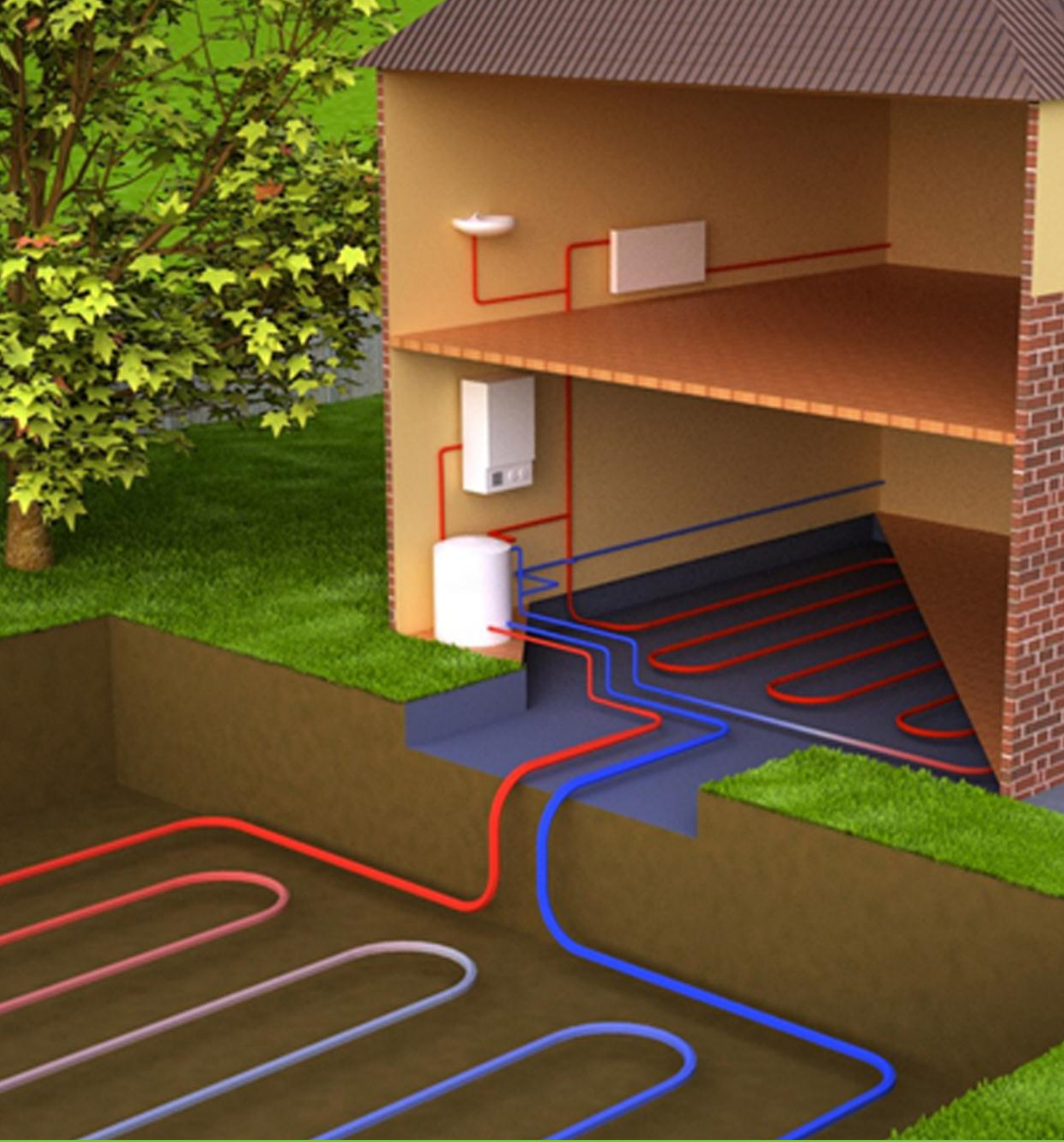

Heat Pumps: Water, Air and Ground Source

monmouthshire
sir fynwy

Cover image: Schematic of a ground source heat pump
source: http://www.homesinharmony.co.uk/images

Air Source Heat Pumps

Technology Description

Heat pumps use the same principles as applied in a refrigerator to effectively move thermal energy from one place to another. In the case of air source heat pumps, these take thermal energy from the ambient air and move it into a property to provide space heating, even at ambient temperatures as low as -15^{o}C. Heat from the outside air is absorbed into a fluid, which then passes through an electrically driven compressor where its temperature is increased before entering the heating and/or hot water circuits of the house.

Heat pumps produce output heat at a lower temperature than from a standard boiler. As a result, it is not normally possible to use a heat pump to directly replace a boiler in standard low water volume radiator systems. Instead, they are best used in under floor heating systems or in high volume radiator systems such as those using traditional large, cast iron radiators. Air source heat pumps are also ideal when used to supply warm air distribution heating systems. Here, reversible heat pumps can be used to provide warm air in the winter and cool air in the summer.

Heat pumps require electrical energy to operate with each unit of electrical power producing many times more units of heat energy (the so called ‘coefficient of performance’ or COP). This makes them a low carbon technology if the electrical power is from a fossil source. However, if the heat pump is driven by a renewable electricity source then it will also become a renewable technology.

Air source heat pumps usually comprise a heat collector and compressor unit. These can be arranged such that the compressor unit is inside the building meaning that only the heat transfer system is mounted externally. However, some systems can comprise a free-standing, ground mounted, outside unit that is visually similar to packed air-conditioning units, which are in effect the same technology but providing cooling not heating.

Air Source Heat Pumps – SWOT Analysis

Strengths	Weaknesses
▪ Highly efficient. ▪ Can be easily fitted to any building. ▪ Baseload heating supply across the year. ▪ Based on well understood technology with a mature supplier base. ▪ (Unlike ground or water source heat pumps) no need to install collector systems. ▪ Not constrained by ground conditions or water volumes as are ground and water source heat pumps respectively. ▪ Where required, can be used reversibly to provide winter heat and summer cooling. ▪ Can negate the cost of gas connection, liquefied gas or oil tanks, etc. in new build situations.	▪ Requires electrical energy to operate. ▪ Where electricity costs are high relative to heating fuels this can render the technology less commercially attractive. ▪ Air source heat pumps are less efficient than ground or water source heat pumps. ▪ Cannot directly replace existing heating boilers in low water content, radiator based heating systems ▪ Only a truly renewable technology when supplied with renewable electricity. ▪ Can be more visually intrusive than ground or water source heat pumps. ▪ Few possibilities for community benefit, but may have a role in the alleviation of fuel poverty in some circumstances.
Opportunities	**Threats**
▪ Highly flexible in application, especially in new build situations. ▪ A potentially simple replacement for oil or liquefied gas in rural locations away from the gas grid, but this may require changes to the existing radiator system.	▪ Can increase local electrical demand and cumulatively this may require local electricity grid upgrade. ▪ Physical space may prevent use. ▪ Cumulative impacts may lead to noise and visual issues.

Ground Source Heat Pumps

Technology Description

Heat pumps use the same principles as applied in a refrigerator to effectively move thermal energy from one place to another. In the case of ground source heat pumps, these make use of the constant temperature of the earth below around 1.5m depth as a source of energy to provide space heating. Thermal energy from the ground is absorbed into a fluid which then passes through a compressor where its temperature is increased before entering the heating and hot water circuits of the building. This process is achieved either by using a closed loop collector system installed in trenches underground, or by the use of boreholes into which a closed loop collection system is installed. In both cases the surface area of the collector must be sized to allow sufficient energy to be absorbed to meet demand. This in turn is linked to the capacity of the ground to dissipate thermal energy. Wet, dense soils tend to have greater capacity to dissipate thermal energy than do dry, open soil structures.

Heat pumps produce heat at a lower temperature than a standard boiler. As a result it is not normally possible to use heat pump technology for direct boiler replacement in standard low water volume radiator systems. Instead they are best used in under floor heating systems or in high volume radiator systems such as those using traditional large, cast iron radiators. All heat pumps are also ideal for supplying air distribution heating systems, especially as in these applications reversible heat pumps can be used to provide warm air in the winter and cool air in the summer.

Heat pumps require electrical energy to operate with each unit of electrical energy producing many times more units of heat energy (the so-called coefficient of performance or COP). This makes them a low carbon technology if the electrical power is from a fossil source. If the heat pump is coupled to a renewable electricity source then it will also become a renewable technology.

Ground source heat pumps usually comprise an underground collector and collector/compressor unit. The size of the collectors is based on the load to be met and the capacity of the ground to supply or dissipate energy. Compressors can be located within the building or in a small outside container.

Ground Source Heat Pumps – SWOT Analysis

Strengths	Weaknesses
▪ Can be easily fitted to most buildings where the collector is large enough to meet the required demand. ▪ Baseload heating supply across the year. ▪ Based on well understood technology with a mature supplier base. ▪ Where required, can be used reversibly to provide winter heat and summer cooling. ▪ Can negate the cost of gas connection, liquefied gas or oil tanks, etc. in new build situations.	▪ Requires electrical energy to operate. ▪ Only a truly renewable technology when supplied with renewable electricity. ▪ Where electricity costs are high relative to heating fuels this can make it less commercially attractive. ▪ Requires installation of an underground collector system (unlike air source heat pumps). ▪ Ground conditions can limit outputs. ▪ Cannot directly replace existing heating boilers in low water content, radiator based heating systems.
Opportunities	**Threats**
▪ Highly flexible in application, especially in new build situations. ▪ A potentially simple replacement for oil or liquefied gas in rural locations away from the gas grid, but may need some modification to the heating system. ▪ Any ground works create the opportunity to install heat pump collectors	▪ Can increase local electrical demand and cumulatively this may require local electricity grid upgrade. ▪ Physical space may prevent use, especially for collector systems. ▪ Cumulative impacts may lead to ground freezing/heating, noise and visual issues.

Water Source Heat Pumps

Technology Description

Heat pumps use the same principles as applied in a refrigerator to effectively move heat energy from one place to another. In the case of water source heat pumps, these make use of the thermal energy in bodies of water as a source of energy to provide space heating.

Water source heat pumps can be close or open loop in design. Closed loop systems employ a closed loop collector system submerged in the water, similar to the approach used in ground source heat pump systems. This is useful if the water is saline. Open loop systems physically draw the water through the system and extract thermal energy directly. Here, particles, water purity, etc. can be an issue.

The thermal energy collected from the water is absorbed into a fluid, which then passes through a compressor where its temperature is increased before entering the heating and hot water circuits of the building. A big issue with water sourced heat pumps is the potential to either warm or cool the 'donor' water body and the impact that this might have on wildlife.

Heat pumps produce heat at a lower temperature than a standard boiler does. As a result, it is not normally possible to use heat pump technology for direct boiler replacement in traditional low water volume radiator systems. Instead, they are best used in under floor heating systems or in high volume radiator systems such as those using traditional large, cast iron radiators. All heat pumps are also ideal for supplying air distribution heating systems, especially as here reversible heat pumps can be used to provide warm air in the winter and cool air in the summer.

Heat pumps require electrical energy to operate with each unit of electrical energy producing many times more units of heat energy. This makes them a low carbon technology if the electrical power is from a fossil source. If the heat pump is coupled to a renewable electricity source, then it will also become a renewable technology.

Water source heat pumps usually comprise either a submerged closed loop collector or suitable extraction and filtration systems in the case of open loop systems. Both open and closed loop systems are then linked to a collector/compressor unit, which can be located within the building or in a small outside container.

Water Source Heat Pumps – SWOT Analysis

Strengths	Weaknesses
▪ Can be easily fitted to most applications where the available water body is of sufficient volume or flow to meet the required demand. ▪ Supplies baseload heating supply across the year. ▪ Based on well understood technology with a mature supplier base. ▪ Where required, can be used reversibly to provide winter heat and summer cooling. ▪ Can negate the cost of gas connection, liquefied gas or oil tanks, etc. in new build situations.	▪ Requires an available water body. ▪ Requires electrical energy to operate. ▪ Only a truly renewable technology when supplied with renewable electricity ▪ Where electricity costs are high relative to heating fuels this can render the technology less commercially attractive. ▪ Requires installation of a collector system (unlike air source heat pumps). ▪ Water volumes can limit outputs ▪ Cannot directly replace existing heating boilers in low water content, radiator based heating systems
Opportunities	**Threats**
▪ Highly flexible in application, especially in new build situations. ▪ A potentially simple replacement for oil or liquefied gas in rural locations away from the gas grid. ▪ Any water containment systems, areas of standing water (lakes/ponds) or flowing water can be used.	▪ Can increase local electrical demand and cumulatively this may require local grid upgrade. ▪ Thermal impact on the donor water body can prevent use. ▪ Varying water flow/rainfall, etc. can affect water volume and thus thermal capacity.

The Technology – Spatial Elements

- Heat pumps are small scale with spatial implications at the micro level. All require compressor units as the central element of the heat pump system, which interfaces with the heating or cooling system. Ground and water source heat pumps require collectors to link with this system. Air source heat pumps draw thermal energy directly from external air.

- Heat pumps retrofitted into existing properties are more likely to have connectors/compressor units externally fitted. New build properties could include these as internal to the building. Collectors for ground source heat pumps are located under the ground either in vertical boreholes or horizontal trenches with coiled collectors. For new developments these can be located under parts of the scheme e.g. under car parking areas, to make best use of land.

- Heat pumps are suitable for domestic and non-domestic uses. They are well suited to rural locations as an alternative to fossil fuels (which are either absent or costly). Air source heat pumps are well suited to commercial property as they can provide both warm air as heating in winter and cold air in summer.

- They can be used in larger developments by having a bank of heat source pumps to heat a larger building. It could even be possible to have a ground or water source heat pump supplying a small group of residential properties (e.g. 2 or 3 properties), if the right energy output can be achieved. They could be used for a housing development e.g. an air source heat pump per property.

