SUSTAINABILITY STATEMENT INTO

LOW AND ZERO CARBON ENERGY SYSTEMS FOR NEW CARE HOME

AT

COUPALS ROAD, HAVERHILL

SUFFOLK

BY

HIBEC LTD
106A HIGH STREET
WARWICKSHIRE
B95 5BY

REF C2223459
DATE 16/05/23

Introduction

This Sustainability Statement into Low and Zero Carbon (LZC) energy systems for Haverhill Care Home, Coupals Road, Haverhill, Suffollk is produced to be compliant with BREEAM 2018 Requirements Issue ENE 04 Low and Zero Carbon Technologies.

The aim of ENE 04 is to reduce carbon emissions and atmospheric pollution by encouraging local generation from renewable sources to supply a significant proportion of the energy demand.

The purpose of this Sustainability Statement is to set out the approach to reducing carbon dioxide (CO_2) emissions and optimising energy efficiency for the proposed development. The Statement provides a strategy which accords with the current building regulations as well as local planning policy."

This statement also needs to consider Policy LPP 72 of the Local Plan (July 2022). This requires that the proposed development includes renewables and low carbon energy technology to provide at least 19% improvement in energy performance over the building regulations (2013) unless the revised building regulations exceed this requirement.

It is not a costing exercise to establish the most economical solution, but clearly, the renewable solution still has to have to be commercially viable to encourage the client to invest in the technology.

This sustainability statement has been undertaken by John White of HIBEC Ltd.

John is an independent specialist Energy Consultant with over 15 years' experience and a registered CIBSE Low Carbon Consultant and is accredited for the provision of commercial EPC's.

The LZC technologies considered in this study are those defined by Directive 2009/28/EC of the European Parliament on the promotion of the use of energy from renewable sources which covers:

- Solar Hot water systems
- Photovoltaic solar systems
- Small scale hydroelectric power
- Wind turbines
- Biomass heating systems, stoves and community systems
- Combined heat and power (CHP) and micro-CHP systems
- Community heating systems from waste heat.
- Heat pumps, either air, water or ground source.
- Other systems that may be available i.e., Anaerobic Digestion

The whole site and each LZC have been considered against the criteria set down in the BREEAM documentation as follows:

- Energy generated from LZC Source per year
- Life costing costing of potential systems and payback
- Local planning requirements, land use and noise
- Sustainability of generating and exporting heat/electricity
- Grants available
- All technologies appropriate to the site and energy demand of the development
- Reasons for excluding other technologies

This study was undertaken at the developments concept design and prior to procurement, equivalent to RIBA Stage C.

Building Regulations (2021)

Approved Document Part L Volume 2 states that "A New building must be built to minimum standard of total energy performance. This is evaluated by comparing calculations of the performance of the 'actual building' against calculations of the performance of a theoretical building, called the 'notional building' This must be carried out both at the design stage and when the work is completed."

"The notional building is the same size and shape as the actual building and has standardised properties for fabric and services. The full properties of the notional building are set out in the '*National Calculation Methodology Modelling Guide'*.

The energy performance of the notional building is described using the following metrics;

1. The Target Primary Energy Rate in kWh_{PE}/m^2 per year.
2. The Target Emission Rate in $kgCO_2/m^2$ per year.

The target primary energy rate and target emission rate must be calculated using one of the calculation tools in the approved methodology, used in line with the version policy as stated in the methodology. It must also be calculated using approved software.

In order to be compliant with building regulations the Building Primary Energy Rate and Building Emission Rate must be equal to or lower than the Target Primary Energy Rate and Target Emission Rate.

Braintree Local Plan (adopted July 2022)

Policy LPP 71 (Climate Change) states applicants will be expected to demonstrate that measures to lower carbon emissions, increase renewable energy provision and adapt to the expected impacts of climate change have been incorporated into their schemes, other than for very minor development. Planning permission will only be granted for proposals that demonstrate the principles of climate change mitigation and adaptation into the development.

The Council intends the District to meet part of its future energy needs through renewable and low carbon energy sources and will therefore encourage and support the provision of these technologies subject to their impacts on landscape and visual amenity, residential amenities including noise, pollution, heritage assets and their settings, biodiversity and designated nature conservation sites, soils, and impact on the highway, being acceptable.

