

Sustainability Statement

Land South of Holt Road, Wrexham Barratt Homes and Bloor Homes North West

Wrexham County Borough Council

December 2018

Version 3



Executive Summary



The following statement seeks to demonstrate the potential options available at the proposed development of Land South of Holt Road, Wrexham. The developers will meet the reduction in emissions across all dwellings relative to approved document Part L1A (Wales 2014) Building Regulations baseline. This will be achieved through the use of improved energy efficiency measures such as improved thermal fabric efficiency, air tightness and effective heating controls. Any dwellings that do not meet Part L1A (Wales 2014) through fabric alone, will benefit from improved mechanical and electrical systems, such as Flue Gas Heat Recovery.

Barratt Homes and Bloor Homes North West has instructed Briary Energy to create this document, which examines the feasibility of suitable LZC (Low to Zero Carbon) sources, high-efficiency alternative systems, and low carbon energy efficiency measures.

It also looks at energy efficiency measures that could be implemented at the development to make energy and CO₂ savings beyond current building regulations.

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.

The proposed Land South of Holt Road, Wrexham development will comprise of up to 600 dwellings. The developer will meet the Building Regulations reduction in emissions across all dwellings relative to a (Wales 2014) Part L1A Building Regulations baseline, and will be achieved solely through the use of improved energy efficiency measures such as improved thermal fabric efficiency, air tightness and effective heating controls.

An indicative mix of more than a dozen different house types has been selected from existing stock. These dwellings include affordable housing; detached; semi-detached; and terraced. With a split ratio providing 15% 2 bedrooomed, 60% 3 bedrooomed and 25% 4 bedrooomed housing. By taking the fabric first approach we meet the improved U-value thresholds required in Wales. Any dwellings that do not surpass approved document L1A (Wales 2014), will benefit from high efficiency Ideal Logic Code Combi boilers, which have a built in Flue Gas Heat Recovery System, our indicative analysis supported by SAP calculations show that a 13.5% Energy Demand saving, and a 13.4% CO₂ saving can be achieved across the development. Therefore these dwellings surpass approved document part L1A (Wales 2014).

Glazing to over 30% of the façade area will have a U-Value of 1.4 W/m²k with a solar transmittance factor 0.5 to provide day lighting and prevent overheating.



PPW10 - Chapter 5

Energy

5.7.4 The Welsh Government is committed to delivering the outcomes set out in Energy Wales: A Low Carbon Transition⁵⁶. Our priorities are:

- reducing the amount of energy we use in Wales;
- reducing our reliance on energy generated from fossil fuels; and
- actively managing the transition to a low carbon economy.

5.7.7 The planning system should secure an appropriate mix of energy provision, which maximises benefits to our economy and communities whilst minimising potential environmental and social impacts. This forms part of the Welsh Government's aim to secure the strongest economic development policies, to underpin growth and prosperity in Wales, recognising the importance of decarbonisation and the sustainable use of natural resources, both as an economic driver and a commitment to sustainable development.

5.7.8 The benefits of renewable and low carbon energy, as part of the overall commitment to tackle climate change and increase energy security, is of paramount importance. The continued extraction of fossil fuels will hinder progress towards achieving overall commitments to tackling climate change. The planning system should:

- integrate development with the provision of additional electricity grid network infrastructure;
- optimise energy storage;
- facilitate the integration of sustainable building design principles in new development;
- optimise the location of new developments to allow for efficient use of resources;
- maximise renewable and low carbon energy generation;
- maximise the use of local energy sources, such as district heating networks;
- minimise the carbon impact of other energy generation; and
- move away from the extraction of energy minerals, the burning of which is carbon intensive.

5.7.14 Welsh Government planning policy recognises an energy hierarchy. The Welsh Government expects all new development to mitigate the causes of climate change in accordance with the energy hierarchy for planning, as set out in the following energy policies. Reducing energy demand and increasing energy efficiency, through the location and design of new development, will assist in meeting energy demand with renewable and low carbon sources. This is particularly important in supporting the electrification of energy use, such as the growing use of electric vehicles. All aspects of the energy hierarchy have their part to play, simultaneously, in helping meet decarbonisation and renewable energy targets.

5.7.15 Planning authorities should consider the energy needs of new development it is considering for its area and assess, with grid operators, if the necessary infrastructure is in place to meet future demand. The local balance of the energy network will be a crucial consideration in this regard, and planning authorities should consider the best places for local renewable energy generation to help improve the resilience of the grid in the future.

5.8 Reduce Energy Demand and Use of Energy Efficiency - Sustainable Buildings

The planning system should support new development that has very high energy performance, supports decarbonisation, tackles the causes of climate change, and adapts to the current and future effects of climate change through the incorporation of effective mitigation and adaptation measures.

5.8.2 The Welsh Government's policy is to secure zero carbon buildings while continuing to promote a range of low and zero carbon technologies as a means to achieve this.

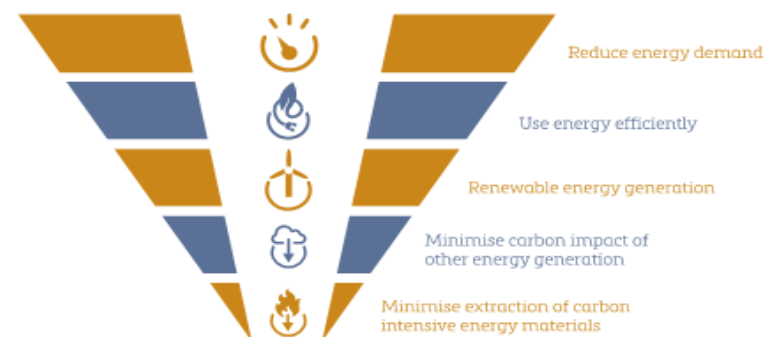
5.8.3 Sustainable building design principles should be integral to the design of new development.

Development proposals should:

- mitigate the causes of climate change, by minimising carbon and other greenhouse gas emissions associated with the development's location, design, construction, use and eventual demolition; and
- include features that provide effective adaptation to, and resilience against, the current and predicted future effects of climate change.



Figure 9: The Energy Hierarchy for Planning



TAN12 (Technical Advice Note)

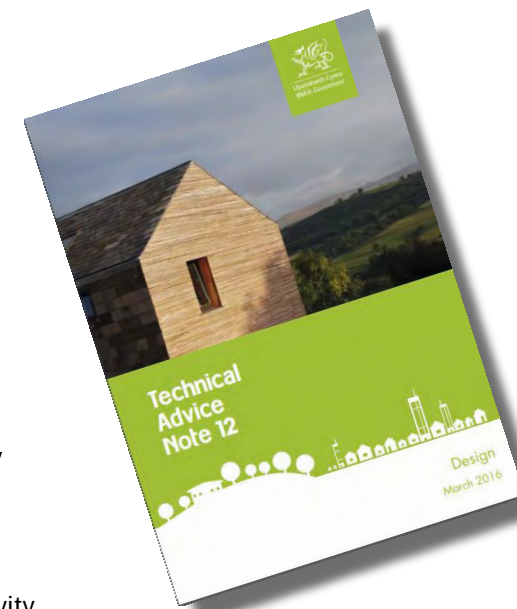
Design Response Following Appraisal of Context

By incorporating:

- sustainability measures to reduce the environmental impact associated with buildings and minimising the demand for energy (low and zero carbon sources), water, and materials and creation of waste;
- approaches to development which create new opportunities to enhance biodiversity;
- adaptable and flexible development that can respond to social, technological, economic and environmental conditions/changes; (e.g. the current and future effects of climate change) over time to minimise the need to demolish and rebuild.

