Renewable energy and your historic building

INSTALLING MICRO-GENERATION SYSTEMS: A GUIDE TO BEST PRACTICE

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

www.cymru.gov.uk

Cadw

Key points to consider	Solar hot-water panels	Solar electric (photovoltaics)	Heat pumps	Micro wind turbines	Biomass	Hydroelectric
Wherever possible, equipment should be installed away from the main historic building or key feature of a site. Principal elevations or dominant roof slopes should be avoided.	●	●	●	●	●	
Consider structural impact of heavy equipment on a historic building.	●	●		●		
Consider impact on the setting of a historic building or monument.	●	●	●	●	●	●
Consider cumulative visual impact of more than one installation on a building or group of buildings.	●	●				
Consider impact of colour, texture and finish of equipment against the fabric of a historic building.	●	●			●	
Excavation or drilling work required to install pipes or cables may disturb buried archaeology. Seek advice from your regional archaeological trust.	●	●	●	●	●	●
Storage batteries require the protection of a well-ventilated room or shed away from living areas where there is no health risk and no danger of damaging the historic fabric of a building.		●		●		●
When installing cables or pipes in a building, choose routes that will cause the least amount of damage.	●		●			
Ensure that equipment is easily accessible for future maintenance without disturbing the fabric of a historic building; also, that it can be removed or replaced without causing damage.	●	●	●	●	●	
Consider environmental impact on natural habitats. Seek advice from the Countryside Council for Wales or Environment Agency.	●	●	●	●	●	●
Discuss proposals with the planning and building control sections of your local authority at an early stage to check whether any form of consent is required.	●	●	●	●	●	●

Contents

Introduction

At the mention of renewable energy, usually the first thing we think of is large wind farms or hydroelectric schemes producing enough electricity to serve hundreds, if not thousands, of homes and businesses. But interest is also growing in the use of micro-generation systems serving individual or small groups of buildings. Micro-generation is the production of heat, electricity or both on a small scale from a low carbon source. Many of the technologies use renewable sources, such as solar and wind power, whilst others continue to use fossil fuels, but with greater efficiency than conventional systems. Although many people have already installed micro-generation technologies in their properties, its use is set to become increasingly popular. As a consequence, solar hot-water panels, domestic-sized wind turbines and photovoltaic arrays (PVs) will be a far more common sight in the future.

There is no reason why owners of historic buildings should not consider these changes. However, if you are thinking about installing a micro-generation system in a historic building, a conservation area, a historic park or garden, an ancient monument or on an archaeological site, thought should be given to protecting the fabric or character of the building or landscape and its setting. The historic environment is central to Wales's cultural heritage and sense of identity and, as such, deserves our care and attention.

This guidance is not intended to provide technical advice, which is already available from organizations including the Energy Saving Trust (www.energysavingtrust.org.uk). Instead, its purpose is to encourage local planning authorities and owners of historic buildings and sites, as well as the installers of micro-generation equipment, to consider carefully the design and siting of micro-generation systems. It should also make people aware of the range of opportunities and different solutions that are available to help lessen the impact of micro-generation technology on the historic environment. By using examples of good practice Cadw hopes to demonstrate that the historic environment need not be excluded from actions to secure a more sustainable future, but this should be achieved through the careful preservation and sympathetic management of the historic environment.

The Welsh Assembly Government is committed to taking action to reduce the emission of greenhouse gases. Recognizing that micro-generation has a vital role to play in achieving this objective, the Welsh Assembly Government published the Micro-generation Action Plan for Wales in March 2007 to promote the use of these technologies. It sets targets for the installation of 100,000 micro-heating systems, 200,000 micro-electricity systems, and 50 combined heat and power systems in Wales by 2020.

Opposite: This hydroelectric powerhouse has been designed to fit into the landscape by using a turf roof and local stone, and utilizing the natural land form.

Right: Here, solar panels in the roof are well hidden behind the tower and hardly visible from the street. Unless panels can be screened like this, avoid positioning them on principal elevations and prominent roof slopes.

Types of micro-generation technology

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Re-roofing may provide an opportunity to install an integrated flat plate solar collector in a discreet location. This type of system can blend into the roof slope better than a framed panel that stands proud of the cladding, but remember to store sufficient slates or tiles to re-cover the area when the panel is removed at the end of its life. This avoids the problem of trying to find matching materials.

There are several types of micro-generation systems and an increasing variety of products on the market. A successful installation depends on the choice and location of equipment taking into account the architectural, historic or archaeological importance of a site.

SOLAR HOT-WATER PANELS (SOLAR THERMAL COLLECTORS)

Solar hot-water panels are the most common type of micro-generation technology currently used due to their relatively low cost and ease of installation. They can be used to produce hot water and, occasionally, for space heating. A domestic system consists of three main components: a solar collector, a heat-transfer system, which may include a pump to circulate water, and a hot-water cylinder. The cylinder may be a separate one serving just the solar hot-water system or, more commonly, it may combine solar and more conventional forms of hot-water production.