Policy LPP 72 (Resource Efficiency, Energy Generation and Energy Efficiency) states the Local Planning Authority will encourage appropriate energy conservation and efficiency measures in the design of all new development. Such measures could include site layout and building orientation, natural light and ventilation, air tightness, solar shading, reducing water consumption and increasing water recycling in order to contribute to the reduction in their total energy consumption.

Opportunities for decentralised energy networks will be encouraged and promoted where possible and where they conform to other Local Plan policies, in order to reduce carbon emissions.

All new dwellings shall meet the Building Regulations optional requirement for water efficiency of 110 litres/person/day.

All planning applications for new residential dwellings shall include renewable and low carbon energy technology to provide at least a 19% improvement in energy performance over the requirements of the Building Regulations (2013) unless:

a. Revised Building Regulations standards exceed this requirement, or
b. All new non-residential buildings with a floor area in excess of 500sqm shall achieve a minimum BREEAM rating (or its successor) of 'Very Good'.

Site Description

The development is the construction of a new care home with associated support areas.

The building is on the site of a former hotel, where there is no centralised plant or district heating system installed to service this new building and there are no plans for a site wide district heating and CHP facility.

There is mains gas and electricity available to these buildings.

The building is located in close proximity to a residential area so consideration has to be given to the likely planning issues and restrictions that this may place on renewable solutions.

There are no planning issues or criteria that have been applied to this building with respect to use or noise.

Renewable technologies can be installed either on or off site and can cover the whole site.

All systems are considered below, but most LZC technologies are available for installation in the building; however, not all systems are suitable for all building uses, for example, physical size may be a deciding factor, but the operational use of the building is usually more significant.

As a care home with office facilities, the majority of the energy used in this building will be for Heating, DHW and Lighting.

The building has been designed to minimise energy use through efficient insulation and the use of translucent fabrics to maximise daylight, therefore the renewables need to be considered against how they perform with respect to the occupancy pattern and users' requirements.

The systems also need to account for practical considerations such as rate of response to fluctuating demand as well as assessing the overall potential energy saving.

The occupancy patterns of the building are therefore significant. There is a seasonal heating demand, frequent 'all year' intermittent peak demands on the DHW i.e., showering activity, and constantly changing electrical demand for lighting.

Consequently, due to diversity and patterns of use, more than one renewable technology may be appropriate or advantageous and some systems unsuitable.

Site Carbon Emission and Energy Demand

The energy consumption for each building service is estimated using the National Calculation Methodology approved software IESVE and using the appropriate technology in IESVE in addition to or instead of the services in the 'base' building the performance of each renewable has been established.

The energy consumption of the building has been carried out using 2021 building regulations.

When considering the aim of the ENE 04 credit, where reduction of Carbon emissions is the objective, the type of fuel used to satisfy the above energy demand must be considered.

Each fuel has a differing amount of CO_2 released upon use. This 'fuel factor' gives us the kgCO_2/kW of fuel used.

We will use the official DCLG fuel factors as follows in our calculations where required.

Natural gas	0.210 kg CO_2/kW
Mains electricity supplied	0.139 kgCO_2/kW
Mains electricity displaced	0.146 kgCO_2/kW

Base Building Construction and Plant Data

Walls	0.26 W/m^2.K
Floor	0.18 W/m^2.K
Roof	0.18 W/m^2.K
Windows	1.60 W/m^2.K
Personnel Doors	1.60 W/m^2.K

Air Tightness 5.00 m^3/hr.m^2@50Pa

Heating throughout will be from a gas fired boiler operating at 95% efficiency serving radiators.

Hot water is produced by gas fired hot water heaters operating at 95% efficiency.

LED lighting throughout the building is set at 120 lumens/watt

Ventilation is as follows.

- Supply & extract MVHR to bedrooms, lounges and office spaces with a SFP of 1.6w/l/s with 80% heat recovery efficiency
- Extract ventilation to all WCs and cleaners stores with a SFP of 0.5 w/l/s

Base Building Emissions and Energy Demands
Using the IESVE software, the following emission rates and energy demands have been established for the base buildings.