Design Solutions

- Landscape/townscape setting – the way in which a new development will work with the site and its landscape context. Including key features and qualities such as pattern, form, grain, appearance, colours and elements to also meet the objective of sustaining character and reinforcing legibility.
- Biodiversity and local environment – includes aspect of layout/planting) the way in which the development will maintain/enhance opportunities for species to inhabit the area and building fabric and how will the development maintain and improve habitat connectivity and illustrate how the development will integrate with open spaces, including management and aftercare;
- Energy efficiency/carbon reduction – the way in which new development seeks to minimise the energy demand and carbon emissions associated with the development through implementation of the energy hierarchy, or deliver zero carbon standards;
- Sustainable materials – use of materials with a low environmental impact (embodied energy), reduced energy inputs, sourced sustainably (i.e. Forestry Stewardship Council timber), locally sourced (to reduce transport emissions), and the use of used, reclaimed and recycled materials;
- Water – sustainable approach to water supply (rainwater harvesting), demand management (water efficiency) and drainage (e.g. permeable surfaces for pavements/traffic) and its effect on the local water table;
- Waste management – the way in which waste will be dealt with during and after construction (re-use and disposal), including the provision of appropriate facilities for sorting, storing and recycling of waste in buildings and across the site;
- Climate resilience – the way in which the development is climate proofed to take into account the climate the development is likely to experience over its expected lifetime by managing and minimising climate change effects (e.g. extreme temperatures);
- Sustainable building standards – the use of nationally recognised and quality assured standards to demonstrate that environmentally sustainability design solutions (as set out above) have been incorporated into new developments.



Combined Heat and Power along with renewable energy/low carbon technologies are not required for developments which do not include Commercial Areas (non-domestic). However, this site will benefit from a number of 'Flue Gas Heat Recovery Combi' boilers FGHR) - Carbon reducing technology.

Policy SP19: Climate Change

Wrexham Local development Plan 2013-2028

To mitigate against the effects of climate change and adapt to its impacts, development proposals will need to demonstrate that they have taken into account the following:

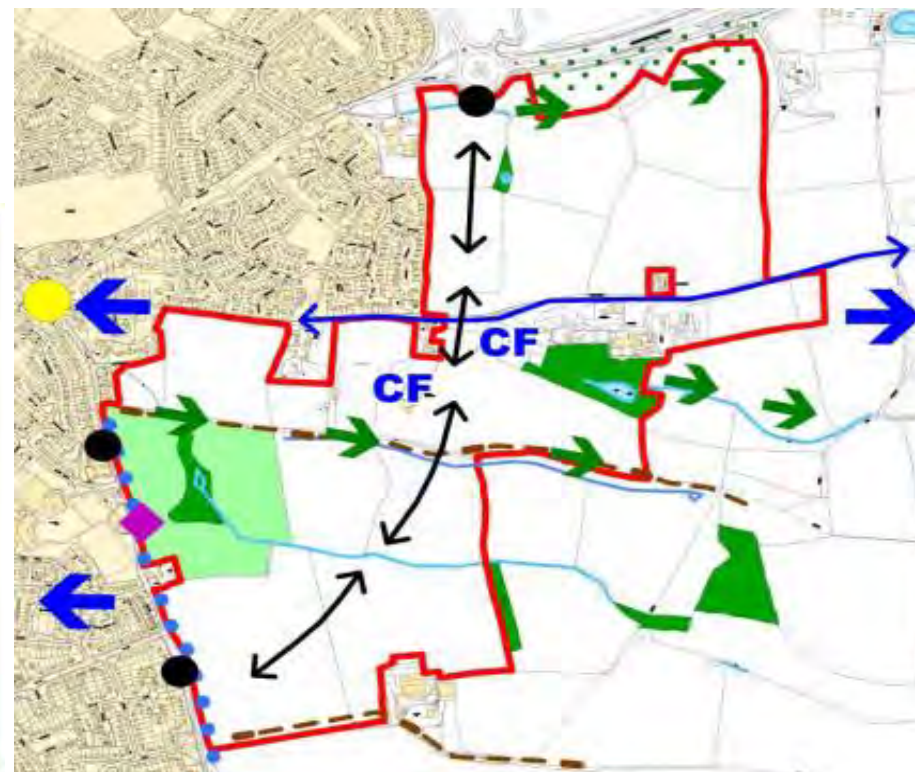
- i. Reducing carbon emissions;
- ii. Protecting and increasing carbon sinks
- iii. Adapting to the implications of climate change at both a strategic and detailed design level;
- iv. Promoting energy efficiency and increasing the supply of renewable energy; and
- v. Maintaining ecological resilience
- vi. Avoiding areas susceptible to flood risk in the first instance in accordance with the sequential approach set out in national guidance; and
- vii. Preventing development that increases flood risk.

This policy places carbon emissions and climate change resilience at the heart of the LDP reflecting its importance in the Wellbeing of Future Generations Act⁹¹. The policy provides a framework for sustainable growth by promoting development that mitigates the causes of climate change and is able to adapt to its likely effects.

It would be expected that developments use the Design and Access Statements (DAS)⁹² accompanying relevant applications to demonstrate how proposals deliver this policy by explaining how the design of the proposal responds to environmental sustainability. The content of the DAS will vary dependent on the project but the following issues are the starting point for consideration; the DAS can be used to explain: -

- How the proposal firstly seeks to reduce carbon emissions through reducing energy demand by maximising energy efficiency and reducing the need to travel. Secondly how renewable energy and low carbon development have been incorporated to reduce reliance on fossil fuels;
- How carbon sinks, trees and soils, are affected by development. If trees or soils are removed, covered or disturbed (by compaction or contamination) during the construction process their ability to store carbon is compromised and stored carbon is released. As far as practicable, trees should be retained and protected, and land kept as functioning vegetated soil open to the fall of organic matter, with new trees and shrubs provided by developers wherever possible;
- How the proposal adapts to the implications of climate change which include likely increased temperatures, more frequent and severe flooding and extreme weather events. This applies not just to the buildings themselves but also to public realm and landscape where trees can provide protection both by shading and active cooling (particularly in Wrexham town centre, other retail and commercial centres, and where young children, older people, and people with mobility impairments gather);
- How flood risk within areas susceptible to fluvial and surface water flooding has been considered in accordance with TAN15: Development and Flood Risk⁹³.

KSS2 emerging masterplan map



Policy RE1: Development and Renewable Energy/Low Carbon Technology

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 provides further detail to policy SP19 with the purpose of maximising the potential for renewable energy on large scale new developments within the County.



The UK government has committed to sourcing 15% of its energy from renewable sources by 2020. Modelling undertaken on behalf of the Department for Energy and Climate Change (DECC) suggests that by 2020, this could mean that more than 30% of our electricity and 12% of our heat, may be generated from renewable sources. These targets are presented as the lead scenario, which relies on strong, co-ordinated efforts from several sectors including local authorities.

PPW enables Local Planning Authorities to assess strategic sites to identify opportunities to require higher sustainable building standards (including zero carbon) where requirements are demonstrated to be evidence-based and viable. Particular reference is made to opportunities for minimising carbon emissions associated with the heating, cooling and power systems. This includes utilising new or existing low and zero carbon energy supply systems (such as district heating systems), encouraging the development of new opportunities to supply proposed and existing development, and maximising opportunities to co-locate potential heat customers and suppliers.