There are two main types of solar panel: flat plate collectors, which consist of an absorber plate with a transparent cover, and evacuated tube collectors, which consist of a row of glass tubes each containing an absorber plate. Evacuated tube collectors are generally more efficient, but they tend to be more expensive, more fragile, and arguably, more conspicuous.

A domestic system will require a solar collector covering roughly 4 square metres, although the individual panels do not necessarily have to be located together. This can help to reduce the overall visual impact in situations where the collector may otherwise be an overly dominant feature. A large collector on a small roof slope may look out of scale.

Solar collectors are most frequently sited on roof slopes with a south-west to south-east orientation and at a pitch of 30–50 degrees. Nevertheless, they can be installed at a very shallow pitch just steep enough to allow rainwater to wash off dirt and debris. In the case of evacuated tube collectors, it is also possible to install them vertically on a wall. Care does need to be taken when installing panels on a lead roof. The design and location of fixings and pipework must take account of the natural expansion and contraction of lead over time.

Flat plate collectors can be installed flush with the plane of the roof, but most are installed in frames that stand proud of the roof cladding by up to 125mm, which may make them quite conspicuous. However, both types of fitting have their advantages. Raised panels are usually fitted within aluminium frames, which are attached to the roof using roof-tile hooks that slip under the slates or tiles and are fixed to the rafters. The only penetrations through the roof are to accommodate the pipes that connect the solar collectors to the hot-water tank. This involves minimal external alteration to the building and the equipment is very easily removed at the end of its life.

Conversely, flush-fitting solar panels are integrated into the roof structure. They can potentially blend in better, but installation requires the removal of the roof cladding beneath the panels. This is unlikely to be acceptable where the roof forms part of the special interest of a listed building, but may be acceptable if re-roofing is required. The additional depth of the panel should be accommodated through omission of the battens to which the slates or tiles are normally fixed, rather than trimming the roof timbers or removing rafters. Flashing will be required around the panels in order to ensure a good weather-tight seal.

© National Trust

These flat plate solar collectors are installed in a hidden roof valley at the back of the building. The dark coloured frames help to further reduce the visual impact.

Chris Laughton — www.solardesign.co.uk

Installing solar panels at a low angle on a flat roof can be a good choice for a historic building. However, care is needed when installing them on a lead roof as the lead sheet may tear if it is not allowed to expand and contract naturally.

Chris Laughton — www.solardesign.co.uk

There will usually be more than one possible location for solar panels, so consider all of the options, even if some do not provide the optimum conditions. Evacuated tube collectors are more efficient than flat plate collectors and they can be installed vertically on a wall if a suitable location can be found.

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With a little thought, PVs can easily be integrated into the design of new garden structures, such as this pergola.

Try to install solar panels and photovoltaic (PV) arrays as free-standing units if possible. The impact of this installation could have been further reduced by choosing a dark coloured frame and providing some soft landscaping.

SOLAR ELECTRIC (PHOTOVOLTAICS)

In a photovoltaic system, light hitting the silicon in a solar photovoltaic (PV) cell is converted directly into electricity. The greater the intensity of light, the greater the flow of electricity. Individual PV cells are connected together to form a module. Modules are linked to form a PV array. After conversion from direct current (DC) to alternating current (AC), the power generated by the cells is carried into the building's normal electrical system to work alongside the existing electricity supply. Excess power should ideally be exported to the National Grid to help offset the cost of buying electricity back during the night and at other periods of low electricity

The area of a typical domestic-sized PV system will be 10–15 square metres. These units are less obtrusive than many due to their colour and simple design.

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These PV arrays have been installed as bespoke free-standing units that stand on a flat roof hidden behind a parapet wall.

generation. Alternatively, it can be stored in batteries.

Crystalline PV cells are encapsulated in a transparent, insulating polymer with a tempered glass cover. Amorphous silicon cells are less efficient than crystalline cells, but they can be deposited on a range of materials, making them suitable for curved or flexible surfaces. The technology is therefore very versatile and PV arrays come in a variety of shapes and colours. They can be used as opaque wall cladding or as transparent cells to replace glass.

Modules may be framed, similar to solar hot-water collectors, for installation on roofs or as free-standing units. Some manufacturers also produce small modules that are used as roof cladding instead of slates. The appearance of these does vary, but the choice is increasing as manufacturers strive to replicate the appearance of natural slate. Nevertheless, unless discreetly located they will rarely be a suitable substitute for stone tiles, pegged slates or slates laid in diminishing courses.

PV arrays need a shade-free site orientated between south-east and south-west. Shade on any part of the array will greatly reduce the performance of the whole unit. The ideal pitch is 30–40 degrees, but this can be reduced to as little as 15 degrees, enabling arrays to be installed on flat roofs or behind parapet walls. As with solar hot-water panels, care must be taken when installing PVs on lead roofs.

A typical domestic system of 10–15 square metres will supply approximately half of a household's annual electricity demand.

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Above left and right: Amorphous silicon cells can be used to coat glass. This example is on a new building, but this type of glass set into a well-designed frame could be used to good effect on historic buildings where large areas of new glazing are proposed, such as a threshing barn that is being converted to domestic use.