4537m² Total Floor Area

Total Building Energy Consumption	119.01	kW/m²/a	539948.40	kW/a
Annual Energy Consumption Heating	5.66	kW/m²/a	25679.42	kW/a
Annual Energy Consumption Cooling	0.00	kW/m²/a	0	kW/a
Annual Energy Consumption DHW	84.29	kW/m²/a	382423.70	kW/a
Annual Energy Consumption Auxiliary	17.08	kW/m²/a	77491.96	kW/a
Annual Energy Consumption Lighting	11.99	kW/m²/a	54398.63	kW/a
Building Emission Rate	22.82	kgCO2/m²/a		

The following renewables, where considered practicable will be compared to this 'base' building performance figures for Carbon reduction.
For Life Cycle Costing Analysis and payback periods, the following fuel costs will be used, mains electricity 11p/kW and natural gas 5p/kW.

Site Wide and Community LZC Systems

CHP and Waste Heat LZC Systems

The location of buildings precludes the use of waste heat as there is no local waste heat source available.

In addition, the use of waste on site would not be acceptable due to pollution and traffic nuisance close to a residential location.

The proposed site is a former hotel on the edge of Haverhill near a residential area where there is no existing CHP district heating system.

A Site or community CHP system would not be viable in the future to provide a site distributed LPHW district heating system or local community electrical distribution system, due to the diversity and complexity of the types of buildings with vastly differing services and needs.

Consequently, Site Wide Community and CHP LZC Systems are discounted in the consideration of this building at this time.

Hydro Electric Power

There is no local potential for local hydroelectric power due to site location.

Wind turbines

The site location near a residential area makes the use of large site serving wind turbines unviable due to the likelihood of low or disrupted wind speeds

In addition, local planning is unlikely to be a forthcoming in this location.

Local building wind turbines do not offer a viable regular renewable solution and would not be viable on this site.

LZC Systems for Individual Buildings

Each renewables applicable to individual buildings is discussed below:

Solar Hot Water Heating Systems

The results of the Part L calculations for each unit show the energy use for the DHW load is relatively large on this site, however Solar DHW payback or contribution is likely to be negligible.

Any carbon saving is further diminished due to standing losses from the boilers, drop off of condensing efficiency from under loading and constant water pump operation etc.

Consequently, solar hot water panels are not considered viable.

Photovoltaic Solar Panels

The use of solar photovoltaic panels on site is a practical option and can be incorporated into all types of buildings with direct sunlight.

The use of solar panels produces electricity from the sun's energy so the demand from the mains national electrical is reduced.

PV panels are still relatively expensive and only generate approximately 150-200 watts per m2 of panel area, so a considerable area of panels is required to generate a meaningful electrical supply.

The generation of the electrical supply is constant, even if there is no electrical load in the building to use it, but what electricity is not used can be transported to other buildings on site or sold back to the national grid.

However, as the electricity the PV generated displaces mains electricity at the high fuel factor, this has a considerable Carbon reduction benefit

The Carbon emission reduction for a typical system to provide 10% of the energy provided on a southerly facing panel has been estimated using IESVE as follows:

Annual Energy delivered by PV	8.09	kW/m²/a	36704.33	kW/a
CO2 reduction	4.718	tonnes CO2/a		
Energy Reduction	32318.36	kW/a		
Annual fuel cost saving	£3555			
Building Emission Rate reduction	1.04	kgCO2/m²/a		

The usual whole life cycle cost of a 200 m^2 solar photovoltaic panel systems are in the order of £120000 and consequently a payback in excess of 30 years can be expected.

The life expectancy of these systems is approximately 20 years, so there is no fiscal benefit.

The project intends to utilise Photovoltaic panels on the development to ensure the demand for electrical energy is reduced from the national grid. The project also intends to use the energy generated by the PV in the most efficient was by utilising any surplus energy towards the hot water system by using an immersion heater solar power diverter.

Biomass Boilers

Biomass fuel boilers utilise wood pellets, logs or chippings, or a form of energy crop i.e., rape seed or an animal/food waste product.

In most instances a wood fuel is used, with prices being variable dependant on site location in relation to the available supply.

Where there is space available within a dwelling to install a biomass boiler considerable Carbon emissions are achieved as wood as a fuel is virtually carbon neutral.

