SCOTTISH EXECUTIVE
Development Department





planning for micro renewables

ANNEX TO PAN 45 RENEWABLE ENERGY TECHNOLOGIES

PAN 45 ANNEX

Contents

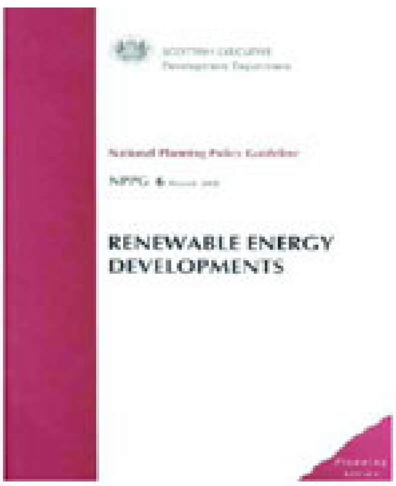
1

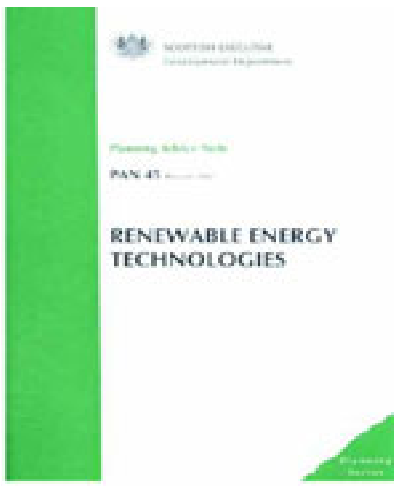
Policy Framework

1. The Scottish Executive is committed to increasing the amount of renewable energy generated and used in Scotland. The policy framework for renewable energy is set out in National Planning Policy Guideline (NPPG) 6: Renewable Energy Developments and in Securing a Renewable Future: Scotland's Renewable Energy. A review of NPPG 6 is underway.

2. Planning Advice Note (PAN) 45: Renewable Energy Technologies supports the policies in NPPG 6 by providing information and best practice on renewables developments, particularly larger installations such as wind farms and waste to energy plants.

3. Increased use of renewable energy, including micro-renewables, can make an important contribution to efforts to reduce carbon emissions in support of climate change and renewable energy objectives. The Scottish Executive is committed to making an equitable contribution to the UK Kyoto target to reduce 1990 levels of greenhouse gas emissions by 12.5% by 2008-12, and has set a target that 40% of electricity generated in Scotland should come from renewable sources by 2020.



4. Microgeneration is widely accepted to be the production of heat (less than 45 kilowatt capacity) and/or electricity (less than 50kW capacity) from zero or low carbon source technologies. In addition to the carbon benefits, increased use of micro-renewables plays an important part in diversifying our energy mix ensuring security of energy supply. It can allow energy to be produced and consumed locally, help alleviate fuel poverty (especially in off-gas network areas) and play a part in meeting renewable energy targets.

5. Advances in micro-renewable technologies and increasing awareness of the benefits of renewables have helped ensure a steady rise in their use across Scotland. Micro renewables can create local employment, in terms of manufacturing and installation and in providing the biomass fuel supply chain.

6. There have been a number of demonstration projects that have played a promotional and educational role in highlighting the benefits of micro-renewables. However, as a result of advances in technology and as economies of scale evolve, micro-renewables are becoming an increasingly practical way of generating electricity and heat for homes and both commercial and public buildings. This PAN explains how the planning system can support the micro-renewables industry in the rollout of the technology. It seeks to encourage the rollout of micro-renewable technologies in a way that protects the environmental quality of both urban and rural areas.

7. There are a wide range of micro-renewable technologies. This Annex will focus on wind, solar thermal, photovoltaic, heat pumps and biomass technologies. Advice relating to the siting and design of micro-hydro schemes can be found in PAN 45. These various micro-renewable technologies can be used individually or in combination to provide renewable energy in all seasons. The best micro-renewable technology to use will vary depending on the local context, available resource and the energy requirements of the applicant. Both planners and installers need to take into account this balance when considering projects.

