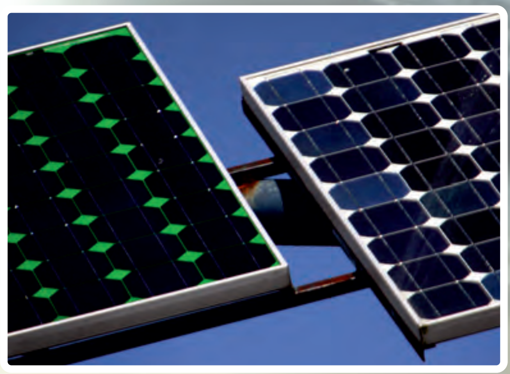
SPG 12 Sustainable Energy



Cyngor Bwrdeistref Sirol Pen-y-bont ar Ogwr

BRIDGEND County Borough Council

Development Planning

Bridgend County Borough Council
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Supplementary Planning Guidance (SPG) 12

Sustainable Energy

DRAFT

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1 Introduction and Summary

1.1 Introduction

1.1.1 Bridgend County Borough Council, with support from the Carbon Trust, is seeking ways in which it can facilitate the sustainable use and generation of energy in new buildings.

1.1.2 The planning system will be one of the key delivery vehicles for achieving this aim, hence specific policy requirements in place within the Bridgend Local Development Plan (LDP).

1.1.3 This, in conjunction with progressive changes in Building Regulations requirements will help to achieve the Welsh Government's target for all new buildings to be built to zero carbon (and nearly zero energy) standards by 2021, which is also the end date of the current Bridgend LDP.

1.2 Purpose of this Document

1.2.1 This Supplementary Planning Guidance (SPG) provides information on how to cut CO_2 emissions by following the Energy Hierarchy - reducing the need for energy, using energy more efficiently and generating energy from renewable and low and zero carbon sources.

1.2.2 This SPG complements policies within Bridgend County Borough Council's Local Development Plan and details how planning policy will be applied to planning applications. The application of, and response to, SPG is an important material consideration in decision making.

1.2.3 This SPG was adopted by Bridgend County Borough Council at its meeting on TBC. Appendix B outlines the responses received during public consultation and the Council's response. SPG12: Climate Neutral Development (2007) adopted by the Council on the 20th December 2007 is hereby cancelled.

1.2.4 Please check the Council's website to ensure you use the most up-to-date planning policies and guidance. www.bridgend.gov.uk

1.3 Who is this Supplementary Planning Guidance for?

1.3.1 The notes for developers which outline succinctly the Council's expectations on its approach to Designing for Sustainable Energy are reproduced below. Further information and background to these notes can be found within the text of the document.

NOTE 1: EXEMPTIONS AND COVERAGE

The following types of development are EXCLUDED from the provisions of this SPG:

1. "Householder" applications for alterations and extensions to dwelling houses.

2. Alterations and extensions to existing non-residential buildings, including:

- **Extensions of up to 10% additional gross internal floorspace**
- **External works where no additional floorspace is being created**

3. Applications for planning permission proposing a change of use only

4. Applications that are solely for the installation of energy efficiency measures or renewable or low / zero carbon energy generation.

'Full' planning applications will need to address the requirements of the SPG in full. Outline applications will need to address the requirements in summary, but will be conditioned by the Local Planning Authority that full details be submitted in order for the permission to be implemented.

1.4 What is required of developers?

NOTE 2: DESIGN AND ACCESS STATEMENTS

All planning applications should be accompanied by Design and Access Statements which shall include information on how the development proposal helps to combat the causes of Climate Change through energy and resource efficiency measures.

NOTE 3: ENERGY HIERARCHY

The Council will expect that, all major development proposals that are required to consider their energy requirements under Policy ENV17 of the LDP use the Energy Hierarchy in the consideration of options.

NOTE 4: DESIGN ISSUES

All Design and Access Statements required under this Supplementary Planning Guidance should outline how the design of a development has taken into account the advice in this document in terms of the following aspects:

- **Site Characteristics**
- **Building Design**
- **Sustainable Construction and Materials**
- **Using Energy Efficiently**

1.4.1 For developments which **do not meet the thresholds for energy assessments required by Policy ENV17 of the LDP**, the Council will expect applicants to have had regard to the design of their developments with a view to mitigating the causes of, and adapting to~~e~~ climate change.

1.4.2 In addressing the issues in Notes 2, 3 and 4, the Council will expect applicants to take a holistic approach, taking into account energy efficiency measures *and* low/zero carbon technologies where appropriate.

1.4.3 For developments meeting the threshold of Policy ENV17, **consideration will need to be demonstrated by way of an Energy Assessment, to each of the first 3 steps in the Energy Hierarchy.**

NOTE 5: TECHNOLOGY OPTIONS

The Council will expect that, all major development proposals that are required to consider their energy requirements will examine, as a minimum, the appropriateness of the following technologies / systems:

- **Solar Photovoltaics & Hot Water (Thermal)**
- **Ground and Air Source Heat Pumps**
- **Wind Turbines**
- **Biomass Boilers**
- **Combined Heat and Power (CHP)**
- **Hydroelectricity**
- **District Heating**

NOTE 6: ENERGY OPPORTUNITIES

The Council will expect that, all major development proposals that are required to consider their energy requirements will use the Bridgend Energy Opportunities Plan (or similar) in the consideration of sources of renewable electricity and the potential to link to district heat networks.

NOTE 7: ENERGY ASSESSMENT STRUCTURE AND AIMS

Within an energy statement, the Council expects to receive calculations of predicted primary regulated energy and associated CO_2 emissions in addition to a written description of the measures to be employed in consideration of achieving the requirements of Part L of the Building Regulations. The statement may also refer to application plans where necessary.

The Council also invites developments to achieve 10% of their primary regulated energy requirements from renewable or low/zero carbon sources.

1.5 How to use this SPG

1.5.1 All readers are encouraged to read information contained within **Section 2: Policy Context** and **Section 3: Bridgend Context** so they are aware of the reasons why this guidance has been produced as well as the national and local policy context.

1.5.2 Where this guidance provides specific additional notes on the requirements of the Council arising out of this SPG, they are clearly defined in within the document.

1.5.3 The Council will use the low carbon principles of the 'energy hierarchy' in its desire to reduce carbon emissions in new developments. Essentially this prioritises measures within developments to the following order:

1st Measures which reduce the need for energy to be generated in the first place.

2nd Measures which ensure that when energy is generated it is used as efficiently as possible.

3rd Measures which enable energy to be generated onsite using renewable sources or low/zero carbon technologies.

4th Measures which facilitate 'Allowable Solutions' to offset any carbon reduction targets which are unable to be met on-site.

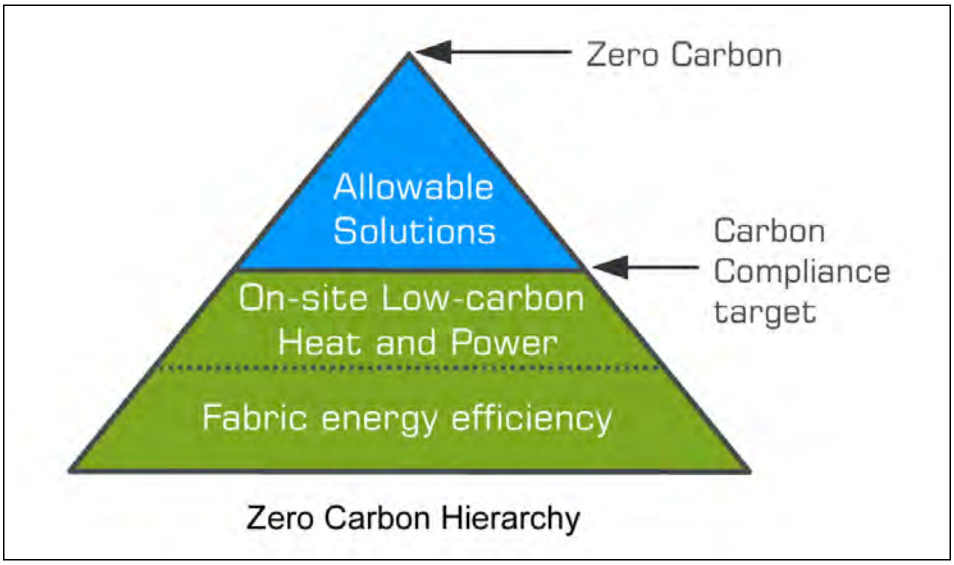


Diagram 1: Energy / Zero Carbon Hierarchy Diagram
Source: Zero Carbon Hub

1.5.4 The rest of this SPG has been structured in the order of the energy hierarchy accordingly. The status of Allowable Solutions, whereby off-site projects or measures that reduce carbon emissions - which developers may support to achieve zero carbon buildings in the future, is not considered as part of this document.

1.6 Pre Application Advice

1.6.1 The planning implications of all of the energy efficiency measures and renewable and low/zero carbon energy technologies will need to be assessed in detail by the Local Planning Authority once an application is submitted. Amenity considerations to surrounding residents / businesses are likely to be key to the determination of such applications.

1.6.2 It is therefore advisable to seek advice from the Council as early as possible in to the development design process, to ensure the appropriateness of the options selected, informed by an initial energy assessment. The Council offers a Pre Application Advice Service (details available on the website) whereby relevant advice can be sought on the appropriateness of a scheme before it is formally submitted for determination.

2. Policy Context

2.1 Climate Change

2.1.1 The concept of climate change is generally accepted by the majority of the world's nations as something that is happening, and that further change is inevitable. It is predicted that Wales will be warmer by on average between 1.1 – 2.9ºC by 2080. Climate change is now viewed by the UK and Welsh Government as an important issue.

2.1.2 Measures need to be taken to both mitigate the causes and adapt to the impacts of climate change. The carbon dioxide already released into the atmosphere has already determined the climate changes that will occur for the next 30 – 40 years. However beyond this point we still have the ability to make a choice.

2.1.3 The European Union (E.U) has agreed to a cut of 8% in its carbon dioxide emissions as part of its commitment to the Kyoto Protocol. The distribution of this 8% among the E.U Member States has meant that the UK has to reduce its greenhouse gas emissions by 12.5%.

2.1.4 This supplementary planning guidance considers both mitigation and adaptation measures.

2.1.5 It is important that the effects of climate change are considered over the lifetime of a development. A development may have a design life of 20 – 50 years (depending upon location and usage intensity) but in reality developments may well be used for considerably longer than this timeframe. For example many of the terrace houses constructed within the Bridgend Valleys were built prior to the First World War to house workers within the regions thriving coal industry.

2.1.6 Climate change could make a development unusable in the future whether due to being too uncomfortable or too expensive to operate (e.g. unaffordable insurance). However, taking climate change is taken into consideration now buildings will be better placed to function regardless of future impacts of climatic changes.

2.2 Impacts of Climate Change

2.2.1 Due to the build-up of carbon dioxide and other greenhouse gases from the burning of fossil fuels in the Earth's atmosphere our climate is changing. The main impacts of climate change are:

- Warmer, wetter winters.
- Hotter, drier summers.
- Doubling of extreme rainfall events by the 2080's.
- Rising sea levels.
- Potentially higher peak wind speeds.

- Greater unpredictability of extreme weather events.

2.2.2 The UK Climate Impacts Programme (UKCIP) produces the latest climate change scenarios for the UK. The UKCIP scenarios illustrate how our climate may change in response to four different rates of greenhouse gas emissions, namely:

- Low Emissions
- Medium-Low Emissions
- Medium-High Emissions
- High Emissions

2.2.3 They are only predictions based upon computer simulations that need to be used in conjunction with other climate models in order to make decisions regarding adaptation to future climate changes.

2.2.4 In terms of temperature: the climate of Wales is predicted to become warmer by 1.1 – 2.9ºC by the 2080's. This is a quite significant temperature increase that could have an effect upon buildings and how they are used. Also higher external temperatures are likely to create higher internal temperatures, which will cause particular problems within residential buildings such as domestic properties, care homes and hospitals. Failure to deal with increase temperatures could cause heat stress, which could increase summer deaths especially amongst the elderly.

2.2.5 In terms of rainfall: change predictions for Wales are that rainfall will increase by 7% to 15% by the 2050's depending upon which emissions scenario is looked at. However, this increased rainfall will not be uniform throughout the year; rather winter rainfall will become more intense, with summer rainfall decreasing. This is likely to cause problems with flooding in the autumn and winter and drought in the summer months.

2.3 European and UK Policy Response to Climate Change

2.3.1 The European Union (EU) has set itself targets for reducing carbon emissions in order to combat climate change. For 2020, the EU has made a unilateral commitment to reduce overall greenhouse gas emissions from its 28 Member States by 20% compared to 1990 levels. These targets, known as the "20-20-20" targets, set three key objectives for 2020:

- A 20% reduction in EU greenhouse gas emissions from 1990 levels.
- Raising the share of EU energy consumption produced from renewable resources to 20%.
- A 20% improvement in the EU's energy efficiency.

2.3.2 The EU is working in a number of areas to legislate for action on climate change and provide support to Member states in terms of research and sharing of best practice.

2.3.3 In terms of legislation, there are two pertinent pieces of legislation relevant to this guidance:

- Directive 2010/31/EU on the energy performance of buildings requires Member States to set minimum requirements for the energy efficiency of buildings with the objective of all buildings having 'nearly zero' consumption by the end of 2018. Public buildings will need to achieve this standard by 2018. This Directive has recently been supplemented by Directive 2012/27/EU.
- Directive 2009/28/EC requires Members States to agree proportions of renewable energy generation which will need to be met by 2020 (in order for the EU as a whole to meet its 20% target). The UK target is 15%.

