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Wrexham, Gatewen Road Residential Site – Energy Statement



QA

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Contents

Section 1 – Executive Summary	4
Section 2 – Introduction	6
Section 3 – Development Proposals	7
Section 4 – Policy and Legislation	8
Section 5 – Energy Strategy	11
5.1 - Baseline Energy Assessment.....	11
5.2 - Passive Design Improvements	12
5.3 - Energy Efficiency Improvements	13
5.4 - Renewable Energy Improvements	14
5.5 - Energy Generation and Distribution Systems	19
5.6 - Energy Performance Calculations.....	20
Section 6 - Conclusions.....	21

Section 1 – Executive Summary

This Energy Statement addresses the planning requirements of Wrexham University as set out in Wrexham's university environmental sustainability strategy.

This Energy Statement has been prepared to illustrate the environmental aspects of the proposed development highlighting the Energy/Carbon emission profile and, assess the options available for reducing energy consumption and associated CO₂ emissions in accordance with Wrexham City Council's policies and guidelines.

All planning policies both national and local that apply to the proposed development have been reviewed together with the Building Regulations Approved document part L2A.

National and local policies require that an environmental assessment is carried out on all public projects. This project is targeting BREEAM 'Very Good ' rating under BREEAM New Construction 2014.

The baseline energy emissions have been developed, producing a Simplified Building Energy Model SBEM calculation for the building. Passive fabric measures across the building including improvements to the thermal performance and air tightness above Part L requirements of the Building Regulations have been incorporated.

Construction Element	Building Regulations Specification (2013)	Development Specification
Ground Floor	0.25 W/m ² k	0.18 W/m ² k
External Walls	0.35 W/m ² k	0.20 W/m ² k
Roof	0.25 W/m ² k	0.18W/m ² k
Windows	2.2 W/m ² k	1.5 W/m ² k
External Doors	2.2 W/m ² k	2.2 W/m ² k
Air Permeability	10m ³ /h/m ² @50Pa	5m ³ /h/m ² @50Pa

In addition to the Passive design measures, Active Building Services are to be designed to minimise direct energy consumption and CO₂ emissions, with particular emphasis on the following;

- Improved Boiler Efficiencies;
- Reduced Standing Losses from Pipes and Cylinders;
- Increased Hot Water Generating Efficiencies;
- Energy Efficient LED Lighting;
- Improved Lighting Controls;
- Heat Recovery Ventilation;
- Low Energy Motors in Pumps and Fans;
- Efficient Heat Recovery in other systems and,
- Enhanced electric panel heater controls

Renewable and Low Carbon technologies have been considered and of the available solutions, it is recommended that the proposed scheme implements a combined heat and power system.

There are number of options for the houses , the two options which we are looking at are :

Traditional type system: which is utilising gas boiler and PV to offset the electrical contributions to property.

Modern type system: which utilising air source heat pump to provide heating via underfloor heating system and hot water and PV to offset the electrical contributions to property.

We have calculated some sample SAP Calculations which have been calculated to take account the selected renewable energy technologies proposed for this development. The SAP's calculations have been calculated for the proposed two methodology's for the houses.

Traditional type system: which is utilising gas boiler and PV to offset the electrical contributions to property.

The dwelling carbon emission rate (DER) of **7.02 kg/m2/per annum** led to a total carbon reduction of **11.29 kg/m2/per annum** from the target emissions rate (TER) of **18.31 kg/m2/per annum**

Therefore, the CO₂ reduction due to utilising the energy hierarchy on this development has been calculated to be **61.7%** on each property and therefore in line with Wrexham Council Core Strategy Development Plan Document.

As detailed within the Core Strategy Plan the total energy demand of the development at this stage has also been calculated to be

342020 kwh/annum for heating

167661 kwh/annum for hot water

51362 kwh/annum for electric

Therefore, giving a total energy demand of 561043 Kwh/annum

Modern type system: which utilising air source heat pump to provide heating via underfloor heating system and hot water and PV to offset the electrical contributions to property.