8. Installation of micro-renewables will need to be assessed against the requirements of the planning system. Micro-renewables can be retrofitted to existing buildings, where they may be the subject of a specific application; or they can be built into new developments. The planning controls and considerations to be taken into account will vary across different technologies. Small schemes can provide a limited but valuable contribution to renewables output, local and national energy requirements and towards tackling climate change. Planning authorities should not reject a proposal simply because the level of output is low.

9. Permitted development rights are extended to certain types of development through the Town and Country Planning (General Permitted Development) (Scotland) Order 1992 (GPDO). The Executive has commissioned research into a review of the GPDO to consider updating the permitted development rights and related conditions and restrictions. This research will also consider the scope for increasing the permitted development rights for micro-renewables. Some micro-renewables may already be covered by permitted development rights, whilst other technologies will require a planning application – these issues are discussed further in this document

Micro-Wind

10. Micro-wind turbines have been used for many years in domestic, light industrial and farming applications for both water pumping and electricity generation. Micro-wind turbines have the potential to provide electricity in both domestic and commercial locations. The power generated and associated carbon emission reductions per turbine are relatively small, but cumulative benefits could be significant. The cost of micro-wind is falling and will be amongst the most financially viable technologies as more devices are installed, particularly since Scotland has the best wind resource in Europe.

11. There are currently an estimated 650-700 micro-wind installations in the UK. It is likely that we will see an increased use of micro-wind on homes and both commercial and public buildings. At present the typical financial payback period on micro-wind is 7-12 years. However, the cost of micro-wind turbines is predicted to fall as the technology develops. Additionally, there is a range of funding schemes in place which help fund the installation of micro-wind turbines. A domestic micro-wind turbine could save an average household (with an average wind regime) approximately a third of its typical energy requirement. The larger micro-wind systems can provide nearly all the energy required in a home.

12. After the initial outlay of the micro-wind turbine and associated equipment, running costs are comparatively low as they require little in the way of maintenance. Micro-wind turbines typically have a working life of 20-25 years, although excessive turbulence will cause fatigue damage, reduce the amount of power generated and shorten a turbine's working life. However, as the testing and development of micro-wind turbines continues and more knowledge and experience is gained and shared among manufacturers it is likely that the lifespan of turbines will increase.

Existing Planning Controls

13. Most micro-wind turbines are likely to require planning permission. However, it is for planning authorities to consider whether planning permission is required for micro-wind turbines in the particular circumstances of each case and taking into account the size, location, and surroundings of the proposed siting of the device. There are no specific permitted development rights for micro-wind systems. However, the Executive will be examining the option for new permitted development rights for micro-renewable systems in the context of the review of the GPDO, see paragraph 9.

How Do They Work?

14. Turbines catch the wind's energy using blades which are mounted on a shaft. The shaft is connected, normally via a gearbox, to a generator which produces electricity. The blades and shaft are connected to the nacelle, which contains the gearbox and other power/mechanical components. The micro-wind turbine may have a tail or motor to align the blades with the direction of the wind to maximise energy generation. Wind speed increases with height and the greater the wind speed, the more power is produced. Most wind turbines undergo test certification procedures, which must conform to the guidelines laid down by the International Electro-technical Commission (IEC), the main standard for small wind turbines is BS EN 61400-2 1996.

Stand-alone

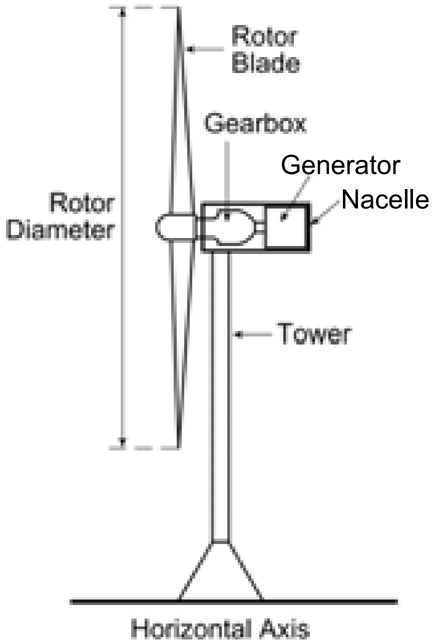
15. Micro-wind systems are often used as a source of power in remote locations where conventional methods of supply are expensive or impractical, for example where new power lines would be required. The wind turbines are generally connected to batteries, which are charged when spare energy is produced and provide power when needed, for instance during periods of low wind speeds. It is common to combine this with a diesel generator for use when additional power is required. There will likely be a need for associated equipment housing for any batteries and generator and thus these systems generally require more thorough safety precautions/measures to be undertaken, with regard to fuel storage and battery banks. This may involve separate storage areas/compartments.