2.3.4 In the UK, the 2008 Climate Change Act commits us to reduce carbon emissions by 80% of 1990 levels by 2050. The Act also established the Committee on Climate Change which advises the Government on its progress towards meeting targets. Recent legislation has also been developed to improve the energy efficiency of existing buildings which will reduce the amount of energy consumed by the country as a whole, together with the provision of 'Smart Meters' which allow individuals to manage their energy needs.

2.3.5 In 2009, the UK Government published its Renewable Energy Strategy which outlines how it anticipates it will meet its 15% target for renewable energy generation. The preferred scenario is to generate 30% of its electricity, 12% of its heat and 10% of transport energy by renewable sources. This was accompanied by a range of incentives and actions which the Government envisages will help us to meet these targets.

2.3.6 In terms of heating, in 2013 the UK Government set out the next steps to ensure affordable and secure low carbon heating plays an important role in the nation's energy mix in the publication of "*The Future of Heating: Meeting the challenge*". This has also led to the creation of a dedicated unit with the Department for Energy and Climate Change to assist in bringing forward District Heat Networks across the UK.

2.4 Policy in Wales

2.4.1 The Welsh Government produced a Climate Change Strategy in 2010 to show how it would play its part in tackling Climate Change. In setting out its action the Welsh Government set the following targets:

- Reduce greenhouse gas emissions by 3% per year from 2011 in areas of devolved competence, against a baseline of average emissions between 2006-10.
- Achieve at least a 40% reduction in greenhouse gas emissions in Wales by 2020 against a 1990 baseline.

- The 3% target will include all ‘direct’ greenhouse gas emissions in Wales except those from heavy industry and power generation, but including emissions from electricity use in Wales by end-user.
- Set target ranges for sectoral emissions reduction.

One of the areas for action from the strategy is to ensure that: “*the land use planning system enables low carbon development and adaptation to the impacts of climate change”.*

2.4.2 *Energy Wales: A Low Carbon Transition* was published by the Welsh Government in 2012 and sets out how, within its areas of devolved responsibility the Welsh Government will operate to meet carbon emission targets and increase renewable energy production. It recognises that a: “*clear, streamlined, consistent, transparent and accountable planning and consenting regime (including ancillary consents) is fundamental if we are to achieve our energy ambitions and unlock Wales’ energy potential*.”

2.4.3 Planning’s wider role in shaping places with lower carbon emissions and resilience to climate change is set out in Planning Policy Wales. The Assembly Government has also produced Planning Policy Wales and Technical Advice Notes [TAN] 8, on Renewable Energy; 22, on Sustainable Buildings; and 12, on Design.

2.4.4 Changes have been made to ‘permitted development’ rights to make provision for the installation of certain types of micro-generation by householders without the need for planning permission, namely solar photovoltaic and solar thermal panels, ground and water source heat pumps and flues for biomass heating.

2.4.5 The Planning and Energy Act, 2008, enables local planning authorities in Wales to set reasonable requirements in the LDP for the generation of energy from local renewable sources and low carbon energy and for energy efficiency. The Act is complemented by the policies contained in PPW that cover such issues and provides a legal basis for the implementation of LDP policies against the national framework.

2.4.6 As well as planning policy, the Welsh Government has also produced a range of supporting background research including the planning implications of different renewable energy technologies as well low carbon technologies which can be integrated into the fabric of developments. It has also produced a toolkit on undertaking Renewable Energy Assessments and energy opportunities planning. Further information on these is given later on in this document.

2.4.7 In addition to its planning policy formulation role, since December 2011 the Welsh Government has also been responsible for setting Building Regulations. A revision to Part L of the Regulations is expected in 2014. A ministerial statement in July 2013 confirmed that it was the Welsh Government’s intention to regulate to achieve an aggregate reduction in CO2 emissions of 8%, compared to Part L 2010 standards in domestic buildings and 20% for non-domestic buildings. These changes are likely to be the first step in order to achieve zero carbon standards by 2021. These regulations will replace the national planning policy requirements which had previously been stipulated in Planning Policy Wales.

2.4.8 Even though the Council does not have a specific target for renewable energy production in its Development Plan, it considers that there is still a role for the planning system to play in influencing the amount, and type of renewable / low carbon technologies in new development which will meet the proposed 2014 Building Regulations. Importantly; when the regulations are reviewed in 2016 (and subsequent years) there will be a lead-in time, where developers submitting planning applications will need to consider when they intend to begin developing their sites in order to achieve the desired energy efficiency targets.

2.5 Additional Benefits

2.5.1 While the extent to which we can contribute to reducing man-made Climate Change is limited, reducing a building's energy and promoting the generation of energy from renewable / low and zero carbon sources also has other, more easily evidenced and quantifiable, beneficial effects. These include diversifying the UK's 'energy mix' away from a heavy reliance on fossil fuels. It is widely acknowledged that, although the contribution from buildings integrated renewable / low carbon technologies will be small, it will be a fundamental part of the country's future suite of energy generation techniques.

2.5.2 In relation to this, the promotion of renewable / low carbon technologies will also reduce the UK's reliance on fuelling its energy supply by using resources from overseas. In a fluctuating energy market, the long term stability of energy prices can help to be achieved by the contribution from energy which is generated from local, renewable resources with the associated benefits of alleviating fuel poverty.

3. Bridgend Context

3.1 Bridgend Local Development Plan (LDP)

3.1.1 The need to achieve sustainable energy use is great. By 2020, it is predicted that demand for electricity will be approximately 0.7GWh and heat demand, 2.2GWh (a GigaWatt hour of electricity is equivalent to 100 million 10W light bulbs being used for 1 hour)**.**

3.1.2 The Bridgend LDP was adopted on the 18th September 2013. The following policies are relevant those which this guidance supplements.

Strategic Policy SP2: Design and Sustainable Place Making

All development should contribute to creating high quality, attractive, sustainable places which enhance the community in which they are located, whilst having full regard to the natural, historic and built environment by:

1) Complying with all relevant national policy and guidance where appropriate;
2) Having a design of the highest quality possible, whilst respecting and enhancing local character and distinctiveness and landscape character;
3) Being of an appropriate scale, size and prominence;
4) Using land efficiently by:
(i) being of a density which maximises the development potential of the land whilst respecting that of the surrounding development; and
(ii) having a preference for development on previously developed land over greenfield land;
5) Providing for an appropriate mix of land uses;
6) Having good walking, cycling, public transport and road connections within and outside the site to ensure efficient access;
7) Minimising opportunities for crime to be generated or increased;
8) Avoiding or minimising noise, air, soil and water pollution;
9) Incorporating methods to ensure the site is free from contamination (including invasive species);
10) Safeguarding and enhancing biodiversity and green infrastructure;
11) Ensuring equality of access by all;
12) Ensuring that the viability and amenity of neighbouring uses and their users / occupiers will not be adversely affected;
13) Incorporating appropriate arrangements for the disposal of foul sewage, waste and water;
14) Make a positive contribution towards tackling the causes of, and adapting to the impacts of Climate Change; and
15) Appropriately contributing towards local, physical, social and community infrastructure which is affected by the development.

3.1.3 Policy SP2 of the LDP represents the starting point for the assessment of all planning applications within Bridgend County Borough. The policy demands a high quality of design in all development proposals. For the majority of applications, Design and Access Statements will be used within the Development Control process to ensure that information relating to each of the 15 criteria is considered to ensure the policy is implemented effectively. In specific relation to this SPG criteria 1, 2, 8 and 14 are particularly relevant and the information contained within this SPG will enable these issues to be addressed.

Policy PLA4: Climate Change and Peak Oil

All development proposals will be required to make a positive contribution towards tackling the causes of, and adapting to the impacts of Climate Change and Peak Oil issues. Means of achieving this may include:

1) Having lower carbon energy requirements by reducing energy demand, and promoting energy efficiency;
2) Utilising local materials and supplies wherever feasible;
3) Encouraging the development of renewable energy generation;
4) Having a location and layout which reflects sustainable transport and access principles, thereby reducing the overall need to travel;
5) Having a design, layout and landscaping which:
(i) helps wildlife and habitats to adapt to the changing climate;
(ii) assists cooling of the urban environment, including the use of passive building techniques where appropriate;
6) Using resources more efficiently and minimising waste water use and pollution;
7) Avoiding or minimising the risk from flooding and/or adapting to the increased risk of flooding, coastal erosion and warmer annual mean temperatures; and
8) Promoting sustainable building methods and drainage systems where appropriate.

3.1.4 Policy PLA4 carries this theme on in more detail by highlighting specific ways in which all development proposals can make a positive contribution towards combating Climate Change. Many of these aspects are explored within this document, although some aspects may be covered by other SPGs, including the Council's Green Infrastructure SPG. Additionally, further advice will be available from agencies such as Natural Resources Wales, who will be able to offer further guidance on flooding issues.

3.1.5 The requirements of policies SP2 and PLA4 emphasise the need for climate change issues to be considered at the earliest possible stage in the formulation of development proposals.

NOTE 2: DESIGN AND ACCESS STATEMENTS

All planning applications should be accompanied by Design and Access Statements which shall include information on how the development proposal helps to combat the causes of Climate Change through energy or resources efficiency measures.

3.1.6 Other policies in the LDP deal specifically with the promotion of renewable and low/zero carbon technology within developments.

Strategic Policy SP8: Renewable Energy

Development proposals which contribute to meeting national renewable energy and energy efficiency targets will be permitted where it can be demonstrated that there will be no significant adverse impacts on the environment and local communities.

3.1.7 Policy SP8 represents the Council's strategic policy relating to renewable energy. It is positively worded to promote renewable and energy efficiency technologies, either as a stand-alone development (connected to the National Grid) or as a building / development integrated project. The caveat to this is that there should be no significant adverse impacts on the environment and local communities. The extent to which this is the case will be determined by other policies in the LDP, notably policies SP2 and those policies under the plan's Environment theme.

Policy ENV17: Renewable Energy and Low/Zero Carbon Technology

The Council will encourage major development proposals to incorporate schemes which generate energy from renewable and low/zero carbon technologies. These technologies include onshore wind, landfill gas, energy crops, energy from waste, anaerobic digestion, sewage gas, hydropower, biomass, combined heat and power and buildings with integrated renewable sources.

In achieving this, all development proposals of 10 or more residential dwellings or with a total floor space of 1,000 sq metres or more should, where viable, be able to connect to district supply networks of heat and energy. In addition, energy assessments should be submitted with applications to investigate incorporating on-site zero and low carbon equipment or connecting to existing sources of renewable energy. Such investigations should also examine the potential for heat and electricity generated by the development to power/fuel nearby receptive buildings.

The Council's Energy Opportunities Plan will inform consideration of these issues.

NOTE 3: ENERGY HIERARCHY

The Council will expect that, all major development proposals that are required to consider their energy requirements under Policy ENV17 of the LDP use the Energy Hierarchy in the consideration of options.

4. Reducing The Need To Use Energy

4.1 Introduction

4.1.1 When designing new buildings, consideration should be given to enabling future occupants to use less energy and protect themselves from the detrimental impacts of future climate change.

4.1.2. Features to enhance climate change resilience are generally more cost-effective when incorporated into the design and construction phase of new development. It is therefore sensible to consider and, where appropriate integrate such features into the design of new development at the earliest opportunity.

NOTE 4: DESIGN ISSUES

All Design and Access Statements required under this Supplementary Planning Guidance should outline how the design of a development has taken into account the advice in this document in terms of the following aspects:

- **Site Characteristics**
- **Building Design**
- **Sustainable Construction and Materials**
- **Using Energy Efficiently**

4.2 Site Characteristics

4.2.1 The layout, location and design of a development can have a major impact upon occupant comfort, a building's resilience to climate change, proximity of services and access to open space. The location of a building can affect the distances occupants need to travel and their mode of transport. Many relevant issues are considered when producing the Local Development Plan. However, there are some specific issues omitted that are significant in impacting upon a building's energy use and CO_2 emissions over its life cycle.

4.2.2 Planning a new development site needs careful consideration. The local microclimate and locational setting may impact significantly on the building and surroundings. For instance site topography, vegetation and wind speed will have a considerable impact upon the speed with which wind hits a building. Passive design seeks to work with or respond to site characteristics.

4.2.3 Landform and landscape should be utilised to minimise heat loss in winter and, without over-shadowing useful orientation, provide shade to avoid excessive solar gain in summer. In addition, landscaping should allow for the capture of heat from the winter sun whilst helping to prevent glare.

4.2.4 Ensuring access to sunlight can enhance the enjoyment of the open public space and sustain the health of landscaping and the surrounding natural habitat. However, controlling solar gain is essential to minimising energy use whilst maintaining occupant comfort in buildings.