The dwelling carbon emission rate (DER) of **17.53 kg/m2/per annum** led to a total carbon reduction of **8.77 kg/m2/per annum** from the target emissions rate (TER) of **26.3 kg/m2/per annum**

Therefore, the CO₂ reduction due to utilising the energy hierarchy on this development has been calculated to be **33%** on each property and therefore in line with Wrexham Council Core Strategy Development Plan Document.

As detailed within the Core Strategy Plan the total energy demand of the development at this stage has also been calculated to be

434112 kwh/annum for heating

167664 kwh/annum for hot water

L5350 - Wrexham Sustainability Reports – Energy Statement – Issue 1

42899 kwh/annum for electric

Therefore, giving a total energy demand of 644675 Kwh/annum

Section 2 – Introduction

The site at Gatewen Road is wholly owned by the University and is currently utilised as informal grazing land. The land sits adjacent to an existing Local Authority playground to the west, existing residential properties to the south and recently completed new build residential properties to the north.

The site is also almost completely surrounded by existing residential properties and has a sloping topography with mature trees to two boundaries of its perimeter.

It is proposed that a development of 112 residential units including 28 affordable units is developed leaving a substantial amount of land for use by the community as public open space. As a result, the provision of public open space is above Planning Authority spatial standards. The total number of residential units on site has been dictated by Local Authority development density standards and equates to over 26 dwellings per hectare.

Within the proposed residential layout, public open space is distributed in various pockets with a large central area of space related to the retention of an existing mature tree cluster and topography change.

The proposed access onto Gatewen Road has been developed by the Highways Consultant in collaboration with the Highways Authority and takes account of the existing access location into the site and boundary ownership issues. Parking standards and internal access roads and pedestrian footpaths within the development are also in compliance with Local Authority standards.

The layout of the residential units has been developed to respect the privacy of existing neighbours in respect of aspect and separation with all proposed units also complying with Local Authority privacy and separation design standards.

A landscaping scheme has been developed by the Landscape Consultant and includes the provision for pedestrian connectivity from the development through to both existing footpaths to the north and west of the site.

Section 3 – Development Proposals

The proposed site is to consist of 109 houses with a variety of two, three and four bedroom homes.

The properties will provide high quality accommodation. The proposed development is to form part of the Wrexham & Flintshire SP1 policy which states that between 2013 to 2028, 8525 new homes will be provided in the local Wrexham area in order to support mixed, balanced and sustainable communities around the area.



This Energy Statement has been prepared to illustrate the environmental aspects of the proposed development highlighting the Energy/Carbon emission profile and, assess the options available for reducing energy consumption and associated CO₂ emissions in accordance with Wrexham City Council's policies and guidelines.

Futureserv Consulting Engineers have collaborated with the design team to provide a holistic solution for the building that will provide an efficient envelope and contain intelligent building services reducing the environmental impact of the development whilst providing comfortable living accommodation.

Section 4 – Policy and Legislation

There are a number of planning policies both national and local that apply to the proposed development.

The UK government has signed up to a legally binding agreement to reduce Carbon emissions by 34% based on 1990 levels before 2020 and by 80% before 2050, this responsibility is being discharged using the Climate Change Act 2008.

The National Planning Policy Framework (NPPF), offers specific guidance which highlights the UK's aspiration to support a transition to a Low Carbon future in a changing climate and in particular, to encourage the use of renewable resources such as Renewable Energy and states;

Planning authorities should ensure that development plans contribute to global sustainability by addressing the causes and effects of climate change through policies which reduce energy use and emissions, promote development of renewable energy resources, and take climate change impacts into account in the location and design of development.

Local Policies

The proposed development is located off gatemen rd wrexham , with the local policies adopted by Wrexham City Council outlined within Wrexham's Local Development Framework Core Strategy Development Plan, adopted in 2005, The policy states that Under the Council Priority "An Environmentally Responsible Place" Wrexham County Borough Council are committed to reducing carbon emissions by 50% by 2015/16 and 70% by 2020, against a 2005/06 baseline.

Within this document specific policies highlight carbon emissions reductions and the impacts of climate change. These are as follows;

Policy RE1: Development and Renewable Energy/Low Carbon Technology

L5350 - Wrexham Sustainability Reports – Energy Statement – Issue 1

Development proposals are required to maximise the potential for renewable energy.