In preparing the LDP, Wrexham County Borough Council has undertaken a Renewable Energy Assessment (REA)¹⁵³. The REA aims to identify the potential energy capacity of renewable and low carbon technologies in the local authority area and consider the contribution these can make towards local future heat and electricity energy requirements. The REA has been prepared in accordance with the Welsh Government Practice Guidance "Planning for Renewable and Low Carbon Energy – A Toolkit for Planners"¹⁵⁴. The REA (and future updates) can assist in identifying which renewable energy technologies may be appropriate in particular locations.

Developers of the Key Strategic Sites and major sites are expected to submit an independent energy assessment investigating the financial viability and technical feasibility of incorporating such schemes. Statements should be submitted at the planning application stage to ensure that any viability assessment reflects technological developments and economic circumstances. Developers should refer to the Council's REA in undertaking their energy assessments to identify possible opportunities for renewable and low carbon technologies. The REA contains an energy opportunities plan for each of the Key Strategic Sites and large allocated sites in policy H1 that may present low carbon opportunities. In implementing this Policy it is expected that developers follow the energy hierarchy as advocated by national policy (TAN 12). Further guidance in relation to energy assessments will be issued in the form of SPG. This will specify what is expected of developers to meet the requirement of this policy.

Energy hierarchy through design

The Land South of Holt Road, Wrexham development will be developed with the aim of reducing annual energy consumption, whilst providing energy in the most environmentally friendly way to reduce the annual CO₂ footprints.

This outline strategy has been developed using established methodology (as recommended by Cibse). It has three priorities, seeking to reduce energy use through the cleanest possible solutions. Our priority is always to use a fabric first approach, in order to reduce the CO₂ demand: -

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.

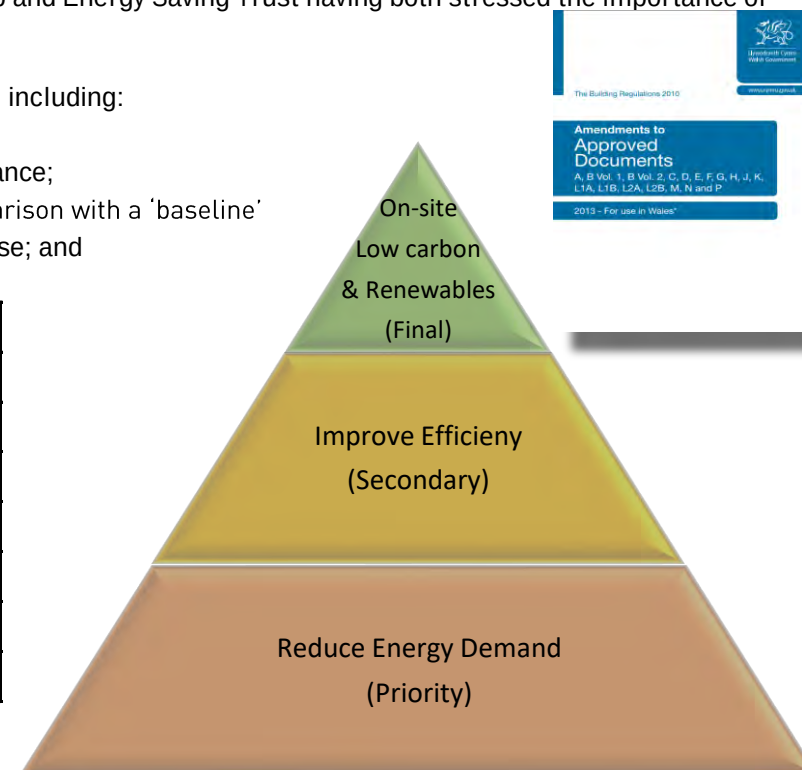
As this hierarchy demonstrates, designing out energy use is weighted more highly than the generation of low- carbon or renewable energy to offset unnecessary demand. Applied to the development of new housing, this approach is referred to as 'fabric first' and concentrates finance and efforts on improving 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 the Zero Carbon Hub and Energy Saving Trust 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/CO2/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



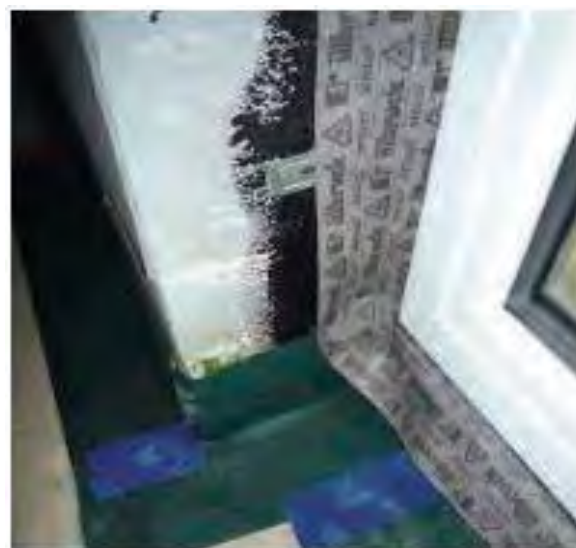
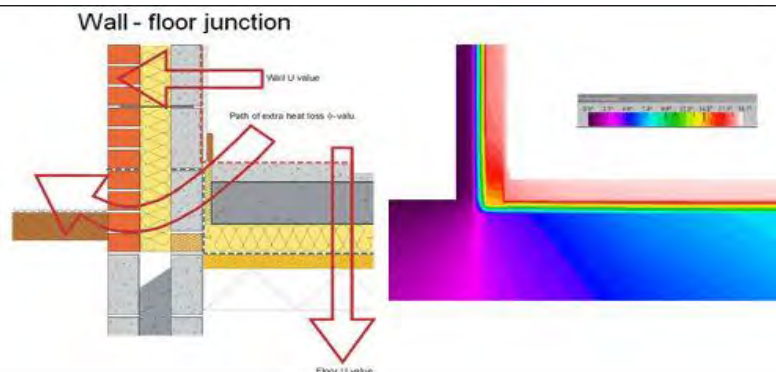
Be Lean - Energy efficient design measures

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

This development will achieve compliance with Approved Document L1A of the Building Regulations (Wales 2014) without relying upon the contribution of renewable energy.

Element	Building Regulations	Proposed
Ground Floor	0.18 W/m ² k	0.18 W/m ² k
External Wall	0.21 W/m ² k	0.21 W/m ² k
Sheltered Wall	0.25 W/m ² k	0.25 W/m ² k
Insulation at Joist/Rafter	0.15 W/m ² k	0.15 W/m ² k
Windows	2.00 W/m ² k	1.40 W/m ² k
Doors	2.00 W/m ² k	1.09 W/m ² k
Air Perm	10.00 W/m ² k	5.01 W/m ² k
Thermal Bridges	0.15 ≤ Y	Knauf Calculated 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.