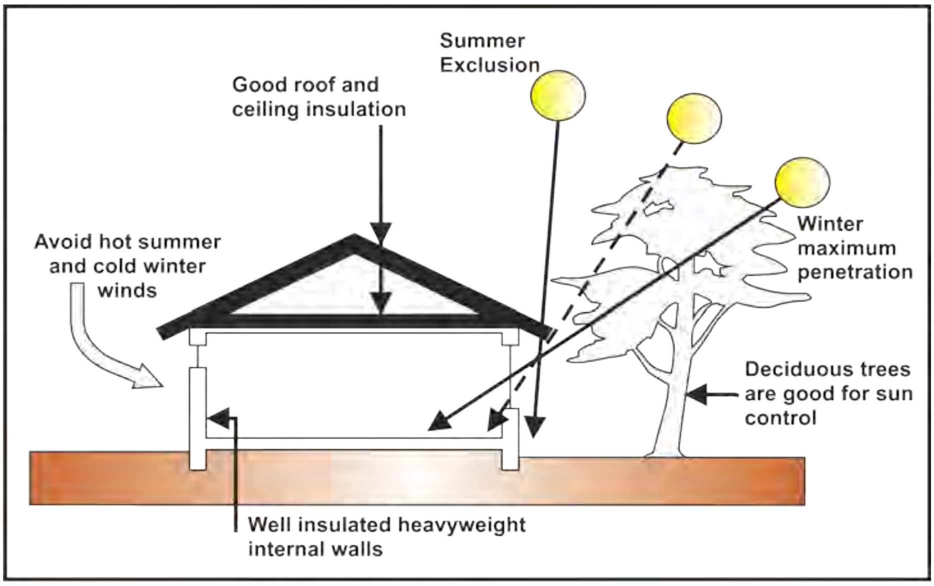


Diagram 2: How Passive Solar Heating Works

4.2.5 The layout of the site needs to be carefully considered if passive solar gain is to be optimised.

1. To optimise useful solar gain the building, and its main glazed area, should be located within 30° of the south.
2. Minimise over-shading by locating tall buildings within a development to the north of the site.
3. Land shadowed by woodland might be utilised for uses other than buildings, such as parking.
4. Find out the direction of the prevailing winds in summer and winter. Shelterbelts should be orientated to the south-west of a development and distanced, on average, 3 – 4 times their mature height from the south facing side of a new development.
5. Trees that will grow above the shadow line of the development should be deciduous, as these trees will allow sunlight to pass through in the winter months but provide screening for ground floor south facing rooms.

4.3 Building Design

4.3.1 The internal layout of buildings should be considered so that the most frequently used spaces are south facing whereas rooms with the potential for high heat gains (e.g. kitchens; use of IT; densely occupied and /or with high levels of activity such as sports) are located to the north.

4.3.2 Climate predictions for the 21st century are that temperatures will increase by 2°C - 3.5°C (UKCP09) In order to cope with future temperature increases buildings need to be designed so that their internal temperatures can be properly controlled otherwise they may be rendered unusable in the future.

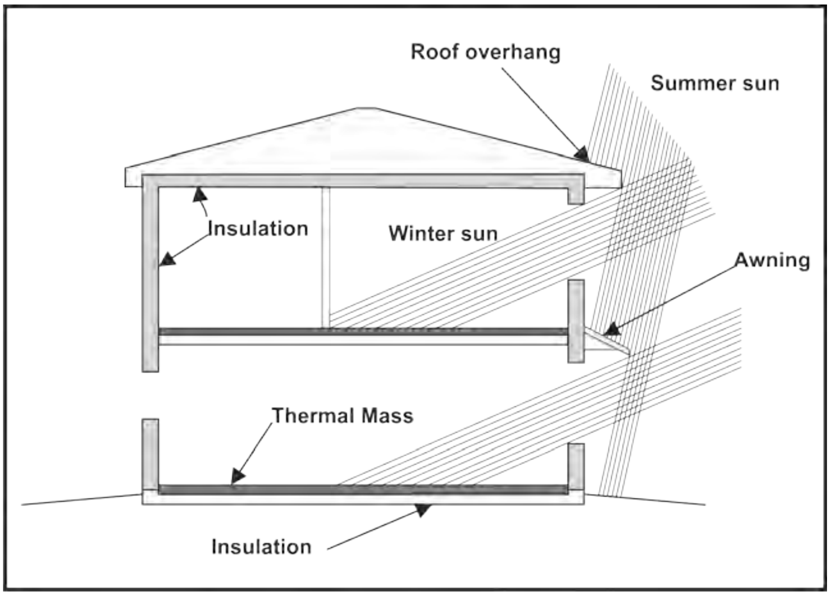


Diagram 3: Simple Passive Solar Design

4.3.3 The availability of solar energy is dependent upon the time of year. Daylight hours are less in winter and the sun sits lower in the sky. Controlling rising temperatures created by excessive solar gain can be achieved through the use of shutters or other shading devices.

Achieving Summer Shade

Window Awnings: Modern window awnings are made from synthetic fabrics such as polyvinyl and are water resistant. The awning should have openings around the tops and sides to vent hot air, the awning can cover the whole side of a building and can be retracted in the winter months to allow natural sunshine to warm the building.

Window Shutters: Window shutters (both interior and exterior) can help reduce both heat gain and loss in a building. Exterior shutters offer added security, weather protection and no use of interior space. Exterior shutters must be integrated into the architecture of the building and therefore are best considered at the design stage of a building.

Roof Overhangs: Exterior roof overhangs provide a practical method for shading windows, doors and walls. Overhangs are most effective for south facing elements if the building is more than about 30° off true south then the effectiveness of the overhang are greatly reduced. Overhangs can be solid or louvered or a combination of both.

4.3.4 Developments designed within the principles of passive solar gain should comprise correctly located and proportional amounts of glazing to avoid negative effects such as overheating, heat loss or increased need for artificial lighting.

4.3.5 Reducing the effects of excessive solar gain through orientation and shading may not be enough to control increased internal temperatures within buildings. To do this, consideration should be given to the use of other strategies such as natural ventilation, as much as possible in place of mechanical air cooling systems, and the use of certain building materials and techniques.

4.3.6 To cool a building, natural ventilation can be used instead of, or in addition to mechanical ventilation. The specific approach and design of natural ventilation systems will vary based on building type and local climate. However, the amount of ventilation depends critically on the careful design of internal spaces, and the size and placement of openings in the building.

4.3.7 Natural ventilation requires consideration of the size and placement of external openings (enter at the windward side and exit at the leeward) and those within a building (windows, louvers, grills, or open plans).

4.3.8 Differences in pressure created by the wind or the buoyancy effect (created by differences in temperature and/or humidity) enable the movement of fresh air. The temperature differences between warm air inside and cool air outside can cause:

1. the air in the room to rise and exit at the ceiling or ridge
2. enter via lower openings in the wall.

4.3.9 Where and when required, architectural features can be used to catch the wind. Within the building, although inlet and outlet should not be directly opposite, obstruction placed between supply and exhaust should be avoided.

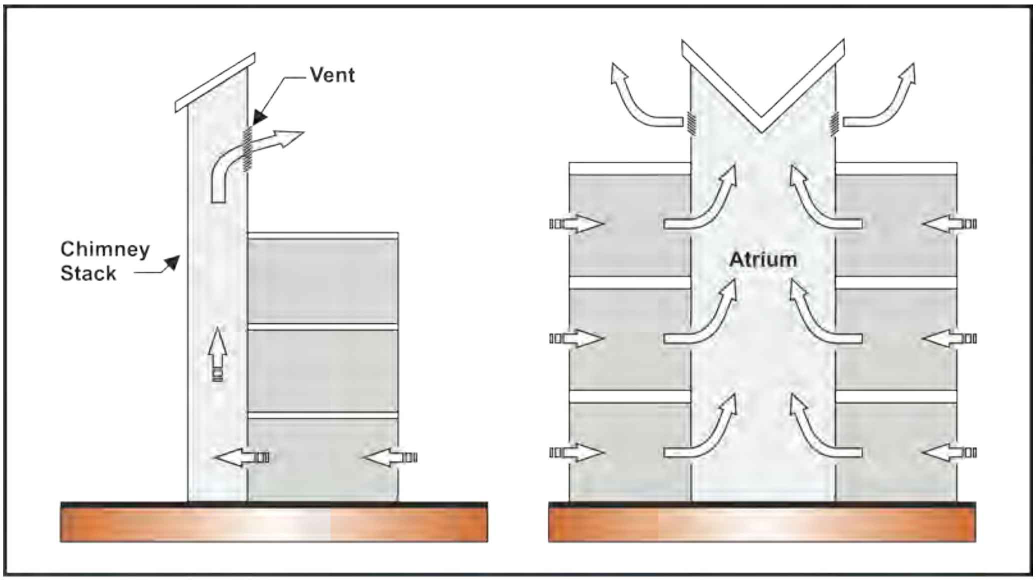


Diagram 4: Cross Section Showing Stack Effect Using a Chimney and Combined Cross and Stack Ventilation Using an Atrium

4.3.10 Stack effect ventilation is an especially effective strategy in winter, when indoor/outdoor temperature difference is at a maximum. Conversely, this type of ventilation is ineffective in summer because it requires that the indoors be warmer than outdoors, an undesirable situation in summer. A chimney heated by solar energy can be used to drive the stack effect without increasing room temperature.

4.3.11 Some of the features used for natural ventilation include solar chimneys, wind towers and openable windows. On hot, calm days, air-exchange rate through the windows is likely to be low. In such cases the use of fan-forced ventilation or thermal mass for radiant cooling may be important in controlling these maximum temperatures.

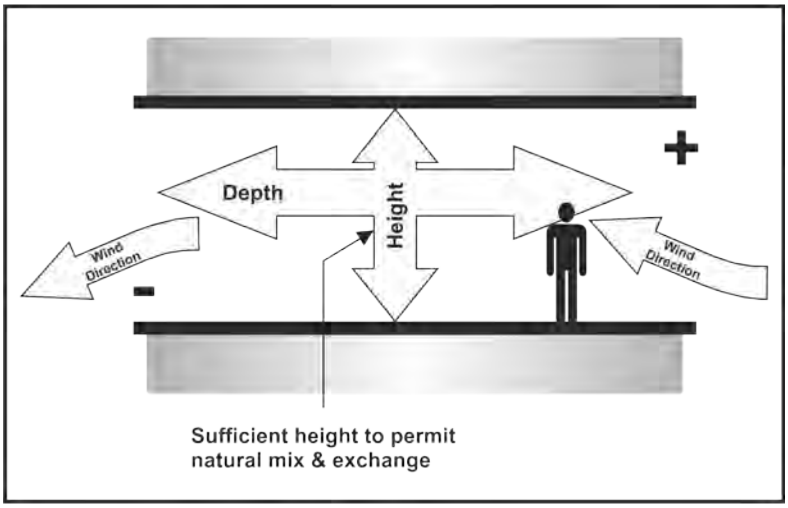


Diagram 5: Natural Cross Ventilation

4.4 Sustainable Construction and Materials

4.4.1 The principle of sustainable construction incorporates and integrates a variety of strategies during the design, procurement and construction of a development. Sustainable construction offers a number of benefits, for example:

1. Improved resource efficiency.
2. Reduced maintenance costs.
3. Conservation of energy.
4. Greater well-being of building occupants.

4.4.2 The correct use of thermal mass and storage provides a buffer against heat fluctuations and allows cooler conditions in summer. Thermal mass is the ability of a material to absorb heat energy. A lot of heat energy is required to change the temperature of high-density materials like concrete, bricks and tiles. Lightweight materials such as timber have a low thermal mass.

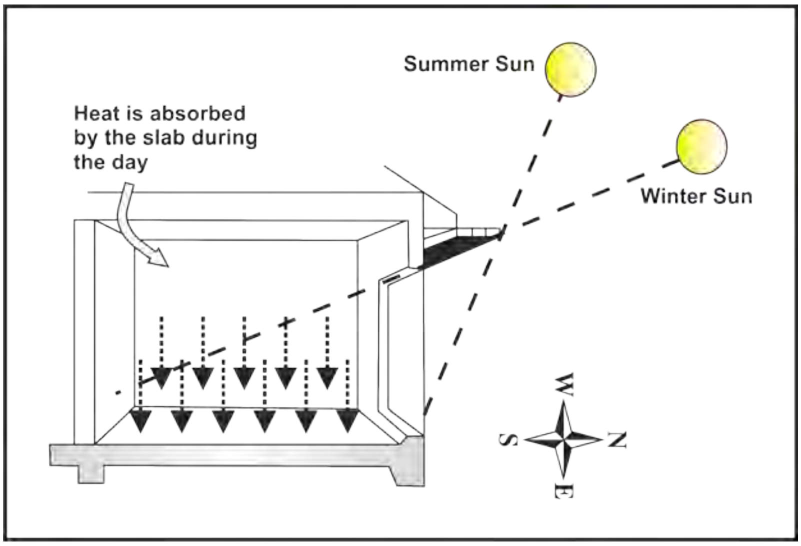


Diagram 6: Thermal Mass 1

4.4.3 Thermal mass acts as a thermal battery. During the summer it absorbs heat keeping the building comfortable. In the winter heat from the sun or internal heaters are stored, and released at night helping to keep the building warm. Thermal mass is most useful within buildings where there is a big difference between day and night temperatures.

4.4.4 Thermal mass is most appropriate within regions that have a large diurnal temperature range. A range of greater than 10°C is generally considered to be suitable for thermal mass application.