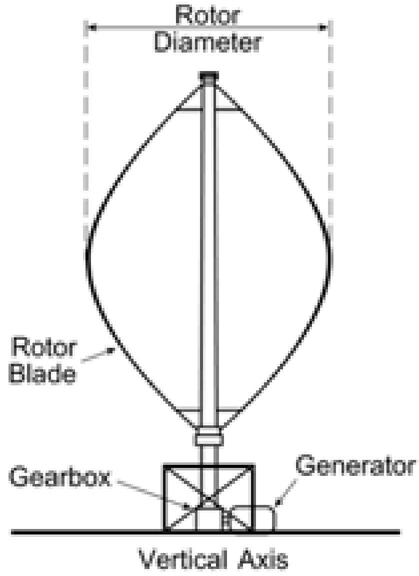
Grid-connected

16. Micro-wind installations can be connected to the grid. In periods of high wind, turbines may produce more power than is needed which allows excess electricity to be exported back to the grid and sold to an electricity supply company. When additional power is required, for instance during periods of lower wind speed, electricity can be imported from the grid.

Types of Turbines

17. Wind turbines can be either horizontal axis or vertical axis style.





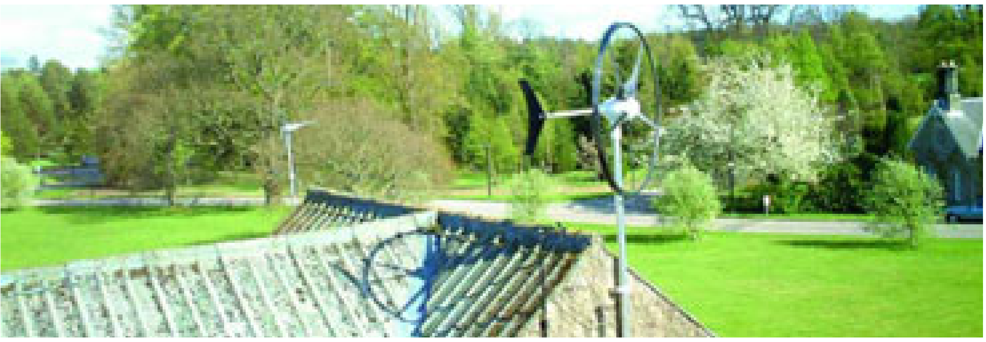
Horizontal Axis Wind Turbines

18. Most wind turbines are horizontal axis machines, which can generate electricity in low wind speeds. Horizontal axis micro-wind turbines generally range in size from 1.75 metres to 4 metres in diameter. To work effectively most horizontal axis wind turbines need to face into the wind. This can either be done by a tail, or a control system and motor to rotate the turbine – this usually depends on the size of the turbine. Other types of horizontal axis machines work ‘down wind’ and face away from the wind.




Vertical Axis Wind Turbines

19. Vertical axis wind turbines are not sensitive to wind direction and so do not require a means of orientating themselves. They are well suited to the turbulent wind found in urban areas as they are not affected by rapid changes in wind direction and able to cope well with upward and downward gusts. There are various designs of vertical axis turbines available, however their installation to date has not been common in Scotland. The main advantages of vertical axis wind turbines are that they are quieter and often thought to be more aesthetically pleasing. However, they are generally less efficient at harnessing the wind energy and require a fairly high wind speed to start rotation.