Planning Permission and Other Consents

The flow chart will help you to identify whether planning permission, Listed Building or other consents are required for your heat pump. Permissions and consents should be applied for in parallel to ensure that there are no delays in taking projects forward. It is advisable to contact NRW at the earliest opportunity if you think you need their permission, consent or license for your project. There are varying statutory deadlines depending on the permit, consent or licence you apply for (see **Appendix 7**).

Where planning permission is required, **Section 6.4** gives guidance on how your application will be assessed and the kinds of issues you need to consider in preparing your application. You will also need to consider the issues which relate specifically to heat pumps.

Heat pumps do not generally give rise to significant impacts.

Key issues in assessing planning applications are likely to be:

- Visual intrusion if compressor units are externally fitted – particularly if there are cumulative impacts; and
- Impacts on hydrology / water flow from water source heat pumps.

Examples of heat pump proposals in Monmouthshire can be found on the Eco Open Doors website:

http://www.monecoopendoors.org.uk/ . Many of these schemes are small scale or domestic in nature and the web site includes contact details for property owners.

Collector loops for a water source heat pump being installed in the Scottish Borders

Image source: **http://www.ihs.com/products/energy-consulting/index.aspx**

Getting Consents: A Summary of the Process

Planning Permission

Air Source Heat Pump:
Will your installation require any kind of enclosure/equipment to be mounted outside the building?

- **Yes** → Planning permission is likely to be required – although if you propose construction of an outhouse this may be permitted development as part of your general householder permitted development rights for extensions to properties.
- **No** → Planning permission not required if the installation is entirely internal.

Ground and Water Source Heat Pumps:
Is your installation for a domestic property and are you applying as an individual householder?

- **Yes** → Planning permission not required if the installation is entirely internal.
- **No** → Installation could be 'permitted development' if within the limits set out in **Appendix 6**. If these limits are exceeded planning permission will be required.
- **No** → Planning permission will be required.

Ground Source Heat Pumps:
You may need to carry out an archaeological investigation as part of any planning application.

Listed Building Consent

Is your building listed?
Check with the HeritageTeam **(paragraph 5.2.2).**

- **Yes** → Listed Building consent may be required, possibly even if the installation is internal.
- **No** → Listed Building consent will not be required.

Trees

Tree Preservation Orders (TPO):
If you plan to fell or do any works to trees you should check whether they are covered by a TPO (**Appendix 7** for contacts)

Conservation Areas:
If you plan to fell or do any works to trees in a Conservation Area you need to inform the Planning Department in writing 6 weeks beforehand (**Appendix 7** for contacts)

Building Regulations

You will also need to check with Building control to find out whether you need building regulations approval (**Appendix 7** for contacts)

NRW Consent

Water Source Heat Pumps:
You may need consent from NRW.

You may also need a specific consent if your site is a SSSI or affects protected species.

Heat Pumps – Site Selection and Planning Issues

This table should be read in conjunction with **Table 6.2**:

Planning issue (See Table 6.2)		Points to Consider
Landscape sensitivity, character and visual impact	Have you considered the visibility of the site in its wider setting?	▪ Installations should avoid siting at the front or sides of properties facing onto a road, to minimise visual impact. ▪ If the installations will be visible consider ways in which you can minimise impacts on landscape or townscape e.g. by screening enclosures or matching the colour of your enclosure/equipment to its surroundings. ▪ Visual impacts are likely to be minimal, and will usually be associated with air source heat pumps.
Ecology	Could the installation affect ecological habitats or species?	▪ If you are installing water source heat pumps, consider whether operation of the heat pumps will have any impact on habitats and species associated with the water source (i.e. warming of water).
Historic Environment	Is the site within a designated area of historic interest (see **Appendix 8**) Will the installation of equipment affect a Listed Building?	▪ If you are installing ground source heat pumps you may need to undertake archaeological investigations (see section 5.2.2 to contact the Heritage team). ▪ If your installation is in a Listed Building, you will specifically need to consider the impact of installation on the structure of the Listed Building and Listed Building Consent will be required, even if the installation is internal.
Access and servicing	Will routine access be required to any part of the system?	▪ Consider how access for delivery of fuel for heat pump operation will be achieved with minimum disruption. This consideration may affect where you can locate installations within your site.
Design of buildings	Is the installation of equipment externally attached to a building or a freestanding building?	▪ Consider how the design of any building housing equipment fits with the design of the building to which it is attached; or it if is free standing, consider the link with adjacent buildings.
Water management, hydrology and flood risk	Would the installation involve use of water and/or affect the hydrology of an area? Does your water or ground source heat pump system involve use of chemicals?	▪ If you are installing water source heat pumps, consider whether use of the water source will have any effect on hydrology in the area (e.g. affecting the water table) as this should be avoided. ▪ If you need to dig trenches for water or ground source heat pump equipment consider if there will be any impact on the hydrology of the area resulting from the earthworks. ▪ If you are in an area of flood risk, consider the location of external pumps and connectors to ensure they are above potential flood levels. This in turn might have an impact on visibility that you will need to consider. ▪ Bear in the mind the best type of soils for ground source heat pumps are those in wetter soil types as these provide better heat conversion than drier soils – so location in an area of flood risk or where soils are more boggy is not necessarily an issue for ground source heat pumps and could be a benefit. ▪ Consent from NRW (Natural Resources Wales) may be required for water source heat pumps. ▪ Consider whether there is any risk of chemical pollution arising from operation of the system into watercourses and how this can be avoided/mitigated.
Health / Quality of life (Noise & soil stripping / storage)	Will the external equipment emit any noise?	▪ If there is potential for any noise from the equipment you propose to install, careful siting will be needed to minimise disruption to neighbours and mitigation measures might be needed such as screening/planting to reduce noise. Bear in

Planning issue (See Table 6.2)		Points to Consider
	Will the installation of equipment require digging, stripping and storage of soil?	mind that for air source heat pumps, an air flow is essential so external equipment cannot be fully enclosed. ▪ For ground and water source heat pumps you will need to consider how you manage the stripping and storage of soil on site during installation to avoid visual intrusion and minimise disruption to neighbours during installation.
Cumulative impacts	Are there other similar installations nearby?	▪ Whilst visual and ecological impacts are likely to be minimal, these may increase if there are a number of installations within a small area; if the area is particularly sensitive (such as in a Conservation Area) then this could begin to have a detrimental impact.
Social considerations / engagement	Have you considered any level of community partnership in association with this scheme?	▪ Consider whether there is potential for a water or ground source heat pump system that could be shared between more than one property. If so, consider if there is any opportunity for a community partnership and community benefit from the scheme (e.g. a community partnership could own the heat pumps and sell heat to occupiers). If you have not considered this, would you welcome working with the local community to share some of the risks and benefits to this development?
Decommissioning	Have you planned for removal of the equipment at the end of its lifetime?	▪ This is the same as replacement of any refrigeration plant. ▪ There is unlikely to be any issues with hazardous waste. ▪ The fate of any heat collector system will depend on its condition and the ease with which underground systems can be accessed for replacement.

Anaerobic Digestion

monmouthshire
sir fynwy

Image source: http://blog.emap.com/footprint/2011/07/22/footprintwire-220711/

Anaerobic Digestion

Technology Description

Anaerobic digestion (AD) is a natural process, similar to that which occurs in the stomach of cows. In the absence of oxygen, bacteria digest (break down) organic materials to produce a methane rich biogas. After cleaning and drying, this gas can be used to displace fossil gas or can be burnt in an internal combustion engine or small turbine to generate electricity and heat.

This treatment process is almost identical to that used to create ‘sewage gas’ from the treatment of human sewage in sewage treatment plants.

Feedstock’s for AD can include the organic fraction from household waste, organic wastes from industrial processes including food processing, crop residues or crops grown specifically as a feedstock. It is also possible to co-digest sewage and other organic materials.

Depending on the feedstock, co-products can include a fibre fraction and a liquid fraction, both of which are potentially useful as fertilisers.

Because the feedstock for AD will typically be sourced locally, this creates the potential for economic benefits of an AD energy project to be retained locally as well.

A typical AD plant will comprise an area to receive and store the feedstock, a process to macerate or pulp the feedstock, holding tanks and the digester tank itself. The gas produced will then go through a clean-up process to dry it and remove acidic elements before being stored and/or used in either an on-site gas engine to support power generation or CHP or piped to a remote location for use.

500m^2 AD plant at Newcastle University. Image Source: **http://blog.emap.com/footprint/2011/07/22/footprintwire-220711/**

Anaerobic Digestion – SWOT Analysis

Strengths	Weaknesses
▪ Baseload generation with the potential for gas storage to minimise risks from plant outage. ▪ Accepts a large range of organic wastes from households, industrial processes, catering, food processing, etc. ▪ Can adapt to changing feedstock. ▪ Proven technology with many suppliers across the development chain. ▪ Commercial waste attracts a gate fee improving the economic performance of AD schemes using this waste. ▪ Local job creation and wealth retention. ▪ Can feed CHP or displace grid gas supply. ▪ AD can operate from kW to MW scale. ▪ All products from the process have a value. ▪ Methane is a more powerful greenhouse gas than CO_2 enhancing environmental benefits of the beneficial use of methane generating wastes such as animal slurry for energy generation.	▪ Relative to the amount of feedstock required, AD is an inefficient source of renewable energy. ▪ The process can have a large physical footprint which means that land-take can be problematic in some applications. ▪ In many cases, waste will need to be transported to the site of the digester creating possible issues. ▪ There is the perception that odour may be a problem leading to potential local opposition. ▪ Additional permitting is associated with waste based processes and will be required for AD. ▪ Limited (but growing) operational capability outside of the water industry. ▪ Has some visual impact, potential for low level noise, transport impacts and air quality issues, all of which need to be considered.
Opportunities	**Threats**
▪ As a rural county, Monmouthshire potentially has a range of AD feedstock's available including animal waste. ▪ Can reduce the cost of waste processing from food production increasing profitability. ▪ The process can fit well into a farm business. ▪ Visually, AD resembles other existing agricultural processes. ▪ As landfill taxes rise, AD will become more economically attractive as a route for organic waste treatment. ▪ AD is recognised as having value in controlling nitrate release in agriculture.	▪ As a biological process, there is the potential for contamination to stop the process leading to failure of energy supply and potentially breaches of any discharge consents. ▪ Possibility of EU waste legislation to change impacting on AD viability.

The Technology – Spatial Elements

- The combination of buildings, tanks, space for storage and access for delivery of feedstock's, means that AD plants can be quite industrial looking, but not dissimilar to other agricultural tanks and silos. There is no standard number or size of buildings, tanks, or other structures needed. This will depend on the size of the project, type of feedstock's to be used, the selected digestion process and the nature of the energy output. For instance, whether gas storage will be involved, or whether extra thermal stores of hot water will be needed. There may also be a requirement for on-site treatment of co-products from the process such as fibre for composting, although this treatment can also be off-site such as in an existing local composting facility. Additional treatment activities will add to the space requirement and may have other impacts.

- AD plants are often constructed as standalone units, but they can also be associated with other developments, especially where these produce the feedstock that will be used in the AD process.

- An AD system could be used to heat and/or power a residential development although fitting the spatial requirements into a residential 'landscape' would need careful thought. One possibility may be in association with rural housing sites.

- AD is more usually associated with industrial or agricultural businesses where it can be used to process waste products into energy and further products (compost) both of which have a value. AD plants could also be attached to public facilities such as hospitals, to deal with waste products.

- While AD generally applies at the larger scale, in theory it can operate at small, even domestic scale as well. This means that at the individual farm or business level AD may be an option.

Planning Permission and Other Consents

The diagram on the following page sets out the need for planning permission and other consents. It is advisable to contact NRW at the earliest opportunity if you think you need their permission, consent or license for your project. There are varying statutory deadlines depending on the permit, consent or licence you apply for (**see Appendix 7**).

Section 6.4 gives guidance on how your application will be assessed and the kinds of issues you need to consider in preparing your application. In addition, you will need to consider the issues in the table below which relate specifically to Anaerobic Digestion.

Key issues in assessing planning applications are likely to be:

- Landscape and visual impact (depending on the location) – how large an area will be needed, and how tall will the buildings need to be?
- For large scale civic amenity sites transport / access is likely to be a key issue; and
- Impacts on ecology and human health through disturbance of habitats and species, noise pollution, water pollution, pests and air quality.

Getting Consents: A Summary of the Process

Planning Permission

Planning permission is required. Although this is under review by the Welsh Government and may change.

Listed Building Consent

Is your site within the curtilage (garden/boundary) of a Listed Building? Check with the Heritage Team (**para 5.2.2**)

Yes

Listed Building consent may be required if your proposal includes alterations existing structures/buildings.

No

Listed building consent will not be required.

Trees

Tree Preservation Orders (TPO):
If you plan to fell or do any works to trees you should check whether they are covered by a TPO (**Appendix 7** for contacts)

Conservation Areas:
If you plan to fell or do any works to trees in a Conservation Area you need to inform the Planning Department in writing 6 weeks beforehand (**Appendix 7** for contacts)

Building Regulations Approval

Building regulations approval will be required.

NRW Consent

If your scheme uses waste you likely require consent from NRW.

You may also need a specific consent if your site is a SSSI or affects protected species.