The Council will encourage developers of the Key Strategic Sites and major sites (100 dwellings or more or development exceeding 1000m²) to incorporate schemes which generate energy from renewable and low carbon technologies. This includes opportunities to minimise carbon emissions associated with the heating, cooling and power systems for new development.

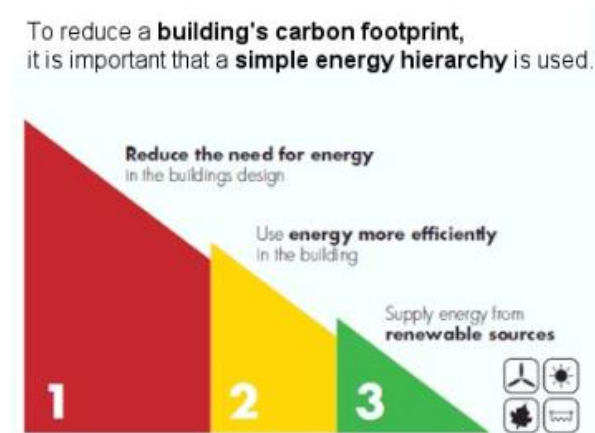
An independent energy assessment investigating the financial viability and technical feasibility of incorporating such schemes will be required to support applications.

This policy outlines the need to introduce renewable technology on any future developments in the County of Wrexham.

Wrexham Borough Council is looking to utilise low carbon measures on any future developments as outlined below.

Wrexham Borough Council is looking to provide 10% of energy requirements for low carbon energy sources for all new build projects in the borough.

To reduce a building's carbon footprint, the below hierarchy is used to assist.



Contributing to the Carbon Offset Fund

Once energy efficiency measures and renewable or low-carbon technology opportunities have been maximised, any remaining CO2 emissions can be offset through contributions to a carbon offset fund, which will be invested in off-site renewable energy and energy efficiency projects throughout the city.

BREEAM

Wrexham Borough council require the sustainability of the development assessed under BREEAM and to meet the standards set out in the table below;

All residential development achieves at least the following level of the Code for Sustainable Homes		All non-residential developments with a floor space of over 500 m ² achieve at least the following BREEAM standards.
from adoption (2010)	Level 3	BREEAM 'very good'
from 2012	Level 4	BREEAM 'excellent'
from 2016	Level 6	BREEAM 'excellent'

The development is stated to be code for sustainable homes level 3 or Breeam 'Very Good' standard.

Reduction in CO2 emissions is seen as a major component in mitigating climate change. In this regard, areas of Government policy give rise to the following three national and regional targets:

- A national reduction in CO2 emissions by 34% in 2020 and by 80% in 2050, (from a 1990 baseline) to which buildings will need to make a proportionately higher contribution, as set out in the Climate Change Act 2008.

- A national increase in renewable energy capacity by 15% by 2020 as set out in the UK Renewable Energy Strategy, which will require an uplift in current levels.

Building Regulations Part L2A (2013)

The proposed development is being designed to comply with the Building regulations approved document Part L2A, 2013 edition. This approved document was effective on 6th April 2014.



L2A Conservation of fuel and power
in new buildings other than dwellings

specifications have been strengthened to deliver 9 per cent carbon dioxide savings relative to part L 2010.

The main changes in this approved document from the previous revision are that;

- The notional building used to determine carbon dioxide and fabric energy efficiency targets is the same size and shape as the actual building, constructed to a concurrent specification. **The Part L 2013**

