in to the heat emitters (radiators) and into the hot water tank. This intake is measured by a heat meter so that each unit can be charged individually. There is usually a local hot water tank in each house to reduce time to get hot water.

Community heating at proposed development

There are practical difficulties with installing community heating at this location. Firstly the proposed development has a high density and does not allow for sufficient space to provide a shared installation. Secondly the proposed development is separated in three distinct groupings that are spread over the existing site. This makes connecting all units to centralised system logistically incoherent and prone to maintenance errors.

Combined Heat and Power

Background

Combined Heat and Power (CHP) is generally considered a commercial product, however, there are two ways this can be incorporated within this site.

Micro CHP - a single house system, which acts like a system boiler, but uses spare energy to drive a generator. This can provide electricity directly to the houses and as the boiler runs most often in the morning and evening (the same times as peak electricity demand), the most effective use is made of the electricity.

The second approach would be to build a single CHP unit for the site, which would provide heat and power for all 9 units. This would require a large CHP unit and water store, which may fit in the plant room. A larger system needs to run continuously to be efficient and there is no heat demand for such a system 24 hours a day. This is also a poor option.

The cost of the Baxi product was approximately £ 6000 per boiler. The maintenance requirements are similar to the standard gas boiler and the size of boiler available is expected to be suitable for

the houses. This makes it equivalent in cost to both solar PV and ASHP. The boilers are expensive and the boiler part is old technology and has poor efficiency ratings
This makes it a poor option.

6 Be green - Renewable energy options appraisal

Biomass Heating

Background

The CO_2 that is released when wood fuel is burnt is equivalent to that taken from the atmosphere through photosynthesis during tree growth. Even allowing for CO_2 generated during planting, harvesting, processing and transport of the wood, replacement of fossil fuel with wood fuel will typically reduce net CO_2 emissions by over 99%, assuming that the wood is managed sustainably. Whilst wood fuel has been utilised for centuries, technological applications for its use have progressed rapidly in recent years, with Austria and the Scandinavian countries leading the way. Wood fuel can be split into three categories; wood chips, wood pellets and logs.

Woodchips arise mainly from woodland management or dedicated wood-fuel crops, such as coppice willow. They are best suited to a building or buildings with a consistent '24/7' heat requirement throughout the heating season, such as schools, halls of residence, old peoples' homes, hospitals, prisons etc., or for district heating/CHP schemes. They require large storage spaces which makes them unsuitable for single houses and will therefore not be considered for individual use.

Wood pellets are mainly produced from untreated wood waste, such as sawdust, pulverised pallets or reclaimed timber. They are more expensive then wood chips, however, they are easier to store and handle, require less storage space and have a higher calorific value. Pellets are typically used in smaller systems, down to the domestic level, Pellet fuelled systems are operated much like oil or LPG based boilers, with a small time lag when first starting up.

Logs are a well-known fuel and tend to be used in smaller heating systems and domestic stoves. They normally require a higher manual input that pellets and chips, so are not under consideration for this site.

Domestic Wood Fuel Boiler Systems

Wood fuel heating can be undertaken in one of two ways; district/communal heating or individual property based boilers. In this instance, it will be the latter that is considered, as a communal system is not deemed to be economically viable for this site as there is only one dwelling. The focus regarding fuel source will be on pellet fired systems due to storage space constraints and operational issues, which render wood chip and logs an unrealistic option at the individual property level.

Wood fuel heating systems typically comprise the boiler (and flue); in some instances, a thermal store; a circulation/distribution pump & associated mechanical services; electrical services;

controls package and a fuel storage facility connected to the boiler, either internal or from a hopper or bunker via a screw feed auger.

System set up is essentially the same as for a conventional domestic boiler, with a programmer controlling when heat is required. The issues that needs addressing at the earliest stage of design are whether to install a thermal store and how/where fuel will be stored and fed into the boiler.

The thermal store allows the boiler to operate efficiently during the periods when the heat demand is low or experiences unpredictable peaks. This is likely to be the case during the seasons of spring and autumn and when providing domestic hot water (DHW) only during the summer (if this option is selected over solar thermal or electrical heating options). Most biomass boilers tend to operate at their maximum efficiency when they are working at full load, therefore, a heat distribution with many peaks is not conducive to optimum operational efficiency. A thermal store will enable the boiler to run at full load until the tank is at the required temperature. The buffer tank will then feed the demand of the central heating system and DHW until the temperature of the water in the tank drops below a set point and the boiler needs to fire up again.