Roof Mounted Turbines

20. A number of companies have developed micro-wind turbines that can be mounted on buildings and other structures, including domestic properties. Roof mounted turbines can be either horizontal or vertical axis. Rooftop mounted turbines are likely to increase the overall height of a building to take advantage of higher wind speeds and will be comparable in height to a large television ariel or chimney stack. These will be attached to sturdy structural elements, such as external walls, but chimney stacks will generally not be suitable. The building must be able to take the extra weight and the extra wind load caused by the turbine and installations should meet the satisfaction of the council's Building Standards officer. (See para 28)

Turbines on Towers

21. Micro-wind turbines can be fitted on towers. These turbines tend to be horizontal axis and can be mounted on either lattice or solid towers, set in secure foundations. Taller towers can be supported by guide wires to ensure their stability. Higher towers will reach greater wind speeds and therefore have increased power generation capacity, but will have an increased visual impact.

Building Integrated Turbines

22. There is growing interest in integrating wind turbines into buildings and other structures. In this setting wind turbines can be used as a design feature as well as a method for generating renewable energy. They can be integrated at the design stage into homes and both commercial and public buildings, particularly tall buildings. Micro-wind turbines can also be integrated into buildings so that they are concealed from view. They can be incorporated into both the design of side elevations and with roofscapes. Ducted turbines sit at the edge of the roof of a building and utilise the updraft of the airflow along a building side.

Siting and Design

23. The perceived visual impact of micro-wind turbines depends on how they are seen both in terms of the image they convey and their siting and composition. Micro-wind turbines can be seen as symbols of positive action to address climate change and promote sustainability.

24. The erection of micro-wind turbines must be undertaken in a manner that keeps the environmental impact to a minimum whilst still ensuring they provide sufficient power. Sensitive siting and design in both urban and rural areas can reduce visual intrusion and play a part in making these installations an accepted feature. Individual circumstances will dictate the optimum position for micro-wind turbines. This will be influenced by the size of the installation and its surrounding environment. The potential impacts of micro-wind turbines are considerably less than wind farms. However, the potential siting of micro-wind turbines close to, on, or integrated with buildings means that special attention must be given to the need to protect amenity.

25. The ideal location for a micro-wind turbine is up high, taking advantage of prevailing south-westerly winds. It should preferably have a clear exposure, free from excessive turbulence and obstructions such as large trees or buildings. Planning authorities and developers will both need to be flexible in considering locations so as to ensure an adequate balance is struck between maximising energy production and minimising unwelcome visual impacts. It is possible to locate micro-wind turbines in more enclosed locations and still generate an appropriate amount of power for a home, however, the financial payback periods are likely to be consequently longer. Planning authorities can ask applicants to provide justification for siting a micro-wind turbine in a given location or encourage alternatives to be considered at the pre-application stage.

Colour and Form

26. The colour and finish of the wind turbine should be appropriate to the setting and designed to minimise visual impact and reflection of light. It is best practice to colour the various elements of the turbine as part of the manufacturing, which can be done either through painting or by coating with a coloured gel base. Where the main background is the sky then an off-white colour may be appropriate. If the main background is vegetation then a green/brown colour may be suitable. Where the main background includes building elements the best colour will vary, although in many cases green/brown is likely to be the most appropriate. There will usually be cost implications in colouring the turbines and in some instances for practical reasons it may not be possible to colour the blades. However, it may be possible to colour the associated equipment such as the mast or the cabling. Conditions can be attached to limit corporate branding on the turbine.

27. The siting and design of micro-wind systems should aim to minimise the contrast with the surroundings. This can be achieved by using simple shapes with clean lines, developing a balanced composition in proportion to the surrounding environment; and using regularity, order and symmetry wherever possible. The form of micro-wind turbines clearly relates to their function, which makes them legible built elements, which can easily be understood by the observer – making them a distinctive element in the landscape may be appropriate in some circumstances.

Roof Mounted Turbines

28. Turbines should be sited in a way that creates a balanced composition that does not undermine the architectural integrity of the building or structure. They are generally positioned on the highest point of the roof, however, to reduce their visual impact it may be possible to locate them at a lower position provided they have a 0.5m clearance from the base of roof. Consideration should be given to positioning the micro-wind turbine at the rear of the property, where visual impact will typically be lessened. High rise buildings may seek to install a series of turbines around the perimeter of the roof, to take advantage of updrafts around the building. Siting should consider the relationship to other existing roof structures such as chimneys, aerials, masts equipment housing, or where they can follow the form and positioning of traditional elements on roofs like chimneys. Where more than one turbine is proposed the aim should be to achieve a balanced composition, by grouping them together or installing through the use of symmetry. In some circumstances it may be better to site a turbine on a tower in the land adjacent to a building, particularly where a roof mounted turbine will damage the building's architectural integrity.