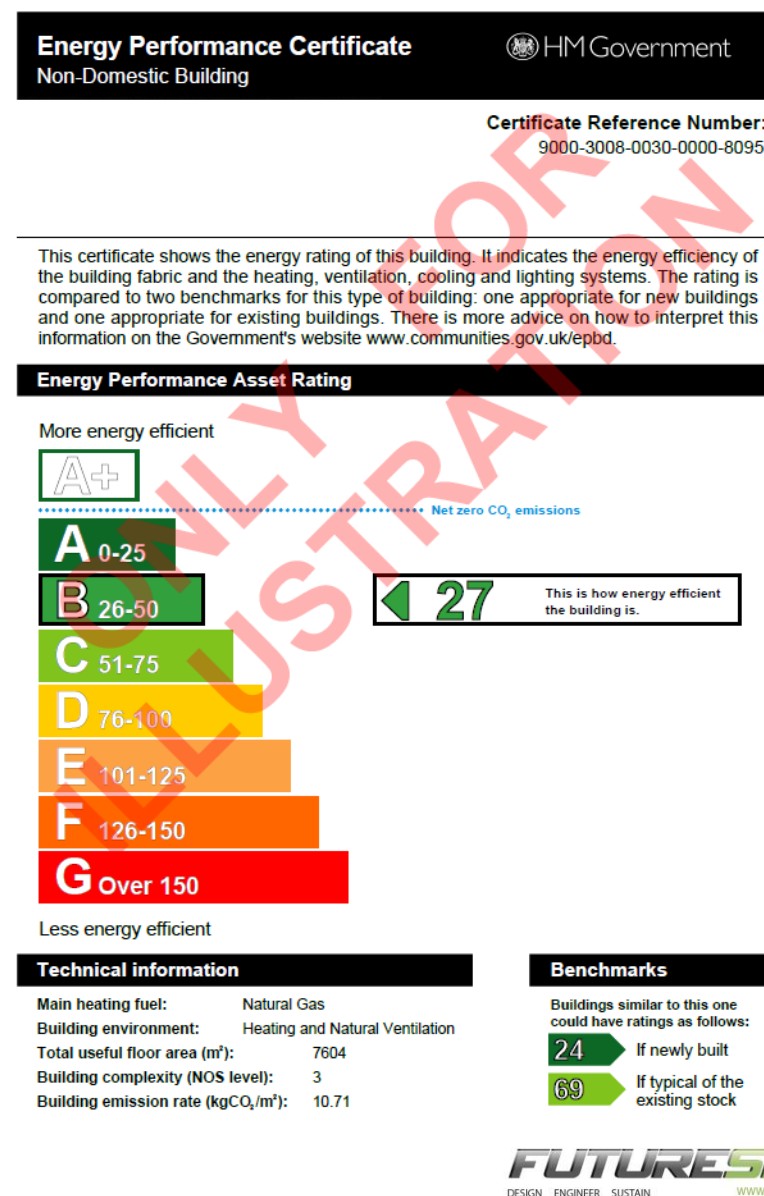
Section 5 – Energy Strategy

5.1 - Baseline Energy Assessment

Futureserv Ltd have conducted analysis for this stage of the development on the complete development to show compliance with the Building Regulations Part L2A:2013 therefore setting a reference baseline. This was carried out to understand the developments Carbon emissions without any Carbon Emission mitigation measures.

This baseline energy assessment has been developed, producing preliminary sap calculations for the typical house types . The baseline model has been created to provide Target Emission rates (TER). The SAP calculations then in turn produce a Building Emission rate (BER) which is equal to or lower than that of the TER.

SAP is an Industry standard computed generated assessment for calculating the energy aspects of a property. The SAP engine within the computer software assesses how energy efficient a building is based on energy use and CO2 emissions.



5.2 - Passive Design Improvements

On the completion of the model and establishment of the Target Emission rates (TER), the building emissions have been reduced through judicious passive design. This has involved an assessment of non-energy consuming design decisions to create a fabric first approach to energy efficiency. This is through;

- Improved air permeability performance
- Better thermal Insulation

Passive fabric measures across all the building include improvements to the thermal performance and air tightness above Part L requirements of the Building Regulations and this effectively allows the building envelope to attenuate external conditions without recourse to active Building Services.

The table to the right presents the proposed material specification that will be incorporated within the building design to limit heat losses and ensure efficient operation of the proposed properties at gatewen road.