It is recognised that thermal stores are large; normally starting at 400-1,000 litres in capacity and that this may only be an option for house types A, A1 and possibly F due to space constraints. There are a number of options for fuel storage and these are governed by space restrictions and desired frequency of delivery. In most cases a prefabricated hopper located adjacent to the building (and boiler) filled by a tanker blowing pellet in directly or an excavated bunker fed the same way would be the preferable solutions. The advantage of these methods is that a hopper or bunker allows for the pellets can be automatically fed into the boiler and, if adequately sized, reduces number of deliveries per annum.

Fuel Supply

Pellet supply is a rapidly maturing market and there are many suppliers both locally and nationally that could supply this site, both with bulk and smaller delivery options. Bulk purchase has good economies of scale over regular deliveries, with the acceptable size of the external pellet store giving the restriction in capacity.

Biomass Heating at the Development Site

The entire borough is designated a smoke free zone. Biomass systems would contribute to local air pollution and this site is therefore not suitable for biomass units.

Ground Source Heat Pumps

Background

In the UK, the earth at a depth of 2 metres and below has a constant temperature of around 11-12 °C throughout the year. Due to the ground's high thermal mass, it stores heat from the sun during the summer. A ground source heat pump (GSHP) can upgrade this heat from the ground to provide space heating and, in many cases, heating for DHW. For every unit of electricity used to generate the useful heat, 3-4 units of heat are produced. Whilst not truly a renewable energy technology because of the requirement to input electricity, heat pumps do still have a significant impact in reducing CO2 emissions and are cost competitive in terms of running costs against direct electricity, oil and LPG fuelled systems and in some instances mains gas. They can therefore be regarded as a sustainable energy solution.

The Technology

In the case of GSHP systems there are three important elements to consider:

The ground loop - comprises lengths of plastic pipe buried in the ground, either in vertical boreholes or horizontal trenches. The pipe is a closed circuit and is filled with a special liquid, which is pumped round the pipe absorbing heat from the ground. A horizontal trench of about 30m length will provide for about 1kW of heating load. Trenches are normally a minimum of 5m apart and 1.5 - 2m deep. Borehole based collectors will be at depths of between 60 and 80m. On this site, the only option is boreholes.

Heat pump — these are similar in operation to refrigerators and air conditioners. By vaporising and condensing a refrigerant a heat pump is able to move heat from one place to another. In the case of ground source heat pumps, the evaporator takes heat from the water in the ground loop and consequently, the condenser gives up heat to the heating distribution system. A compressor within the heat pump compresses the gaseous refrigerant to increase the temperature to that needed for the distribution circuit.

Heat distribution system — GSHPs are suited to low temperature (35 - 40C) heating systems as less energy is needed to upgrade from the source temperature. Under-floor heating, ducted warm air and low temperature radiator heating systems are therefore particularly suited for heat pumps. Use of conventional radiator systems is possible but needs careful analysis before proceeding, although split systems involving under-floor heating downstairs and radiators upstairs are increasingly popular in new-build properties. Heat pumps can also supply all, or a fraction of DHW and an element of summer cooling, if the installation is designed correctly.

As already stated, energy is needed to run the heat pump cycle and to compress the vapour and expand the liquid to vapour for the production of useful heat. The efficiency of this process is measured by the ratio of the useful heat delivered and the energy used by the compressor. This ratio is called the Coefficient of Performance (CoP). The CoP of the current generation of ground source based heat pumps varies from 3.5 to 5. Since the CoP shows performance for a single set of parameters, a second measure is included to show the performance of the heat pump over an entire year. It is called the Seasonal Performance Factor (SPF), which is the ratio of annually delivered useful heat over annually used driving energy. The calculations for SPF are now included in a SAP calculation known as Appendix Q, which is publicly available.

GSHPs at the development site

The use of GSHPs at the current site is not feasible. Due to the existing buildings in the area, installing new boreholes for the ground loops is not viable. The use of GSHP has therefore been discarded.

Air Source Heat Pumps

Background

ASHPs work on the same principal as a GSHP, however, the medium from which heat is extracted is the external air rather than the ground. ASHPs will generally have a lower seasonal CoP compared to GSHPs due to the generally lower air temperatures compared to the ground. They may require additional backup in extremely cold conditions and this facility is normally provided by an electric booster built into the system. Its requirement will be limited, but it can provide peace of mind to the end user, although it can lead to large electricity bills in the depths of winter.