Anaerobic Digesters – Site Selection and Planning Issues

This table should be read in conjunction with **Table 6.2**:

Planning issue (See Table 6.2)	Key questions	Points to Consider
Landscape sensitivity, character and visual impact	Will the AD plant be located in a designated landscape? (see **Appendix 8**) Have you considered the visibility of the site in its wider setting?	▪ If you are considering an AD plant in the Wye Valley AONB or on the edge of the Brecon Beacons National Park, size and siting of a potential development will be particularly important planning considerations. ▪ Smaller scale plants well integrated with agricultural sites are more likely to get planning permission than large industrial units in or close to designated landscapes. ▪ Consider how to reduce visual impact by use of screening or selection of colour and type of materials. Other factors such as the need for delivery access, and where heat is piped to will also influence site layout and therefore how visual impact can be reduced. ▪ If the AD plant is located on the edge of a settlement consider the wider visual impact on townscape character and views to/from the plant and the settlement. ▪ Consider how on-site boundary treatment can be used to reduce visual impact.
Ecology	Could the AD plant affect ecological habitats or species? (see Appendix 8 for designations)	▪ The potential for contamination should be considered and if possible avoided (both on and off site). Mitigation measures (e.g. bunding to contain spillage) may be required. Particular care should be taken close to designated sites.
Historic Environment	Is the site within a designated area / site of historic interest, on a listed building or within a Conservation Area? (see **Appendix 8**)	▪ At these sites, smaller schemes well integrated with the site in terms of building design, or using vegetation as screening are more likely to be acceptable.
Access & Servicing	What feedstock's will you be using and how often will they be delivered?	▪ If your AD plant is intended to use feedstock's from sources other than your own, you will need to identify how often and in what sort of vehicle supplies will be made, in order to identify the potential impact of traffic movements to and from the site. Consider how delivery of feedstock can be managed in terms of timings if there is likely to be disruption in terms of noise and nuisance, particularly where a site is relatively close to residential properties. A Transport Assessment may be required. ▪ Ensure that the site layout has sufficient space for on-site vehicle movements generated as a result of delivery of feedstock's.
Water management, hydrology and flood risk	Are there any watercourses near to the potential site?	▪ You will need to plan protection measures against process failures that might lead to release of high strength liquid waste into the environment. This might require mitigation measures such as bunding to contain leakages. AD plants will need to be compliant with environment legislation, with the appropriate licenses obtained. You are likely to require consent from NRW.
Human Health & quality of life (pests & odours)	Will the plant attract pests? Is there potential from unpleasant odours?	▪ There is potential for impacts on human health related to the storage of waste and pest control, and proposals should seek to ensure that storage facilities take account of this. ▪ Your planning application will need to include information on whether there is potential for odours to be emitted and how this can be mitigated.

Planning issue (See Table 6.2)	Key questions	Points to Consider
Agriculture	Is the AD plant likely to take any agricultural land?	▪ Developments should be well related to existing buildings rather than taking land in agricultural use where associated with existing farm enterprises.
Cumulative Impact	Are there any other anaerobic digesters in the vicinity of your proposed installation?	▪ Check whether there are any other AD units existing or proposed in the vicinity. The potential for cumulative impacts will be particularly important in relation to landscape, visual, historic environment and ecological impacts.
Social considerations / engagement	Where will your fuel supply come from? Have you involved the local community in the development of your project? Have you considered any level of community partnership in association with this AD scheme?	▪ If possible fuel supplies should be sourced locally as this can help to reduce local waste as this minimises transport impacts and can help to reduce the burden on local landfill sites. It can also help to support local businesses that grow feedstock's. ▪ Consider the opportunity to work with a local community through early consultations and discussions in the development of your project (discussions and outcomes can be recorded in the Design and Access Statement/information accompanying the planning application) ▪ Consider whether there is any opportunity for a community partnership and community benefit from the AD scheme. If you have not considered this, would you welcome working with the local community to share some of the risks and benefits to this development?
Decommissioning	Have you planned for removal of the equipment at the end of its lifetime?	▪ Monmouthshire County Council will require decommissioning of technologies and their removal and return of land to its former use where this was productive. It will seek to include conditions on planning consents which require a mechanism and organisation in place to decommission.

Farm scale AD

Image source: **http://www.ambergreenenergy.co.uk/anaerobic-digestion-ad-plant/**

Biomass

Image source: http://www.hotel-magazine.co.uk/hotel-goes-green-to-slas
bills/

Biomass Combustion

Technology Description

Biomass is the term that describes solid fuels coming from biological sources, such as wood and straw. Biomass can also be produced from energy crops such as coppiced trees and energy grasses such as Miscanthus. The term Biofuel is usually used to describe liquid fuels such as oils from oilseeds or bio-alcohols. The usual characteristic of biomass is that the material is dry, not least as this increases the effective energy yield from the material.

Biomass combustion is used to serve heat applications. Biomass for power generation or CHP is dealt with in another section of this SWOT analysis.

Small scale (domestic) combustion of biomass can be in stoves or larger batch fed combustion plant. Batch combustion systems are usually connected to a large insulated water tank that acts as a thermal store to provide day-round heat. These systems tend to burn logs or whole straw bales.

Larger scale combustion systems can be from large domestic to industrial scale. They are typically based on designs similar to traditional coal combustion systems and are fed by pelleted or chipped wood or by chopped straw. They are normally automatic in operation, including fuel feed. Ash production is typically low compared with coal. Matching fuel quality to the specification of the combustion plant is essential in terms of moisture content and particle size. Biomass that is too wet for the design of combustion system can lead to poor air quality, excessive plume, smoke, etc. and material that is over or under size can cause failure of the fuel feed mechanisms.

Biomass energy systems have the capacity to deliver a range of local economic and social benefits associated with fuel supply, especially for smaller combustion systems. This is because wood fuel supply creates a market for otherwise uneconomic woodland management activities such as thinning, removal of poor quality trees, harvesting residues, etc. In effect this means that the value of fuel sales is retained locally and potentially available to deliver these wider benefits.

A typical biomass system comprises a fuel reception/storage facility, a combustor within a building or container and a flue or chimney. Flue gas clean-up to remove particles, etc. is also always included in larger plant.

It can sometimes be more cost effective for biomass heating to take the baseload and to use other systems such as a gas boiler to 'top-up' as required.

Biomass Combustion – SWOT Analysis

Strengths	Weaknesses
▪ Biomass can provide a valuable income from un-merchantable material such as wood harvesting residues, pre-commercial thinning operations, removal of dead trees, etc. ▪ Biomass harvesting can contribute to bringing woodlands back into production and the creation of habitat and biodiversity.	▪ Air quality can be an issue with biomass use that has the capacity to limit uptake. ▪ Solid fuel supply will increase transport movements. ▪ Plant size is large relative to similar plants using fossil fuel systems.

Strengths	Weaknesses
▪ Money spent on biomass fuel is retained within the local supply chain. ▪ Jobs will be created from biomass supply. ▪ Biomass is a baseload energy source. ▪ Biomass fuel costs are not directly linked to oil (as with most fossil fuels) potentially leading to more stable fuel prices into the future.	▪ The need for on-site solid fuel storage adds to land take and cost.
Opportunities	**Threats**
▪ Monmouthshire is a wooded county creating opportunities for fuel supply. ▪ The rural nature of the county makes it ideally placed to create and support a biomass supply infrastructure. ▪ There is an existing forest products industry in South Wales. ▪ Monmouthshire has good access to other potential sources of biomass fuel giving potential to create a larger and thus more sustainable biomass industry. ▪ Biomass can provide income into local woodland management activities further enhancing the attractiveness of the county. ▪ Good opportunities for community owned biomass combustion schemes.	▪ If no credible, dependable fuel supply infrastructure exists then a biomass scheme will not be 'bankable' and cannot be developed. ▪ The large physical size of a biomass system may render it inappropriate for some developments.

Domestic scale biomass boiler

Image Source: http://www.mgrenewables.com/product/Biomass_Systems.html

Biomass Combined Heat and Power (CHP)

Technology Description

Biomass is the term that describes solid fuels coming from biological sources such as wood and straw. Biomass can also be produced from energy crops, such as coppiced trees, and energy grasses, such as Miscanthus. The term Biofuel is usually used to describe liquids fuels, such as oils from oilseeds or bio-alcohols. The usual characteristic of biomass is that the material is dry, not least as this increases the effective energy yield from the material.

Biomass CHP is used to generate electricity and heat applications. Biomass combustion for heat only generation is dealt with in another section of this SWOT analysis.

Biomass CHP is usually only considered at large (MW) scale due to issues around the efficiency of electricity generation; however, as new conversion processes that are capable of operating efficiently at smaller scale become commercialised, this ceiling will fall.

Biomass CHP is achieved either by using combustion systems or so called advanced conversion processes. Combustion systems are based on designs similar to traditional coal combustion systems and can be grate or fluidised bed designs. These are almost all fed by chipped wood or whole bales of straw/energy grasses, with the latter usually progressively fed into the combustion process rather than using a batch fire approach. These combustion processes are used to create steam to drive a turbine using a rankine cycle, the same as in coal fired power plant. Most large scale biomass plants are at the 10's MW scale; however, using organic fluid based heat transfer systems in the rankine cycles can be more effective in smaller scale plant.

Advanced conversion comprises gasification or pyrolysis. In simple terms, these processes burn the fuel in limited oxygen such that the combustion process is stopped at the point of gas formation. This is similar to the way in which 'town gas' was produced from coal prior to the supply of natural gas to our homes. In pyrolysis systems the product is a liquid. These systems have the potential to operate efficiently at far smaller scales, even down to kW levels. This is because the gas or liquid products can also be used in engines or turbines significantly increasing the efficiency of electrical generation.

When operating as CHP, around 2-3 times as much heat is produced as electricity, making the availability of a large, base heat load essential. This is usually serviced using a heat main, also known as a district heating network. In reality, it is the availability of the heat demand which dictates the economic viability of a CHP system.

A typical biomass system comprises a fuel reception/storage facility, a combustor within a building or container and a flue or chimney. Associated plant such as for water purification where steam is being generated will also be required. Flue gas clean-up is also always included. Unless the heat demand within the CHP application can guarantee that all of the heat will be used as soon as it is generated, then a cooler/condenser unit will be required as a heat sink. These are unlikely to comprise traditional cooling towers but instead will use systems in which fans draw air through a 'radiator' system.

Biomass CHP – SWOT Analysis

Strengths	Weaknesses
▪ Biomass can provide a valuable income from un-merchantable material such as wood harvesting residues, pre-commercial thinning operations, removal of dead trees, etc. ▪ Biomass harvesting can contribute to bringing woodlands back into production and the creation of habitat and biodiversity. ▪ Money spent on biomass fuel is retained within the local supply chain. ▪ Jobs will be created from biomass supply. ▪ Biomass is a baseload energy source. ▪ Biomass fuel costs are not directly linked to oil (as with most fossil fuels) potentially leading to more stable fuel prices into the future.	▪ Traditionally biomass CHP plant are by their very nature very large, although smaller plant are becoming available. ▪ Solid fuel supply will significantly increase transport movements. ▪ The fuel supply requirements of a large scheme will likely exceed the capacity of the may limit the capacity to supply smaller heat-only projects. ▪ Air quality is an issue with any combustion process. ▪ The limited availability of large, constant heat loads restricts the uptake of any CHP system. ▪ If coolers are required to dissipate unwanted heat this will add to cost and the parasitic electrical load. Issues with noise may also result.
Opportunities	**Threats**
▪ Monmouthshire is a wooded county creating opportunities for local fuel supply. ▪ The rural nature of the county makes it ideally placed to create and support a biomass supply infrastructure. ▪ There is an existing forest products industry in South Wales. ▪ Constant heat loads can be serviced by a CHP, giving the increased benefit of electricity generation ▪ Monmouthshire has good access to other potential sources of biomass fuel giving potential to support a larger biomass CHP plant.	▪ If no credible, dependable fuel supply infrastructure exists then a biomass scheme will not be 'bankable' and cannot be developed. ▪ The large physical size of a biomass system may render it inappropriate for some locations. ▪ The increasing thermal efficiency of new buildings makes new development an increasingly unviable option as a heat load restricting the uptake of CHP systems in new developments.

The Technology – Spatial Elements

- For small scale domestic biomass heating systems, structures will be internal apart from the flue/chimney required (which is where there may be a planning implication). For larger schemes including most biomass CHP, there will be a combination of buildings and space for storage and access for delivery of the biomass used. This means that biomass CHP can be quite industrial looking. There is no standard number or size of buildings and storage space needed. It will depend on the extent of energy output. A particular consideration with biomass CHP is whether preparation of the biomass fuel (to bring fuel to the right moisture content for use, for example) is required and whether this will be done on-site or elsewhere. On-site fuel storage will be required however, with the size of the storage facility dictated by operational considerations.

- Biomass heat systems are suitable for domestic and non-domestic uses. They are well suited to rural locations as an alternative to fossil fuels (which are either absent or costly). They can be used to drive industrial processes. Individual biomass heat systems can be used as the individual property /business level.

- Biomass CHP is larger scale and could be used to support heat and electricity needs in both residential and non-residential developments. An important consideration at all scales is the sourcing of biomass fuel; what will be used, where will it be sourced and will it be regularly and reliably available. This is important as biomass systems are specified to the fuel source that is used and if alternative biomass fuels are used this can cause problems in functioning of the system.

Planning Permission and Other Consents

Planning permission is likely to be required for biomass heating and CHP systems. However, small scale domestic biomass heating installations may not require planning permission. The diagram on the following page sets out the need for planning permission and other consents. Permissions and consents should be applied for in parallel to ensure that there are no delays in taking projects forward. It is advisable to contact NRW at the earliest opportunity if you think you need their permission, consent or license for your project. There are varying statutory deadlines depending on the permit, consent or licence you apply for (see **Appendix 7**).

Section 6.4 gives guidance on how your application will be assessed and the kinds of issues you need to consider in preparing your application. In addition, you will need to consider the issues in the table below, which relate specifically to Biomass combustion and CHP.