An airtightness of 5m³/hr/m² @50Pa is targeted for this development to minimise uncontrolled ventilation. An improved air tightness reduces heat losses and energy demand of the properties

Construction Element	Building Regulations Specification (2013)	Development Specification
Ground Floor	0.25 W/m ² k	0.18 W/m ² k
External Walls	0.35 W/m ² k	0.20 W/m ² k
Roof	0.25 W/m ² k	0.18W/m ² k
Windows	2.2 W/m ² k	1.5 W/m ² k
External Doors	2.2 W/m ² k	2.2 W/m ² k
Air Permeability	10m ³ /h/m ² @50Pa	5m ³ /h/m ² @50Pa

5.3 - Energy Efficiency Improvements

In addition to the Passive design measures described in the preceding Section to improve the building envelope performance, the Active Building Services are to be designed to minimise direct energy consumption and CO₂ emissions, with particular emphasis on the following;

- Improved Boiler Efficiencies;
- Reduced Standing Losses from Pipes and Cylinders;
- Increased Hot Water Generating Efficiencies;
- Energy Efficient LED Lighting;
- Improved Lighting Controls;
- Positive Input Ventilation;
- Low Energy Motors in Pumps and Fans;

It is currently proposed for the houses that heat energy for Domestic Hot Water to be generated using an efficient combi boiler or electrical hot water cylinder.

The House ventilation systems will be natural ventilation via openable windows to achieve passive ventilation throughout the building.

A positive input ventilation unit will be installed on a central position on property to control condensation around the property. The positive input ventilation unit gently circulates air around the home from a central position on the landing in a house or the central hallway to transform a stagnant and stale atmosphere into a fresh, healthy and condensation free environment. a positive input designed to operate continuously at low speed air volumes created by energy efficient fans.

This will allow the construction of a tightly sealed and correctly ventilated environment reducing thermal heat loss through reduced infiltration, whilst at the same time improving air quality and reducing the occurrence of moisture and mould.

All internal lighting installations will make use of low energy technologies. 100% low energy lighting provision within the houses.

L5350 - Wrexham Sustainability Reports – Energy Statement – Issue 1

All fans, motors and pumps shall be specified to incorporate ECA accredited technology and appropriate controls.



Construction Element	Specification
Ventilation	Natural & Positive Input Ventilation
Lighting	100% Low Energy Fittings
Space Heating	LTHW radiators or underfloor heating.
Water Heating	Via Efficient Combi Boiler or electric hot water cylinder
Heating & Hot Water Control	Via room thermostats and programmer

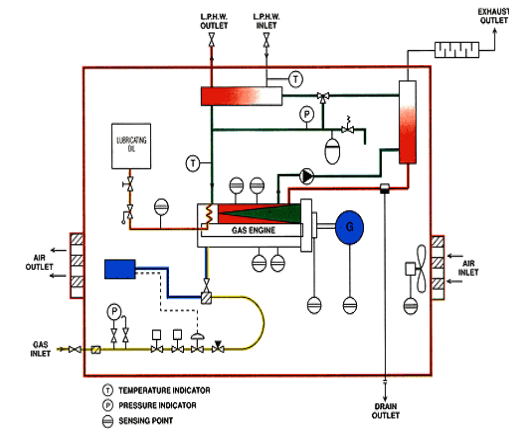
5.4 - Renewable Energy Improvements

In order to comply with Wrexham's Local Development Framework Core Strategy Development Plan which requires that the development's Carbon emissions are reduced by 10% when compared to a building meeting Part L of the Building Regulations 2013, renewable and/or low or zero carbon emission systems have been targeted.

All currently acknowledged and commercially available technologies have been considered and assessed with the conclusions summarised below;

Combined Heat and Power (CHP)

On-site generation of electricity and the utilisation of waste heat from this process within a building can create a beneficial arrangement whereby the transmission losses of grid supplied electricity can be omitted. The use of CHP tends to require a steady and continuous heat demand therefore the large. Therefore because there not being a steady continuous heat demand it is deemed that a CHP is not a viable option for this scheme.



Diagrammatic layout of small scale CHP unit

Solar Thermal Collectors

The use of flat plate & evacuated tube thermal panels has been identified as a potential method of harnessing renewable solar energy by pre-heating domestic hot water provision.

The recent introduction of the renewable Heat Incentive may further improve the financial viability for the technology.