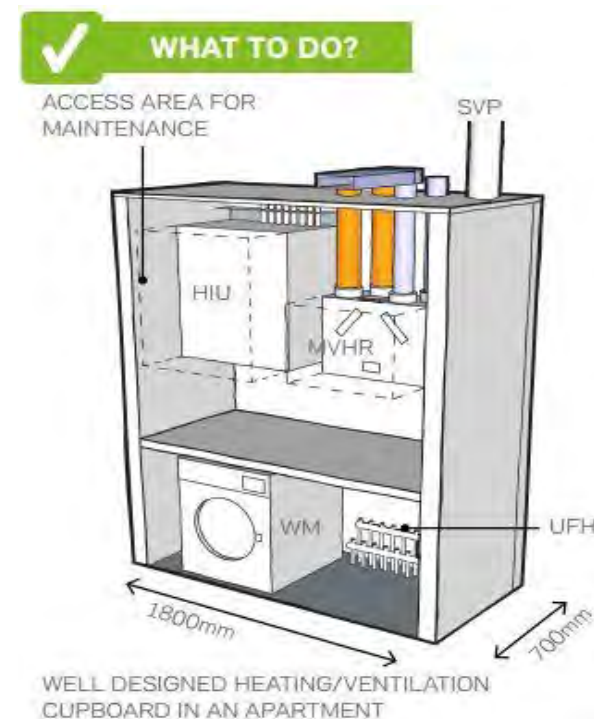


Additional improvements to thermal performance can be achieved by ensuring good practice airtightness targets are achieved. Simple measures like sealing around services (eg water, gas and cables), using proprietary seals and collars, ensuring blockwork is sealed and parging layer/plaster finish is applied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

Be Clean - Energy efficient mechanical & electrical systems



Having reduced energy demand through the fabric first approach, we now look to specify mechanical and electrical systems with efficiencies that far 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, ventillation, 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, ground source heat pumps...

Element	Compliance	Proposed
Low energy lighting (efficacy $\geq 45\text{lm/W}$)	75%	100%
Ideal Logic Code Combi, Combi ESP1 & Logic System S18	88%	89.6%
Shower Save (WWHRS)	N/A	N/A
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	Weather/load compensator
Greenwood Cmev and Dmev	0.7 I/W/s (SFP)	0.177 I/W/s (SFP)

Be Green - Decentralised and 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.

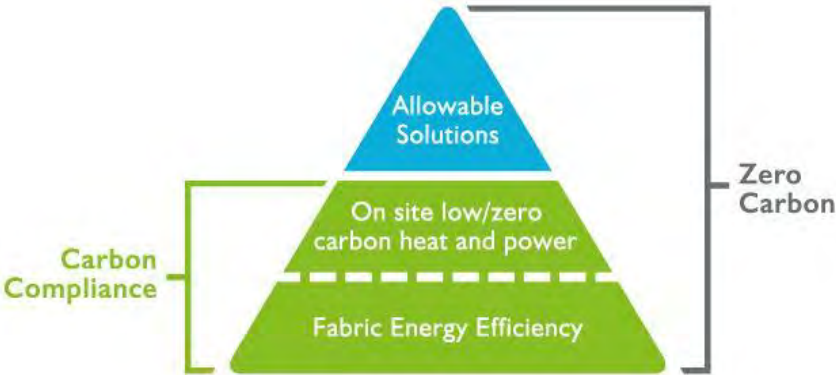
Low carbon technologies

- 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).

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



Considered technologies	
Solar hot water	No
Solar Photovoltaic	No
Wind Turbines	No
Biomass	No
Micro CHP	No
ASHP	No
GSHP	No
CHP Natural Gas	No
CHP Biogas District	No
Flue Gas Heat Recovery	Yes
Waste Water Heat Recovery	No
Fabric Approach	Yes



District Heating

District heating energy systems are assessed in accordance with the following hierarchy: -

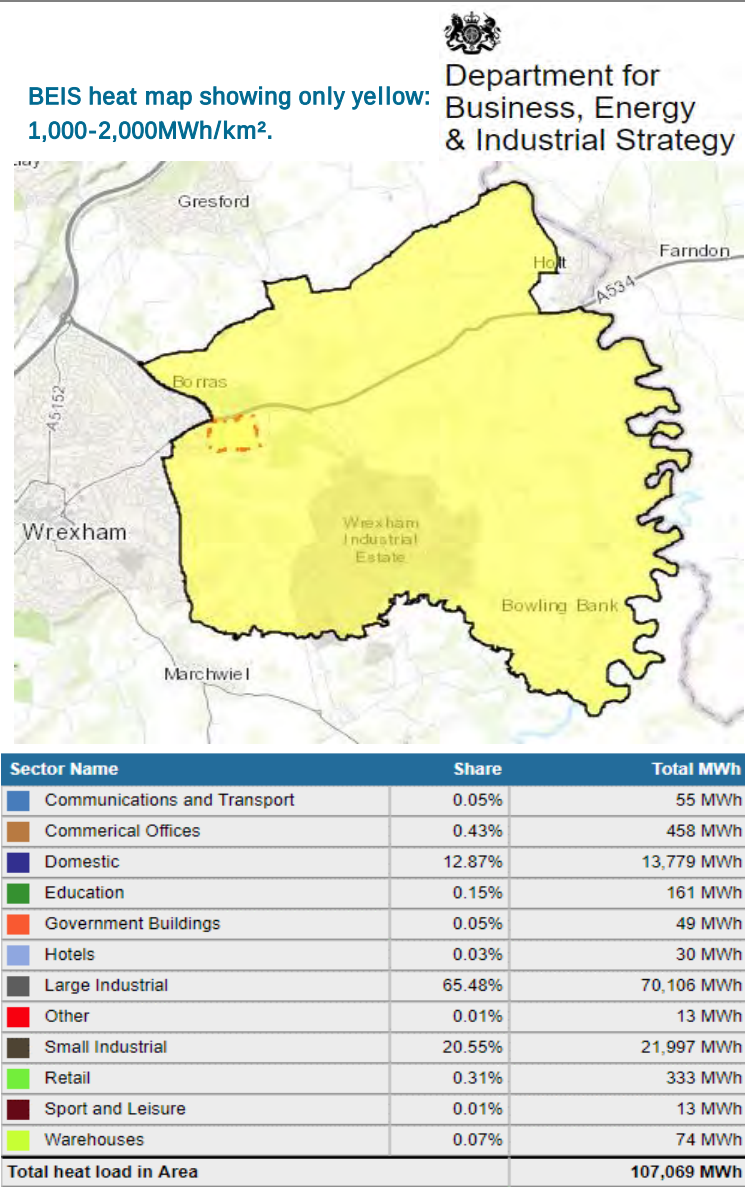
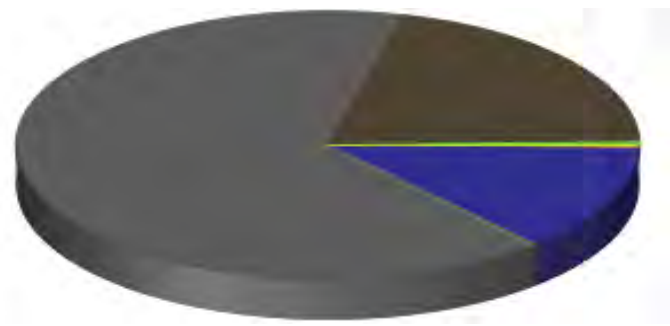
- Connection to existing heating and cooling networks;
- Site wide combined heat and power (CHP) network;
- Communal heating and cooling.

The heat map shows that there are no district heating (DH) networks nearby. The heat map would also show if there were any future and potential DH networks planned nearby. There has been discussion regarding a potential heat network to the south, as part of a commercial inclusion. **A full utility statment will be carried out.**

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

- the site is mainly residential, with units dispersed over a large area. This will mean that a large distribution network would be required, and it is anticipated that distribution losses would be high.
- the site will be constructed in phases, so a temporary heating system would need to be installed to serve initial phase, and the carbon reductions would not be realisable until the majority of the development had been constructed, and the district heating network came online.
- 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 existing District Heat networks.
- the home owners would be tied to the same supplier, removing choice.
- A MAX Fordham report (A case against the widespread use of district heating and CHP in the UK Issue 3 / August 2010) found that CHP and district heating systems are generally more expensive to run, consume more energy and issue more CO2 than an equivalent “conventional” systems.