Towers

29. Towers should be sited in a way that minimises the landscape impact. Whilst tall towers and hilltop locations will be best for capturing maximum wind energy, smaller towers and low lying locations should still be able to generate sufficient energy to meet the requirements of an average home.

30. Careful consideration should be made to the desired height of the turbine. While it will be important to avoid undue turbulence and areas of low wind speed, the choice of height needs to be carefully balanced with the visual prominence of the turbine in relation to existing buildings and surrounding landscape features. Where possible the height of towers should relate to the height of existing vertical elements in the landscape such as light columns, telegraph poles, trees, buildings and other structures. A turbine sited on a prominent ridge is generally not desirable. Where possible towers should be coloured to minimise the visual impact.

Natural Heritage

31. The key natural heritage issue related to micro-wind turbines is likely to be that of landscape and visual impact particularly in rural areas and on the urban edge. Micro-wind turbines will likely be an appropriate development within natural heritage designations provided that an appropriate approach to siting and design has been undertaken and that areas of high sensitivity have been avoided.

32. Good siting should relate to existing features and patterns within the local landscape, whether this be the grouping of farm buildings, the line of hedgerow or the proximity of power lines.

33. It is unlikely that micro-wind turbines will cause a significant increase in bird strike, beyond those already arising from birds flying into existing buildings, windows and other obstacles. Further information on birds and habitats is provided in PAN 45, paragraphs 84-88.

34. The effects of installing a micro-wind tower should be considered in terms of the ground disturbance that may be arising from construction. Full restoration measures that are appropriate to the site should be provided by the applicant. Close attention should also be paid to the need for ancillary infrastructure or servicing, such as vehicles or powerlines to the proposed location. Particular care should be paid to such proposals where they are in prominent locations or cross areas of sensitive habitat or areas of species interest. Further information regarding natural heritage can be found in NPPG 14 ‘Natural Heritage’ and PAN 60 ‘Planning and Natural Heritage’.

Historic Environment

35. NPPG 18 sets out the Executive's planning policies in relation to the historic environment with a view to its protection, conservation and enhancement. NPPG 5 and PAN 42 set out Executive policy on archaeology, planning and scheduled monuments. It will not normally be possible to site micro-wind turbines on scheduled ancient monument and it will be difficult site them on listed buildings. However, there may be opportunities to site micro-wind turbines in conservation areas or within the curtilage of listed buildings. Where this is proposed care must be taken to ensure respect is paid to the site and setting of listed buildings, scheduled monuments and other important elements of the historic environment, including gardens and designed landscapes, and to important views and vistas to and from these buildings, monuments and sites, which may be identified in a conservation area appraisal. If micro-wind turbines are being integrated into listed buildings they should be concealed wherever possible, for instance through the use of ducted micro-wind systems. Further information is given in the Memorandum of Guidance on Listed Buildings and Conservation Areas within Appendix 1, in particular section 1.7 'Items Fixed To The Exterior of the Building'.

Siting Opportunities

36. Wind turbines can be designed as a piece of art helping to increase awareness and knowledge of renewable energy technology. Areas that already have engineered forms and structures may offer the best opportunity for siting equipment. These may include:

- industrial areas;
- wastewater treatment sites;
- on or near electricity pylons, water towers, floodlighting towers and gasometers;
- civic amenity sites;
- retail parks; and
- harbour areas.



Amenity Issues

Noise

37. Advice on noise is given in SODD Circular 10/1999, PAN 56 and PAN 45 paragraphs 65-68. New designs of micro-wind systems have greatly reduced noise levels due to improved blade design and reduced mechanical noise. Modern turbines are also easier to control and can be shut down at very high wind speeds.