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Above and left: There are some good examples of PV roof cladding that emulate the look of natural slate and the technology is constantly evolving. The slates pictured have the advantage of being thin and non-reflective, though rarely will they be a suitable substitute for Welsh slate on a principal roof slope.

HEAT PUMPS

Heat pumps work on the principle of absorbing heat from one place and releasing it in another. Heat is collected from one of three sources: the air, the ground or a body of water. The heat is transported around a sealed system by a refrigerant, which is circulated by a compressor. The system operates in a continuous cycle while the pump is running.

Heat pumps can be used to supply hot water; they can also be used for space heating, but work best in a well-insulated building. Heat pumps are most frequently connected to an under-floor heating system and their continuous use allows a build up of residual heat that requires little topping up. They may also be connected to oversized or fan-assisted radiators. Some types of heat pump can be used in reverse to provide air conditioning.

Ground-source heat pumps are the most common type of heat pump installed in the UK at present. The initial set-up cost is higher than an air-source heat pump, but they are more efficient. The heat is collected in a series of narrow boreholes approximately 100 metres deep, or alternatively, in a horizontal ground loop installed around 1.8 metres below the surface of the ground, where the temperature is relatively stable. Care needs to be taken in siting a ground-source heat pump as the excavation or drilling work required to install the pipes could disturb buried archaeology. If you are connecting a ground-source heat pump to an under-floor heating system this can also have implications for archaeological remains buried within a building. Minimal disruption will be caused where the floors have previously been replaced or need to be removed to address problems such as damp.

Air-source heat pumps are less common than ground-source heat pumps, but they are well suited to coastal areas where the ambient temperature is higher. They occupy a relatively small space: the heat exchanger usually comes in a metal box approximately 1 metre high. They must be sited in a well-ventilated

Below left and right: This air-source heat pump is installed on a discreet flat-roofed area and is barely visible from anywhere on or around the building. It was installed to provide hot water for a new bathroom as an alternative to extending the existing hot-water system, which would have disturbed the original 1930s interior.

location, such as on a flat roof or on a wall with a suitable circulation area.

Whatever type of heat pump is used, an energy source will be needed to operate the compressor. This energy input could be provided by another type of micro-generation system, such as a photovoltaic array.

Below: Consider carefully the location of buried cables or pipes to avoid damaging archaeological remains. The installation of this horizontal ground loop shows the depth of the trench required to put in a ground-source heat pump.

Bottom: Wherever possible, relay the original floor on top of an under-floor heating system to avoid damaging the character of the building. Before lifting floors, seek advice from your regional archaeological trust about the possibility of finding buried archaeology.

MICRO WIND TURBINES

Most electricity generating turbines have between two and five blades around a central hub. The motion of the blades turns a rotor, converting the kinetic energy of the wind into electrical energy. The amount of power generated depends on the 'swept area'. Therefore, the larger the area the greater the potential output. A domestic system would typically produce 1–6 kilowatts, but smaller systems can be used to recharge batteries or to power low-voltage equipment.

Ideally, the system should be connected to the National Grid, allowing excess electricity to be sold. In locations where connection is not feasible, batteries can be used to store excess energy until it is required.

Turbines must be sited in a reasonably exposed location and work best at a height where wind speeds are high and there are no obstructions from buildings, trees or other features that would cause turbulence. Consequently, they are often difficult to integrate successfully into an urban environment and are more suitable for rural locations. The Energy Saving Trust advises that turbines should be considered only where the local annual average wind speed is 6 metres per second.

A turbine may be mounted on a pole or a lattice tower as a free-standing unit. The pole or tower will need to have reinforced concrete foundations and a cable connecting it

Top: Small-scale wind turbines can sometimes be fastened to a bracket attached to a building, but make sure first that the building can withstand the additional loading.

Above: Choose a site that allows the height of a free-standing turbine to be as low as possible and try to locate it so that when viewed from sensitive locations it will be seen against a landscape backdrop.

to the building to which it is to supply energy. Cables are usually buried in the ground at a depth of no less than 0.5 metres in order to protect them from damage. Alternatively, a turbine may be fastened to a bracket mounted on the wall of a building so that it stands up above the roofline.

BIOMASS

A small-scale biomass system generates heat for hot water and space heating by burning organic matter. Although carbon dioxide is released in the process, this is balanced by the amount absorbed during the growth of the plant matter. This gives the system potential to be close to carbon neutral in use.

Whereas large systems may use materials such as municipal or agricultural waste to produce electricity as well as heat, domestic appliances usually use wood pellets, wood chips or logs. A domestic biomass system is a very quiet, efficient and controllable source of heat. However, as with other solid fuel systems an alternative method of heating water, such as an electric immersion heater or solar panels, is likely to be needed during the summer months and at other times of low demand when it is not viable to keep the boiler operating.

Left and below: Two biomass boilers of different scales: the one above is fitted into a domestic fireplace, whilst the other is sited in an outbuilding and serves several properties.