There are no noise issues with this LZC, but due to the flue/smoke emissions must be considered and local authority approval sought, and smokeless zones respected or approved plant that are certified smokeless installed.

Flue heights need to be investigated and Topographical surveys done to ensure smoke dissipation and no nuisances to local residents or college staff and students.

In addition, the fuel storage facility and fuel transfer system to the boilers, at the volumes that would both be considerable, with additional vehicle roadways added for fuel delivery to the storage area.

The use of biomass boilers to the buildings would also create additional vehicular activity on a site. Central Biomass boilers whole life cost will be in the order of approximately £15000.00 making the payback period likely to be in excess of 20 years bearing in mind the low LPHW and Hot water demand in the building.

Considering the operational factors, fuel storage, delivery the economics would be unviable, other renewables may be more appropriate for this development.

Ground Source Heat Pumps

The use of ground source heat pumps to the buildings is one option and when incorporating low temperature hot water heating, typically an underfloor heating system and domestic hot water system gives a viable LZC solution.
There are two options for ground source systems; firstly, to use a ground coil installed in a loop about one metre below ground.

The second option is for a vertical borehole.

The main fuel of the GSHP is mains electricity, so the efficiency of the system is paramount when considering the heating fuel being displaced is gas at over half the fuel factor.

At the above fuel factors and 90% efficient gas heating the GSHP must be 210% efficient to achieve the same carbon emissions.

A GSHP can be expected to operate at 400% efficiency therefore making it an attractive carbon reducing renewable.

The GSHP typically delivers low temperature hot water suitable for under floor heating systems.

There is considerable ground area required for these systems, which is not available as this site is on an industrial estate next to a railway line and a canal.

Boreholes would be another alternative, but due to the location of the site this has been advised as impractical.

Whilst there are no noise issues with this LZC, however this LZC uses grid supplied electricity with the result that the Nitrous Oxide (NOx) emissions of the dwellings will increase and potential BREEAM credits for Pollution may be lost.

This is not considered a sustainable or practical viable solution.

<u>Water Source Heat Pump and Air Source Heat Pump</u>

The use of water source heat pumps is not a viable option due to the site location and no water sources nearby.

The use of air source heat pumps to these buildings is a practical option upon the same basis as the GSHPs.

In this instance there are two types of heat pump operation that we may consider.
The first will provide heating only, the second will be by reverse cycle heat pump which will also provide cooling in the same rooms.

The buildings will benefit from cooling to achieve an all-year level of comfort and therefore this system would be used.

To show a like for like comparison, the additional cooling load will be removed.

Whilst the ASHP operate typically at 380% efficiency, slightly less than the GSHP or WSHP, there is a considerable cost saving as there is no borehole or burial of pipe work making the application of ASHP economically attractive.

4537m² Total Floor Area

Total Building Energy Consumption	117.96	kW/m²/a	535184.50	kW/a
Annual Energy Consumption Heating	2.46	kW/m²/a	11161.02	kW/a
Annual Energy Consumption Cooling	2.60	kW/m²/a	11796.20	kW/a
Annual Energy Consumption DHW	84.29	kW/m²/a	382423.70	kW/a
Annual Energy Consumption Auxiliary	16.62	kW/m²/a	75404.94	kW/a
Annual Energy Consumption Lighting	11.99	kW/m²/a	54398.63	kW/a
Building Emission Rate	22.26	kgCO2/m²/a		
Less cooling at FF 0.139	21.90	kgCO2/m²/a		

Annual CO_2 reduction due to use of ASHP to provide heating to the Care Home will be $0.92kgCO_2/m^2/a$.

The energy saving is modest, and there is no Commercial grant for air to air heat pumps.

The additional cost of an air source heat pump system above the cost of installing the gas boiler systems are in the order of £25000.00 and consequently no payback can be expected.

However, the building needs the cooling to provide a suitable environment for occupants.

In addition to providing heating and cooling to the Care home an Air Source heat pumps could also be used to generate the DHW for the buildings.