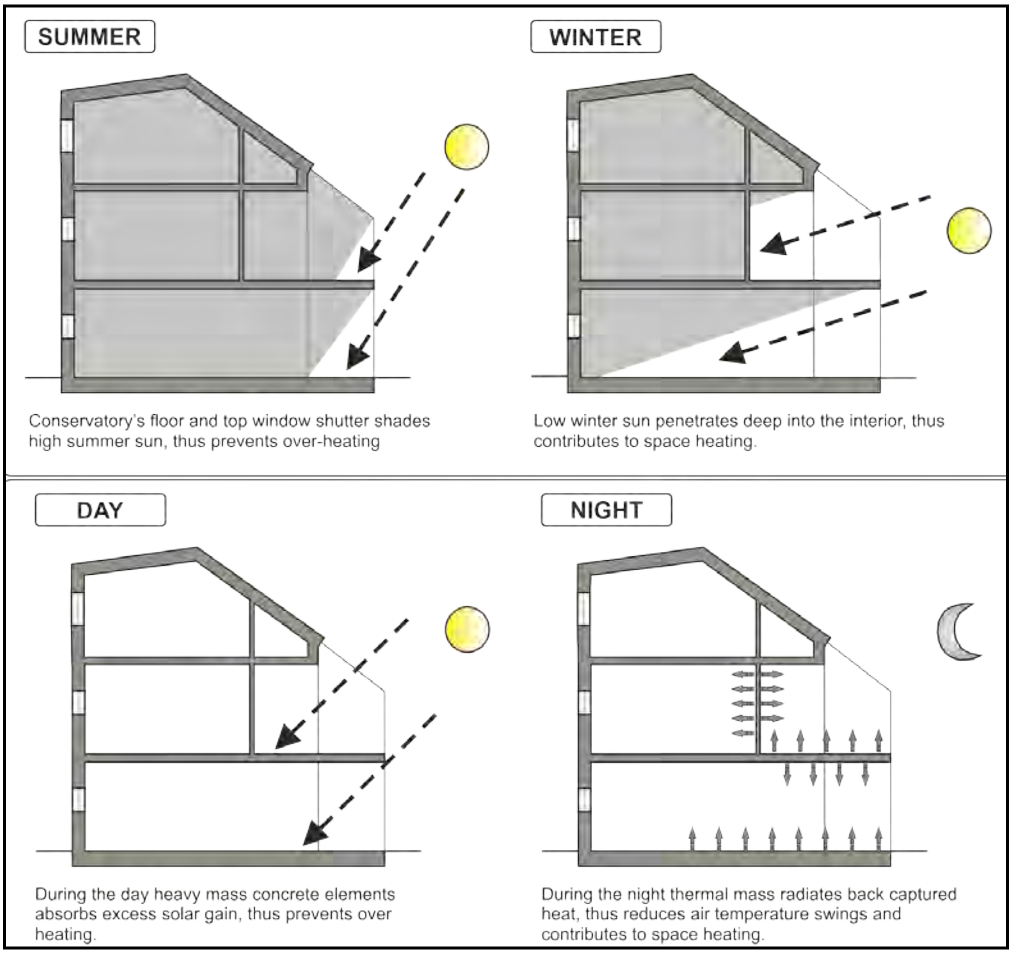


Diagram 7: Thermal Mass 2

Thermal Mass Location Advice

Heating Application: Locate thermal mass in areas that receive direct sunlight or radiant heat from heaters.

Heating and Cooling: Locate the thermal mass inside the building on the ground floor for ideal winter and summer efficiency. The floor is usually the most economical place to locate heavy materials and earth coupling can provide additional thermal stabilisation;

Location: Thermal mass should be located in south facing rooms which have good solar access, exposure to night breezes in the summer and additional sources of heating (heaters);

Cooling Application: Protect thermal mass from summer sun with shading or insulation if required;

Additional Thermal Mass: This should be located near the centre of the building brick walls, slabs and water features can provide this.

4.4.5 The location of the thermal mass within a building will have an enormous impact upon its performance. Generally thermal mass should be located inside the insulated building envelope and must be left exposed internally to allow it to interact with the building interior.

4.4.6 Building and construction activities world-wide account for around 3 billion tons of raw materials annually. Using green building materials and products promotes the conservation of non-renewable resources and reduces the contribution made to climate change of the extraction, transportation, processing and installation of raw materials.

4.4.7 Embodied energy is the energy consumed by all of the processes associated with the production of a building, from the acquisition of natural resources to product delivery. This includes the extraction and manufacturing of materials as well as their transport, maintenance and disposal. Buildings are a complex combination of a variety of materials, with each one contributing to the buildings total embodied energy. The most important factor in reducing the impact of embodied energy is to design long life, durable and adaptable buildings.

4.4.8 Embodied energy can vary widely between products and materials and the choice of material within a building will greatly affect the embodied energy within its structure.

4.4.9 Higher embodied energy level can be justified if it contributes to a lower operating energy use. In addition to contributing to reducing operational energy use within a building, selection of materials can contribute to reducing energy in the following ways:

- Materials with higher recycled content often require less energy to produce and also conserve precious natural resources.
- Consider products that are manufactured by companies that seek aim to reduce energy consumption, minimise waste and reduce the emission of greenhouse gases.
- Locally produced building materials will use less transport fuel.
- Select materials that can be re-used or after use.

5 Using Energy Efficiently

5.1 Introduction

5.1.1 In designing new buildings, it is the very early decisions that determine whether or not the building will be energy efficient. This section describes the major factors in achieving energy efficient buildings once the early decisions have been taken about built form and passive solutions.

5.1.2 During the design processes, heating, ventilation, cooling and lighting systems may be selected that will enable the building to meet the energy efficiency requirement of Part L of the Building Regulations.

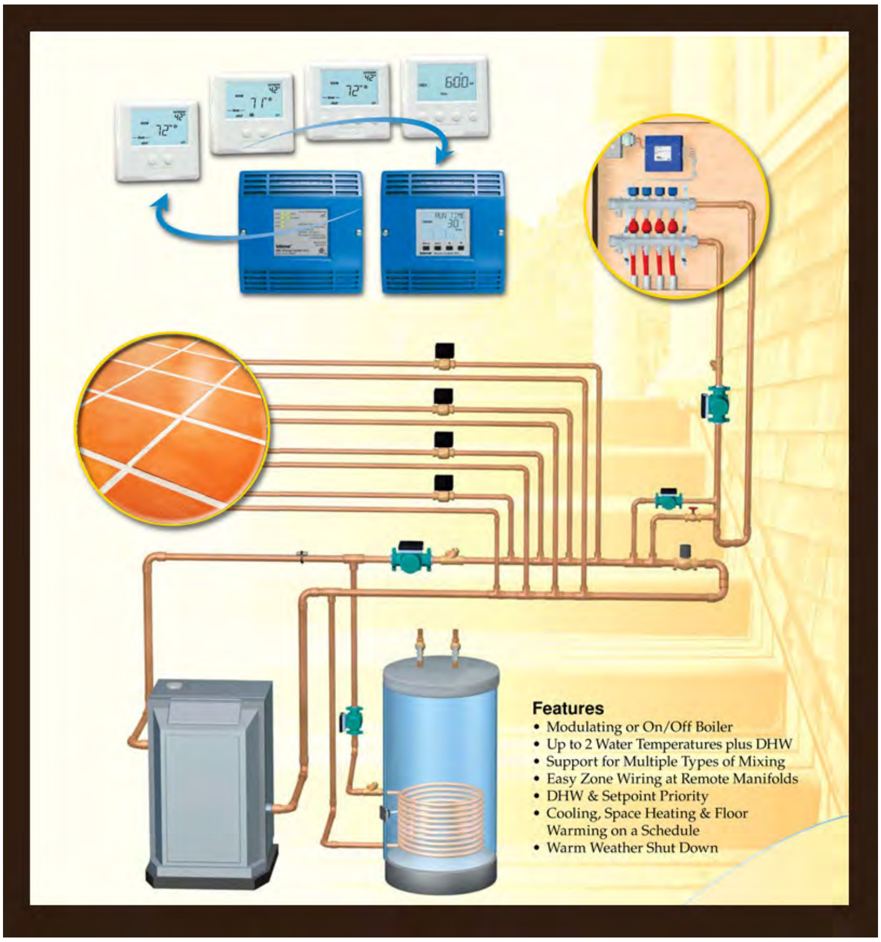


Diagram 8: Using Energy Efficiently

5.1.3 In considering the above services, steps can be taken to ensure energy is will be used efficiently by building occupants as follows:

1. Select efficient plant.
2. Avoid over provision and over-sizing - buildings services spend most of their life at part-load so efficiencies should be considered under such conditions.
3. Develop safe and effective control strategies which are both robust and flexible. A balance is required between central and local occupant control.

4. Avoid large systems operating needlessly due to small, local demands such as server rooms.
5. Select zones to meet the requirements of different areas underpinning comfort, flexibility and energy efficiency.
6. Install variable speed drives, particularly on fans and pumps.
7. Avoid simultaneous heating and cooling.
8. Ensure building systems are easy to operate and to understand.
9. Ensure complete handover to managers, operators and occupants, with thorough commissioning, involving post occupancy evaluations, to guarantee systems operate correctly.
10. Support this with good documentation (Part L2 now requires a building energy log-book) to clearly show the design intent.

Types of Heating Control

Time Control: A time switch that turns heating on and off at a fixed time each day. This works well within office buildings.

Optimum Start Control: This automatically switches the heating system on so that the building reaches the desired temperature in time for occupation.

Weather Compensation: This automatically varies the buildings temperature in response to weather conditions.

Room Thermostats: These keep the temperature within the room at the required level. Modern electric thermostats can control temperatures to within 0.5°C and cost less than £100.

Zone Controls: These are useful when certain parts of a building require more heat than others, or when only certain areas need to be heated.

Management Systems: These are computer based systems that automatically monitor and control a range of building services such as heating, lighting and air conditioning.

5.1.4 There is a strong interaction between the building envelope, building services and the way people use buildings. Building designers should consider how to take account of these human factors as they are the biggest influence on future energy consumption.

5.1.5 Simplicity in the design, operation and maintenance of the plant and controls is important above all as over-sophisticated plant with complex controls leads to poor management and high energy use.

6. Building Integrated Renewable and Low & Zero Carbon Technologies

6.1 Introduction

6.1.1 From modelling of the existing and potential uptake of Building Integrated Renewables it is estimated that there will 10.7MW of renewable electricity generating capacity and 9.4MW of renewable heat generation in Bridgend by 2020.

6.1.2 The Government has set out its Renewable Energy Route Map which envisages a significant role for micro-generation in the energy mix of Wales. There is likely to be an increasing emphasis on the uptake of Micro-generation technologies, particularly in the consideration of energy assessments required as part of the LDP.

6.1.3 Micro-generation in Bridgend County Borough will play an important part in any area wide renewable energy assessment. It is considered that micro-generation technologies, for the most part, can be installed on a variety of buildings.

6.1.4 The Council encourages developers, when considering renewable and low / zero carbon technologies within their developments to assess the appropriateness of the full range of options which are on offer. The Council, through its energy assessments, require a 'core' set of technologies to be examined.

NOTE 5: TECHNOLOGY OPTIONS

The Council will expect that, all major development proposals that are required to consider their energy requirements will examine, as a minimum, the appropriateness of the following technologies / systems:

- **Solar Photovoltaics & Hot Water (Thermal)**
- **Ground and Air Source Heat Pumps**
- **Wind Turbines**
- **Biomass Boilers**
- **Combined Heat and Power (CHP)**
- **Hydroelectricity**
- **District Heating**

6.1.5 The examination of each of these technology options should be undertaken in the required Energy Assessment as part of the requirements of Policy ENV17 of the LDP. The characteristics of each of these technologies are described in more detail below.

6.1.6 Natural gas boilers are the most common solution for the provision of Space Heating (SH) and Domestic Hot Water (SHW) in residential and non-domestic buildings. Modern boilers achieve efficiencies in excess of 90% and natural gas is usually readily available and can provide, at least in the medium term, a robust and continuous supply. However, natural gas is a fossil fuel with associated carbon dioxide emissions and stocks are not readily replenished once exhausted.

6.2 Solar Photovoltaic

6.2.1 As with solar hot water, solar energy involves the use of the sun's free energy but, in the case of photovoltaic panels (PV) to provide electricity. Solar PV requires only daylight and not direct sunlight to generate electricity. As such, power can be generated even on a cloudy day.

6.2.2 Solar PV comprise two main components:

1. Solar collectors to collect the sun's rays so that when light shines on the cell it creates an electric field causing electricity to flow.
2. Wiring, including an inverter to convert the direct current electricity from the panel to alternating current so it can be connected to the building's main electricity distribution board.

6.2.3 There are many types of solar PV panels with different characteristics (crystalline cells, thin-film, hybrid). They consist of one or two layers of semi-conducting material, normally packaged together into panels or other modular forms.

Photograph 1: Typical Roof Mounted PV Installation
Source: AECOM Technology Corporation

6.2.4 Small – scale installations can vary from $0.5m^2$ to $1m^2$. They can be connected together to form an array that can cover a few m^2 to hundreds of square meters. A typical small-scale array would have an area of 9 to $18m^2$.

6.2.5 Solar collectors are usually placed on the roof of a building, but can also be wall mounted or stand alone (free standing) structures. PV systems can also be found in a roof tile form and can be mounted vertically and horizontally to form part of the building structure.

6.2.6 For best performance solar collectors will need to face between southeast and southwest and be of the shade of trees and buildings. East or west installations can also provide good performance and can be used for a building with a roof or wall that faces within 90 degrees of south.