The piechart and table show the heat loads by sector type of the geographic area affected by this development, in the yellow shaded area on the heat map above.



Low to Zero Carbon Technology Reductions

A number of different energy strategies have been considered within this assessment, which will include the practical implications of installing each technology and quantity to achieve the required mandatory improvement in DER over (Wales 2014) Building Regulations, will be discussed in more detail later in this report, should any of these technologies be considered economically viable for the Land South of Holt Road, Wrexham development.

	Number of Dwellings Applied to	Energy Saved %	Carbon Saved %	Capita Cost per m ²	Cost Per kg/CO ₂ saved over 15 years	Cost per Kw Saved over a 15 year period	Recommended?
Solar hot water	600	9.3%	7.6%	£30.12	£1.53	£0.23	No
Solar Photovoltaic	600	6.8%	10.6%	£20.48	£0.02	£0.01	No
Wind Turbines	2	0.1%	0.2%	£43.38	£0.11	£0.04	No
Micro CHP	600	15.9%	12.9%	£42.17	£0.00	£0.00	No
ASHP	200	17.2%	14%	£54.22	£3.04	£1.78	No
GSHP	150	17.3%	14.1%	£54.22	£3.06	£1.80	No
Flue Gas Heat Recovery	550	7.6%	6.2%	£3.61	£3.63	£6.88	Yes
Waste Water Heat Recovery	600	10.3%	8.4%	£5.42	£1.20	£2.67	No
Fabric Approach	600	13.5%	13.4%	N/A	£0.00	£0.00	Yes

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.

Solar Hot Water

Considered for this development?
No

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.

Land South of Holt Road, Wrexham Solar Thermal Calculation	
Number of plots with panels	1200
Size of Panel	4.5 m ²
Number of Panels per plot	2
Total m ²	5400 m ²
Average kWh/m ²	294
Energy produced by panels	1585400
Energy% Saved From Panels	9.3%
CO ₂ % Saved From Panels	7.6%

Solar thermal systems are considered technically feasible on all buildings with suitable roof orientations and space to accommodate hot water cylinders. However:

- *Installation is restricted to favourable orientations on an individual building basis
- *The benefit of installation is limited to the water heating demand of the building
- *Safe access must be considered for maintenance and service checks
- *Buildings need to be able to accommodate a large solar hot water cylinder
- *Distribution losses can be high if long runs of hot water pipes are required
- *Visual impact may be a concern in special landscape designations (e.g. AONB)

For these reasons, Solar Thermal is not Considered Viable for this site

Photovoltaic Collectors (PV)

Considered for this development?

No

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).

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 100kWp to be shared amongst 600 dwellings. Carbon emissions could be reduced by 10.61% compared with Part L (Wales 2014) Target Emission Rate, and energy demand reduced by a further 6.84%.

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.

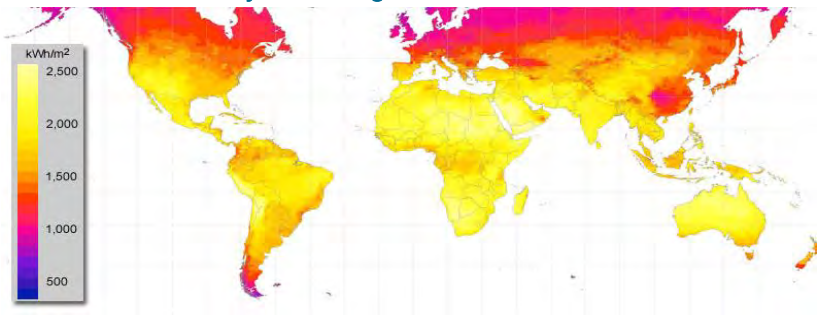
Photovoltaic Collectors (PV) Calculations

Considered 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%	Total site kWp PR = Perf Ratio H = Annual irradiation r=panel yield(%) A=Panel Area(m²) E=Energy (kWh)							
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%								
		South	100.0	0.89	1054	20%	500	93,806.00	Total Energy kWh 258,545.00
		SE/SW	100.0	0.89	997	20%	500	88,733.00	
		East/West	100.0	0.89	854	20%	500	76,006.00	
		NE/NW	0.0	0.89	686	20%	0	0.00	
		North	0.0	0.89	640	20%	0	0.00	
			300.0						

Yearly sum of global irradiance



Amount of PV Panels to meet 300kWp Requirement

- 240w Panels
1250 Panels Required
- 250w Panels
1200 Panels Required
- 260w Panels
1154 Panels Required



On the face of it, PV panels would be considered technically feasible for all buildings with suitable roof orientations.
However;

- *poor design and installation can lead to lower than expected yields (e.g. from shaded locations)
- *Installation is restricted to favourable orientations
- *Occupiers may not benefit from Feed in Tariff payments where the contract is held by a landlord
- *Safe access must be considered for maintenance and service checks
- *Visual impact may be a concern in special landscape designations (e.g. AONB) Reflected light may be a concern in some locations

For these reasons, Solar Thermal is not Considered Viable for this site

Micro wind turbine

Considered 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's 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.

Benefits

Wind power is a clean, renewable source of energy which produces no carbon dioxide emissions or waste products.

In the UK we have 40% of Europe's total wind energy. 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.



The Government wind speed database predicts local wind speeds at Land South of Holt Road, Wrexham to be 5.7 m/s at 10m above ground level, 6.2 m/s at 25m above ground level and 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.

Heat Pumps (ASHP & GSHP)

Considered for this development?

No

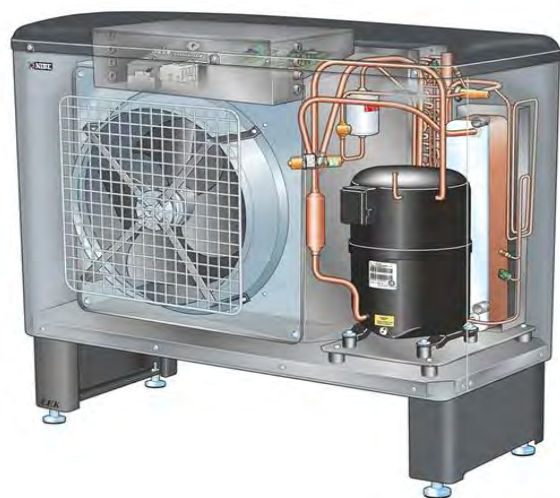
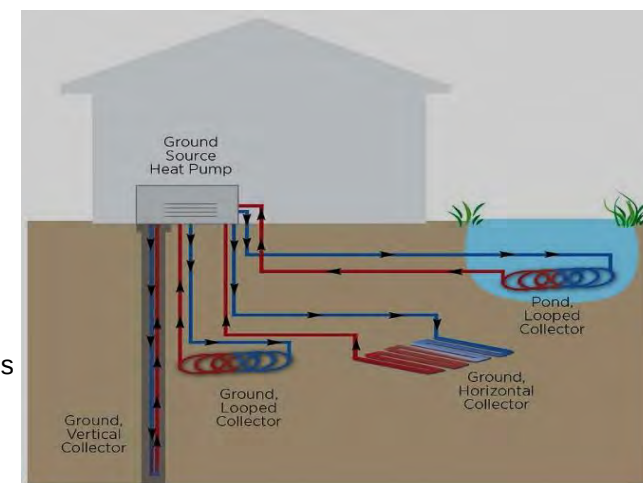
There are two types of heat pumps, ground source and air source. Heat pumps work in a very similar way to fridges and air conditioners and absorb heat from the ground or from the air. Ground or air source heat pumps are mainly designed to work with under floor heating systems because of the lower design 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.