ASHPs can either be monoblock units or split systems. The external unit is normally next to a wall of the building they serve. It is advisable to locate the unit to protect it from high winds. In addition, the fans and compressors do make a small noise (40 - 50 dB), so it is worth considering locating the plant away from windows and adjacent buildings. It is also possible to reduce this noise by mounting the unit on a noise-absorbing base. Manufacturers display the noise levels of the units to enable an informed selection.

In a split system the outdoor unit can be located up to 10-50 meters away from the indoor heat exchanger. The external unit absorbs heat from the air and transfers this to a refrigerant, which is transferred via refrigeration pipe-work to the heat exchanger. The external unit will be between 80 - 120cm high, 90 - 110cm wide and 30 - 40cm deep. Acoustically, they tend to have noise levels of around 40 - 50dB, therefore they are normally mounted on rubber spacers to counter any issues of disturbance.

The indoor unit is a wall mounted compact unit that can be located anywhere in the house. It does not require flues or ventilation. Its main function is to transfer the heat in the refrigerant from the outdoor unit to the house heating and hot water system. Dimensions are typically 90- 120cm high, 50 - 65cm wide and 35 - 60cm deep. The domestic hot water tank is the final key component and is normally complete with recirculation connection, tank sensor, tank heater overload and the usual controls.

ASHPs at the Development Site

The use of ASHPs at the Development site is worth considering technically as this is a new development and the heat pumps can be installed to feed under-floor heating or mixed under-floor/radiator systems, which would allow for optimum performance. Table 7 shows the potential impacts on CO_2 reduction if installed in both houses at the site. Assumptions include the ASHP providing the DHW and space heating requirements, but no cooling, and working to a CoP of 3.5.

The average CoP in SAP software is around 3.5, which is marginally less than the CoP used for ground source heat pumps. Data shows that installing an ASHP system in all of the properties is estimated to be 29% and thus meets the planning condition requiring a reduction of 19% in CO_2 from building regulations.

However, the development requires large glazed wall and therefore there is not much opportunity to mount the external units on the dwellings. For this reason ASHP is discarded.

Solar Photovoltaics

Background

Solar generated electricity is created by the technology of photovoltaics (PV) — solid state semi-conductors that convert light into electricity. When light (a photon) hits a PV cell it gives energy to an electron. The electron moves away from the cell into an electrical circuit. The electricity created is direct current (DC). This can either be used to charge batteries or in this case it will be converted to alternating current (AC) via an inverter to meet some of the electrical demands of the site/building and also enable it to be tied into the grid.

Systems are easily incorporated into new roofs, the technology being simple to install. The panels themselves when connected together form an array. The capacity is measured in kilowatts hours peak (kWh). A rating calculated using a defined theoretical set of conditions rather than maximum or typical output.

Solar PV panels are available in a variety of different forms including;

- Mono-crystalline
- Poly-crystalline
- Thin film
- Hybrid

Mono-crystalline and hybrid panels are the most efficient at turning daylight into energy, but it may be easier to install thin film panels in the form of solar roof tiles rather than fitting a standard roof and in roof panels. Solar roof tiles come in a variety of different physical sizes and capacities, they do not currently vary much from a grey/blue/black colour.

The key location requirements for a PV array are to avoid shading and to face within 45° of south, although they will work at a reduced efficiency facing east/west. A tilt of between 30 & 45 degrees is also preferable, but not essential.

Generation & Tariffs

In terms of generation capability, I kWp installed of PV should produce around 800 kWh of electricity per year situated in a southerly-facing, un-shaded location. A I kWp array made up of conventional panels will need around 4 m^2 of space on a roof with around 0.5 m^2 of internal space required for the inverter and associated equipment.

The electricity generated will be used within the house first, which will offset electrical requirements, leading to saving for the occupiers. In addition to this, payment can be received from utilities for the simple fact of generating renewable electricity. This is known as the feed-in tariff. This will guarantee a payment for every unit of electricity generated by a PV system up to a rated capacity of 4 kW peak for a period of 25 years. The amount paid in feed in Tariffs is changing during the course of this project and the actual amount that will be paid is not currently published. It is likely that this form of subsidy will end in 2019.

The property owner will also receive a small payment from the electricity supply company for any excess electricity generated. This is likely to happen during the day when the house is unoccupied.

Solar PV at the development site

The proposed development site is technically suitable for solar PV technology as there is a large flat roof. 4 kW of panels fitted (approximately 16 panels) can be fitted to the roof.