6.2.7 The roof where the solar collector is to be installed should be strong enough to support the weight and prevent any safety issues arising.

6.2.8 The electrical grid connection requires approval from the distribution network operator (DNO) but, once installed, PV panels are considered to have low maintenance if they are installed correctly (requiring only cleaning and infrequent replacement of the inverter).

6.3 Solar Hot Water

6.3.1 Solar hot water or 'solar thermal' (ST) systems convert energy from the sun to hot water. Unlike fuel used in boilers, radiation from the sun is not always sufficient and therefore ST usually supplements other technologies (often boilers) by pre-heating DHW.

6.3.2 ST can be utilised by non-domestic and residential buildings. Similarly to biomass boilers, ST requires an insulated water tank to store hot water for when it is required. Although ST can be stand-alone, it is best located as near to point-of-use as possible (e.g. an occupied building).

6.3.3 If building occupants are able to defer use of DHW until the ST has been allowed to heat the cylinder then a greater proportion of DHW can be supplied from ST as opposed to supply from a gas or other boiler.

6.3.4 Un-shaded roof spaces orientated within 30^o of south is optimum for performance although other orientations will also work to a lesser extent. Other considerations include the ability of the roof structure to hold the additional weight of the solar collectors should be considered before installation.

6.4 Heat Pumps

6.4.1 Heat pumps can utilise stored solar energy from the ground, water or air to provide heating, hot water and cooling. Although the source of the energy is renewable and zero carbon, such systems require electricity for pumping, which, depending upon the source of electricity, can reduce the environmental benefit.

Diagram 9: Ground Source Heat Pump
Source: AECOM Technology Corporation

6.4.2 A ground source heat pump circulates a working fluid around either a vertical or horizontal pipe in the ground to extract heat by way of evaporation. A compressor then raises the fluid to the required delivery temperature (typically 30 to 50 ^{o}C) and is then delivered into the distribution system via another heat exchanger (the condenser).

6.4.3 Heat pumps are especially well matched to under floor heating systems which do not require high temperatures. Using large surfaces such as floors, as opposed to radiators, allows for a lower temperature heat transfer fluid.

Photograph 2: Air Source Heat Pump
Source: AECOM Technology Corporation

6.4.4 Air source heat pumps draw heat from the ambient outside air during the heating season and reject heat outside during the summer cooling season.

6.4.5 The temperature of outdoor air is much less stable than that of earth below the ground surface. The Coefficient of Performance of a heat pump depends predominantly on the temperature difference between the internal environment and external thermal reservoir, and therefore can significantly vary throughout the year. The seasonal efficiencies of ASHPs are very susceptible to changes in outside air temperature, and are therefore typically less than those of GSHPs.

6.4.6 Furthermore, because the air temperature may drop below 0ºC, moisture in the air may condense and form ice on the external heat exchanger. This can reduce the heat transfer coefficient, and must be melted periodically using a “defrost cycle” which warms up the external heat exchanger using energy to no useful gain inside the building.

6.4.7 Water source heat pumps (WSHP) extract heat from bodies of water or rivers (with a reasonably high flow volume in order to minimise any resulting changes in water temperature). As with GSHPs, despite the relatively low temperatures of the water source, heat can be extracted from it in a heat exchanger to feed a low-temperature central heating system.

6.4.8 The key design and planning issues associated with heat pumps are as follows:

1. there is a need to ensure the location of the heat pumps does not impact visually or acoustically on the surrounding area
2. particularly for water and ground source heat pumps, care should be taken to protect species and habitats when locating pipes and pumps. The EA and others should be consulted, specifically with leakage and impacts on geology and archaeology in mind
3. for water source pumps an abstraction license from Natural Resources Wales is normally required.

6.5 Wind

6.5.1 Wind turbines can produce electricity without carbon dioxide emissions, ranging from watts to megawatt outputs. 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.

6.5.2 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.

6.5.3 Turbines can be installed with a free-standing mast or building-mounted, and are commonly deployed as single machines supplying energy to specific buildings or developments such as single homes, farm buildings, schools and businesses.

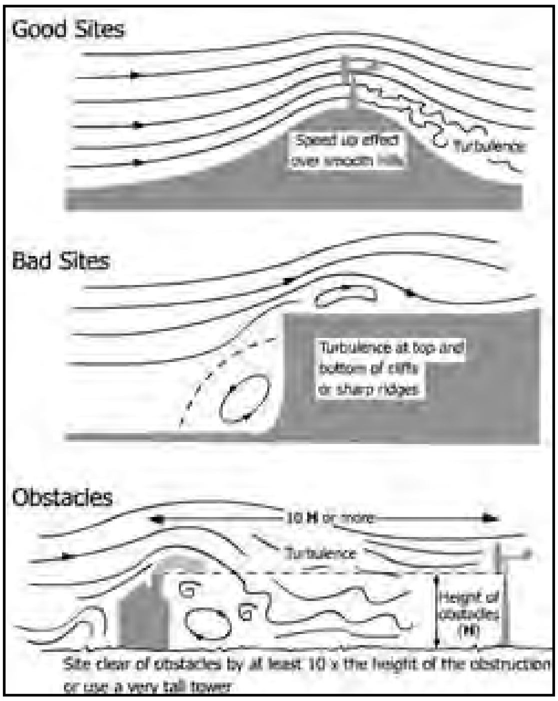


Diagram 9 : Good and Bad Site Selection for Wind Energy
Source: AECOM Technology Corporation

6.5.4 Turbines operate between a range of wind speeds defined by the cut-in and cut-out wind speed, which is specific to the turbine model. The power is conditioned and transformed to an appropriate voltage, and is then supplied directly to a building at micro/small scale.

6.5.5 Turbines should be sited in a reasonably exposed location and work best at a height where there are no obstructions from buildings, trees or other features that would cause turbulence (as this will affect the amount of energy the wind turbine can generate).

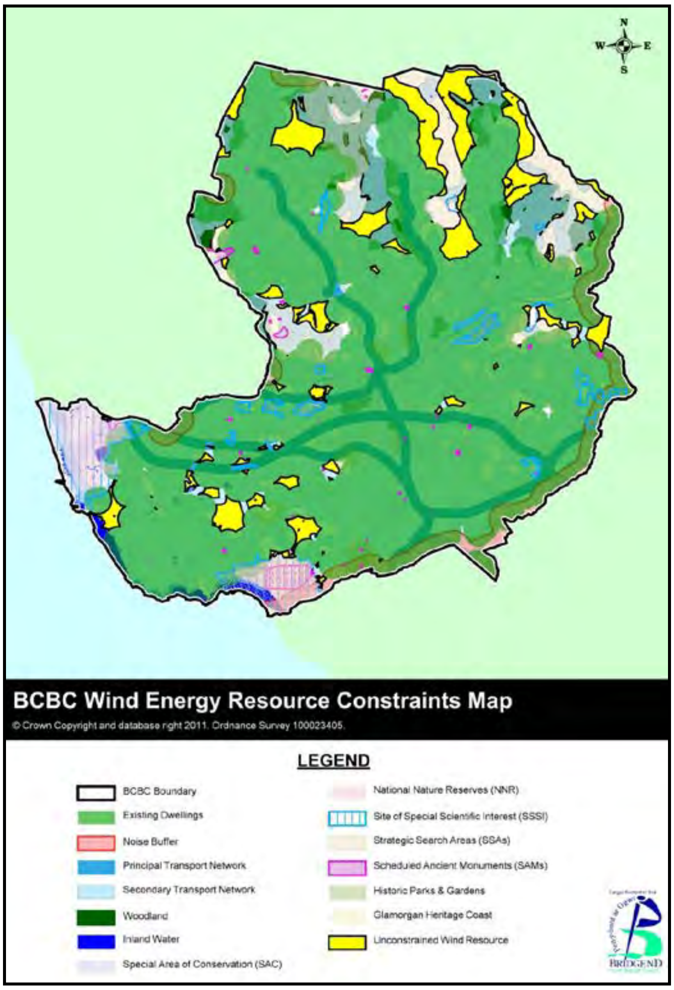


Diagram 10: Wind Energy Resource Map
Source: Renewable Energy Assessment 2011

6.5.6 Issues associated with wind turbines include visual impact related to landscape or shadow flicker. Consideration of local wildlife, particularly bird migration and bats for urban installations should be undertaken in addition to analysis of topple distances, access and transport routes (in the construction phase) and acoustic impact.

6.6 Biomass

6.6.1 As an alternative to gas, small / community scale biomass energy plants are virtually all designed as heat plants for domestic and small commercial use. These may comprise of standalone stoves used as room heaters or boilers.

6.6.2 Biomass is energy from animal and/or plant matter as follows:

1. wood from forestry sources or wood waste
2. energy crops such as miscanthus or short rotation willow coppice)
3. agricultural residues and the biodegradable fraction of municipal solid waste.

Photograph 3: Biomass Boiler
Source: AECOM Technology Corporation

6.6.3 Fuel may come in the form of logs, pellets or chips or, in the case of wetter wastes, sludge that may be better processed using anaerobic digestion to generate biogas or produce bio-fuel for use in transport. This section refers mainly to boilers which combust the woody residues.

6.6.4 When provision is made for replacing that which is burnt, is considered carbon neutral. It is considered neutral as the carbon dioxide released when the fuel is burnt is equivalent to that which is absorbed during the fuel's production.

6.6.5 Biomass systems can deliver both SH and DHW through similar distribution systems but differ to gas fuelled boilers in some significant ways. Biomass is a solid fuel and therefore the fuel will require vehicular delivery, a storage facility and a mechanical fuel feed. The use of solid fuel means that there is likely to be a higher maintenance requirement with a biomass boiler.

6.6.6 As a less common technology, designers should ensure that there is a robust supply chain to ensure quality and continuous supply of fuel, that the system is fully controlled and all elements of the system are compatible, and that skills are readily available for commissioning and maintenance. For these reasons, biomass boilers are often used in non-domestic buildings rather than residential dwellings.

6.6.7 If a local wood fuel supply chain can be established, it can offer up environmental management, agricultural diversification and rural economic regeneration opportunities.

6.6.8 Characteristic of a biomass boiler is that they are unable to 'modulate down' to the extent of a gas boiler which often means they are substituted by a gas boiler to provide the DHW during summer. Biomass boilers are not as responsive as their gas counterparts and hence, are often accompanied by water tanks to be used as a thermal store to enable their continuous running. It is essential that boiler and thermal store are sized accurately.

6.6.9 Planning issues may comprise the following:

1. visual impact of a flue
2. potential to disturb bats in attics during installation
3. air quality controls from an increase in nitrogen oxide emissions
4. increase in noise and dust from fuel deliveries, plant operation
5. increase in transport movements
6. visual impact on heritage features and/or damage to structure of listed buildings

Most of these issues can be overcome through sensitive design, careful planning, site monitoring and management.

6.7 Combined Heat & Power

6.7.1 CHP units are engines that produce heat and electricity simultaneously and can run on gas, biomass or other fuels. CHP units are described in terms of their electrical or thermal output (kiloWatt electrical / kilowatt thermal).

6.7.2 CHP enables a process whereby heat, normally wasted during centralised power generation, is used – typically to heat a building. The heat from CHP units can also be used to meet cooling demands via the use of absorption chillers. This can involve either a centralised chiller, distributing "coolth" via a chilled water network, or decentralised absorption chillers in individual buildings. This approach is sometimes referred to as "trigeneration" or CCHP [Combined Cooling Heat and Power].

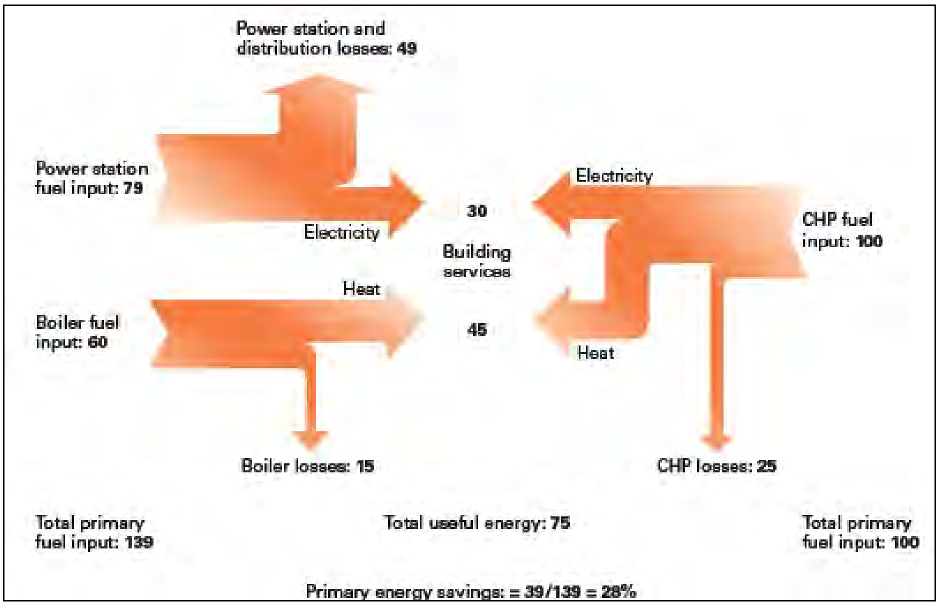


Diagram 11: Energy Savings from Combined Heat and Power (CHP) Compared to Conventional Sources

6.7.3 At the point of use, CHP can exceed 80% efficiency. Whilst this is lower than a traditional gas boiler, once compared with centralised electricity generation in the UK which ranges between 38-52%, equates to significant CO_2 savings. Local production means that electricity and distribution and transmission losses are also reduced.