Biomass can be used in either a stand-alone system to heat a single room, or can be connected to a central-heating and hot-water system. It can also be used as a district heating system to serve larger sites or groups of buildings. Schemes such as the conversion of a farm complex to residential or commercial use may be particularly suited to this type of system, where a centralized boiler-house produces hot water which is circulated via a network of flow and return pipes.

Wood-chip and wood-pellet boilers can be fitted with automated feed hoppers. Space will be required to store the fuel and to keep it dry, and the system will also need a flue to remove waste gases. With a small domestic appliance it may be possible to install the flue in an existing chimney.

HYDROELECTRIC

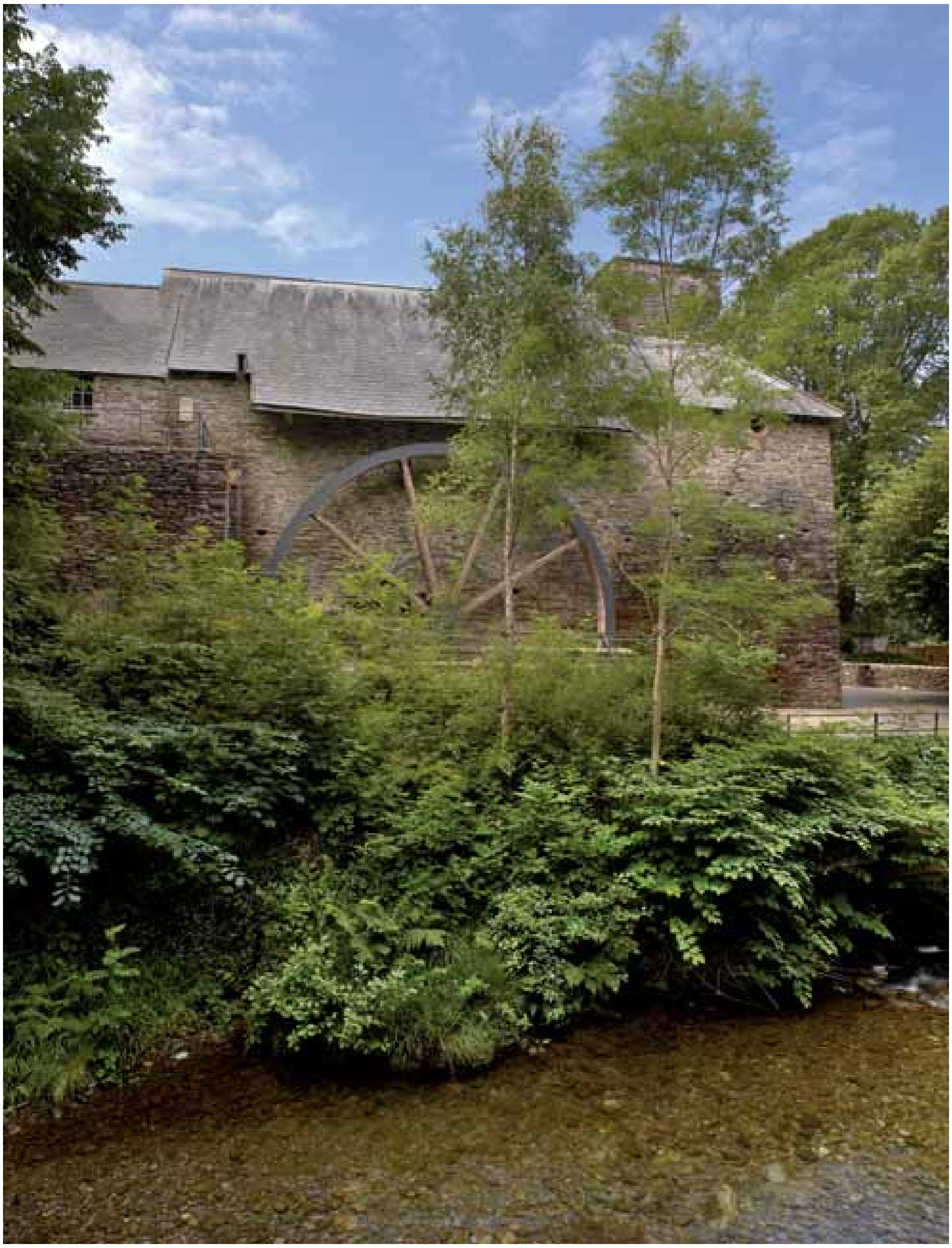
Hydroelectric schemes have a very long history of use and many water mills are listed for their architectural or historic interest. In a hydroelectric system, running water turns a turbine to produce electricity. The amount of energy that can be released depends on the amount of water flowing per second, the flow rate and the height that the water falls, as well as the efficiency of the system. The electricity produced can be supplied directly or through batteries using an inverter to convert the current from DC to AC. Alternatively, it can be connected to the National Grid.

A system will typically consist of an intake incorporated into a weir to divert the watercourse; a leat or penstock pipe; a powerhouse, monitored by a control panel, in which a turbine and generator convert the power of the water into electricity; an outflow pipe to release the water back into the watercourse; and underground cables or overhead lines to transmit the electricity to the point of use.