Table 6: Energy implications for total site with Solar PV

CO_2 saving per house for 4 kWh	Number of houses reqd. to meet CO_2 reduction	Total reduction %
1,700 kg	available roof	13.4

The shape of the roof area of this house makes it practicable to fit sufficient panels to reach the 19% target, therefore this is a good option.

Solar Thermal

Background

Solar thermal heating systems (STHS) utilises energy from the sun, in the form of heat, to supply heat to hot water systems. This is achieved by using a solar collector filled with a liquid medium, which absorbs heat from the radiation of the sun (it does not have to be sunny to work) and transfers this heat, via a heat exchange system in a dual coil hot water tank. Collector technology is split between flat plate collectors and evacuated tube systems. In new build sites like the current development, the flat plates can be mounted directly on the rafters and a flashing kit fitted round them to make a better looking installation. They can also be fitted on a flat roof

STHS will provide a portion of the annual domestic hot water requirements depending on the details of the end use and size of solar collector system installed, and is generally guaranteed at 50% of hot water requirements over the course of a year (on a southerly facing roof), although in many instances this is often higher. This will be around 95% of hot water requirements from the end of May through to mid-September, whilst in winter a 20% contribution can be expected on average.

There are now a number of solar thermal tile products entering the market and these allow for total roof integration options, although, like photovoltaics (PV — see previous section), the product is still only available in a traditional grey/blue slate type colouring and is more expensive than both flat-plate and evacuated tube systems.
The hot water from a solar thermal system is normally supplied as a pre-heat to a twin coil hot water storage tank linked to the main heating system for the home. There will also be a drain-back unit (on some systems), pumps, controllers and pipe-work to interface with the existing boiler system.

Both flat-plate and evacuated tube collectors tend to be guaranteed for around 20 years but are known to last well over 30 years. Other parts such as pumps have standard time guarantees associated with standard plumbing products. Annual maintenance requirements are minimal and it would be reasonable to check the system on a 2 year cycle, although it could be included with standard annual boiler servicing.

STHS collectors are best located on un-shaded, pitched roofs, facing south for optimum performance, although other orientations within 45° either direction from due south or horizontal mounting do not significantly affect output. Even at east/west facing alignments, the system will still perform to around 75% of efficiency.

STHSs have the same locational requirements as solar PV, although shading issues are not as critical and space requirements are significantly less. There is, therefore, space to locate collectors on the southerly facing roofs of the dwellings. It is suggested that around 4.0 m^2 of roof space is taken as a standard detached house requirement for panel based systems in this instance, but this will need confirmation by suppliers/system design team.

It is also worth noting that a renewable heat payment may be available to new home owners.

Solar Thermal and the development site
ST collectors have the same location requirements as solar PV, although shading is less of an issue. Logistically the three top flats and the annex can easily be connected to a solar thermal system.
The table below shows the CO_2 savings that can be achieved. With 8.4% this would not be sufficient to meet the target.

Table 7: Energy implications for total site with Solar Thermal

CO_2saving per house	Number of houses installed	Total reduction %
1,078	4	8.4

Since this option does not meet the target CO_2 reduction, this option is a poor choice.

Building Mounted Wind Turbines

Background

A building mounted turbine is one that is attached to the side of a building using mounting brackets. They typically range in rated output from 100W to 1.5kw. They should always be several meters above the roof line and must have a clear, unimpeded draw on the wind coming from the south west, which is the prevailing direction of the wind in the UK. The amount of energy generated is determined by the nature and velocity of the wind and the area swept by the blades. Blade shape and rotation speed determine efficiency.

Grid connection and tariff structures operate in the manner described for PV under the previous section.

Wind Power at the Development Site

The problem with installations in an environment with other properties nearby is the uneven flow of the wind as it is disturbed by roof shapes and trees. As this location has houses on all side, this type of system will not work efficiently. Therefore this system is considered an unsuitable option.

5. Conclusion.

The proposed combination of increased energy performance of the building fabric and the provision of a 4 kWp array of photovoltaic cells will provide 19.9% CO_2 reduction of the proposed development when compared with the building regulation requirements. The array would comprise of 16 solar panels and be approximately 30m^2 in size.

Table 8. The energy hierarchy and carbon reductions

Scenario	CO_2 (tonnes/year)	Reduction	Cumulative reduction
Baseline	12.8		
Be lean	11.9	6.5%	6.5%
Be clean	11.9	0%	6.5%
Be green	10.2	13.4 %	19.9%