4537m²	**Total Floor Area**			
Total Building Energy Consumption	55.61	kW/m²/a	252302.60	kW/a
Annual Energy Consumption Heating	2.46	kW/m²/a	11161.02	kW/a
Annual Energy Consumption Cooling	2.60	kW/m²/a	11796.20	kW/a
Annual Energy Consumption DHW	21.94	kW/m²/a	99541.78	kW/a
Annual Energy Consumption Auxiliary	16.62	kW/m²/a	75404.94	kW/a
Annual Energy Consumption Lighting	11.99	kW/m²/a	54398.63	kW/a
Building Emission Rate	7.52	kgCO2/m²/a		

Annual CO_2 reduction due to use of ASHP to provide heating and cooling to the Care Home and DHW to the building will be 15.30 $kgCO_2/m^2/a$.

The project intends to utilise ASHPs to heat the building and also provide a source for hot water production. This is achieved by taking low temperature heat from the environment and raising it to usable temperatures capable of handling the space heating and hot water loads. The seasonal efficiency of ASHPs enables less energy to be used to generate the same amount of heat as other methods. For example, an ASHP with a seasonal coefficient of performance of 3.54 uses 1 unit of electrical energy to generate 3.54 units of heat. The ASHP can also be used in reverse to provide cooling to certain spaces to enable to occupants to provide a stable working/living environment.

The ASHPs refrigerant for the heating (R32, R125 and R134a) and the hot water (R744) are all non-ozone depleting and have amongst the lowest global warming potentials of any refrigerant.

<u>Other Systems</u>

At present there are no other viable LZC's that could be considered for this site such as Anaerobic waste heat generation etc.

Available Grants

The installation of renewable technologies and LZC systems are being actively encouraged by central Government and grants to help with cost of installing systems are often available.

However, many grants have limited funds or run for limited periods depending on the technology being encouraged at the time the development is constructed.

Presently the DECC Renewable Heat Initiative is no longer in operation

Solar PV renewables are no longer supported by the Feed in Tariff.

The above grants can be found on the DECC website, www.decc.gov.uk

Conclusions

Renewable systems can only be considered as viable if they generate energy savings that can be effectively utilised by the building and its occupants or elsewhere on the site, provide a significant Carbon reduction and are not an economic liability.

BREEAM is concerned with Carbon reduction – this is mirrored by the client, who is also interested in the balance of sustainable design and economic viability.

The above analysis of renewable systems shows:

Solar DHW panels is operationally limited, gives a no real scope for Carbon reduction.

Solar PV panels are practical, give a high Carbon reduction and are economically neutral.

Ground Source heat pumps are practical, give a high Carbon reduction and are economically attractive if the RHI grant is available. However, site restrictions make this option unviable.
Water Source heat pump are a not practical option, due to the site location and the no nearby water source. Also, the cost of installation may prove to be unfeasible when compared to other options.

Air Source Heat Pumps are practical, give a high Carbon reduction and whilst are economically unattractive, they do have the benefit of Care Home environment stability through cooling.

The use of renewables will not be required to achieve compliance with Building Regulations ADL2A.

With regards to meeting planning requirements, in particular the Policy LLP 72 of the local plan, if Air Source Heat pumps are used to generate the heating and hot water the building will achieve in excess of 19% improvement in energy performance over the 2013 building regulations. Through the use of ASHPs and PV, the scheme could achieve a reduction of 42% over the 2013 building regulations.

Recommendations

Summary of results for viable options

	Base Build $kgCO_2/m^2/a$ TER/BER	With PV $kgCO_2/m^2/a$ TER/BER	With ASHP $kgCO_2/m^2/a$ TER/BER	With ASHP (Heat Only) $kgCO_2/m^2/a$ TER/BER	With ASHP & DHW $kgCO_2/m^2/a$ TER/BER	With ASHP & DHW & PV $kgCO_2/m^2/a$ TER/BER
	21.86/22.82	21.86/21.78	23.13/22.26	23.13/21.90	7.91/7.52	7.91/6.71

Options	**1**	**2**	**3**	**4**	**5**	**6**
	BER % CO2 improvement over TER (2021 Building Regs)					
	N/A	0.4%	3.8%	5.3%	4.9%	15.2%

We recommend that the air-to-water ASHP is installed for heating and DHW to reduce CO2 emissions and give a stable internal environment (air conditioning in the occupied spaces) and the installation of photovoltaics to reduce the CO2 emissions further.