The number of sites with a suitable watercourse is limited, but, where there is a suitable resource, a small hydroelectric system can be a cost-effective option. Historic mill sites may provide suitable locations for new hydroelectric installations, although consideration needs to be given to the archaeological impact of any new works. As with other types of micro-generation equipment, a back-up power supply may be needed to compensate for seasonal variations. In most cases a Water Abstraction Licence will be required from the Environment Agency. The Environment Agency and the Countryside Council for Wales will be able to offer advice on any mitigation measures, such as the provision of fish ladders, to offset the impact on the ecology of a watercourse.

Left: The hydroelectric equipment needed to run this system is contained in a small powerhouse located next to the stream, which provides the source of energy.

Below: Historic mill sites, such as Dyfi Furnace, could once again be utilized for a modern hydroelectric scheme to help meet the energy needs of the local community.



Choosing a micro-generation system

LOCATION

When choosing a micro-generation system it is important to understand your energy needs; it is equally important to have a clear understanding of the architectural, historic or archaeological significance of the location of the installation. This significance may derive from evidence of past human activities which have shaped the landscape, such as farming or mineral extraction. Alternatively, it may arise from the quality of place unique to our historic towns and villages. A historic building might be of special interest because of its original function, its design and materials or the way it has been adapted over time. Even small details, such as internal fittings, can be important. By ensuring that these factors are properly understood and taken into account the impact of installation can be kept to a minimum and any consent needed, such as planning permission or Listed Building Consent, is more likely to be forthcoming.

ENERGY NEEDS

No single micro-generation system is likely to supply all of the heat and electricity needed in a building, although combinations of technologies can be designed to do so. A solar hot-water system, for example, will provide one third to half of the hot water needed for a domestic property year round. By also installing a biomass system, hot water as well as space heating can be provided during the winter months when solar hot-water panels are likely to be less efficient.

It is also important to remember that in some cases the amount of heat or electricity generated may not be constant and peak production may not coincide with peak demand. Energy generating systems, including photovoltaic arrays and wind turbines, can produce more electricity than is required at the time of production. In such cases, the system can be connected to the National Grid, allowing excess energy to be sold during peak production and bought back at other times. Where connection is not possible, battery storage will help to match energy generation with demand.

SCALE

The scale of the energy requirement will also help to determine what type of system best suits your circumstances. Energy may be required to power a single use, such as a security light or an electric fence, or to meet the energy needs of an individual building or a group of buildings. District heating systems and combined heat and power systems can present opportunities for using technology that may not be viable on a smaller scale, such as utilizing waste heat from industrial processes or using the stored energy in organic matter (biomass) or water (hydroelectric).

In a district or community heating system, a central boiler produces hot water, which is circulated to nearby buildings through a network of pipes. The network may include as few as two or as many as hundreds of properties. This arrangement can be particularly useful for groups of historic buildings, such as converted farm complexes, as only one boiler and flue are needed.

A combined heat and power system produces heat for space heating or hot water, as well as electricity. It can serve one building or supply a local area. These systems are very efficient and use a variety of fuels, including wood pellets.

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COST

Choosing a micro-generation technology that will have a minimal effect on the historic environment need not necessarily cost more or compromise the efficiency of a system. The initial cost of micro-generation equipment and expenditure on installation and ongoing maintenance needs to be considered against the amount of heat or energy that the system can realistically produce.

Installing micro-generation systems at the same time as other works are undertaken can help to offset some of the initial cost, thereby reducing the payback period, as well as reducing the potential for damaging a historic building or underground archaeology. For example, the pipework for a ground-source heat pump could be installed when preparing foundations for an extension.

1. This Grade I listed house and associated building complex is heated using a biomass boiler connected to a district heating system. The hot water is pumped around the site through an underground heat main.

2. The wood used as fuel in the biomass boiler is sourced from the estate woodland and chipped on site.

3. A derelict outbuilding was restored for use as a fuel store and to house the automated wood-chip boiler.

4. The only outward sign of the boiler is the small stainless-steel flue projecting above the rear roof slope of the large outbuilding.

OPTIONS

In order to promote good practice, the UK Micro-generation Certification Scheme (MCS) has been established to certify independently on-site energy production technologies and installers. The scheme is designed to give greater protection for consumers and includes a mechanism for dealing with complaints. MCS registered installers must give accurate predictions of the likely energy outputs of an installation, which should be measured against the possible impact on a historic place or building.

Further information on this scheme, as well as advice on choosing a micro-generation system, is available from the Energy Saving Trust — an organization funded by the government to provide free, impartial advice to householders and communities. Installers who offer a limited range of equipment may not be able to provide this initial advice or to suggest the best solution for a particular situation. The trust will also be able to suggest possible sources of grant assistance and to provide a list of installers.

It is also advisable to discuss proposals with the planning and building control sections of the local authority at an early stage to check whether any form of consent is required.

Minimizing the impact on the historic environment

These free-standing solar hot-water panels have been carefully sited so as to blend in with the surrounding rockery and planting scheme.