Ground source heat pumps

Ground source heat pumps use a buried ground loop which transfers heat from the ground into a building to provide space heating and, in some cases, to pre-heat domestic hot water. As well as ground source heat pumps, air source and water source heat pumps are also available.

The benefits

The efficiency of a ground source heat pump system is measured by the coefficient of performance (CoP). This is the ratio of units of heat output for each unit of electricity used to drive the compressor and pump for the ground loop. Average CoP over the year, known as seasonal efficiency, is around 3-4 although some systems may produce a greater rate of efficiency. This means that for every unit of electricity used to pump the heat, 3-4 units of heat are produced, making it an efficient way of heating a building. If grid electricity is used for the compressor and pump, then you should consult a range of energy suppliers to benefit from the lowest running costs, for example by choosing an economy 10 or economy 7 tariff.



Air and water source heat pumps

Air and water source heat pumps use air or water respectively. They do not rely on a collection system and simply extract the heat from the source at the point of use.

Air source heat pumps can be fitted outside a house or in the roof space and generally perform better at slightly warmer air temperatures. Water source heat pumps can be used to provide heating in homes near to rivers, streams, lakes and lochs for example.

Costs and savings

A typical 8- 12kW system costs £6,000- £12,000 (not including the price of distribution system). This can vary with property and location. When installed in an electrically heated home a ground source heat pump could save as much as £880 a year on heating bills and almost 7 tonnes of carbon dioxide a year. Savings will vary depending on what fuel is being replaced.

GSHP - the area of land required for individual systems means GSHP systems are not viable. While ASHP 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 associated with ASHP located in areas where the temperature in winter regularly drops below -3 meaning the COP drops below that of a gas boiler increasing running costs significantly

Flue Gas Heat Recovery Systems (FGHRS)

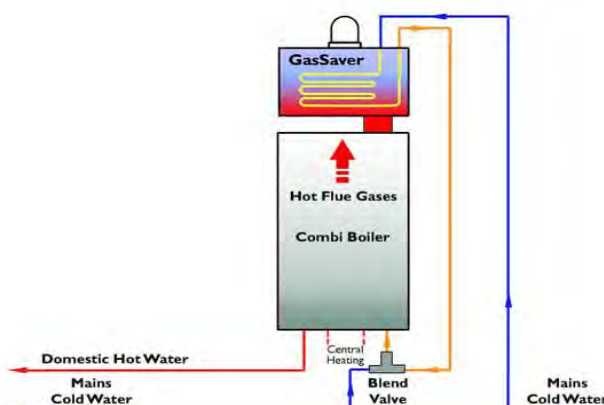
Considered for this development?

Yes

In reality the 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.

Background

Condensing combination boilers only condense when the flow and return water temperature differential is large enough, generally 11°C, during hot water mode the primary heating water is just circulated around the boiler through a secondary heat exchanger and the temperature differential between flow and return water will be very low and therefore the boiler will not condense.



Land use

FGHRS requires no specific land use requirements.

Planning

FGHRS require no additional planning requirements.

How it works

The FGHRS is fitted above the boiler and is connected to the boiler flue outlet; the flue is terminated from the FGHRS as normal.

Cold mains water enters the FGHRS and is pre heated by the waste flue gasses via an air to water heat exchanger, the preheated water is then feed to the inlet cold connection on the boiler therefore reducing the amount of gas required to heat the hot water to a sufficient usable temperature.

Costs and maintenance

FGHRS cost between £500-£650 and according to the manufacture will require none or very little maintenance.

In order to meet energy demand improvements using Flue Gas Heat Recovery Systems, this site would require Ideal Code boilers (or similar) installed in 550 dwellings, site wide. Carbon emissions could be reduced by 6.2% compared with Part L (Wales 2014) Target Emission Rate, and energy demand reduced by a further 7.6%.

Waste Water Heat Recovery Systems(WWHRS)

Considered for this development?

No

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 Recoh-vert (Figure 1), is applicable to upstairs showers, whilst the Recoh-tray (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.

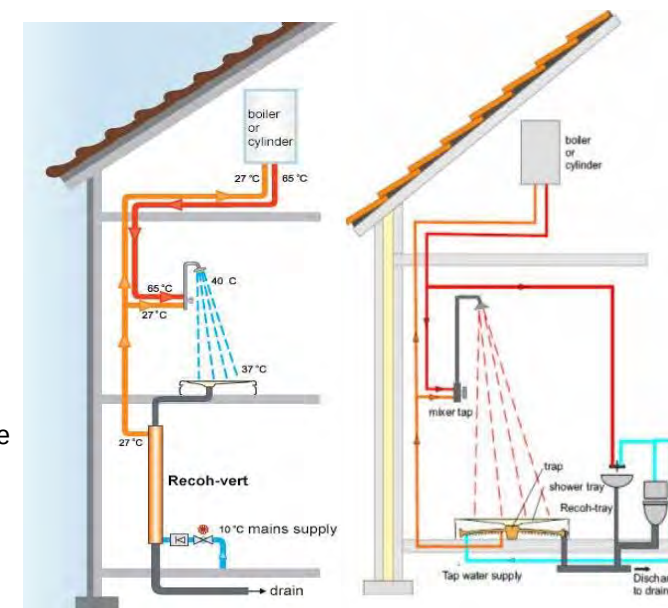


Figure 1

Figure 2



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.



In order to meet significant energy demand improvements using Waste Water Heat Recovery Systems, this site would require WWHR to be applied on up to 600 dwellings, site wide. Carbon emissions could be reduced by 8.4% compared with Part L (Wales 2014) Target Emission Rate, and energy demand reduced by a further 10.3%. It is not viable due to construction methods to install WWHR on every dwelling

Baseline Energy Calculations

A baseline total energy demand has been established for the proposed development. Reductions in demand due to energy conservation measures are considered and form the basis of the renewable energy strategy which follows.

Indicative floor plans for the Land South of Holt Road, Wrexham development have been used in conjunction with an outline accommodation schedule and building specifications to prepare initial preliminary SAP Calculations. SAP calculations have been carried out to Part L1A (Wales 2014).

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

Energy savings are measured in terms AC757of 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 kgCO ₂ e
Gaseous Fuels	Natural Gas	kWh	0.18416 kgCO ₂ e
Biomass	Wood Pellets	kWh	0.01270 kgCO ₂ e



Baseline Energy Calculations (continued)

Predicted Carbon Emissions: Part L1A (Wales 2014) TER, Before Fabric Improvements

	Space Heating Demand	Hot Water Demand	Energy From Pumps and Fans	Energy from Lighting		Totals
Part L1A Plots (kWh/a)	2,600,644	1,452,346	86,385	226,305		4,365,679
CO ₂ Associated with total Energy Demand (kg/a)	478,935	267,464	30,369	79,560		856,328