6.7.4 CHP is normally used in commercial applications although units are now available for the residential market (micro CHP). Due to constant demands for heat, CHP systems are typically found serving individual leisure centres (particularly those with swimming pools, industrial sites, hotels, hospitals and universities (with residential accommodation).

6.7.5 Characteristic of CHP is the production a higher proportion of valuable heat to electricity although this is flexible with more less electricity or heat. This flexibility is important to sizing a CHP system so as to avoid wasting the heat.

6.7.6 The potential planning issues are similar to those of boilers, depending upon the type of fuel employed. However, commercial CHP tends to be larger, require more plant room space, have higher flues and, if biomass is used, require more fuel deliveries, etc.

6.8 Hydropower

6.8.1 Hydropower is the use of water flowing from a higher to a lower level to drive a turbine connected to an electrical generator, with the energy generated proportional to the volume of water and vertical drop or head.

6.8.2 Schemes at the smaller end of the scale (typically below 100kW) are often referred to as micro hydro. The likely range is from a few hundred watts (possibly for use with batteries) for domestic schemes, to a minimum 25kW for commercial schemes.

6.8.3 As water is taken from a stream for hydro purposes an abstraction licence would be needed from the Natural Resources Wales.

6.8.4 There are a number of impacts that should be considered when installing hydropower. Hydro can impact upon the visual character of the landscape, disturb and injure habitat and species and impact acoustically due to the noise of construction and generation. Other constraints upon the use of sites for hydropower schemes include the seasonality of water flows.

6.8.5 Hydropower resource opportunities have been identified by the (former) Environment Agency in "*Opportunity and environmental sensitivity mapping for hydropower in England and Wales*". The results for Bridgend County Borough are shown below. 62 'barriers' were identified in the area, these are structures within rivers that could provide a hydropower opportunity but are also barriers to fish movement.

6.8.6 Removing a barrier is usually the best thing to do to improve the ability of fish to move around a river and fulfill their lifecycle, but this is not always possible. The next best option is to introduce a fish pass. 'Win-win' opportunities are schemes that provide both a good hydropower opportunity, and could, through incorporation of a fish pass, improve the ecological status of the associated fish population.

6.8.7 Those areas defined by the Environment Agency as 'Win-Win' locations are sites with the potential to generate over 10Kw that is designated as heavily modified under the Water Framework Directive. 22 such sites were identified in Bridgend County Borough with the potential to generate 0.9MW.

Authority	Number of barriers	Total power potential / MW	% of power potential classified as potential win-win	Total power potential classified as potential win-win / MW
Bridgend	62	1.86MW	48%	0.9

Table 1: Potential Energy Generation from Hydropower Sites
Source: Renewable Energy Assessment 2011

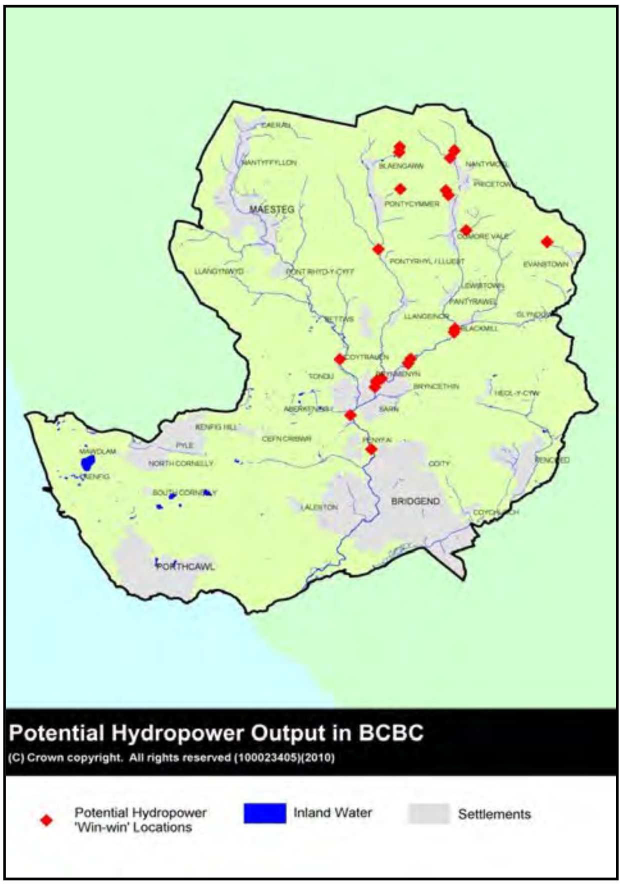


Diagram 12: Potential Hydropower Sites
Source: Renewable Energy Assessment 2011

7. Decentralised Energy

7.1 Introduction

NOTE 6: ENERGY OPPORTUNITIES

The Council will expect that, all major development proposals that are required to consider their energy requirements will use the Bridgend Energy Opportunities Plan (or similar) in the consideration of sources of renewable electricity and the potential for district heat networks.

7.1.1 In preparing the LDP, the Council prepared a Renewable Energy Assessment (which is updated as part of this document) to indicate the potential level of energy generation from renewable sources. The assessment acknowledges that, in the generation of renewable heat sources in particular, the potential for heat energy generation in the County Borough falls below the national targets set out in the UK Renewable Energy Strategy.

7.1.2 In order for development proposals to set out how they will make a contribution towards providing increased levels of energy generation from renewable and low/zero carbon resources, energy statements should be prepared for all major development proposals (defined in Policy ENV17). The Council will therefore expect all major development proposals to examine the potential for renewable and low/zero carbon technologies on-site and, where appropriate, the sharing of that energy with the wider community.

7.1.3 When considering new development, the following priorities should be assigned:

1. Where there is an existing district heat network (DHN), in close proximity , or firm proposals for such a network, all avenues should be explored to enable connection to either receive or supply energy to the network.
2. Where DHN connection is not possible for economic, functional or technical reasons, then alternative site-wide systems should be considered.
3. Building integrated renewable or low carbon energy systems should be considered lastly where site wide energy solutions are not viable or in addition to where these can supplement district, community or site solutions.

7.1.4 To future-proof against changes in energy generation and/or use, or the future availability of networks, development should be enabled to connect if they could be considered viable to do so (for example in terms of their density or heat load) in the future. Examples of the elements to be addressed include:

1. Consideration of plant room space and layout, safeguarding for the installation of district heating heat exchangers in the energy centre/plant room and other ancillary items to connect to a future DE network.
2. Appropriate design of on-site heating systems, such as, compatible return temperatures, tees and isolation valves to facilitate the connection to a district heating heat exchanger in future.
3. Safeguarding an identified route from the energy centre/plant room to the property boundary, roadway or similar for flow and return pipes to enable connection to a future area wide DE network.
4. Appropriate design of building fabric such as soft foundations, or built in penetrations in the energy centre/plant room wall with "knock-out" panels which would allow a pipe from the DE network to be pushed through the wall without significant structural alterations or other works.

7.2 Context

7.2.1 Decentralised energy generation uses a series of local systems generating heat and/or power or near the point of use, connected to local distribution networks.

7.2.2 In particular, Bridgend County Borough Council is seeking to meet 2.1% of its demand for space heating and domestic hot water from renewable and low and zero carbon sources. The aim of decentralised systems is to generate more energy from renewable and low and zero carbon sources.

7.2.3 In fulfilling these aims, it is crucial that new development is available to utilise the heat from such systems if available. Therefore, development proposals should investigate using decentralised energy generation.

7.3 District Heating

7.3.1 A District Heating Network [DHN] is the term given to a system providing multiple individual buildings with heat generated from a single source. The source is generally an energy centre in which heat can either be generated from a boiler or a CHP/CCHP (Combined Cooling Heat and Power) unit using traditional fossil fuels or from a low carbon source such as biomass.

7.3.2 A practical realisation of this is a centrally located energy centre building transmitting heat (as hot water) along buried pipes to a number of buildings in the local area. The pipes are known as heat mains. The scale can be anywhere from a few blocks of flats to a significant proportion of a city. A common solution is to provide a heat exchanger in each building which is controlled and operated in the same way as the gas boiler it replaces, and buildings can retain a conventional heat distribution system, such as radiators.

7.3.3 Heat is sold to consumers in the same way that gas or electricity is sold traditionally, i.e. by metering of end use and regular billing. This is combined with a service charge to cover maintenance of the shared distribution system.

Diagram 13: District Heating Network

7.4 Bridgend Energy Opportunities Plan

7.4.1 In undertaking a Renewable Energy Assessment (REA) as part of its evidence base in support of the Local Development Plan, Bridgend County Borough Council has produced an Energy Opportunities Plan (EOP) to consider how the Council can assist in the development of networks and also to assist developers and designers to more readily identify opportunities for decentralised energy.

7.4.2 The Bridgend Energy Opportunities Plan takes a Geographical Information Systems (GIS) approach. The heat map clearly shows the strategic new development sites, and other opportunities, such as potential anchor heat loads, either within or in close proximity to each other, the relative heat density of different areas, locations of high heat users, large heating plant as well as existing and planned energy networks.

7.4.3 The Bridgend EOP contains data from the public sector estate including schools, Council buildings and leisure centres. The EOP shows that there is potential for networks around key growth and opportunity areas.

7.4.4 Fuel poverty is a key concern of national governments and Local Authorities alike. Those areas of the County Borough where over 20% of households are in fuel poverty are clearly shown in the Energy Opportunities Plan. Also highlighted are those areas of the County Borough designated as a Community Energy Saving Programme (CESP) area. CESP targets households across Great Britain, in areas of low income, to improve energy efficiency standards, and reduce fuel bills.

7.4.5 The Energy Opportunities Plan is reproduced overleaf. It is also available online at the Council's website.

7.4.6 The GIS layers which contain the energy data are also available from the Council, subject to the signing of the necessary licence agreement. Those persons interested in obtaining this data should contact the Development Planning team directly. The Council intends the map to become a live document and online tool to be continuously updated as new information becomes available.

7.5 How to use the Plan

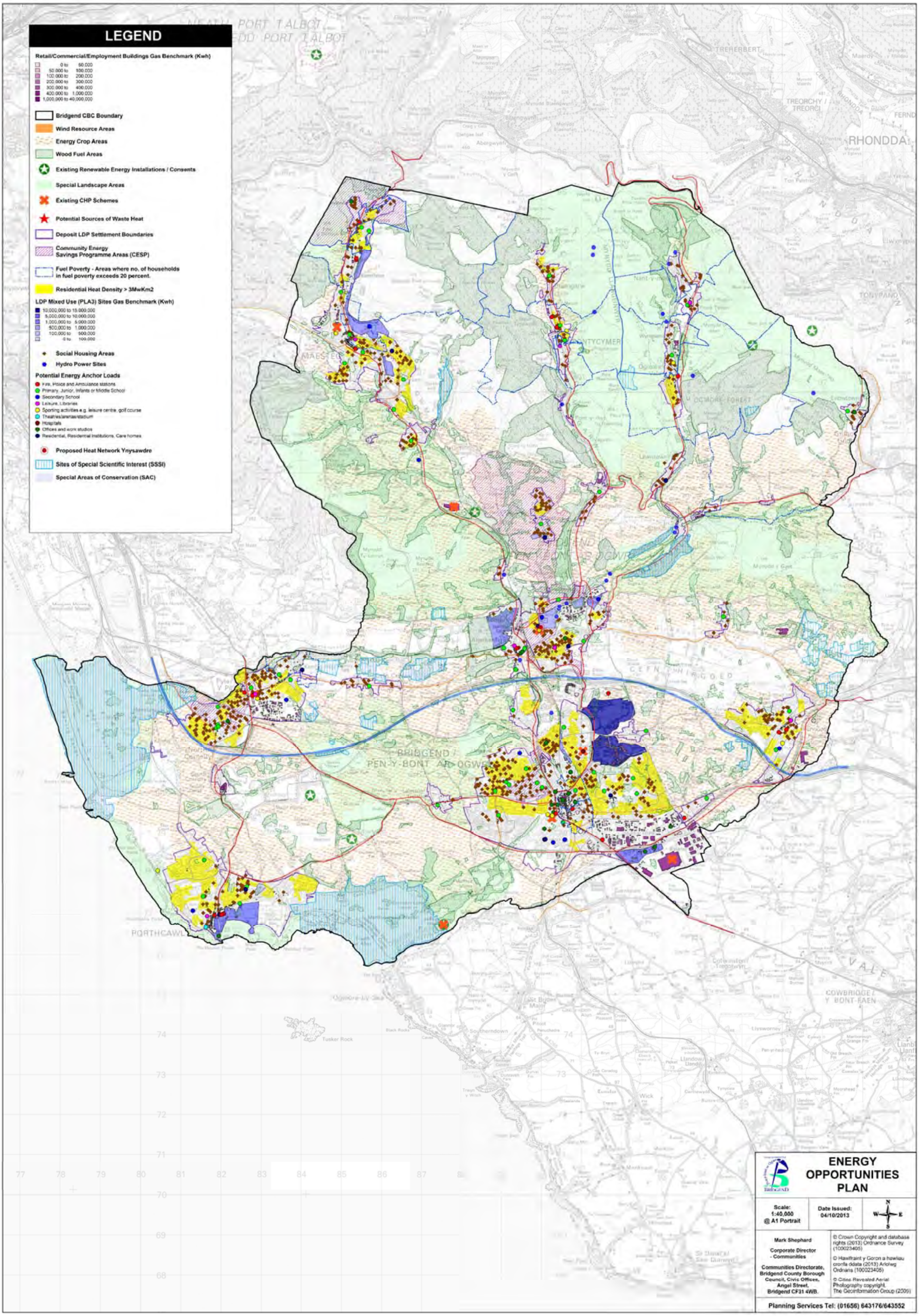
7.5.1 Developers should consult the EOP and contact the Council for the latest information on existing and proposed decentralised energy networks.