Example of Solar Thermal unit

Solar thermal collectors technology is presumed to not to be a viable option for this project due to space requirements on each roof of the property.

Solar Photovoltaic Panels

The option to utilise roof mounted or Building Integrated Photovoltaic panels to generate electrical energy is a renewable energy method of generating Carbon free electrical power.

Due to the density in occupancy within property, there is likely not to be a fairly constant base electrical load requirement on each building, therefore we can discount solar photovoltaic panels.

Flat roof areas of the building are relatively limited and payback periods for Photovoltaic panels can be onerous.

The use of PV technology is to be a potential considered for each property due to carbon offset that it provides in SAP energy assessments.

Wind Turbines

Wind energy can be a cost effective method of renewable power generation and turbines can produce Carbon neutral electricity with outputs ranging from watts to megawatts.

The most common design is for three blades mounted on a horizontal axis, which is free to rotate into the wind on a tall tower. The blades drive a generator either directly or via a gearbox (generally for larger machines) to produce electricity.

The electricity can either link to the grid or charge batteries. An inverter is required to convert the electricity from direct current (DC) to alternating current (AC) for feeding into the grid.

There are a variety of wind turbines on the market ranging from smaller turbines that can be attached directly to a buildings structure to larger stand-alone turbines.

City centre and sub-urban locations generally experience poorer yields for electricity output from small and medium scale wind turbines, due to obstructions and variations in local topography.

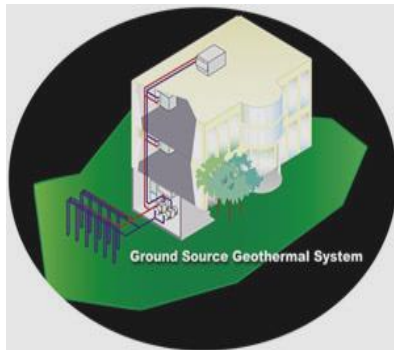


Wind Turbine Installation

Also taking into account the visual impact and unwanted noise in an environment with sleeping accommodation the use of wind turbines are discounted from inclusion at this development.

Ground Source Heat Pumps

The ground below buildings remains at a constant temperature of around 10°C to 12°C offering the ability to extract energy in the winter and discharge energy in the summer from cooling with the energy exchange being achieved via open or closed loop systems linked to heat pumps.



Ground Source Heat Pump Installation

The footprint of the development and the surrounding site conditions do not have the potential to deliver an element of space available for closed loop heat

exchange, due to this and the likely yield, peak load demand and cost feasibility, we have discounted Ground Source Heat Pumps at this development in favour of better performing technologies.

Air Source Heat Pumps

Air source heat pumps provide an accepted solution for using renewable energy taken from ambient air to heat a building in the winter and discharge heat from cooling in the summer.



Typical External Condenser Unit

We have considered utilising air source heating pumps to feed the heating requirements for the properties, in utilising this method this would be in-conjunction with underfloor heating within each of the properties.

Biomass

Some success on other projects has been made with the implementation of wood fuelled energy equipment forming a Carbon Neutral heat source however these projects have tended to be light density Sub-Urban or even rural in their location. The relatively constrained nature of this site, together with limited storage space and potential delivery issues reduces the opportunity to take advantage of a Biomass solution for this development.



Plantroom Biomass Installation

In addition, flue emissions and the requirements the Clean Air Act has led to a dismissal of this technology for this particular scheme.

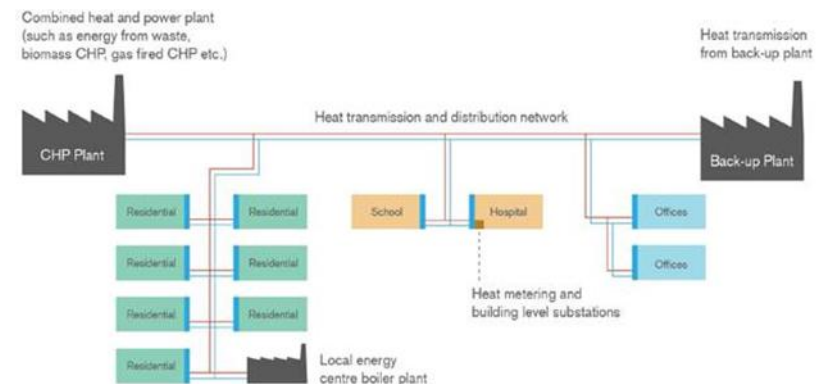
Local Heat Sources

Local heat sources are a good source of reducing CO₂ within a project, as distribution losses are minimised and greater efficiency is gained.