38. Noise stemming from micro-wind turbines will generally be of an acceptable level. However, to protect nearby residents from any potential noise, a condition can be attached to any consent controlling the level of noise. A detailed noise assessment should not be required. Where turbines are fixed to a building, there may be a risk of noise disturbance from vibration to the building itself or neighbouring buildings and a condition might be attached that appropriate measures should be taken to mitigate any such vibration.

Electromagnetic Interference

39. Like any electrical equipment, micro-wind turbines have the potential to produce electromagnetic interference. However this is unlikely to be a significant issue; where problems do arise, it is likely to be highly localised and should be able to be technically overcome. The small diameter of micro-wind turbines will limit any potential effects on television and radio reception. It is unlikely that small rooftop wind turbines will effect either mobile phone reception or fixed radio/microwave communications links. Micro-wind turbines are also unlikely to have any detrimental effects on aviation and associated radar/navigation systems. It is also unlikely that electrical interference from such systems will interfere with the smooth operation of the micro-wind turbine.

Shadow Flicker

40. Advice on shadow flicker is provided in PAN 45, paragraph 64. The small diameter and likely location of micro-wind turbines greatly reduces the probability of shadow flicker occurring. Therefore in the majority of cases shadow flicker will not be an issue, however, information on shadow flicker can generally be provided by the companies who produce the equipment.

Visual Distraction

41. The potential for micro-wind turbines to distract road users may need to be assessed. However, potential for them to distract drivers will reduce as the number of micro-wind turbines increases and they become more of an accepted and unobtrusive feature of urban and rural areas. It is unlikely that micro-wind systems will be any more of a visual distraction than existing elements in the environment, such as advertising hoardings.

Case Studies

Fife Schools Pilot Project

As part of pilot project launched by the then Deputy Enterprise Minister rooftop micro-wind turbines have been installed on five Fife primary schools, including Collydean Primary School, Glenrothes. The initiative was jointly funded by the Scottish Executive through the Scottish Community and Household Renewables Initiative, Renewable Devices, ScottishPower and Fife Council.

Each turbine can generate up to 4000 kW hours of green electricity each year, saving up to 1720kg carbon dioxide, and cutting the school's energy bill. The turbines have also served an education role in raising awareness of renewables amongst the pupils.

Domestic Off-Grid Micro-Wind

In this example located near Milnathort, Kinross, the applicant sought to install a micro-wind turbine as part of the renovation of an off-grid house. The reasons for this were both on sustainable development grounds and due to the high costs of getting a grid connection, despite the property not being remote.

Pre-application discussions were held and initial concerns that the turbine would be bad neighbour development were eradicated when it was discovered the mast was only 10m high. The property has no near neighbours.

Planning permission for the turbine was granted in 2001 by Perth and Kinross Council. A modification was later submitted to change the position of the tower in January 2002 this was granted a month later in February 2002. The turbine has blades 1.3m in length. The 1.5kw turbine provides most of the energy required for the property. A power house was also built to house the control panel, and back-up battery packs and diesel generator.

3 Solar

42. Energy from the sun has been harnessed for thousands of years. Scotland has one of the best conditions in Europe for making use of solar energy. This may seem surprising, as solar radiation levels are relatively lower than in other European countries. This is, however, offset by the fact that we heat our homes for more months of the year, allowing better utilisation of available solar energy overall. Solar energy can be utilised in several ways, including passive solar design, solar hot water systems and photo-voltaic cells (PV), which generate electricity from solar radiation, this section will focus on the latter two as issues of sustainable layouts and making best use of resources can be found in other planning guidance, eg PAN 67 and PAN 68.

43. The amount of electricity that can be produced from solar panels will vary with the intensity of sunlight, the type of technology being used, and any overshadowing by trees or buildings. However, even on the cloudiest days energy comes from indirect sunlight, called diffuse solar radiation. On a cloudy day PV cells can produce up to 30% of the power output of a sunny day. However, there is still an inevitable mismatch between peak availability and peak demand of energy. This shortfall can be overcome by combining solar energy with a complementary technology such as wind which has a different seasonal pattern.