7.5.2 The Plan contains much useful data and can assist developers and designers to:

1. identify renewable and low and zero carbon energy resources (e.g. wind energy; availability of waste heat or existing low and zero carbon technologies such as CHP units) within the vicinity of a development site
2. reveal the presence of useful features (such as local heat density, and the number of public sector buildings) in the vicinity of a development site

7.5.3 The Energy Opportunities Plan should be seen as a high-level strategic starting point to identify possible significant customers of a district heating scheme, before more detailed financial and commercial assessments are carried out.

7.5.4 It would generally be the role of an experienced energy consultant engineer to assess the appropriateness / financial viability of such systems within development proposals, taking into account potential anchor heat customers in the vicinity of the site that may have an interest in connecting to a scheme to make carbon or cost savings.



LEGEND
Retail/Commercial/Employment Buildings Gas Benchmark (Kwh)
0 to 50,000
50,000 to 100,000
100,000 to 200,000
200,000 to 300,000
300,000 to 400,000
400,000 to 1,000,000
1,000,000 to 40,000,000
Bridgend CBC Boundary
Wind Resource Areas
Energy Crop Areas
Wood Fuel Areas
Existing Renewable Energy Installations / Consents
Special Landscape Areas
Existing CHP Schemes
Potential Sources of Waste Heat
Deposit LDP Settlement Boundaries
Community Energy Savings Programme Areas (CESP)
Fuel Poverty - Areas where no. of households in fuel poverty exceeds 20 percent.
Residential Heat Density > 3MwKm2
LDP Mixed Use (PLA3) Sites Gas Benchmark (Kwh)
10,000,000 to 15,000,000
5,000,000 to 10,000,000
1,000,000 to 5,000,000
500,000 to 1,000,000
100,000 to 500,000
0 to 100,000
Social Housing Areas
Hydro Power Sites
Potential Energy Anchor Loads
Fire, Police and Ambulance stations
Primary, Junior, Infants or Middle School
Secondary School
Leisure, Libraries
Sporting activities e.g. leisure centre, golf course
Theatres/arenas/stadium
Hospitals
Offices and work studios
Residential, Residential Institutions, Care homes
Proposed Heat Network Ynysawdre
Sites of Special Scientific Interest (SSSI)
Special Areas of Conservation (SAC)
NEATH PORT TALBOT
TREHERBERT
TREORCHY / TREORCI
RHONDDA
TONYPANDY
MAESTEG
NANTYCYMER
OGMORE FOREST
CEFN HIRGOED
BRIDGEND / PEN-Y-BONT AR OGWR
PORTHCAWL
Ogmore-by-Sea
Tusker Rock
VALE
COWBRIDGE / Y BONT-FAEN
ENERGY OPPORTUNITIES PLAN
Scale: 1:40,000 @ A1 Portrait
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N
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Mark Shephard
Corporate Director - Communities
Communities Directorate, Bridgend County Borough Council, Civic Offices, Angel Street, Bridgend CF31 4WB.
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8. Bringing It All Together: An Energy Assessment Guide

8.1 Introduction

8.1.1 The purpose of this section of the document is give assistance and guidance to developers on submitting energy assessments with major planning applications which bring together all aspects of the guidance which is contained in this report and elsewhere. It has been produced as a step by step guide to ensure that it is easy to use.

8.1.2 In summary the energy assessments required by Policy ENV17 of the LDP should estimate the regulated annual baseline energy consumption and CO2 emissions from the development. The assessment should then show how the current (or, if appropriate depending on the likely construction date of the development) building regulations requirements will be met, using the energy hierarchy steps as a guide.

8.1.3 In addition, the Council would like to invite developers to strive to achieve 10% of the developments regulated primary energy from on-site renewable sources. **This is not a policy requirement**, but would rather demonstrate the developer's willingness to strive to reduce the carbon footprint of the development, whilst also contributing towards meeting national renewable energy targets. This request should also not be construed as the Council advocating that fabric energy efficiency measures should not be maximised as the first steps of the energy hierarchy, rather this would be in addition to this.

NOTE 7: ENERGY ASSESSMENT STRUCTURE AND AIMS

The Council expects energy statements to contain a written report outlining the energy saving / generation measures proposed together with calculations showing the carbon savings achieved through regulated emissions[1]. This may also refer to application plans where necessary.

The report will need to demonstrate consideration of the issues that will assist in meeting targets as required by Building Regulations. The Council also invites developments to achieve 10% of their energy requirements from renewable or low/zero carbon sources.

8.1.4 The Council, in partnership with the Carbon Trust, has registered with the online **ENplanner** tool to enable Energy Assessments to be produced to a recognised format and standard. This tool can be accessed online at: www.enplanner.com. This tool effectively takes an applicant through the steps which are outlined below.

[1] *Regulated emissions include those which arise from fixed services (e.g. heating, cooling and lighting) within the development as controlled by Building Regulations. They do not include the emissions resulting from the use of appliances by the occupiers of the development.*

8.1.5 However an assessment is carried out, it should be conducted in the following fashion:

Step 1: The likely development start date should be considered to assess the anticipated Building Regulations standards to be met.

8.1.6 This first step is important as it is acknowledged that many major developments have extended lead-in times which may impact upon the Buildings Regulations requirements at the time when development actually commences. This is will be particularly important as we move towards zero carbon homes by 2020 and the likely scenario of step-changes in emission savings before then. It is likely that the use of integrated low carbon / renewable technologies within all developments will be necessary as these requirements increase.

Step 2: Calculate the estimated regulated primary energy consumption and CO2 emissions for the proposed development.

8.1.7 For residential development the regulated CO2 emissions can be calculated using the Standard Assessment Procedure Wales ((SAP(W)). Further information on this can be accessed via www.bre.co.uk/sap2009. For non-residential development this can be undertaken using the Simplified Building Energy Model Wales (SBEM(W)). Information regarding this can be accessed here via www.ncm.bre.co.uk. In completing the Council's Energy Assessment, where compliance software has been utilised, energy from renewable electricity should not be removed from the reported primary energy demand.

8.1.8 If the level of detail required for these assessments is not available, benchmark data is available from CIBSE TM46 Energy Benchmark. The Enplanner tool will calculate these estimates for you.

Step 3: Consider each element of the design of the building as outlined in Sections 4 and 5 of this report and describe how the guidance or other solutions will be used to reduce energy consumption and carbon emissions.

8.1.9 The Guide gives a range of design and construction techniques which can be used to reduce the need to use energy. The Energy Assessment should examine each of these elements and describe how the design of the development has been influenced by them. In particular, careful explanation and justification may need to be made where energy efficient designs result in unusual external appearances of buildings. Further justification may be required to explain how this design appropriately assimilates itself in to the surrounding built environment.

8.1.10 From these measures, appropriate assumptions can therefore be made to calculate the reduced energy consumption and carbon use from the development once these measures have been put in place.

Step 4: Consider how a mix of the renewable energy resources together with the technologies listed in Section 6 of this report can be used to make savings in carbon dioxide emissions to meet building regulations requirements (if required) or the Council's suggested target of 10% of primary regulated energy from renewable / low carbon energy generation.

8.1.11 The Energy Opportunities Plan will give an idea of the potential renewable energy resources available in the vicinity of a development together with an indication of the potential 'heat demand' in an area which could make district heat networks a possibility. This, together with the guidance in Section 6 and the 'Further Reading' section of this report will assist developers in making an informed choice of the most appropriate renewable or low/zero carbon technologies to use in their developments.

8.1.12 The Energy Assessment should consider each of the technologies listed in Note 5 and objectively assess the appropriateness of each of these in terms of the planning issues concerning design and amenity (noise, smell, dust, visual impact etc.) highlighted in Section 6 and Policy SP2 of the LDP, and the contribution which each of these will make towards meeting the energy consumption requirements of the development.

Step 5: All the above steps can be brought together in a single Energy Assessment document / report which confirms that the Building Regulations requirements have been considered and gives estimated figures of the energy generation from renewable and low carbon sources.

8.1.13 The energy statement should be submitted as a supporting document for all planning applications which meet the threshold identified in Policy ENV17 of the LDP. This should follow the step-by-step guide above in considering energy and carbon use in the context of the energy hierarchy and include the required written justification, emission calculations and reference to any plans which detail the measures used (i.e. in the design, construction or energy generation) to achieve the energy and carbon emission savings.

8.1.14 Any application which is not accompanied by such a statement may be delayed in being registered or determined or is at risk of being refused as insufficient information will have been provided (as required by adopted Policy) to properly determine the planning application.

8.1.15 An example energy statement from Enplanner is available to view at Appendix A. If the online tool is not used, the Council will expect developers to use a similar format in producing their own Energy Assessments.

9. Further Reading

9.1 There is an abundance of advice and guidance which has been published by other organisations which the Council considers is relevant and will use itself in the determination of planning applications. The purpose of this section is to signpost developers to these sources of information. Documents which have been published by the Welsh Government and are considered to be the most relevant in the determination of planning applications in Wales. However, other advice and guidance is available and will therefore be useful to developers in making their assessments.

Reducing The Need To Use Energy

How to Implement Solar Shading
http://www.carbontrust.com/media/19525/ctl065-how-to-implement-solar-shading.pdf

9.2 Air conditioning is an expensive way of keeping buildings cool, especially as fuel prices rise. Solar shading can be a very cost-effective alternative.

KS15 Capturing Solar Energy (CIBSE Knowledge Series 15, 2009)
https://www.cibseknowledgeportal.co.uk/component/dynamicdatabase/?layout=publication&revision_id=147&st=solar+energy

9.3 This publication provides an overview of the available domestic and non-domestic solar system solutions, technologies and applications. It is principally directed at the designers of building services and others who may not be aware of the many solar options available and their possibilities. It will also help clients, building owners and facilities managers to understand the possibilities of using solar technology in their buildings.

TM37 Design for Improved Solar Shading Control, CIBSE (2006)
https://www.cibseknowledgeportal.co.uk/component/dynamicdatabase/?layout=publication&revision_id=120&st=solar+gain

9.4 This publication provides guidance on the design of facades to incorporate appropriate levels of solar shading, and gives information on some of the design options available. Avoiding overheating due to solar gain is a key design requirement to minimise the use of mechanical cooling and reduce energy consumption by cooling systems.

Using Energy Efficiently

BSRIA: Specifying building management systems (TN 6/98)
https://www.bsria.co.uk/information-membership/bookshop/publication/specifying-building-management-systems-tn-698/

9.5 Provides background information and guidance relating to the wide range of issues which should be considered when specifying a building management system (BMS).

Carbon Trust: Heating Control, Maximising Comfort, Minimising Energy Consumption (2011)
http://www.carbontrust.com/media/10361/ctg065_heating_control.pdf

9.6 This technology guide covers heating control. It introduces the main energy saving opportunities for exising systems and explains how upgrading controls can cut energy consumption and save money.

CIBSE Guide F: Energy efficiency in buildings (2012)
CIBSE: Introduction to energy efficiency (A companion to CIBSE Guide F)
CIBSE KS14: Energy Efficient heating (2009)
https://www.cibseknowledgeportal.co.uk/

9.7 2012 edition of 'CIBSE Guide F' includes a new section on 'developing an energy strategy'. This reflects the changes to planning policy, which now include targets for reducing carbon dioxide emissions from new developments and the need to submit a detailed energy strategy report as part of the planning application.

9.8 A new companion document to the Guide, titled 'Introduction to energy efficiency', is also available on the CIBSE Knowledge Portal that introduces the main Guide and summarises the current policy agenda; the changing role of building services engineers, and the key themes of Guide F.

9.9 The 'Energy Efficient heating' publication provides an introduction to energy efficient heating systems for engineers and building professionals that need an overview of the subject.

Generating Renewable and Low & Zero Carbon Energy

Technical Advice Note (TAN) 8: Planning for Renewable Energy (2005)
http://wales.gov.uk/topics/planning/policy/tans/tan8/?lang=en

9.10 Annex C of Technical Advice Note (TAN) 8: Planning for Renewable Energy published by the Welsh Government gives a technological outline of various types of renewable energy technologies. These relate to large and small scale energy generation techniques, not all of which will be appropriate for development on a site level basis. The Council will only expect developers to examine technologies which will be appropriate for integration into the fabric of the built environment.

Practice Guidance: Planning Implications of Renewable and Low Carbon Energy Development (2011)
http://wales.gov.uk/topics/planning/policy/guidanceandleaflets/planningimplications/?lang=en

9.11 This document expands upon the advice given in TAN8 (see above). For each technology the guidance gives: a simple description; the main financial and technological constraints; any planning procedural issues which may need to be addressed; an outline of the social, economic and environmental benefits and impacts of the technology and potential design measures which can be taken to mitigate impact.