© Monmouthshire County Council

The valley between pitched roofs provides an ideal location for these evacuated tube solar collectors. They are bolted to the rafters and the only penetrations through the roof are to accommodate the water pipes. It will be relatively easy to remove the system when it reaches the end of its life and to restore the roof covering.

Once you have chosen the most suitable form of micro-generation technology for your historic building or environment, you should make further efforts to ensure it is well integrated. Although every historic building will present different options to minimize the impact, the following are key issues which should be considered for every installation.

SITING

Wherever possible, micro-generation equipment should be installed away from the main historic building or key feature of a site. It will rarely be acceptable to install equipment on the principal elevation of a listed building or on a dominant roof line. It is preferable to install solar panels and PV arrays on outbuildings — such as garages — or as free-standing units (with good insulation of pipework to help minimize heat loss).

Some types of micro-generation technologies require the use of storage batteries to store excess electricity. These are potentially hazardous and relatively bulky and will require the protection of a well-ventilated room or shed away from living areas so as not to pose a health and safety risk and also where there is no danger of damaging the historic fabric of a building.

In addition, consideration should be given to the space required for the storage of fuel, in the case of a biomass system especially.

If installation away from the main historic building or feature of a site is not feasible try to make use of less prominent parts of the building — such as hidden roof valleys or rear extensions — or try and screen equipment from view by locating it behind parapet walls. It might be possible to site an air-source heat pump to the rear of a building, in a service area, or on a flat roof where it would have the least visual impact. It might be the case that certain micro-generation technologies become less energy efficient when placed in a more discreet location. For example, solar panels may not benefit from full sunlight or be at the optimum orientation and pitch. You could overcome this problem by increasing the size of the panels.

The impact of micro-generation technologies on the setting of a historic building or monument is also important. With care, most types of free-standing equipment may be successfully integrated into the landscape or screened from view. However, this integration is much more difficult to achieve with micro wind turbines. A well-chosen site should allow the turbine to be viewed against a landscape setting rather than open sky, and also for its height to be as low as possible. In addition, the potential impact of noise, vibration and shadow flicker on your and neighbouring properties should be considered. In sensitive locations it might be preferable to use other forms of renewable energy.

This ground-source heat pump is connected to an under-floor heating system and is sited in the service area to the rear of a converted stable block so as to be as discreet as possible.

Photographed with kind permission of St Fagans: National History Museum

The control equipment for the ground-source heat pump at this site is housed in a purpose-built stone outhouse that echoes the design and materials used in the church itself.

DESIGN

The colour, texture and finish of equipment in comparison with the background material will all influence how noticeable the micro-generation system is once installed. The design of early types of equipment paid little or no attention to appearance or visual impact, but this is beginning to change. The design and colour of visible ancillary equipment, such as pipes, frames, stands or poles, is just as important as the micro-generation equipment itself.

If installing equipment on a historic building, think about the characteristics of the building's structure and architectural 'vocabulary' as this may give clues as to what is likely to be successful visually. Elevations may be symmetrical or have a strong horizontal or vertical emphasis. Echoing such features may help installations to blend into their surroundings, whereas a strong contrast may make them more conspicuous.

Scale is also an important consideration. Whereas a large building may be able to accommodate a comparatively large area of solar panels, the same installation on a small vernacular cottage may overwhelm the scale and character of the building. However, it may be possible to locate the panels in separate locations in order to spread the impact.

CUMULATIVE VISUAL IMPACT

A single installation is unlikely to meet the total year-round demand for heat and electricity at a building or site. Complementary systems are likely to become more

A new shed clad with corrugated iron sheets was built on the lower end of this cottage on the site of a former outbuilding. It houses a biomass boiler and its simple design and small scale, together with the choice of materials and colour of the cladding and flue all help to ensure that the extension is in keeping.

Above and left: The banks of solar panels serving the listed farmhouse and holiday cottage at this site are situated on the hillside behind the agricultural buildings and can only be seen at a distance. The robust scale and simple form of the installation is fitting in this location and does not detract from the setting of the listed buildings.

commonplace in the future. Whereas most buildings are capable of accommodating a degree of change, multiple installations may have an unexpected cumulative visual impact.

This also applies to separate buildings within a group. Conservation areas are designated so on the basis of their quality of place, the result of many factors including the grouping and scale of buildings and the relationship between buildings and spaces. Other types of designation include Historic Parks and Gardens, and World Heritage Sites. However, the qualities that led to designation can easily be harmed unless the visual impact of micro-generation systems on neighbouring buildings and the wider street scene and landscape is carefully considered.

STRUCTURAL IMPACT

Some types of micro-generation equipment can be very heavy. Where equipment is to be mounted on the exterior of a building it is advisable to first obtain a structural survey from an appropriately qualified historic buildings advisor to ensure that the structure and historic fabric of the building will not be damaged. This is particularly important if you are considering installing a wind turbine on an existing building, although in practice, there will be few traditional buildings where turbines are likely to be acceptable because of their visual impact. The structure on which the turbine is mounted must be capable of withstanding not just the weight of the equipment (up to 30 kilograms), but also the forces exerted on the blades, particularly during periods of high wind. Chimneys and infill panels in timber-framed buildings are unlikely to be able to withstand these additional stresses.