Key issues in assessing planning applications are likely to be:

- Visibility issues and impacts on landscape and townscape, particularly in historic areas. Mitigating the impact of buildings and in particular flues (even on domestic scale projects) will be important;
- Traffic and noise associated with delivery of feedstock's;
- Noise from plant operation – noisy elements such as the air cooling condenser should be located away from sensitive areas; and
- Air quality – emissions from plant operation and odour from some biomass fuels.

Examples of Biomass proposals in Monmouthshire can be found on the Eco Open Doors website: **http://www.monecoopendoors.org.uk/** . Many of these schemes are small scale or domestic in nature and the web site includes contact details for property owners.

Getting Consents: A Summary of the Process

Planning Permission

Is your installation for a domestic property and are you applying as an individual householder?

Yes

Installation could be permitted development if within the limits set out in **A1 (Appendix 6)**. If these limits are exceeded planning permission will be required.

No

Planning permission will be required

Trees

Tree Preservation Orders (TPO):
If you plan to fell or do any works to trees you should check whether they are covered by a TPO (**Appendix 7** for contacts)

Conservation Areas:
If you plan to fell or do any works to trees in a Conservation Area you need to inform the Planning Department in writing 6 weeks beforehand (**Appendix 7** for contacts)

Listed Building Consent

Is your site within a Listed Building or within the curtilage (garden/boundary) of a Listed Building?

Check with the Heritage Team **(para 5.2.2)**

Yes

Listed Building consent may be required if your proposal includes alterations to existing structures/ Buildings.

No

Listed Building consent will not be required.

Building Regulations

Building regulations approval may be required.

NRW Consent

NRW regulate the burning of biomass in appliances with a rated thermal input of 50MW and above or if the biomass is classed as waste a rated thermal input of 3MW and above. Any proposal below the above criteria may still require a permit from the Local Authority.

Biomass – Site Selection and Planning Issues

This table should be read in conjunction with **Table 6.2**:

Planning issue (See Table 6.2)		Points to Consider
Landscape sensitivity, character and visual impact	Will the Biomass plant be located in a designated landscape (see **Appendix 8**) Have you considered the visibility of the site in its wider setting?	▪ Very careful consideration of siting within the landscape will be required if you are considering a biomass plant at anything larger than domestic scale in the Wye Valley AONB or on the edge of the Brecon Beacons National Park. ▪ If you are installing biomass heating in a domestic property where planning permission is required (and even if not required) then consider the impact of the flue that you will require; will it be visible in the landscape? ▪ Consider how to reduce visual impact by use of screening or selection of colour and type of materials. Ensure that buildings are not in the direct line of vision of neighbouring properties. The height of the flues will be an important consideration. ▪ Consider whether there will be a wider impact on the townscape character of an area from a biomass plant if located in or on the edge of settlements; and if so, how this can be minimised by careful siting and screening.
Ecology	Could the Biomass plant affect ecological habitats or species? (see **Appendix 8** for designations)	▪ If the Biomass plant is proposed near to a designated or sensitive ecological area, impacts on species from delivery and storage of feedstock's should be avoided. ▪ Consideration of habitats and species on site will also be important. Schemes should be designed to avoid habitat loss or disturbance from emissions or noise, either through careful siting or as part of re-creation of habitats within the overall development.
Historic Environment	Is the site within a designated area / site of historic interest? (see **Appendix 8** for designations)	▪ At sites of Listed Buildings or SAM's, smaller, domestic scale schemes well integrated with the site in terms of building design or screening are more likely to be acceptable. ▪ If you are located in or on the edge of a Conservation Area, the visual impact of flues will be important and should preserve or enhance the character of the area. This is true for domestic properties as well as CHP plants.
Access and servicing	What feedstock's will you be using, where will these be sourced and how often will they be delivered? What kind and size of vehicle will be used?	▪ The potential impact from delivery of biomass feedstock's will need to be considered. For larger plant you will be expected to provide information on numbers and regularity of deliveries to the plant and consider what the impact of traffic generation will have on surrounding properties and on the road network. (A Transport Assessment may be required) ▪ Ensure that the road network to the potential site is capable of taking the level of traffic likely to be generated in terms of delivery of biomass feedstock. ▪ Ensure that the site layout has sufficient space for on-site vehicle movements generated as a result of deliveries
Human health and quality of life (air quality)	Will any plume of smoke be emitted from the process?	▪ Careful siting of flues/chimneys will be important in relation to factors such as prevailing wind conditions, to minimise any adverse impacts from emissions on nearby properties. You should check with the equipment supplier whether any licences or

Planning issue (See Table 6.2)		Points to Consider
		permissions are required for your installation. Impacts may vary with weather and seasons.
Cumulative Impact	Are there any other Biomass plants (or similar – e.g. Energy from Waste) in the vicinity of your proposed installation?	▪ Check whether there are other Biomass plants existing or proposed in the vicinity. The potential for cumulative impacts (including from Energy from Waste and Gas CHP plants) will be particularly important in relation to the visual impact of flues on landscape or townscape.
Social considerations / engagement	Where will your fuel supply come from?	▪ If possible fuel supplies should be sourced locally as this can help to reduce local waste as this minimises transport impacts and can help to reduce the burden on local landfill sites. It can also help to support local businesses that grow feedstock's. Biomass energy has great potential to return economic benefit to the local community from local fuel supply. Note that woodland thinning requires a licence from the (Natural Resources Wales NRW) (Appendix 7). Consent is also required from NRW for afforestation projects such as short rotation coppice or forestry above certain thresholds.
	Have you involved the local community in the development of your project?	▪ Consider the opportunity to work with a local community through early consultations and discussions in the development of your project (discussions and outcomes can be recorded in the Design and Access Statement/information accompanying the planning application)
	Have you considered any level of community partnership in association with this Biomass scheme?	▪ Consider whether there is any opportunity for a community partnership and community benefit from the AD scheme. If you have not considered this, would you welcome working with the local community to share some of the risks and benefits to this development?
Decommissioning	Have you planned for removal of the equipment at the end of its lifetime?	▪ Typically the time-expired boiler and associated ancillary equipment will be disposed of as scrap metal – in the same way as other CHP or boiler systems. ▪ There are unlikely to be any issues with hazardous waste.

Retrofitted biomass boiler and fuel store at Roden Dogs Trust, Shrewsbury

Image source: **http://organicenergy.wordpress.com/**

Energy from Waste

monmouthshire
sir fynwy

Image source: http://www.nce.co.uk/awards/bci-awards/bci-awards-2009
civils/5207821.article

Energy from Waste

Technology Description

Energy from Waste describes the process whereby waste is disposed of by combustion or thermal processing and energy is captured from the process, normally in the form of electricity. CHP becomes an option where a suitable heat load exists.

Waste combustion is normally undertaken in plant based on coal combustion equipment. The Waste Incineration Directive (WID) legislation is implemented through Environmental Permitting Regulations in Wales and ensures that the combustion process is efficient and leads to no harmful emissions. However, the cost of compliance of the WID tends to favour larger (district scale) combustion plant.

In the past, most energy from waste plants were so called 'mass burn' incinerators, where the entire amount of waste collected was burnt normally after the removal of metal and glass. These days, the increase in recycling and the increased commodity values associated with recovered materials from recycling means that these materials are removed prior to combustion. This means that most plastic, paper and card is removed from the waste stream for recycling and is not burnt.

As a result, energy from waste plants are now smaller and not based on mass burn approaches. In addition, it is normal to have a recycling facility associated with the energy facility to specifically remove recyclates prior to combustion of the residual material. These smaller plants are ideal for advanced conversion processes, which include gasification and pyrolysis. In simple terms, these processes burn the waste in limited oxygen such that the combustion process is stopped at the point of gas formation. In pyrolysis systems the product is a liquid. Other advanced technologies such as those based on plasma are also now available. One benefit of advanced conversion plant is that they have the potential to operate commercially at town scale.

Energy from waste is an essential element of any zero waste to landfill strategy, as there will always be material which cannot be recycled for reasons of non-hazardous contamination, poor quality or lack of a ready market.

When operating as CHP, around 2-3 times as much heat is produced as electricity making the availability of a large, base heat load essential. This is usually serviced using a heat main, also known as a district heating network. In reality, it is the availability of the heat demand which dictates the economic viability of a CHP system.

As described above, most energy from waste plants are co-located with a Municipal Recycling Facility (MRF) to separate out the recyclable materials leaving only the non-recyclable combustible fraction to be used for energy. In addition to the MRF, a typical waste to energy plant comprises a fuel reception/storage facility, a combustor within a building or container and a flue or chimney. Flue gas clean-up is also always included. Unless the heat demand within the CHP application can guarantee that all of the heat will be used as soon as it is generated, then a cooler/condenser unit will be required as a heat sink. These are unlikely to comprise traditional cooling towers but instead will use systems in which fans draw air through a 'radiator' system.

Energy from Waste – SWOT Analysis

Strengths	Weaknesses
▪ Energy from waste is an essential element of a zero waste to landfill policy providing re-use of combustible materials that cannot be recycled. ▪ The WID Directive ensures that energy from waste is a clean process. ▪ The payment of a gate fee to dispose of waste can make energy from waste a commercially attractive option. ▪ Is a baseload technology. ▪ Underpins a zero waste to energy strategy.	▪ Until small (kW) scale energy from waste plant become generally available only large scale, stand-alone applications will be possible. ▪ Energy from waste requires long term waste supply contract and the involvement of a waste contractor, so it is inappropriate for a community based scheme. ▪ Transport of fuel can create local issues. ▪ If coolers are required to dissipate unwanted heat this will add to cost and the parasitic electrical load. Issues with noise may also result.
Opportunities	**Threats**
▪ Waste is ubiquitous as is the need to manage it in an acceptable way making waste effectively a 'constant' supply option (subject to legislation). ▪ The advent of technology that can support smaller scale applications. ▪ Annual increases in landfill tax will make this an increasingly attractive option compared to landfill. ▪ Increasing transport costs will make small, localised energy from waste systems based on advanced conversion processes.	▪ Continued poor perception of energy from waste based on 1970's incineration plant performance reduces public acceptance. ▪ EU waste legislation has the potential to impact on the future availability of feedstock for energy generation.

The Technology – Spatial Elements

- A combination of components is required in energy from waste system. In addition to the combustion system and fuel store these include fuel pre-processing, flues/chimneys, possible water treatment plant store/pump if heat needs to be moved. And a cooling tower/air blast condenser system if the heat produced is not all used beneficially. While usually these are housed in a single building, multiple building configurations are also possible. These can appear industrial in nature.

- Energy from Waste can be used in relation to waste from domestic and non-domestic uses, it could be appropriate for new residential, including, potentially the strategic sites identified in the LDP given the level of waste that might be generated. However, it is most likely to be used as part of an industrial process or development.

- As noted above Energy from Waste Plants are often associated with municipal recycling facilities

Planning Permission and Other Consents

Planning permission is required for energy from waste plants. The diagram on the following page sets out the need for planning permission and other consents. Permissions and consents should be applied for in parallel to ensure that there are no delays in taking projects forward. It is advisable to contact NRW at the earliest opportunity as their consents can take some time to obtain (see Appendix 7).

Section 6.4 gives guidance on how your application will be assessed and the kinds of issues you need to consider in preparing your application. In addition, you will need to consider the issues in the table below, which relate specifically to Energy from waste plants.

Getting Consents: A Summary of the Process

Planning Permission

Planning permission is required.

Listed Building Consent

Is your site within a Listed Building or within the curtilage (garden/boundary) of a Listed Building?

Check with the Heritage Team (**para 5.2.2**).

Yes

Listed Building consent may be required if your proposal includes alterations to existing structures/ buildings.

No

Listed Building consent will not be required.

Building Regulations

Building regulations approval may be required. Consult with Building Control **(Appendix 7)**

NRW Consent

You will require consent from NRW.

You may also need consent if your site is a SSSI or affects protected species.

Trees

Tree Preservation Orders (TPO):
If you plan to fell or do any works to trees you should check whether they are covered by a TPO (**Appendix 7** for contacts).

Conservation Areas:
If you plan to fell or do any works to trees in a Conservation Area you need to inform the Planning Department in writing 6 weeks beforehand (**Appendix 7** for contacts).

Key issues in assessing planning applications are likely to be:

- Visibility issues and impacts on landscape and townscape, particularly in sensitive areas. Mitigating the impact of buildings and in particular flues (even on smaller scale projects) will be important. Plants can look quite industrial and so are best suited to areas which are less visually sensitive. (e.g. existing industrial areas, or well screened sites);
- Potential for impacts on human health and environment from pollution due to emissions, noise, odour and pest issues from waste storage, and leakage into groundwater. This may be more about public perception than actual risk, and so this needs to be addressed at an early stage;
- Discussions with community and stakeholders need to be opened early on in the process to address and avoid any misconceptions about the plant and its likely impacts and to help avoid and mitigate any impacts;
- Traffic and transport issues associated with deliveries; and
- The role of the plant in the waste hierarchy needs to be identified – beneficial re-use and recycling of waste should take priority over combustion of waste as an energy solution.