Three considerations are given when utilising a connection to local heat source

1. Site location and distance to local heat source
2. Energy type and temperatures i.e heating or cooling and temperature of energy medium.
3. Type of development connecting to local source.

Local supply of heat and power minimise distribution losses, thereby achieving a greater efficiency and reducing CO₂ emissions, when compared to the individual systems. In a communal energy system, energy in the form of heat, cooling, and/or electricity is generated from a central source and distributed via a network to surrounding residencies and commercial units. (see example below – source CIBSE)



Due to location of the development , it is not feasible provide the scheme as district heating scheme.

Total Assessments

The central Building Services Systems will be supplemented by Renewable and Low Carbon technologies to further reduce the associated Carbon emissions.

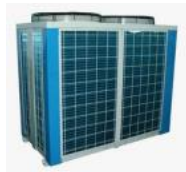
Of the available solutions considered, it is therefore recommended that the proposed scheme implements the following renewable energy technology:

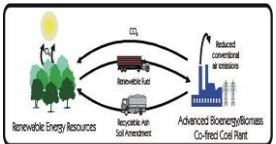
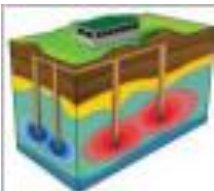
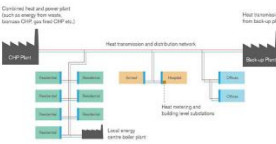
Renewable Technology	Image	Comments
Combined Heat and Power DISCOUNTED		The integration of Combined Heat and Power technology is has been discounted for this scheme due to the base load of the proposed development being not consistent.
Solar Photovoltaic SELECTED		The use of solar photovoltaic panels is good energy efficient technology to utilise due to carbon offset that the technology provides in terms of free energy performance. The systems are low maintenance, easily integrated with building design and no

- Solar Thermal Collectors

The inclusion of solar thermal collectors is considered to be the most appropriate for this development and has been incorporated into the primary heat generation for the hot water systems. This will reduce the primary energy use requirement within the development, i.e. the Domestic Hot Water generation.

The Energy Model has been calculated to take account the selected renewable energy technologies proposed for this development

		there are limited ongoing costs.
Air Source Heat Pumps SELECTED		The use of Air Source Heat Pumps has been included as a potential option , due to good carbon footprint that they offer to each property.
Solar Thermal DISCOUNTED		There is potential to include flat panel solar thermal collector located at roof level serving the domestic hot water systems. However this solution would conflict with the selected LZC for heat discharge capacity.

Biomass Boilers DISCOUNTED		Biomass boiler solutions have been discounted at this location due to potential clean air issues, deliverability logistics and the lack of available storage space for the required quantity of fuel.
Wind Turbines DISCOUNTED		Wind turbines have been discounted due to the resulting visual/noise impact from the equipment, and relatively poor performance of the solution when used within Urban and Sub-Urban locations.
Ground Source Heat Pump DISCOUNTED		The inclusion of Ground Source Heat Pumps have been discounted within this development due to the conflict with the selected technology, system cost viability and also the site constraints.
Local Heat Source DISCOUNTED		The inclusion of local heat sources has been discounted within this development due to proximity of the proposed development

5.5 - Energy Generation and Distribution Systems

The case for renewable energy systems is clear and we understand that Wrexham City Councils current energy policy requires developments to make the fullest contribution to the mitigation of climate change, and to minimise Carbon Dioxide emissions.

As a consultant, Futureserv has an over-arching philosophy delivering design of truly sustainable energy systems, employing the widely recognised hierarchy;

- Be Lean - Reduce demand wherever possible utilising passive measures.
- Be Clean - Where energy is used, then it should be optimised to operate at the highest efficiencies practical.
- Be Green - Take advantage of renewable options to reduce fossil fuel energy sources.