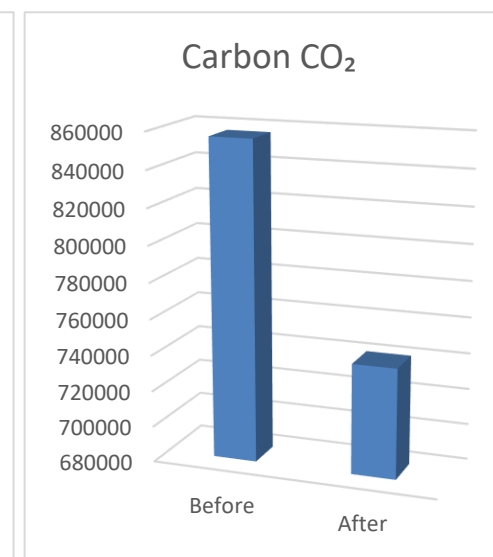
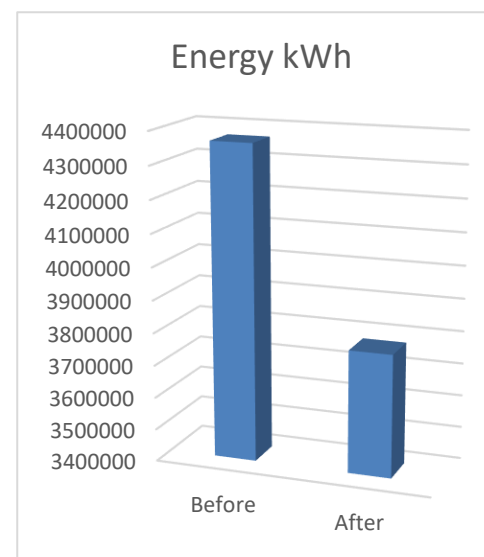
Predicted Carbon Emissions: Part L1A (Wales 2014) DER, with improved fabric, controls and heating system

	Space Heating Demand	Hot Water Demand	Energy From Pumps and Fans	Energy from Lighting		Totals
Plots (kWh/a)	2,435,373	1,071,163	45,000	226,447		3,777,983
CO ₂ Associated with total Energy Demand (kg/a)	448,498	197,265	15,820	79,610		741,194

When compared against Part L1A (Wales 2014) Building Regulations: -

Total CO₂ demand for the residential units at the Land South of Holt Road, Wrexham is calculated to be 741194 kg per annum. This represents a saving of 13.4% over the Part L1A (Wales 2014) compliant figure of 856328 kg per annum.

Total energy demand for the residential units at the Land South of Holt Road, Wrexham is calculated to be 3777983 kWh per annum. This represents a saving of 13.5% over the Part L1A (Wales 2014) compliant figure of 4365679 kWh per annum.



Potential energy reduction mitigation summary

A fabric first approach has been adopted at the Land South of Holt Road, Wrexham. By constructing to the specifications as detailed on Page 5, carbon emissions are reduced by 13.4% compared with Part L (Wales 2014) Target Emission Rate, and energy demand reduced by 13.5%.

Sustainable Design Considerations

Energy efficient design is only a part of a sustainable design strategy for modern homes. This section of the statement outlines the considerations that have been made to ensure that the proposed development will be designed and constructed to the highest standard of sustainable living.

Energy Conservation

Further energy consumption reductions are achieved through the provision of energy efficient white goods (where applicable) ensuring that all appliances have a minimum energy rating of A+.

Energy display monitoring devices & smart meters are designed to show the energy consumption within the home. This will help the occupants to develop an understanding of the energy they use and therefore enable them to improve their habits to reduce energy consumption.

Flood Consequence Report and drainage strategy

This development does not have any substantial rivers nor lakes, which directly affect it. A Flood Consequence Report and drainage strategy has been prepared in support of the outline application

Management

Potentially, A suitable designed Home User Guide may be produced and made available to all new occupants as part of the handover pack. It will provide information on the energy efficient design of the dwellings, how to operate the services and equipment in the home and also provide important information about the remainder of the site and its

Household Waste

Potentially, All dwellings may be provided with external space for household waste, compliant with British Standard BS5906, i.e: 100ltrs volume for a single bedroom dwelling, with a further 70ltrs for each additional bedroom. Additional space for green recycling bins, blue bags, and food waste bins, will also be provided in accordance with the local recycling initiatives.

Air Quality

The development is not in an AQMA and a Air Quality Assessment has been prepared as part of the application

Pollution

To reduce the amount of greenhouse gas emissions associated with the development, all insulation used in the building fabric and services shall have a Global Warming Potential (GWP) of less than 5, which is the current minimum standard for all construction insulation. By selecting suitable insulation products, the development is helping to minimise future effects of global Climate Change. The proposed gas fired system boilers will have a NOx rating of under 40mg/kWh.

Even though this development falls outside of AQMA's, potential boilers can have the low NOx rating of only 38mg/kWh, surpassing the requirement for air quality.

Water Conservation

Performance target: Level 3/4 Less than 105l/pp/pd

Water consumption in the UK has risen by 70% over the last 30 years. Trying to meet the increasing demand by creating new sources of water supply is both expensive and damaging to the environment. The efforts should be focused on reducing the demand for water and managing existing resources. Good water management can contribute to reducing the overall level of water consumption maintaining a vital resource and having environmental as well as cost benefits in the life cycle of the building. Water efficient devices will be fully evaluated, and installed, wherever possible.

The specification of such devices will be considered at design stage and each will be subject to an evaluation based on technical performance, cost and market appeal, in order to comply with the water use regulations. The following devices may be incorporated within each dwelling: water efficient taps, water efficient toilets, low output showers, flow restrictors to manage water pressures to achieve optimum levels and water meters to all homes with guidance on water consumption and savings. The amenity spaces will have discretely located rainwater butts which could be provided to assist with landscaping maintenance.

Installation type			Unit of measure		Capacity/ flow rate		Use factor		Fixed use		Litres/ person/day	
WC (dual flush)			Full flush volume		4.00		1.46		0.00		5.84	
			Part flush volume		2.60		2.96		0.00		7.70	
Taps (excluding kitchen/utility room taps)			Flow rate (l/min)		4.00		1.58		1.58		7.90	
Bath (where shower also present)			Capacity to overflow		170.00		0.11		0.00		18.70	
Shower (where bath also present)			Flow rate (l/min)		8.00		4.37		0.00		34.96	
Bath only			Capacity to overflow		N/A		0.50		0.00		0.00	
Shower only			Flow rate (l/min)		N/A		5.60		0.00		0.00	
Kitchen/utility room sink taps			Flow rate (l/min)		6.00		0.44		10.36		13.00	
Washing machine			Litres/kg dry load		8.17		2.10		0.00		17.16	
Dishwasher			Litres/place setting		1.25		3.60		0.00		4.50	
Waste disposal unit			Litres/use		N/A		3.08		0.00		0.00	
Water softener			Litres/person/day		N/A		0.00		0.00		0.00	
Greywater Contribution		N/A	Rainwater Contribution		N/A	Normalisation factor		0.91	Total calculated use			109.75
Normalised total water consumption			99.88		External water use		5.00		Total Water Consumption			104.88
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									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.

Site Location & Public Transport

The transport of people between buildings is the second largest source of CO₂ emissions in the UK after energy use in buildings, and remains the main source of many local pollutants. Energy use and emissions from transport are growing at 4% per year, and at the same time, the effects of climate change are becoming more severe; there will be greater pressure to control CO₂ emissions from transport.

In addition to energy use and CO₂ emissions, in areas of high transport usage there is likely to be an increase in congestion, noise and airborne pollution, which have an adverse impact on the health and quality of life of the local inhabitants. The proposed buildings location and design will aim to minimise the use of private cars and the associated impacts. A travel plan will be generated to cover all aspects of travel to avoid using cars. Electric vehicle charging points will be included for every dwelling.