Energy from Waste – Site Selection and Planning Issues

This table should be read in conjunction with Table 6.2:

Planning issue (See table 6.2)		Points to Consider
Landscape sensitivity, character and visual impact	Will the energy from waste plant be located in a designated landscape? (Appendix 8) Have you considered the visibility of the site in its wider setting?	▪ If you are considering a plant in the Wye Valley AONB or on the edge of the Brecon Beacons National Park then siting and design of the building will be particularly important. Early consultation with a landscape officer is recommended in order to address the potentially significant impact of large facilities. ▪ In any location, visual impact on surrounding properties, landscape setting and townscape character will be a key issue. Design, colour, materials and screening and on-site boundary treatment will all be important. ▪ If the Energy from Waste plant is part of a strategic site, its location within the overall scheme from a visual perspective is an essential consideration and it is likely that it may be better located within/adjacent industrial uses, given the industrial nature of this type of development.
Ecology	Could the energy from waste plant affect ecological habitats or species? (see Appendix 8)	▪ Refer to Table 6.2
Historic Environment	Will the energy from waste plant be located in within a designated	▪ Proposals close to or on the site of Listed Buildings or other designated historic sites should avoid any visual or other impacts on those buildings or sites. The relationship between the plant and the setting of

Planning issue (See table 6.2)		Points to Consider
	area/site of historic interest? (see Appendix 8)	any Listed Buildings will be important considerations, and mitigation measures through design and screening are likely to be required. Larger plants are likely to be more difficult to accommodate in a way which is acceptable. ▪ If there is to be trenching associated with the plant, then archaeological investigations may need to take place before any groundwork's are undertaken.
Access and servicing	What waste products will you be using, where will these be sourced and how often will they be delivered? What kind and size of vehicle will be used?	▪ Identify where waste materials will be sourced from, how often and in what sort of vehicle supplies will be made, in order to identify the potential impact of traffic movements to and from the site. Consider how delivery of waste can be managed in terms of timings if there is likely to be disruption in terms of noise and nuisance, particularly where a site is relatively close to residential properties. ▪ Ensure that the road network is capable of taking the level of traffic likely to be generated in terms of delivery of waste. ▪ Ensure that the site layout has sufficient space for on-site vehicle movements generated as a result of delivery of waste.
Water management and Hydrology	Are measures being taken to avoid pollution of groundwater and local water courses?	▪ Consider potential for heat and chemical pollution from underground pipe systems. Appropriate measures should be put in place during the construction phase to prevent contamination.
Human Health and Quality of life (Noise, air quality, odour and pest control)	Do you expect any plume, smoke or odour to be produced from the process? Will there be issues of pest control that could cause local nuisance?	▪ The operation of the Energy from Waste plant should comply with the EU Waste Incineration Directive and consent will be required from NRW. The planning application will need to demonstrate that these would be met. ▪ Consider how you will ensure that your buffer store of waste fuel does not harbour pests.
Cumulative impacts	Are there other Energy from Waste or similar (e.g. Biomass) plants in the vicinity?	▪ Check whether there are other Energy from waste or similar plants existing or proposed in the vicinity (e.g. biomass, Gas CHP) The potential for cumulative impacts is greatest in relation to the visual impact of flues on landscape or townscape.
Social considerations / engagement	Have you considered opportunities to sell heat or power to nearby communities?	▪ Consider the potential of strategic sites identified in the LDP for Energy from Waste plants – operations could be located close to new residential communities. It may be possible to work with the developer to provide a district heating network. In addition, bringing communities on board early can be of benefit to all and reduce opposition to the scheme. Heat could be sold at an attractive price to communities, whilst still making a profit for the operator. Early discussions with community and developers are important. (discussions and outcomes can be recorded in the Design and Access Statement/Environmental Statement accompanying the planning application).
Decommissioning	Have you planned for removal of the equipment at the end of its lifetime?	▪ Typically the time-expired boiler and associated ancillary equipment will be disposed of as scrap metal, as with any heating or CHP system.

Tyseley energy from waste plant – Birmingham.

Image source: **http://openbuildings.com/buildings/tyseley-energy-from-waste-plant-profile-24123**

Fuel Cells

Image source: courtesy of Ballard Power Systems Inc

Fuel Cells

Technology Description

A fuel cell is a device that converts the chemical energy present in a fuel into electricity by using a chemical reaction involving oxygen or another oxidizing agent, with water or CO_2 created depending on the nature of the fuel. In this regard, the process is similar to combustion which also involves the oxidation of a fuel to release energy along with water or CO_2 but, in the case of combustion, the form of energy produced is mainly heat.

There are many types of fuel cells but they all comprise an anode (negative side), a cathode (positive side) and an electrolyte that allows charges to move between the two sides of the fuel cell. In some designs, the electrolyte itself creates the separation between the anode and cathode, in others a membrane is used.

Hydrogen, hydrocarbons such as natural gas and alcohols like methanol can all be used as fuel sources but the fuel cell is designed to use only a single fuel source. Where the hydrogen alcohol or gas is from a renewable source, then the fuel cell system will itself become a renewable energy technology. In most power generation applications, solid oxide fuel cells are used, not least as these can run on natural gas.

The main advantage of fuel cells is that as the chemical process produces electricity as the main product, the efficiency of fuel use is very high. As the balance of heat and electricity output better favours electricity, the lower levels of heat produced match a wider range of heat load demands thus increasing the market for CHP applications from fuel cells.

Fuel cells can range in output from kW to MW, with typically larger output systems comprising banks of smaller fuel cells.

Fuel cells are typically also much smaller than conventional CHP systems and do not require a flue system, making the typical fuel cell installation no more than a simple container. It can sometimes be more cost effective for fuel cells to take the baseload and to use other energy to ‘top-up’ as required.

Fuel Cells – SWOT Analysis

Strengths	Weaknesses
▪ High efficiency of fuel conversion. ▪ Small size. ▪ Baseload generation. ▪ Can operate at a wide range of scales. ▪ Can operate from readily available fuels such as natural or liquefied gas. ▪ No emissions issues and no flues are required. ▪ Silent in operation. ▪ Flexible locations. ▪ Fuels are typically high density and liquids or gases, removing fuel storage issues.	▪ Only a low carbon technology unless the fuel can be created from a renewable resource. ▪ Until in volume production, costs will be high. ▪ The best fuel for a fuel cell is hydrogen, but this will require a new fuel infrastructure to be created.
Opportunities	**Threats**
▪ Capable of operating at the domestic scale, right up to community scale if required. ▪ Can support CHP operation. ▪ The low impact nature of the technology and flexibility of location make it applicable to a very wide range of applications.	▪ The technology is just entering full commercialisation leading to perceived risk. ▪ Longevity of the cells over decades has yet to be demonstrated.

The Technology – Spatial Elements

- Fuel cells are small units and are likely to be internally situated, especially where they are used on an individual basis. If banks of fuel cells are used in a development they may be externally situated and this is where spatial implications might arise.

- Fuel cells could be used in domestic and non-domestic situations. As they are in early stages of development, there is limited experience of their use in different types of development.

Planning Permission Requirements

Planning permission is required for non-domestic fuel cell plants, and may be required for individual domestic installations. The diagram on the following page sets out the need for planning permission and other consents. Permissions and consents should be applied for in parallel to ensure that there are no delays in taking projects forward. It is advisable to contact NRW at the earliest opportunity as their consents can take some time to obtain (see Appendix 7).

Section 6.4 gives guidance on how your application will be assessed and the kinds of issues you need to consider in preparing your application. In addition, you will need to consider the issues in the table below, which relate specifically to Fuel Cells. Key issues in assessing planning applications are likely to be:

- Visibility issues and impacts on townscape, particularly in historic areas.

Getting Consents: A Summary of the Process

Planning Permission

Is your installation for a domestic property and are you applying as an individual householder?

- **Yes** → Is your installation completely inside the property?
  - **Yes** → Planning permission will not be required.
  - **No** → Will the installation be attached to the property?
    - **Yes** → Planning permission is likely to be required.
    - **No** → If you propose to house one or more fuel cells in an outhouse, this may not require planning permission.
- **No** → Planning permission is required.

Fuel cells are a new technology so requirements for planning permission may change – you should check with the planning department (**para 5.2.2**).

Listed Building Consent

Is your site within a Listed Building or within the curtilage (garden/boundary) of a Listed Building?

Check with the Heritage Team (**para 5.2.2**)

- **Yes** → Listed Building consent may be required if your proposal includes alterations to existing structures/ buildings.
- **No** → Listed Building consent will not be required.

Trees

Tree Preservation Orders (TPO):
If you plan to fell or do any works to trees you should check whether they are covered by a TPO (**Appendix 7** for contacts).

Conservation Areas:
If you plan to fell or do any works to trees in a Conservation Area you need to inform the Planning Department in writing 6 weeks beforehand (**Appendix 7** for contacts).

Building Regulations

Building regulations approval will be required.

NRW Consent

You may need consent if your site is a SSSI or affects protected species.

Fuel Cells – Site selection and Planning Issues

This table should be read in conjunction with **Table 6.2**:

Planning issue (See table 6.2)		Points to Consider
Landscape sensitivity, character and visual impact	Will the fuel cell installation be located in a designated landscape? (**Appendix 8**) Have you considered the visibility of the site in its wider setting?	▪ If you are considering a bank of fuel cells, you will need to consider the impact on the landscape setting. The size of individual fuel cells is such that any landscape issues are likely to be minimal. ▪ Installations on buildings should be avoided at the front or sides of properties facing onto a road, to minimise visual impact and any wider impacts on townscape character. ▪ If the installations will be visible consider ways in which you can minimise this e.g. by screening, design or colour.
Historic Environment	Is the site / building within a designated area / site of historic interest? (**Appendix 8**)	▪ Installations on Listed Buildings should be located so as to avoid any impacts on the character of the building. ▪ If your installation is in a Listed Building or within its curtilage, Listed Building Consent will be required.
Access and servicing	Will any routine access be required to any part of the system? Will you need to deliver fuel by road to the system?	▪ Where fuel cells are using anything other than mains supplied natural gas, consider how access for delivery of fuel for fuel cells will be achieved with minimum disruption. What type of vehicle and how many vehicle movements will be involved? This consideration may affect where you can locate installations within your site.
Cumulative impacts	Are there other fuel cells in your area?	▪ Check whether there are other externally located fuel cells within the immediate vicinity. Given the scale of fuel cells, cumulative impacts are more likely to be an issue at townscape level, rather than in relation to landscape setting.
Decommissioning	Have you planned for removal of the equipment at the end of its lifetime?	▪ Depending on the nature of the fuel cells, specialist disposal to appropriate recycling facilities may be required.

Gas CHP

Image: Gas CHP system linked to a District Heating network at a leisure centre.
source: http://www.tecogen.com/our-customers-recreational-facilities.htm

Gas CHP (Including Micro CHP)

Technology Description

While fossil (natural) gas is not a renewable energy, using it to fuel a CHP system is considered to be low carbon in that it captures and makes beneficial use of the heat produced in the electricity generation process. This heat is typically lost from large power stations.

Micro CHP systems are typically targeted at domestic scale application of a few KWe. They can comprise very small gas engines of the kind described below but, increasingly, the capacity to generate electricity is incorporated into the domestic gas boiler. Typically technology such as the Stirling engine is employed to deliver this outcome. The Stirling engine is based on external combustion, where a heat source external to the engine (in this case the gas combustion process) expands a transfer medium which drives a piston and turns a micro generator. These systems generate electricity opportunistically when the heating boiler is operating rather than being led by the electrical demand. However, they can provide a direct replacement for the domestic heating boiler.

Outside of the micro technology area, there are two main technology options for gas CHP systems. At smaller scale (up to around 5MWe) gas fired internal combustion engines are often used linked to an appropriate alternator systems. Heat is recovered from the engine water jacket and the exhaust system. These gas engines are highly efficient compared with steam cycle based generation systems and can also be scaled to kW sizes.

Larger systems tend to use gas turbines, although micro-gas turbines are available and are in use. The exhaust heat from the turbine can either be captured in a heat recovery boiler system to service a heat market, or used to drive a second turbine, with the remaining thermal energy captured in a heat recovery boiler.

Clearly, access to a good gas supply is essential in all cases.

A typical gas CHP system comprises a gas infeed/control system, the prime mover (an engine or turbine) and alternator or generator. Larger systems where the heat demand within the CHP application cannot provide a guarantee that all of the heat will be used as soon as it is generated, then a cooler/condenser unit will be required as a heat sink. These are unlikely to comprise traditional cooling towers but instead will use systems in which fans draw air through a ‘radiator’ system.

Gas CHP (including micro CHP) – SWOT Analysis

Strengths	Weaknesses
▪ Is a well-developed and low cost technology. ▪ Fuel supply is not seen as a risk. ▪ Well established technology supply chain. ▪ Efficient use of gas fuel, especially compared with large gas fired power stations. ▪ The scalability of the technology makes it potentially applicable to a number of situations.	▪ Not a renewable technology. ▪ The carbon performance of the technology relative to renewables is poor, making it a poor option to meet increasingly tight carbon compliance in new build situations. ▪ As with any combustion process, there is potential to impact on air quality.
Opportunities	**Threats**
▪ Constant heat loads can be serviced by a CHP, giving the increased benefit of electricity generation. ▪ A retrofit option (especially at the micro scale). ▪ Small footprint makes it applicable to town centre and other 'tight' locations.	▪ More gas is being imported and the world price of gas is linked to the price of oil. The benefit of CHP is often down to the cost advantage of electricity compared to gas. Where this is eroded by rising gas prices, schemes can quickly become unviable. ▪ Is likely to become less competitive compared with renewables where renewables are subsidised.

The Technology – Spatial Elements

- At the small scale, the main spatial implication of gas CHP will be external flues/chimneys; other equipment is likely to be internal to the property. At the large scale there may be a requirement for buildings to house large scale combustion systems, boilers, turbines and cooler/condensers (if heat has to be stored) depending on the system used, making it quite an industrial looking development . Access to a reliable gas supply is essential meaning that in some rural locations without mains gas access, this technology is not an option.

- Gas CHP is suitable for domestic and non-domestic uses at the building scale. Larger gas CHP plants can be used to supply specific users or developments where there is a known heat demand.

- Gas CHP applies at the small building scale and the large scale and could be appropriate for new developments including strategic sites proposed in the LDP.