Solar panels and PV arrays can also add a considerable amount of weight to a roof, particularly when they are used in addition to the existing cladding. The weight is carried by the rafters, which in many traditional buildings, especially vernacular cottages and agricultural buildings, are smaller than current standards. Whilst they are perfectly adequate to support the existing roof covering, they may not be capable of carrying the additional dead weight or the uplift created by the wind.

BUILDING INTERIORS

When installing cables or pipes for solar panels, PV arrays or heat pumps choose routes that will cause the least amount of damage, even if they are less direct. It may be possible to use existing conduits or to lift floorboards that have previously been re-laid to minimize disruption. Try to locate elements as discreetly as possible and ensure that any alterations are easily reversible.

Avoid cutting through structural timbers, such as floor joists, as this can weaken them. If chasing in cables or pipes, take care to avoid damaging historic items, such as panelling, plaster cornices and wall paintings, and to remember that features of interest may be hidden by later additions or decoration. Similarly, the excavation of floors to install an underfloor heating system can disturb archaeological remains within the building, such as evidence of an open hearth in a medieval hall-house or the foundations of partition walls previously removed. If features are discovered during the installation work, stop immediately and seek advice from the local planning authority.

Internal and external alterations to a listed building are likely to require Listed Building Consent, so it is essential to seek advice from the local planning authority at an early stage.

BURIED ARCHAEOLOGY

Systems that depend on buried cables or pipes to connect the energy source to the place where the energy is required, such as free-standing solar panels, ground-source heat pumps, and hydroelectric systems, have the potential to damage underground archaeology. Similarly, wind turbines mounted on masts or lattice towers will require substantial foundations of a metre or more in depth, which may disturb underlying features.

Areas that are more likely to contain buried features of interest, apart from known archaeological sites, may include historic town or village centres. In most cases it will be possible to balance the need to preserve archaeological features with the desire to install micro-generation systems. However, advice should be sought from the relevant regional archaeological trust. In addition, any works affecting a scheduled ancient monument will require Scheduled Ancient Monument Consent and in such cases Cadw should be consulted at an early stage.

MAINTENANCE AND REMOVAL

When installing a micro-generation system, it is important to ensure that the equipment is easily accessible to allow for future maintenance without disturbing the fabric of a historic building. You must also ensure that the equipment can be removed or replaced without causing unnecessary damage. Try to minimize the damage, both at the time of installation and removal, by fixing into mortar joints rather than bricks or masonry, as repairs will be easier to undertake and less obtrusive. When a system has reached the end of its useful life or simply needs replacing, ensure that any redundant equipment, cables, pipes and fixings are removed, and any damage made good using materials appropriate to the building, such as lime mortar.

WILDLIFE

Many historic buildings and landscapes support a variety of wildlife by providing breeding and roosting sites, as well as feeding grounds. Many species, including all bats and many types of birds, are protected in law. The Wildlife and Countryside Act 1981 gives full protection to bats, making it illegal to intentionally kill, injure or handle any bat or to intentionally damage, destroy or obstruct access to any place that a bat uses for shelter or protection. Many historic buildings are home to bat colonies, which can be disturbed by work to roofs and attic spaces. Before undertaking any work that will affect a protected species, seek advice from the Countryside Council for Wales on how to avoid disturbing a natural habitat and to check whether a licence is required.

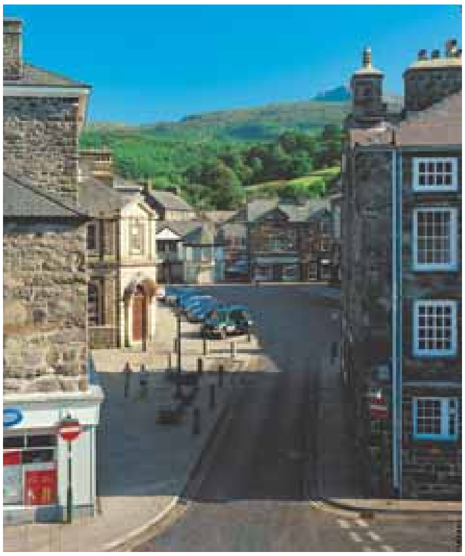
Similarly, seek the advice of the Environment Agency for any works affecting a watercourse in the case of hydroelectric technologies. In most cases, a Water Abstraction Licence will be required.

Opposite: The qualities that led to the designation of a conservation area, such as Dolgellau, could be harmed if the visual impact of multiple installations is not carefully considered.

Planning controls, building regulations and the need for consent

Before installing any micro-generation equipment check with the local authority whether any form of consent is required. Even if you have been offered a grant do not assume that you will not need to obtain further permissions. Approval may be required under the Building Regulations. The installation of some types of micro-generation equipment will also need planning permission. Where proposals affect historic buildings or areas, the local planning authority will take into account the likely impact on the historic building. The impact on the setting of the historic property is also a material consideration.