44. Both energy and carbon emissions savings can be made with solar technologies. The average domestic solar hot water system can reduce CO_2 emissions by 0.25-0.5 tonne per year, depending on the fuel replaced, and provide almost all of a home's hot water during the summer months.

45. Solar PV is currently one of the most expensive technologies, however, prices of solar power systems have steadily fallen over the past decade and are anticipated to continue to fall as the technology advances and economies of scale occur. Solar systems are therefore predicted to become a more familiar feature in the environment.

Existing Planning Controls

46. In some cases, providing that solar panels are not of an unusual design, or sited on a listed building, or in a designated area, they can be regarded as permitted development and thus do not require to seek planning permission. The GPDO Class 2 explains permitted development rights in relation to additions or alterations to dwellinghouse roofs. Class 23 of the GPDO will be relevant for industrial and warehouse developments.

Types of Systems

Solar Hot Water Systems

47. Solar hot water systems have been available in the UK since the 1970s and the technology is now well developed with a large choice of equipment to suit many applications. Solar hot water systems are mainly used for domestic water heating but can also be used in other settings such as light industrial, agricultural use and swimming pools. In the UK, an average household will reduce its annual energy consumption levels for providing hot water by approximately 50% after installing a solar hot water system.

48. Solar hot water systems work on the principle of water being pumped through the solar panel and heated by solar energy when the sun is shining. This heated water then flows through a heat exchanger, warming the stored water in the hot cylinder. In effect this serves to pre-heat the water so that less energy is required from traditional sources such as the boiler. The collectors are silent and generate no emissions.

49. The key component in a solar hot water system is the collector. There are two different types of solar collectors; flat plate systems and evacuated tube systems:

Flat Plate Collectors

These are the simplest and most common form of solar hot water heating panels. They are made from a sheet of metal painted black which absorbs the sun's energy. The metal sheet is embedded in an insulated box and covered with glass or clear plastic on the front.

Water is fed through the panel in pipes attached to the metal sheet and picks up the heat in the metal. These types of systems are sometimes described as having a similar appearance as a sky-light, although they tend to be larger than a typical skylight. Flat plate collectors can be positioned on roofs or walls.