Planning Permission Requirements

Planning permission is required for non-domestic externally located and stand-alone Gas CHP systems. The diagram on the following page sets out the need for planning permission and other consents. Permissions and consents should be applied for in parallel to ensure that there are no delays in taking projects forward. It is advisable to contact NRW at the earliest opportunity as their consents can take some time to obtain (see **Appendix 7**).

Section 6.4 gives guidance on how your application will be assessed and the kind of issues you need to consider in preparing your application. In addition, you will need to consider the issues in the table below, which relate specifically to Gas CHP.

Key issues in assessing planning applications are likely to be:

- Visibility issues and impacts on landscape and townscape, particularly in historic areas. Mitigating the impact of buildings and in particular flues (even on domestic scale projects) will be important; and

- Noise from plant operation – noisy elements should be located away from sensitive areas.

Getting Consents: A Summary of the Process

Planning Permission

Is your installation for a domestic property and are you applying as an individual householder?

- **Yes** → Is your installation completely inside the property?
  - **Yes** → Planning permission will not be required.
  - **No** → Installation could be permitted development if within the limits set out in **Appendix 6**. If these limits are exceeded planning permission will be required.
- **No** → Planning permission is required.

Listed Building Consent

Is your installation on a Listed Building or within the curtilage (garden/boundary) of a Listed Building? Check with the Heritage Team (**para 5.2.2**).

- **Yes** → Listed Building consent may be required if your proposal includes alterations to existing structures/ buildings.
- **No** → Listed Building consent will not be required.

Building Regulations

Building regulations approval will be required.

NRW Consent

Consent from NRW may be required (see **Appendix 7**).

You may also need consent if your site is a SSSI or affects protected species.

Trees

Tree Preservation Orders (TPO):
If you plan to fell or do any works to trees you should check whether they are covered by a TPO (**Appendix 7** for contacts).

Conservation Areas:
If you plan to fell or do any works to trees in a Conservation Area you need to inform the Planning Department in writing 6 weeks beforehand (**Appendix 7** for contacts).

Gas CHP – Site Selection and Planning Issues

This table should be read in conjunction with **Table 6.2**:

Planning issue (See table 6.2)		Points to Consider
Landscape sensitivity, character and visual impact	Will the Gas CHP plant be located in a designated landscape? (**Appendix 8**) Have you considered the visibility of the site in its wider setting?	▪ Very careful consideration of siting within the landscape will be required if you are considering a gas CHP in the Wye Valley AONB or on the edge of the Brecon Beacons National Park. ▪ If you are installing CHP heating in a domestic property where planning permission is required (and even if not required) then consider the visual impact of the flue that you will require. ▪ Gas CHP needs to be located so as to minimise visual impact on surrounding properties and the wider townscape. Ensuring that buildings and flues are not in the direct line of vision of neighbouring properties or taking mitigation steps such as screening/planting to reduce visibility or using colour of construction materials will be important.
Ecology	Could the Gas CHP affect ecological habitats or species? (**Appendix 8**)	▪ Consideration will be needed in relation to potential adverse impacts on nearby sites as a result of any emissions from flues/chimneys.
Historic Environment	Will the in Gas CHP be located within a designated area / site of historic interest? (**Appendix 8**)	▪ At sites of Listed Buildings or SAM's, smaller, domestic scale schemes well integrated with the site in terms of building design or screening are more likely to be acceptable. ▪ Visual impact will need to be considered for small scale installations and their flues/chimneys as well as larger installations). ▪ If your installation is in a Listed Building or within its curtilage, Listed Building Consent will be required.
Human health and quality of life (air quality)	Will any smoke be emitted from the process?	▪ Careful siting of flues / chimneys will be important in relation to factors such as prevailing wind conditions, to minimise any adverse impacts from emissions on nearby properties. Impacts may vary with weather and seasons.
Cumulative impacts	Are there other CHP plants (or similar) in the vicinity of your installation?	▪ Check whether there are any other CHP plants / installations existing or proposed in the vicinity. (Biomass and Energy from Waste plants should also be considered). The potential for cumulative impacts will be particularly important in relation to landscape, visual and historic environmental impacts.
Social considerations / engagement	Have you involved the local community in the development of your project?	▪ By consultation with the community close to any new development it might be possible to identify a heat demand that will make CHP commercially viable to the benefit of all involved. ▪ Consider the opportunity to work with a local community through early consultations and discussions in the development of your project (discussions and outcomes can be recorded in the Design and Access Statement/information accompanying the planning application).
Decommissioning	Have you planned for removal of the equipment at the end of its lifetime?	▪ Typically the time-expired boiler and associated ancillary equipment will be disposed of as scrap metal, as with any boiler or CHP system.

Schematic of a domestic gas CHP system

Micro gas CHP

5kW Small scale CHP

Image source: **http://www.baxi-senertec.co.uk/documents/Sales_brochure_July_2010.pdf**

Hydroelectricity

Cover Image: Archimedes Screw system at Shane's Castle, Randalstow
Antrim

Source: http://ecoevolution.ie/blog/category/small-scale-hydro/

monmouthshire
sir fynwy

Hydroelectricity

Technology Description

Water is heavy, dense and cannot be compressed. When moving in rivers or other locations, the force of the water flow can be harnessed for energy. This has been well understood for centuries making hydro power a traditional energy source.

Hydropower schemes all comprise a turbine system that is designed to capture the energy in the water and use it to turn a turbine. Large (MW scale) hydropower schemes comprise a dam to hold back water and to create a head and a turbine through which water moves to drive a generator. It is highly unlikely that new dams will be created solely to generate energy. Instead, low head, or 'run of river' schemes are the options of choice.

In the past, most hydropower schemes involved the installation of a separate water collection device (usually called a penstock) which comprised a sluice or gate or intake structure that controls water flow, or an enclosed pipe that delivers water to turbine. These required what could be significant engineering activities and delivered water typically to a Kaplan type turbine in which internal fin arrangements capture water energy within a housing to turn a generator. The issue with these devices is that they can be damaging to fish and other wildlife, requiring extensive by-pass arrangements to be put in place. These can be costly and can reduce the available flow of water to the turbine.

Other options involve the use of Archimedes screws to capture the water energy. These can be mounted singly or in multiple units and typically require less invasive engineering and can also operate in lower head situations. They can also have less damaging impact on fish, although provision for fish and other wildlife is still required. A range of options should be fully considered with an appropriate advisor before selecting an option.

Hydropower schemes therefore comprise a system to direct water into the turbine, the turbine itself and appropriate fish passage or similar.

Hydroelectricity – SWOT Analysis

Strengths	Weaknesses
▪ A renewable technology that can generate electricity to service baseload application. ▪ Proven technology. ▪ Well established supply chain. ▪ Correctly planned, impacts can be minimal.	▪ Electrical connection can be an issue in remote locations, where the cost of connection can make the scheme non-viable. ▪ There are varying statutory deadlines that depend on the environmental permit applied for.
Opportunities	**Threats**
▪ All water outflows, weirs, etc. are potentially suitable for hydro. ▪ Low head applications can be serviced with appropriate technology. ▪ Monmouthshire has the potential for a number of hydro applications. ▪ Man-made water outflows (such as treatment plant) have potential as sites for hydro generation.	▪ Potential impact on environment will remain an issue. ▪ NRW has varying statutory deadlines depending on environmental permits applied for which can lengthen the process. Other requirements such as grid connections can also cause delays.

The Technology – Spatial Elements

- Hydropower schemes use a turbine system to capture energy from water flow. The spatial implications vary depending on whether a traditional Kaplan turbine type of system is used (in which case there are on land requirements for the turbine and water collection/transport devices, a grid connection, as well as devices in the river itself to hold back and create a head of water) or an Archimedes Screw (where all the equipment requirements are based within the water itself and the only on land implication is a connection to the grid supply). The Archimedes Screw system can work effectively where there is less head of water (in gentler gradients of river and without the need for a dam, penstock or other means of delivering water to the turbine). This means it has greater potential for use in more situations, where rivers or other water sources create some weight of water flow.

- Hydroelectric power is suitable for domestic and non-domestic uses. Schemes generally feed directly into the national grid and are not usually associated directly with developments/users. It is nevertheless possible that an individual dwelling could be served by a small hydropower scheme.

- Generally hydropower schemes are standalone schemes. If the circumstances were appropriate for an individual residential or non-residential user located adjacent a water course where an Archimedes screw installation could be made, it might be possible for a hydropower scheme to apply to an individual property.

Planning Permission and Other Consents

Planning permission is required for hydropower schemes along with various permissions, consents and licences from NRW. The diagram on the following page sets out the need for planning permission and other consents. Permissions and consents should be applied for in parallel to ensure that there are no delays in taking projects forward. It is advisable to contact NRW at the earliest opportunity as their consents can take some time to obtain (see **Appendix 7**).

Section 6.4 gives guidance on how your application will be assessed and the kinds of issues you need to consider in preparing your application. In addition, you will need to consider the issues in the table below, which relate specifically to Hydroelectricity.

Key issues in assessing planning applications are likely to be:

- Ecology – Disturbance of aquatic habitats and species is often an issue, and injury or death of fish will have to be avoided. Impact on habitats and species on the river bank is also likely to be an issue for many schemes in rural areas.

- Visibility issues and impacts on landscape may be an issue, although smaller scale schemes often developed in rural areas can often be successfully designed and screened to sit into the landscape.

- Impacts on historic structures such as Listed Buildings and Scheduled Ancient Monuments can be an issue, particularly in areas where there are historic mills, weirs or dams which are related to the project. Industrial archaeology can also be an issue in such areas.

- Riverbanks are often the location of public footpaths, so diversion may be needed.

An example of a hydropower scheme in Monmouthshire can be found on the Eco Open Doors website: **http://www.monecoopendoors.org.uk/** . Many of these schemes are small scale or domestic in nature and the web site includes contact details for property owners.

Getting Consents: A Summary of the Process

Planning Permission

Planning permission is required.

Listed Building Consent

Is you site within the curtilage (garden/boundary) if a Listed Building?

Check with the Heritage Team (**para 5.2.2**).

Yes → Listed Building consent may be required if your proposal includes alterations to existing structures/ buildings.

No → Listed Building consent will not be required.

Building Regulations

Building regulations approval will be required.

NRW Consent

You will require various permissions, consents and licences from NRW.

Trees

Tree Preservation Orders (TPO):
If you plan to fell or do any works to trees you should check whether they are covered by a TPO (**Appendix 7** for contacts).

Conservation Areas:
If you plan to fell or do any works to trees in a Conservation Area you need to inform the Planning Department in writing 6 weeks beforehand (**Appendix 7** for contacts).

Scheduled Ancient Monument Consent

If you are proposing works to the site of a Scheduled Ancient Monument, then consent will be required from Cadw (see **Appendix 7**).

Hydroelectricity – Site Selection and Planning Issues

This table should be read in conjunction with **Table 6.2**:

Planning issue (See table 6.2)		Points to Consider
Landscape sensitivity, character and visual impact	Will the hydropower scheme be located in a designated landscape? Have you considered the visibility of the site in its wider setting?	▪ If you are considering a hydropower scheme in the Wye Valley AONB or on the edge of the Brecon Beacons National Park, size and siting of a potential development will be particularly important planning considerations. (The level of visual impact – and hence the potential acceptability of the scheme is associated with both scale and location). ▪ Hydropower schemes are often located in rural areas. Associated structures with potential for impact include turbine houses, weirs, dams, leats, fencing and power lines. The appearance of waterfalls can also change as a result of water abstraction. Smaller scale operations are likely to be more easily integrated into the landscape with planting to screen structures. ▪ Where buildings cannot be screened, high standards of design and use of materials will help to minimise impacts.
Ecology	Could the plant affect ecological habitats or protected species? (see **Appendix 8** for designations)	▪ Consideration needs to be given to both river bank and the watercourse itself. Careful consideration will be needed in relation to potential adverse impacts related to buildings and structures on the bank or placing of equipment in the watercourse. There is potential for disturbance to aquatic ecosystems and to fish movements, as well as their injury. It is possible that surveys will be required to establish what species are present. Siting should seek to avoid impacts, and if this is not possible mitigate, or compensate. ▪ Specific consideration needs to be given to fish movements up and down the river/watercourse and potential impacts on these. There will be a requirement to incorporate fish passes for any scheme which interrupts fish movement on a watercourse.
Historic Environment	Is the site within a designated area / site of historic interest? (see **Appendix 8** for designations)	▪ There may be opportunities to re-use historic structures such as mills, weirs and dams within hydropower schemes. ▪ Archaeological potential, particularly where there are historic structures such as industrial structures or leat systems in the area, will need to be investigated.
Rights of Way and Permissive Paths	Will the site of the hydropower scheme cut across any rights of way or permissive paths?	▪ Check whether there are any rights of way or permissive paths near the site, and, if so, whether these will require diversion and how this can be achieved. This may be a particular issue along riverbanks. If you need to divert a path contact the green infrastructure and countryside team on 01633 644850 **countryside@monmouthshire.gov.uk**
Water management, hydrology and flood risk	Will the hydropower scheme impact on water management and hydrology in the area?	▪ Diverting water into a hydropower scheme may impact on water management and quality; and mitigation measures are usually needed. NRW is a statutory consultee, and they encourage pre-application discussions for such schemes. ▪ Permissions, consents and licences from NRW will also be required (**Appendix 7**).
Cumulative Impact	Are there any other hydropower schemes in the vicinity of your proposed installation?	▪ On water courses which are particularly attractive as sources of hydroelectricity there is the possibility of multiple turbines along the length of the water course. This can create multiple impacts on fish, wildlife and visual amenity.
Social considerations / engagement	Have you involved the local community	▪ Consider the opportunity to work with a local community through early consultations and discussions in the development of your project (discussions and outcomes

Planning issue (See table 6.2)		Points to Consider
	in the development of your project? Have you considered any level of community partnership in association with this Hydropower scheme?	can be recorded in the Design and Access Statement/information accompanying the planning application.) ▪ Consider whether there is any opportunity for community partnership. If you have not considered this, would you welcome working with the local community to share some of the risks and benefits to this development?
Decommissioning	Have you planned for removal of the equipment at the end of its lifetime?	▪ It is a feature of hydropower schemes that they have a long operational life. ▪ The main issues with decommissioning will be the physical disruption to the site during component removal and potential detrimental impact on wildlife. ▪ Once removed, all components can be recycled.