Works that would affect the character of a listed building are likely to require Listed Building Consent. Controls apply to both internal and external works whether or not the particular feature affected is specifically mentioned in the list description. This protection will usually extend to any object or structure fixed to the listed building or located within its curtilage — an area of land attached to a house and forming one enclosure with it. The latter may include ancillary buildings, garden structures and boundary walls. Advice on consent should be sought from the local planning authority at an early stage.



Any application for planning permission or listed building consent will need to be accompanied by a design and access statement. This will need to explain why a particular micro-generation system and site have been chosen in favour of other options based on an assessment of the differing impacts on the heritage asset.

At scheduled ancient monuments consent is required for any works that would have the effect of demolishing, destroying, damaging, removing, repairing, altering, adding to, flooding or covering up the monument. Applications should be submitted to Cadw and initial advice can be sought from Cadw or the relevant regional archaeological trust.

FURTHER GUIDANCE

- Planning Policy Wales, Technical Advice Note 12: Design (June 2009) Can be downloaded from www.wales.gov.uk/topics/planning/policy/tans/tan12
- Welsh Office Circular 61/96, Planning and the Historic Environment: Historic Buildings and Conservation Areas (December 1996)
- Welsh Office Circular 60/96, Planning and the Historic Environment: Archaeology (December 1996) Can be downloaded from the Heritage Policy Publications section of the Cadw website: www.cadw.wales.gov.uk

For hard copies of all publications please contact the Publications Centre, National Assembly for Wales, Cathays Park, Cardiff CF10 3NQ, tel: 029 2082 3683, email: assembly-publications@wales.gsi.gov.uk

Energy conservation and alternatives to micro-generation

Micro-generation is only one of the ways in which we can help to reduce carbon emissions. Other energy conservation measures that do not adversely affect the character or fabric of a historic building should be considered first and foremost. Behavioural changes are often the simplest and cheapest options, yet the benefits can be profound. Actions could include reducing the thermostat by one degree, closing curtains or shutters at night, using low-energy light bulbs and switching off electrical equipment when it is not in use. Physical alterations to a building might involve installing loft insulation, draught proofing or secondary double-glazing. However, as with any alteration, care must be taken to protect the character of a historic building and to ensure compatibility with traditional building materials. It is also important to ensure that buildings are properly maintained and well ventilated. This will help to control moisture levels and thereby reduce the amount of heat needed to achieve a comfortable living and working environment. The greatest energy efficiency will be obtained where micro-generation technologies form part of a holistic approach to building management. This applies as much to existing buildings as to new ones.

Although rare, there will be cases where a historic building or site is so sensitive that micro-generation equipment cannot be installed without causing unacceptable harm to its character. In this situation, as well as adopting energy-saving measures, some individuals, businesses or organizations may also opt for voluntary carbon offsetting. This is where greenhouse gas emissions are mitigated by the purchase of carbon offsets. There are an increasing number of companies offering this service, but one simple method of offsetting is switching to one of many electricity suppliers now offering a 'green tariff.' There are three basic types of green tariff: for every unit of electricity you buy the supplier guarantees to buy a set amount of electricity from a renewable source, the supplier helps finance the construction of renewable energy projects, or the supplier helps support other environmental, carbon offset or research projects.

Above left: Keeping windows in a good state of repair, fitting draught proofing and making use of heavy curtains or shutters can greatly improve their thermal performance. This can be further enhanced by the addition of well-designed secondary double-glazing.

Left: Sheep's wool insulation in the roof space is just one of many ways to improve the thermal performance of a historic building.

Contacts and sources of advice

Cadw, Welsh Assembly Government,
Plas Carew, Unit 5/7 Cefn Coed,
Parc Nantgarw, Cardiff CF15 7QQ
Tel 01443 336000
www.cadw.wales.gov.uk

Clwyd-Powys Archaeological Trust
7a Church Street,
Welshpool SY21 7DL
Tel 01938 553670
www.cpat.org.uk

Dyfed Archaeological Trust
The Shire Hall, 8 Carmarthen Street,
Llandeilo SA19 6AF
Tel 01558 823121
www.dyfedarchaeology.org.uk

Glamorgan-Gwent Archaeological Trust
Heathfield House, Heathfield,
Swansea SA1 6EL
Tel 01792 655208
www.ggat.org.uk

Gwynedd Archaeological Trust
Craig Beuno, Garth Road,
Bangor LL57 2RT
Tel 01248 352535
www.heneb.co.uk

Energy Saving Trust Wales
1 Caspian Point, Caspian Way,
Cardiff Bay, Cardiff CF10 4DQ
Tel 029 2046 8340
www.energysavingtrust.org.uk

Countryside Council for Wales
Maes-y-Ffynnon, Penrhosgarnedd,
Bangor LL57 2DW
Tel 0845 1306229
www.ccw.gov.uk

Environment Agency
PO Box 544, Rotherham S60 1BY
Tel 08708 506 506
www.environment-agency.gov.uk

Local authority
Planning department and/or
Conservation Officer

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Cadw is the Welsh Assembly Government's historic environment service, working for an accessible and well-protected historic environment for Wales.

This publication is available in alternative formats. For details please contact Cadw at the address above or telephone 01443 336000.