The proposed Gatewen Road development will be designed to be served by two options which are as follows :

Traditional type system: which is utilising gas boiler and PV to offset the electrical contributions to property. This would typically be 30kw condensing combi boiler complete with efficient control measures, the PV would amount to 2 Kwe, so a G83 domestic application can be obtained.

Modern type system: which utilising air source heat pump to provide heating via underfloor heating system and hot water and PV to offset the electrical contributions to property. This would typically be 8kw air source heat pump complete with efficient control measures, the PV would amount to 2 Kwe, so a G83 domestic application can be obtained.

The main Mechanical and Electrical plant systems would be located within property at a designated position i.e either a cupboard to situate the boiler plant in or an external wall secure area which will incorporate the air source heating

pump technology. The solar panels would be located on south facing roof on the properties, with the inverter typically located in the loft or a store cupboard.

All plant and equipment would be equipped with energy control measures incorporating variable speed drives, with low energy motors provided on ventilation fans and hydraulic pumps.

5.6 - Energy Performance Calculations

To enable demonstration that the environmental benefits associated with our energy hierarchy approach to energy demand and emission reductions at Gatewen Rd. SAP stroma software has been used to generate energy typical house demand calculations for the development.

The below tables present baseline energy demand and emissions and actual energy demand and emissions for the Building in the form of Target Emission Rates and Building Emission Rates (Kg CO₂/m²/annum)

Proposed Technology	Target Emissions rate (Kg/m2/per annum)	Dwelling Emissions rate (Kg/m2/per annum)	Target Energy Reduction on Each Property (%)	Energy Reduction on Each Property (%)
Gas combi boiler combined with PV	18.31	7.02	10	61.7
Air Source Heat Pump combined with PV	26.3	17.53	10	33



Typical Gatewen Road Development

Carbon Reduction from Target Emission Rates for Traditional type system	61.7% reduction
Carbon Reduction from Target Emission Rates for Modern type system	33% reduction

Energy Demand for Traditional type system	561043 kwh/annum
Energy Demand for Modern type system	644675 kwh/annum

Therefore, the CO₂ reduction due to utilising the energy hierarchy on this development has been calculated to be **61.7 % and 33 %** dependant on the technologies which are to be chosen, these therefore in line with Wrexham City Council Core Strategy Development Plan Document which states that CO₂ reduction of at least 10%.

Section 6 - Conclusions

This energy statement has summarised the energy hierarchy requirements for Gatewen Road to respond to emission reduction targets set out within the Wrexham Local Development Framework Core Strategy Development Plan.

The development will incorporate passive energy techniques available in the construction industry to reduce its ongoing requirement to consume energy to

heat, ventilate and light the building, this is achieved by improved efficient fabric design in excess of the thermal properties set out within the Building Regulations.

The development will incorporate energy efficiency measures in its Building Services to reduce the carbon footprint of the site below the passive improvement stage, using highly efficient heat generation plant, heat recovery systems and energy efficient and highly controllable lighting.

The development will make use of renewable and Low Carbon energy techniques typically comprising of the following:

Traditional type system: which is utilising gas boiler and PV to offset the electrical contributions to property. This would typically be 30kw condensing combi boiler complete with efficient control measures, the PV would amount to 2 Kwe, so a G83 domestic application can be obtained.

Modern type system: which utilising air source heat pump to provide heating via underfloor heating system and hot water and PV to offset the electrical contributions to property. This would typically be 8kw air source heat pump complete with efficient control measures, the PV would amount to 2 Kwe, so a G83 domestic application can be obtained.

The development may also make use of a PV system to generate electricity. The use of this system will require further design development and will be assessed as part of the BREEAM process.

Overall, the Carbon emissions from the proposed Gatewen road development shows potential for a total reduction in emissions from baseline set by current Building Regulations Part L 2013.

The strategy improves on the fundamental principles of the Building Regulations, and will make a significant contribution to reducing the annual CO₂ emissions of the development.