Osbaston Hydro project, Monmouthshire – Archimedes screw system
Image source: Monmouthshire County Council

Solar Power

monmouthshire
sir fynwy

Cover Image source: Stock Xchange

Solar Power

Solar Water Heating

Technology Description

Solar thermal panels capture thermal energy from the sun. While this water can be used for space heating (usually in conjunction with other heat sources), its major use is to supply hot water.

To achieve this, a liquid (usually water or water plus an antifreeze agent) in a closed loop is passed through either glass plate collector systems, or evacuated tube systems which are usually mounted on a roof or suitable surface. Orientation to optimise energy yield is important, with south facing systems at an angle of tilt 35^{o} to the horizontal being ideal.

The thermal energy produced is then usually stored in a water cylinder. This system is integrated into normal hot water supply systems such that solar derived hot water is used preferentially to water heated by fuel use.

Given that solar water systems are made from glass, systems are designed to avoid or overcome damage from water freezing.

Typical solar water heating systems usually comprise suitably located panels usually linked to a second water cylinder and a separate pumped circuit to service the solar panels/tubes plus appropriate controls.

Solar Water Heating – SWOT Analysis

Strengths	Weaknesses
▪ A proven renewable technology. ▪ Low maintenance costs/high reliability. ▪ Better unsubsidised economic performance than PV systems. ▪ Hot water can be stored and used as required.	▪ Heat is a lower value product than electricity. ▪ As the carbon content of natural gas is lower than that of grid electricity, the carbon performance of solar water heating is lower than for renewable electricity generating technologies. ▪ Water content can add to weight. ▪ More efficient evacuated tube systems may require replacement if vacuum seals fail.
Opportunities	**Threats**
▪ Can be located on many roof systems. ▪ Easily integrated into hot water supply systems.	▪ As a glass based system, solar water heaters can be fragile. ▪ Some potential issues with solar water heating systems harbouring Legionella potentially adding to operating costs.

Solar Photovoltaics (PV)

Technology Description

Solar photovoltaic (PV) systems generate electrical power by converting solar radiation into direct current electricity using semiconductors to create voltage or electric current on exposure to light.

Photovoltaic power generation employs a number of solar cells containing a photovoltaic material sealed within a glass fronted solar panel. The materials that can be used in PV cells include monocrystalline silicon, polycrystalline silicon, amorphous silicon, cadmium telluride, and copper indium gallium selenide/sulphide. Other approaches use photovoltaic materials printed directly onto flexible film. While these systems are less efficient, they can also be produced at far lower cost.

PV systems generate direct current electricity at low voltage requiring the use of an inverter to convert the voltage to alternating current and boost it to mains voltage. These inverters can either be built into the PV system, or more usually located remotely from it.

To maximise energy yield, PV cells are usually oriented such that they face south and at an angle of tilt 35^{o} to the horizontal. PV cells can be mounted on traditional pitched roofs, on flat roofs, on a frame, or as free-standing modules on a suitable support.

Evacuated tube system in Northern British Columbia,Canada

Image source: **http://stage3renewables.com/blog/wood-heat-and-solar-thermal-perfect-match/**

Solar Photovoltaics (PV) – SWOT Analysis

Strengths	Weaknesses
▪ Well established technology with an established supply chain. ▪ Can be used widely in a number of applications. ▪ One of the few technologies that can deliver 'free' energy to households, which might be important if used to help people to escape from fuel poverty. ▪ The PV cells require little maintenance.	▪ The energy yield is relatively low, requiring large areas of cells to meet large demands. ▪ An intermittent technology with considerable variation in output across the day and year. ▪ Inverters can have a relatively short lifetime compared to the project life of the PV cells, adding to on-going operational costs.
Opportunities	**Threats**
▪ Most new developments can accept a PV system. ▪ Possible to integrate PV elements into building structure such as cladding, solar shading.	▪ There is evidence of the performance of traditional PV cells falling off with age. ▪ Free standing cells may be vulnerable to vandalism. ▪ The Committee on Climate Change identified PV as one of the most expensive renewable energy technologies. ▪ Where installed in large numbers such as in new housing developments, the maximum generation peak in the middle of the day in summer coincides with low demand and can cause issues with oversupply into the local grid which may cause damage and require costly upgrade to overcome.

The Technology – Spatial Elements

- Solar heat and PV panels are suitable for domestic and non-domestic uses. They are well suited to rural locations as an alternative to fossil fuels (which are either absent or costly) although the fact that they are an intermittent technology needs to be borne in mind.

- Installations are either roof based or ground mounted. External implications of building scale solar heating and PV panels are the panels themselves, as the remainder of equipment needed would be internal to the property.

- Solar heat and PV panels apply at the small scale individual building level. Although building scale, they can be used across large residential and non-residential developments. Solar PV panels can also be aggregated into large scale solar arrays, which have additional requirements for invertors and grid connections, which carry spatial implications. Generally solar arrays are ground mounted. However, in industrial settings, roofs may be an option for development of solar arrays.

- In new developments, solar tiles could be considered instead of panels. However, these suffer from high cost and poor performance relative to panels. This is because electrical output falls with increasing temperature, and when tiles become heated by the loft, they generate less electricity. Whilst tiles are a good option from an aesthetic point of view, from an energy and carbon perspective, they are less attractive.

Planning Permission and Other Consents

The diagram on the following page sets out the need for planning permission and other consents. Permissions and consents should be applied for in parallel to ensure that there are no delays in taking projects forward. It is advisable to contact NRW at the earliest opportunity as their consents can take some time to obtain (see **Appendix 7**).

Section 6.4 gives guidance on how your application will be assessed and the kinds of issues you need to consider in preparing your application. In addition, you will need to consider the issues in the table below, which relate specifically to Solar panels.

Key issues in assessing planning applications are likely to be:

- Landscape sensitivity, visual impact, glint and glare. This will be particularly important for large solar arrays in rural areas, and cumulative impacts of smaller projects installed on buildings. However, domestic installations on buildings may not need planning permission and so control is limited to visibility of installations on non-domestic buildings.

- Historic environment. Townscape impacts of installations on buildings are likely to be a particular consideration in relation to cumulative impacts; however, planning control is largely limited to non-domestic buildings.

- Ecology. Knowledge about negative impacts of panels on species is limited; however, there are potential issues with lighting and fencing in relation to large scale solar arrays. Ecology is an important issue in terms of the potential to enhance or improve biodiversity through new landscape planting.

Examples of Solar projects in Monmouthshire can be found on the Eco Open Doors website: **http://www.monecoopendoors.org.uk/ .** Many of these schemes are small scale or domestic in nature and the web site includes contact details for property owners.

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Getting Consents: A Summary of the Process

Planning Permission

Is your installation for a domestic property and are you applying as an individual householder?

Yes

Installation could be permitted development if within the limits set out in **Appendix 6**. If these limits are exceeded planning permission will be required.

No

Planning permission is required.

Listed Building Consent

Is your installation on a Listed Building or within the curtilage (garden/boundary) of a Listed Building? Check with the Heritage Team (**para 5.2.2**).

Yes

Listed Building consent will be required if your proposal includes alterations to existing structures/ buildings.

No

Listed Building consent will not be required.

Building Regulations

Building regulations approval will be required.

NRW Consent

Consent from NRW will not be required for domestic schemes. For larger arrays it is unlikely to be required unless close to a river (see **Appendix 7**).

You may also need consent if your site is a SSSI or affects protected species.

Trees

Tree Preservation Orders (TPO):
If you plan to fell or do any works to trees you should check whether they are covered by a TPO (**Appendix 7** for contacts).

Conservation Areas:
If you plan to fell or do any works to trees in a Conservation Area you need to inform the Planning Department in writing 6 weeks beforehand (**Appendix 7** for contacts).

Solar Panels – Site Selection and Planning Issues

This table should be read in conjunction with **Table 6.2**:

Planning issue (See table 6.2)		Points to Consider
Landscape sensitivity, character and visual impact (including glint and glare)	Will the panels be located in a designated landscape? (see **Appendix 8**)	▪ Careful siting will be required to prevent unacceptable impacts on landscape settings. Siting of panels on the front roof elevation of properties should be avoided if possible. If your property has several buildings, those which are less prominent, well screened or more 'industrial' might be appropriate for use. In addition, the colour of panels should be selected to be appropriate in its context. If you are considering solar panels or arrays in the Wye Valley AONB or on the edge of the Brecon Beacons National Park or other designated landscapes, this will be particularly important. ▪ Large scale ground mounted solar arrays are less likely to be acceptable in designated landscapes. Landscape sensitivity will be a major planning consideration for all such applications and a LVIA will be essential to accompany a planning application. This needs to include the panels themselves, any buildings required (e.g. for inverters), access and any grid connections. The latter is important - if pylons are required to carry electricity from a solar PV array to the grid, this will have a visual impact even if the solar arrays themselves can be well screened.
	Have you considered the visibility of the site in its wider setting and the potential for glint and glare?	▪ For all ground mounted arrays you will need to consider screening. Long views may be an issue, particularly on sites located on hillsides or adjacent to higher ground. Existing hedges could be allowed to grow to a greater height to screen the array and new hedges planted or other forms of screening used. However, you will need to consider the existing landscape character and ensure that new planting does not change that character. ▪ Adverse impacts from glint and glare from the front facings of the panels also needs to be considered – both in urban and rural contexts; Detailed layouts may be able to mitigate this, whilst still retaining appropriate orientation and slope of panels in relation to the sun. An anti-reflective coating can also be used which reduces glint and glare. ▪ In new developments, solar energy tiles which do not project above the roof level could be considered, although their energy performance is inferior to traditional panels.
Ecology	Could the installation of solar energy panels affect ecological habitats or species? (**Appendix 8**)	▪ For solar array projects, opportunities to retain and improve existing habitats through changes in hedgerow management or strengthening should be explored. In addition, there may be opportunities to improve ground cover species between panels.
	Does your installation involve security lighting/fencing?	▪ Consider the potential impacts of security lighting and fencing on any important habitats and species. Lighting associated with large scale projects in rural areas is unlikely to be appropriate; Security fencing should not cut across regular routes used by animals crossing the site.
Historic Environment	Is the site within a designated area of historic interest?	▪ Proposals for building mounted panels or solar arrays close to Listed Buildings or Scheduled Ancient Monuments should be located so as to minimise impact on those buildings. Where this is not possible mitigation should be considered – perhaps through screening. ▪ On Listed Buildings, panels are unlikely to be appropriate on the roof or visible elevations of the main building. If there are modern additions, or visually concealed areas, then these may

Planning issue (See table 6.2)		**Points to Consider**
		be more appropriate locations for panels. Colours should be chosen to blend with the roofscape. The structural impact as well as visual impacts should be considered. ▪ If the site is in a Conservation Area, changes to the roof scape and external elevations that are clearly visible from the street may have a detrimental or 'modernising' effect on the Conservation Area. Colours should be chosen to blend with the roof scape.
Water management, hydrology and flood risk	Would the installation affect the hydrology or flood risk of an area?	▪ If you are in an area of flood risk, consider the location of connectors to ensure they are above potential flood levels where installations are on individual properties. ▪ For larger scale solar arrays, consider whether there might be an surface water runoff issues from solar panels that might impact on hydrology and potential flood risk and whether any mitigation measures might be needed e.g. water collection and holding area.
Aviation, telecommunications and railways. Glint and glare	Are there any airfields or railways in the vicinity of the site?	▪ Consider whether the site is in the flight path of an airfield and therefore whether there might be any adverse impacts from glint and glare of solar panels. Consultation with the CAA/airfield may be required. ▪ Consider whether the site is located in the line of sight of train drivers or where glare/reflection could impact on signalling. It should be demonstrated that panels are not reflective to ensure solar panels do not interfere with railway operations, screening may also be required.
Design of buildings	In residential or mixed use developments, is the layout design to maximise building orientation within 30degrees of south?	▪ Consider spatial orientation and include evidence of this in your Design and Access Statement/Environmental Statement (if required).
Cumulative impact	Are there any other solar energy installations within the same vicinity as the potential site, or are any proposed?	▪ Cumulative impact is most likely to be an issue for roof mounted individual installations. However planning permission will often not be required for domestic installations. If you propose a solar array or panel on non-domestic buildings, then you will need to consider this issue.
Social considerations / engagement	Have you involved the local community in the development of your project? Have you considered any level of community partnership in association with the solar energy installation?	▪ Consider the opportunity to work with a local community through early consultations and discussions in the development of your project (discussions and outcomes can be recorded in the Design and Access Statement/information accompanying the planning application). ▪ Consider whether there is any opportunity for community partnership. If you have not considered this, would you welcome working with the local community to share some of the risks and benefits to this development?
Decommissioning	Have you planned for removal of the equipment at the end of its lifetime?	▪ PV systems can contain traces of expensive rare elements and so should be recycled.

Solar thermal Flatplate system, Gloucestershire

Image source: **http://www.shineenergy.co.uk/solar-solutions/solar-pv/case-studies**

Roof mounted

Image from **http://gallery.hd.org/terms.html**

Wind

monmouthshire
sir fynwy

Wind

Technology Description – Large Scale (1MW or more)

Wind energy is collected by blades that are directly coupled to a generator. Older machines employed a gearbox between blades and generator; however, compared to modern machines, these were less efficient and noisy.