Practice Guidance: Renewable and Low Carbon Energy in Buildings (2012)
http://wales.gov.uk/topics/planning/policy/guidanceandleaflets/energyinbuildings/?lang=en

9.12 This document gives guidance on how developers can reduce the carbon footprint of a new building, extension or refurbishment by making the most of renewable and low carbon technologies in the design process. It explains the concept of the energy hierarchy (see above) and how energy in buildings is used. A separate publication: (http://wales.gov.uk/topics/planning/policy/guidanceandleaflets/casestudies/?lang=en) highlights some useful examples of how developers have reduced the carbon footprint of buildings by making the most of renewable and low carbon technologies.

Renewable Energy Sources
http://www.carbontrust.com/media/7379/ctv010_-_renewable_energy_sources.pdf

9.13 The Carbon Trust has produced an overview of the main sources of renewable energy which readers to assess which renewable energy technology is a viable option for them. This document gives an outline of a variety of renewable energy generation techniques as well as advice on which types of site may be best suited to that technology as well as an indication of the potential costs and 'payback' periods which will be useful in assessing the overall appropriateness and any impact on the viability of a scheme.

9.14 The Carbon Trust also provides a range of guides and tools to help in the assessment of renewable energy technologies: http://www.carbontrust.com/resources/guides/renewable-energy-technologies/

Sustainable Buildings Portal
http://www.sustainablebuildingportal.co.uk/

9.15 Administered through Constructing Excellence in Wales (CEW), the Wales Low / Zero Carbon Hub has established the Sustainable Buildings Portal which itself is a 'signpost' to examples of best practice for low and zero carbon design and construction. It provides guidance, documents and information on building and infrastructure projects and identifies Welsh Government and UK Government's future requirements.

9.16 Having reviewed the advice and guidance which is available on renewable and low / zero carbon options, the Council considers that there are some renewable technologies which should be examined by developers as standard.

Decentralised Energy

Bridgend Renewable Energy Assessment and Energy Opportunities Plan
http://www1.bridgend.gov.uk/media/164594/SD115.pdf

9.17 This document forms part of the evidence base for the energy policies contained in the Bridgend Local Development Plan (LDP). It assesses the potential for renewable energy from sources within the County Borough. The Energy Opportunities Plan maps these resources together with energy consumption data from key buildings and new development sites. The plan, contained in this document, will provide a useful tool in exploring the potential for decentralised energy systems within the County Borough.

Community energy: urban planning for a low carbon future
Community energy: planning, development and delivery
http://www.tcpa.org.uk/pages/community-energy-urban-planning-for-a-low-carbon-future-.html

9.18 The Town and Country Planning Association (TCPA) and the Combined Heat and Power Association (CHPA) have produced a joint best practice guide - ‘community energy: urban planning for a low carbon future’ which sets out the changes needed in how energy is generated and supplied to achieve a transition to decentralised energy and power based on low and zero carbon technologies.

9.19 Through case studies and a hypothetical city model the guide examines the key features of decentralised energy, including District Heat Networks. It explores which combination of technologies makes most sense at different scales and looks at the opportunities for new and existing building typologies and uses, and the relationship of a town to its rural hinterland. The report suggests the framework needed to promote and facilitate these technologies including district heating, highlighting the role of central and local government, and developers and energy companies in its delivery.

Appendix A – Example Energy Assessment

Energy Statement

Enplanner ID: 1089

10 High Street
Bridgend
Location: CF314WB (51.51, -3.58)

Submitted by: Steve Martin
Email address: steve.martin@encraft.co.uk

Summary

Description of development:

Four detached houses in High Street

This energy statement analyses the energy and CO_2 savings that can be achieved by installing renewable or low-carbon technologies at the proposed development. It also looks at energy efficiency measures that could be implemented at the development to make energy and CO_2 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 2009 for domestic buildings.

The development consists of the following building:

Type	Floor area (m^2)	No. of units	Specification	Primary heating	Secondary heating
C3 General residential (*Detached house or bungalow*)	100	4	Building regs	gas (100%)	*N/A*

This project comes under the **Pen-y-bont ar Ogwr - Bridgend** planning authority where the low carbon policy objective is as follows:

Policy summary

Requires new development to minimise its energy requirements through the application of the energy hierarchy and the use of heat networks where available. Energy assessments should be submitted with major applications to outline efficiency measures and investigate incorporating on-site zero and low carbon equipment.

The assessment will need to demonstrate the reduction in carbon emissions as required by Building Regulations. The Council also invites developments to achieve 10% of their energy requirements from renewable or low/zero carbon sources.

Note: *this is a summary of the local policy provided for indicative purposes only. You should always check directly with the planning authority concerned if you require a formal statement of planning policy.*

The following energy efficiency measures will be implemented to reduce the overall energy consumption and CO_2 emissions of the development before renewable or low carbon technologies are installed:

- Windows and doors
- Fabric insulation

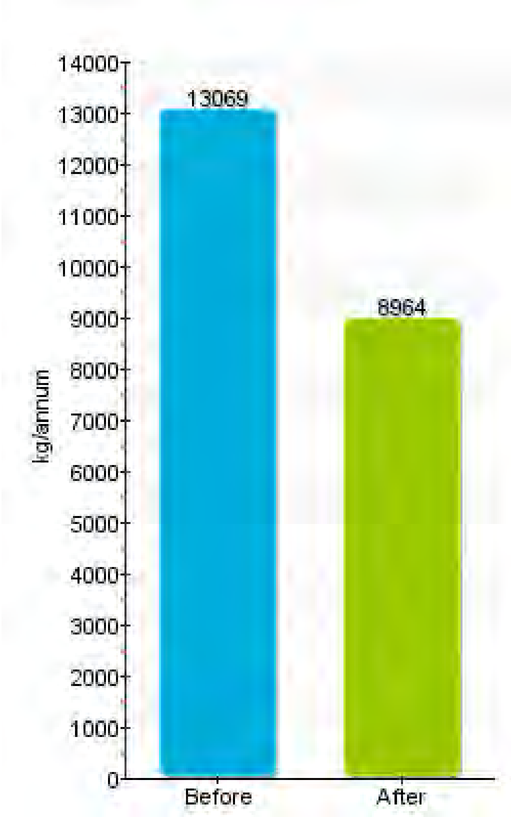
The most suitable low carbon or renewable technology systems that have been chosen to achieve the energy savings are as follows:

- Solar Thermal
- Solar Photovoltaics

The predicted savings achieved by selected low carbon or renewable technology systems after energy efficiency measures are implemented are a **27.8% saving in energy** and a **31.4% saving in CO_2 emissions** as shown in the graphs below.

Predicted annual energy consumption for development before and after installing renewable or low carbon technologies

Predicted annual CO_2 consumption for development before and after installing renewable or low carbon technologies



Based on the information entered in this tool, this development **would meet** the calculable part of this policy.

The following sections go into more detail about selected energy efficiency measures, and low carbon or renewable technology systems.

Energy efficiency measures

This development will benefit from energy efficiency measures to reduce the energy consumption and CO_2 emissions over and above those required to comply with Building Regulations Part L.

The following have been selected as additional energy efficiency measures for this development. The efficiency measures are explained in more detail in the boxes below

Windows and doors

Windows and doors will be improved above and beyond current Building Regulations Part L that is likely to result in a total energy saving of 2.00% for the whole development.

Triple glazing throughout

Fabric insulation

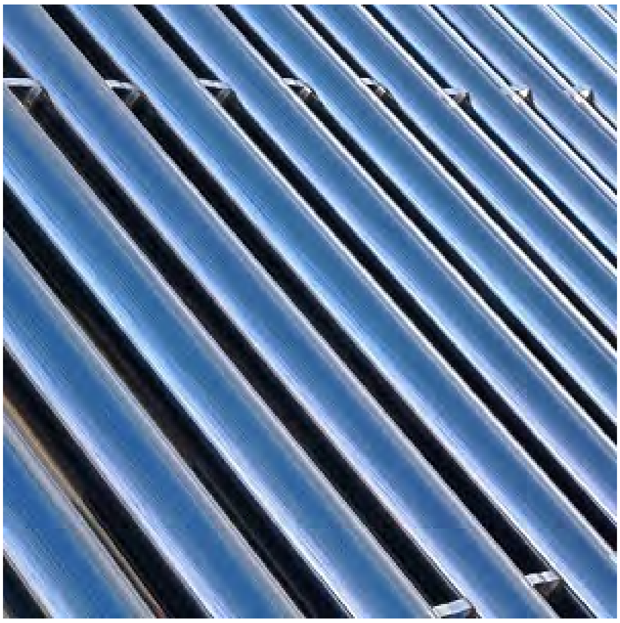
Fabric insulation will be improved above and beyond current Building Regulations Part L that is likely to result in a predicted energy saving of 15.00% for the whole development.

Highest level of insulation throughout

Adding these measures in Enplanner has reduced the predicted energy consumption over Building Regulations Part L by **17.00%** and the CO_2 emissions by **11.71%**. This brings the predicted energy consumption down to **42762 kWh/annum** and CO_2 emissions down to **13069 kg CO_2/annum**. These figures have been used to calculate the energy and CO_2 savings from renewable and low carbon technologies in the remainder of the report.

Proposed technologies

Solar Thermal



Solar water heaters generate hot water directly from sunlight, and work even when it is cloudy. The "collector" heats water or another fluid pumped gently through a panel on the roof. The fluid then circulates through a secondary coil inside a hot water tank. This works to heat water in exactly the same way as the coil from a regular boiler. The end result is a reduction in demand for hot water from the existing heating system. A modern, well-insulated hot water tank will keep this water warm for at least twenty-four hours, until it is needed.

Solar water heating systems are generally specified in square metres (m2), which is the collector area, and determines how much sunlight the system can catch. The heating power of a system will also depend on where in the country it is sited and the direction it faces. A common size of solar collector for domestic use is about 3-4m2 (flat plate). This will deliver around 1,500 kWh per year, which will heat just over half the annual hot water demand of a typical house with 3-4 persons. Most of this will occur during the summer months. For this reason, systems are usually sized to meet all of the summer hot water needs or half of the annual needs for a building: making the system bigger will not help in summer and make a marginal difference in winter.

Advantages:

- Low maintenance costs, only to make sure that the panels are free from debris such as fallen leaves.
- Short installation time of 1 to 3 days for small to medium roof mounted systems.

Disadvantages:

- Ideally the roof should be an unshaded roof space that is oriented between southeast and southwest (south facing is best).
- Payback can be longer than the lifetime of the system, especially for smaller systems.

The following solar thermal system is suggested to achieve energy and CO_2 savings at this development

Specification

- Building use: Domestic
- Area: 12m^2
- Orientation: South
- Pitch: 30°
- Overshading: None/very little (< 21%)
- Replaced fuel: Gas

Financial specification

- Annual savings: £224
- Annual maintenance costs: £288
- Installation cost: £11952
- Payback period: Never
- Internal Rate of Return: 0.0%
- Net Present Value: £-12456

This system is predicted to save **4851 kWh/annum** and **989 kgCO_2/annum** for the development.

Solar thermal is the most appropriate technology for this development because:

Sufficient south-facing roof area

Solar Photovoltaics

A solar photovoltaic (PV) cell consists of two or more thin layers of semi-conducting material, most commonly silicon. When silicon is exposed to light, electrical charges are generated, which are conducted away by metal contacts in the form of direct current (DC). The electrical output from a single cell is small, so multiple cells are connected together and encapsulated to form a photovoltaic module, often referred to as a "PV panel". These are often mounted to a roof and electricity can be used in the building and/or exported to the national grid.

Advantages:

- Very low maintenance costs, only to make sure that the panels are free from debris such as fallen leaves.
- Often has a good payback period for smaller systems in Great Britain (i.e. up to 10kW) due to the feed-in tariff and the export tariff (for any excess electricity the system generates) and falling installation costs.
- PV panels have a lifetime in excess of 25 years.
- Short installation time of 1 to 3 days for small to medium roof mounted systems

Disadvantages:

- Ideally the roof should be unshaded roof space that is oriented between west and east in a southerly direction (south facing is best).
- Although payback is good, up-front installation costs can be high

The following solar PV system is suggested to achieve energy and CO_2 savings at this development

Specification

- Power: 8.2kW
- Building use: Domestic
- Area: 60m^2
- Orientation: South
- Pitch: 30°
- Overshading: None/very little (< 21%)
- Build type: An existing building
- Onsite usage: 50%
- Epc valid: EPC valid and at least Band D or higher
- Multi installation: Not a multi-installation

Financial specification

- Annual savings: £1617
- Annual maintenance costs: £185
- Installation cost: £14740
- Payback period: 10.3 years
- Internal Rate of Return: 11.1%
- Net Present Value: £9286

This system is predicted to save **7044 kWh/annum** and **3116 kgCO_2/annum** for the development.

Solar PV is the most appropriate technology for this development because:

Sufficient south-facing roof area

Disclaimer

The energy and CO_2 figures for the development have been calculated using either benchmarks for typical building types or figures from SAP or SBEM calculations as entered by the applicant, therefore no responsibility is taken for the accuracy of the figures in the energy statement. Renewable and low-carbon technology specifications and energy efficiency measures are indicative only and should not be used for design or construction purposes without seeking additional professional advice. All text in bordered boxes has been written by the applicant therefore no responsibility is taken for their content.

Appendix B – Comments Received During Public Consultation and the Council's Response - TBC