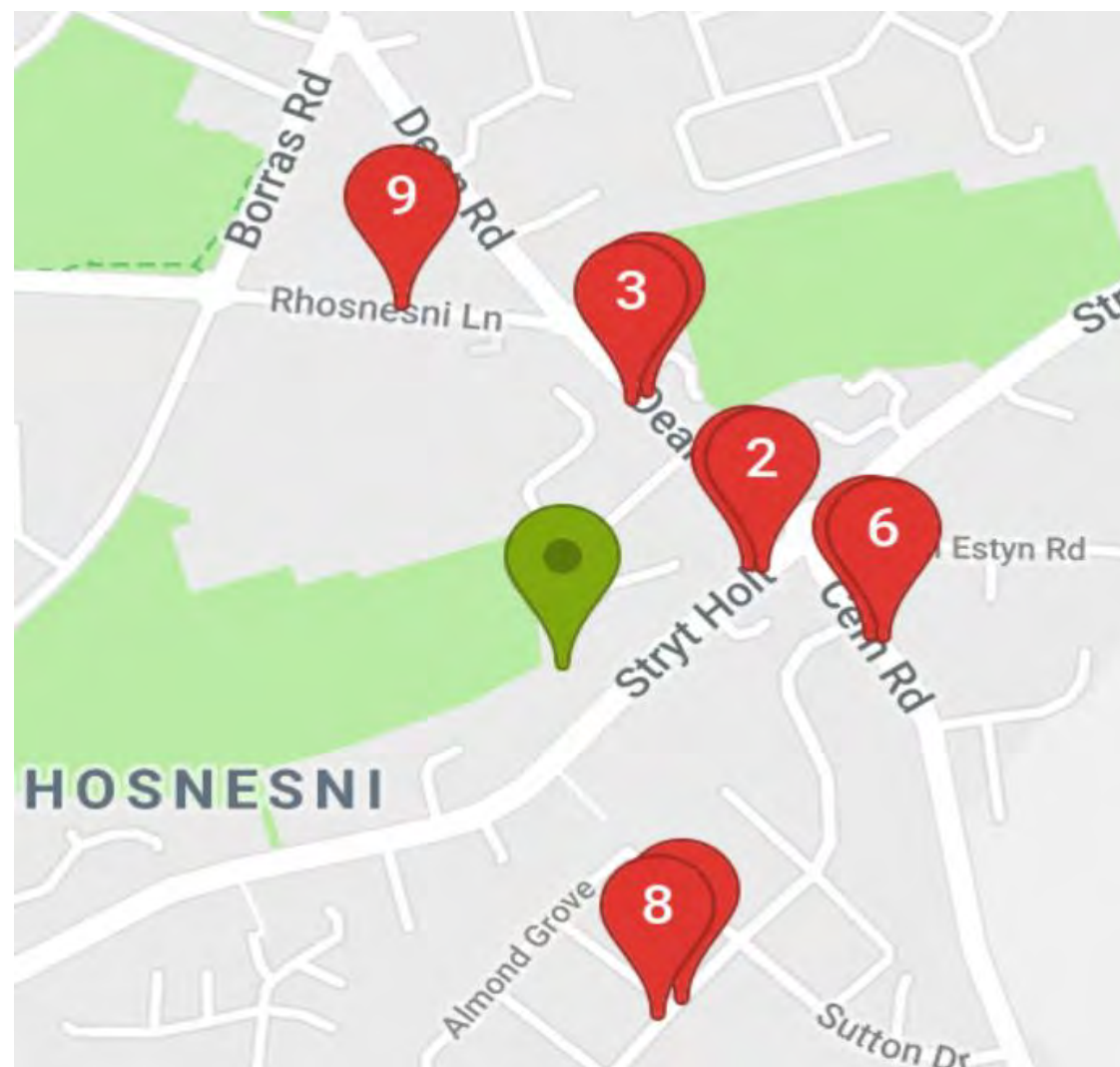
There will be a requirement to consider improvements to the footpaths and create cycle routes improving existing routes connecting to public transport.

There are 9 nearby bus stops that have been identified within 1km of the site, shown on the image to the right.

They are:

- 1 Greyhound Inn (opp) on Holt Road, Rhosnesni
- 2 Greyhound Inn (os) on Holt Road, Rhosnesni
- 3 Post Office (opp) on Dean Road, Rhosnesni
- 4 Fenwick Drive (NW-bound) on Cefn Road, Rhosnesni
- 5 Post Office (o/s) on Dean Road, Rhosnesni
- 6 Fenwick Drive (SE-bound) on Cefn Road, Rhosnesni
- 7 Ash Grove (SW-bound) on Fenwick Drive, Rhosnesni
- 8 Ash Grove (NE-bound) on Fenwick Drive, Rhosnesni
- 9 Gate Hangs High (os) on Rhosnesni Lane, Rhosnesni

The closest rail station is Wrexham Central, which is approximately 1.3 miles to the West by South West of the site. Wrexham Central railway station is the smaller of two railway stations serving the central area of Wrexham in Wales, the other being Wrexham General. It is the southern terminus of the Borderlands Line, also known as the Wrexham-Bidston line, which links north-east Wales to Merseyside. The station has an hourly service to Shotton and Bidston on Monday to Saturday daytimes, dropping to two-hourly in the evenings and on bank holidays.



Construction considerations

This site can potentially benefit from the most stringent of health and safety regulations, by seeking registration with considerate constructors. A NEBOSH accredited health and safety manager will ensure all measures are adhered to and followed. Including reducing sound and dust pollution during the construction phase, allocating appropriate parking and traffic control for the construction teams and all heavy machinery. Ensuring adequate temporary works design and coordination is applied in accordance with the HSE.



Lighting and natural light

High quality lighting design is an important and desirable feature that supports how you feel and use your home. Providing adequate access to and control of lighting within your home is a basic function that contributes to our comfort and health.

Careful consideration could be made to ensure that background lighting levels will meet the requirements as set out in CIBSE Internal Lighting Guide & SLL Lighting Guide with the following targets set as shown in Table 5.0.

All internal and external lighting could be supplied by energy efficient fittings with LED lamps which will offer luminous efficacy greater than 45 lumens per circuit Watt and greater than 60 lumens per circuit Watt for the non-domestic unit.

ROOM TYPE	LUX LEVEL
Entrance Lobby	150
Kitchen	500
Living Space	200
Bathroom	200
Bedrooms	150

Table 5.0 – CIBSE Internal Lighting Guide - recommended lighting levels

Materials

Building and construction activities worldwide consume 3 billion tons of raw materials each year, which account for approximately 50% of total global consumption. Using green/sustainable building materials and products promotes conservation of dwindling non-renewable resources. In addition, integrating sustainable building materials into building projects can help reduce the environmental impacts associated with the extraction, transport, processing, fabrication, installation, reuse, recycling, and disposal of these source materials.

The aim for the proposed development would be for its overall environmental impact to be minimised through the specification of sustainable materials and components.

Materials with low overall environmental impact could be selected for the key building elements in the proposed scheme, targeting A/A+ ratings where possible, from the BRE 'Green Guide to Specification'. The Green Guide rates the environmental impact of different materials and components over their lifecycle, taking into account factors like toxicity, ozone depletion, extraction, ease of recycling, waste disposal etc.

Materials could be selected where possible from responsible suppliers, who can provide environmental certificates for the manufacturing processes of their products (including the supply chain processes), i.e. ISO14001, BES6001 or equivalent certificates.

Recycled materials could be specified where possible and it will be ensured that for all new raw materials being used, as much as much as possible can be recycled at the end of the buildings' life.

Specifying materials with a high-recycled content is a method of saving processing or manufacturing energy. The recycled content of a material can be described as either post-consumer or post-industrial to indicate at what point in the life cycle a material is reclaimed.

Some typical building materials that can contain a high percentage of recycled material include reinforcing and framing steel, concrete masonry units, gypsum wallboard, acoustic ceiling panels and their suspension system.