Energy yield rises at the cube of wind speed. For this reason, turbines are mounted on tall towers. Turbines automatically align with the wind and ‘feather’ their blades in high wind to avoid damage. Turbulence in built up, wooded or similar areas can be a problem for capturing wind energy, with the issue being wind shear, where the wind pressure loading is not the same across the blades.

In lower wind speed areas, larger diameter blades can increase the efficiency of wind capture. Average wind speeds of 6.0 m/s at 45 metres above ground level are considered to be commercially viable; however, as energy costs rise, the economic threshold for wind speed will fall. Larger wind farm projects often install an anemometry mast (“met mast”) to collect real on-site wind data in support of an investment decision.

Space is required for clearance of the turbine blades; exclusion zones are typically 50 – 100 metres, depending on height of turbine. Noise issues relative to background noise can restrict proximity to housing, especially in quieter rural locations.

Vertical axis machines have blades (usually in the form of a cage like structure) which spin around a vertical shaft. They offer some benefits as they can capture energy in more turbulent air compared with the traditional configuration. As such they are often used at a smaller scale in associated with domestic or commercial use.

A typical large wind energy project comprises a number of turbines each with a foundation and a tower. Larger wind farms may also incorporate a small electricity sub-station connection point.

Technology Description – Small Scale (Less than 0.5MW)

The technology employed is essentially the same as for larger machines. At the intermediate scale (100’s kW) smaller machines can be viable on lower masts to minimise visual impacts.

Building scale wind turbines refer to machines of a size that can be physically attached to a building. These can suffer from lower wind speeds at lower levels. There can also be issues with noise and vibration where the machines are mounted directly onto a building, especially due to turbulence and wind shear over rooftops. There can also be problems with the physical strength of buildings being insufficient to take the stress of turbines in high winds.

As noted above, vertical axis designs are often better suited to small scale application, especially in the built environment.

Wind Energy – SWOT Analysis

Strengths	Weaknesses
▪ A well-established technology with a mature supply chain. ▪ Good economic performance relative to other generation options. ▪ Can make a significant contribution to energy supply. ▪ Few perceived financing risks.	▪ Intermittent technology. ▪ Building mounted machines subject to a range of potential issues. ▪ Site access and grid connection can be an issue. ▪ Location to dwellings can be an issue due to shadow flicker and noise.
Opportunities	**Threats**
▪ Industrial sites or those close to roads, etc. can provide lower impact opportunities. ▪ Examples of community owned projects delivering local benefits. ▪ Siting close to commercial development found to be beneficial. ▪ Directly linking wind projects to energy markets creates economic benefit.	▪ Poor public acceptability leading to planning risk. ▪ Radar and microwave link interference can prevent development. ▪ Building mounted machines can cause physical damage.

The Technology – Spatial Elements

- Wind turbines can be ground mounted, although building mounting of micro turbines is possible. Grid connection sub stations may be required for larger wind developments, where grid connection cabling to the nearest connection point will also be required, which may be under or above ground.

- Domestic wind turbines will be mounted in good wind flows above the roof line, between buildings or mounted on poles in gardens. In some of these applications vertical axis machines may be preferred.

- Wind turbines are suitable for non-domestic situations. They can be used to provide power into the national grid or into industrial processes or commercial applications and can be co-located with industrial or commercial premises. As such they could be appropriate in employment land developments and as part of energy supply into strategic sites proposed in the LDP. Large scale wind farms are generally stand-alone developments and usually only provide power directly into the national grid.

- Wind turbines can vary greatly in size, with larger, higher industrial sized turbines producing much more energy per turbine than the smaller, lower turbines used for standalone schemes. This is explored in the Monmouthshire Renewable Energy and Energy Efficiency Study, 2010. (Appendix 2).

Planning Permission and Other Consents

NATS provides air traffic control services in the UK. Wind turbines can impact on NATS infrastructure, as such NATS are a statutory consultee for planning applications received for wind turbines. NATS offer additional advice on their website including tools to ascertain whether your development is likely to have an impact or not:

http://www.nats.aero/services/information/wind-farms/

The diagram on the following page sets out the need for planning permission and other consents. Permissions and consents should be applied for in parallel to ensure that there are no delays in taking projects forward. It is advisable to contact NRW at the earliest opportunity as their consents can take some time to obtain (see **Appendix 7**).

Section 6.4 gives guidance on how your application will be assessed and the kinds of issues you need to consider in preparing your application. Reference should be made to the Planning Advice Note on Wind Turbine Development: LVIA Requirements which sets out a methodology to determine whether or not Environmental Impact Assessment is required for wind turbine development and the minimum requirements and standards of information to be submitted with a LVIA. In addition to this Planning Advice Note and the information provided in **Section 6.4** you will need to consider the issues in the table below, which relate specifically to wind turbines:

Getting Consents: A Summary of the Process

Planning Permission

Is your installation for a domestic property and are you applying as an individual householder?

Yes → Installation could be permitted development if within the limits set out in **Appendix 6**. If these limits are exceeded planning permission will be required.

No → Planning permission is required.

Listed Building Consent

Is your installation on a Listed Building or within the curtilage (garden/boundary) of a Listed Building? Check with the Heritage Team (**para 5.2.2**).

Yes → Listed Building consent will be required if your proposal includes alterations to existing structures/ buildings.

No → Listed Building consent will not be required.

Building Regulations

Building regulations approval will be required if you plan to attach your turbine to a building & for electrical installations.

NRW Consent

Consent from NRW may be required if close to a river and proposals raise the floodplain (see **Appendix 7**).

You may also need consent if your site is a SSSI or affects protected species.

Trees

Tree Preservation Orders (TPO):
If you plan to fell or do any works to trees you should check whether they are covered by a TPO (**Appendix 7** for contacts).

Conservation Areas:
If you plan to fell or do any works to trees in a Conservation Area you need to inform the Planning Department in writing 6 weeks beforehand (**Appendix 7** for contacts).

Key issues in assessing planning applications are likely to be:

- Landscape sensitivity and visual impact. This will be particularly important for standalone schemes in designated landscapes. The specific location of turbines within the site can help to mitigate impacts – e.g. by locating turbines in well screened locations, or on slightly lower ground. Cumulative impacts of large standalone schemes within wider landscape settings will also be particularly important. The Planning Advice Note on Wind Turbine Development: LVIA Requirements should be referred to which provides further detail on these matters.

- Historic environment. Whilst planning permission is no longer required for many domestic schemes, in Conservation Areas, it will still be required when the turbine is visible from a highway which borders the property. Planning Permission will also be required on Listed Buildings. Wind turbines can have a modernising effect on the townscape, and it may be difficult to locate a wind turbine in a way which does not have a detrimental effect on the historic environment, including the setting of listed buildings, in these circumstances.

- Ecology. Schemes should consider the impacts on both bird and bat species in nearby woodland or other habitats in particular, as well as seeking to mitigate for any habitat loss.

- Noise and shadow flicker. Mechanical noise from turbines has been reduced in recent years. Nevertheless, it will be important to consider potential impacts from noise and shadow flicker on neighbouring properties, and how these can be mitigated.

- Access and Servicing. Some Turbines require the transportation of large individual elements to the site. Turbine blades can be up to 40m long and require special transport arrangements. Consideration needs to be given to the capacity of the local road network to accommodate the necessary vehicles, and the likely impact of such vehicles on traffic, as well as to subsequent servicing needs.

An example of a wind turbine project in Monmouthshire can be found on the Eco Open Doors website: **http://www.monecoopendoors.org.uk/** . Many of these schemes are small scale or domestic in nature and the web site includes contact details for property owners.

Wind Energy – Site Selection and Planning Issues

This table should be read in conjunction with Table 6.2:

Planning issue (See table 6.2)		Points to Consider
Landscape sensitivity, character and visual impact	Will the wind turbine be located in a designated landscape? (see Appendix 8) Have you considered the visibility of the site in its wider setting? (see Appendix 8)	▪ If you are considering a wind turbine(s) in the Wye Valley AONB or on the edge of the Brecon Beacons National Park, size, height and siting will be particularly important planning considerations. ▪ Developments of more than building scale wind turbines could be difficult to accommodate without significant landscape implications in designated landscapes. ▪ Visual impacts can include direct impacts from loss of vegetation and more indirect impacts on the landscape character of the whole area. Views from settlements, routes, footpaths, viewpoints and neighbouring properties will be considered. ▪ For smaller developments, the height and specific location will be important – there may be locations which are less visible than others within the site. This will need to be considered against the best locations in terms of wind speed and avoiding turbulence. ▪ Colour and design of the turbine can also help to mitigate visual impacts. ▪ For larger developments, the visual impact of roads, grid connections, new pylons and substations and hardstandings will all be considered as well as the turbines themselves. ▪ Consider the potential for wind turbines in industrial and commercial locations where choice of design of wind turbines (e.g. use of vertical blade wind turbines) could make them more visually acceptable. ▪ Reference should be made to the Planning Advice Note on Wind Turbine Development: LVIA Requirements which provides further details on these matters.
Ecology	Could the turbine / wind farm affect ecological habitats or species? (see Appendix 8)	▪ Consider whether there are any important sites for birds or bats nearby. Investigations may need to be carried out to establish whether the site is on bird / bat flight paths. The specific location of turbine(s) may need to be changed to avoid these routes. The document 'Bats and Wind Turbines' (by CCW, Natural England and SNH) gives further information **http://www.snh.gov.uk/docs/B999258.pdf** ▪ Wind farm developments in upland areas have the potential to impact on the ecology of peatland areas. These areas should be avoided if possible.
Historic Environment	Is the site within a designated area / site of historic interest? (see Appendix 8)	▪ Proposals close to or on the site of Listed Buildings or other designated historic structures will need to be carefully designed so as to minimise the impact on the site / buildings and on their setting. The height, specific location and potential for screening turbines at designated sites will be important. ▪ If your wind turbine is to be attached to a Listed Building, Listed Building Consent will be required. There are particular concerns relating to the structural impacts of micro turbines attached to Listed Buildings (see Cadw guidance para 6.2.5). ▪ You may also need to undertake archaeological investigations. GGAT (Glamorgan Gwent Archaeological Trust) would welcome early pre-application contact from applicants to discuss the

Planning issue (See table 6.2)		Points to Consider
		potential for archaeology in the vicinity of proposed turbines (contact **01792 634223** **planning@ggat.org.uk**).
Access and Servicing	Will local roads be able to accommodate the size of vehicles required to transport the turbines to site? Is there an easily available connection to the national grid?	▪ Turbines include large parts (particularly the blades) and these require large vehicles to transport them to the site. ▪ A travel plan may be necessary to ensure that abnormally large vehicles use roads at quiet times and minimise disruption to local travel patterns. ▪ New overhead power lines may be required to achieve this connection and consideration will need to be given to the impacts of this.
Human health and quality of life (noise, shadow flicker)	Have you considered the potential noise impacts? Will shadow flicker impact on local residents, commercial or industrial properties?	▪ The potential for increase in ambient noise levels due to both mechanical noise and aerodynamic noise should be considered particularly in relation to potential impacts on nearby residents. ▪ Predicted operational noise levels should fall within the limits set by ETSU-R-97 (*The assessment and rating of noise from wind farms*). However work is underway to update this so you will need to check the latest version. ▪ Shadow flicker occurs when the sun moves behind moving turbine blades – the resulting shadow 'flickers' on and off. This can have an impact on the amenity of residential properties. ▪ This can be avoided by siting turbines away from properties, through tree / shrub planting, and shutting down turbines for short periods of time during sunshine.
Aviation, telecommunications and railways	Are there any airfields, radar stations, telecommunication links or railways in the vicinity of the site?	▪ Wind turbines can adversely impact on radar and air traffic control for airfields. If the potential site is in the vicinity of an airfield you may need to check with the CAA/airfield operator to ensure there is no interference to airfield operations. ▪ Telecoms can also be an issue as turbines can interfere with TV, radio and phone signals. You can check this with Ofcom. Where there are potential impacts, these can often be mitigated by changing the specific location of turbines within a site. ▪ Network Rail should be notified of proposals in close proximity to railways. New turbines should be located with a minimum Wind Turbine Setback to be related to the proposed mast height and blade length. You should check with Network Rail to ensure the distance is appropriate to ensure turbines do not interfere with railway operations.
Cumulative Impact	Are there any other wind turbines plants in the vicinity of your proposed installation, or are any proposed?	▪ Check whether there are other existing or proposed wind farms in the area. There are potential cumulative impacts in relation to landscape, visual, historic environment and ecological issues. This requirement is potentially important for large scale wind farms, where visual impact in the landscape will be a key consideration; and for small building scale installations in Conservation Areas.
Social considerations / engagement	Have you involved the local community in the development of your project? Have you considered any level of community partnership in association	▪ Consider the opportunity to work with a local community through early consultations and discussions in the development of your project (discussions and outcomes can be recorded in the Design and Access Statement/information accompanying the planning application). ▪ Consider whether there is any opportunity for community partnership where wind farms or smaller clusters of turbines are proposed e.g. could the

Planning issue (See table 6.2)		Points to Consider
	with the wind turbine scheme proposed?	community take ownership of one turbine and receive the income from it. If you have not considered this, would you welcome working with the local community to share some of the risks and benefits to this development.
Decommissioning	Have you planned for removal of the equipment at the end of its lifetime?	▪ All elements of the turbine are recyclable. ▪ There is a potential high cost in relation to foundation removal.

6kW wind turbine

Image source: Photo taken by Robert Bridges, www.windenergyplanning.com

Vertical Axis wind turbine at Caroline Haslett School

Source: **http://www.quietrevolution.com**

monmouthshire
sir fynwy

pba
peterbrett