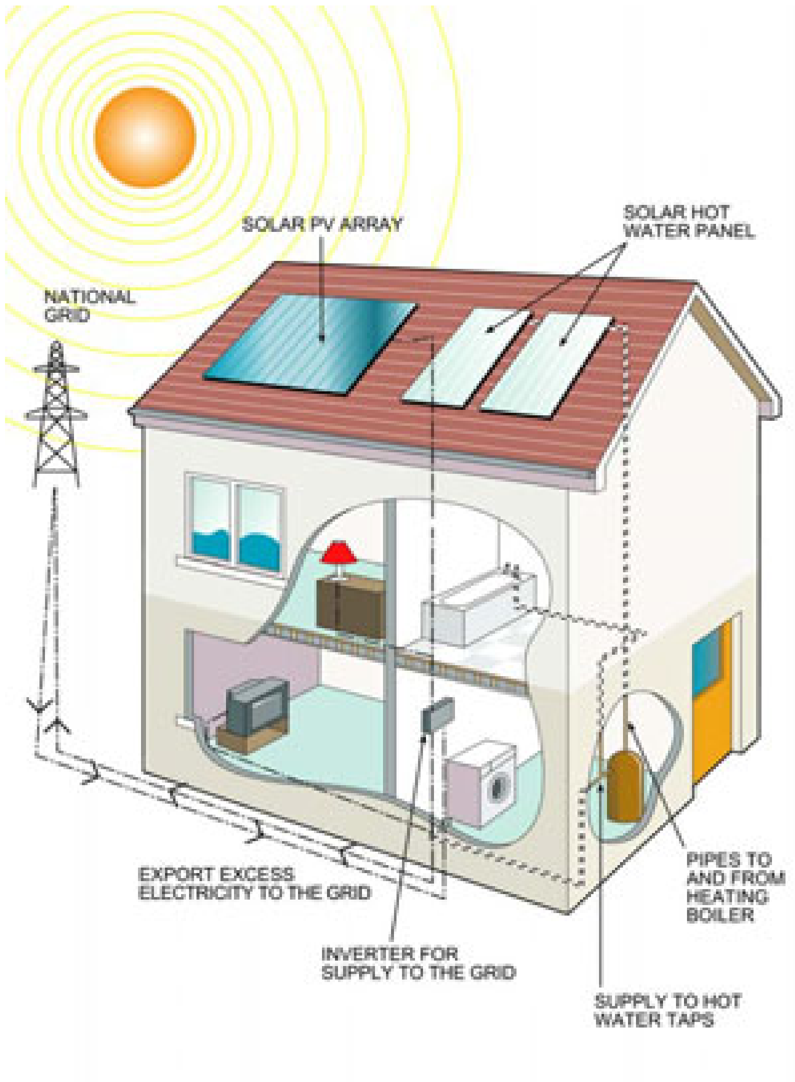
Evacuated Tube Collectors

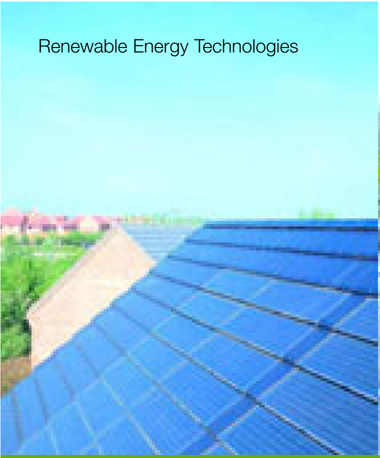
These are made of rows of parallel, transparent glass tubes. Inside each tube is a flat or curved metal plate, attached to a pipe.

They are more efficient because heat loss by convection is negligible compared to the flat plate collector system. They therefore tend to need less area, but can be more expensive.

Photo-Voltaic (PV)

50. PV systems convert solar radiation into electricity. The greater the intensity of the light, the greater the flow of electricity. PV solar panels may vary in appearance, but they are generally dark in colour and have low reflective properties. They can also vary in size and are usually grouped together to form a PV array to meet the required output of electricity. A typical PV array on a dwellinghouse will cover an area of between 9-18m^2. They have no moving parts, generate no noise or emissions, and can be integrated into all types of buildings – houses, commercial and public buildings.





Stand-alone

51. The issue of stand-alone or grid-connected systems is only relevant for PV systems which generate electricity. The use of PV for street lighting, parking meters, and road ‘furniture’ lighting is increasing as it reduces costs of mains connections and cabling. PV is also widely used to provide power for communications and monitoring systems in remote areas. Stand-alone systems will require associated equipment such as a battery to store energy during cloudy periods and an electronic controller to manage the energy from the array to the battery and the load.

Grid-connected

52. A PV array fitted on a building can be connected to the local electricity supply network and export any excess electricity produced to the grid, with the agreement of the network operator and an electricity supplier. Conversely, when demand is high extra electricity can be purchased from the grid through an electricity supply company. However as yet, most PV installations do not sell back to the grid. This may change as more systems are installed and seeking to sell to the grid and the combined input becomes a more attractive proposition to energy suppliers.

Building Integrated Systems and Building Attached (Retrofit)

53. PV solar panels can either be mounted on structures or free-standing, and come in a range of forms such as modules, laminates and solar tiles. PV solar panels or tile systems can be used in place of, or in addition to, traditional roof or façade materials. They can blend in with the built environment to minimise the aesthetic impact on the building. These types of products can serve a dual function: as building material and as a source of renewable energy. They may be installed on existing structures, although costs may be lower if they are integrated into the design of new structures.

Cost and Maintenance

54. Solar panels have proved to be very reliable and can have a design life of 25 years or more. Costs vary due to a range of factors such as size of collector, type of roof and geographic location. Solar panels generally require very little maintenance other than ensuring they are kept relatively clean, checking that shade from trees has not become a problem and where applicable inspecting the battery packs.

Siting and Design

55. Solar panels can be used on roofs, windows and walls. Roof panels are typically more economical for small systems, however, they can suffer from snow coverage in winter. Wall mounting is usually used where there are larger areas to cover, they can benefit from a boosted effect of snow reflection from the ground in winter, however, their positioning can be susceptible to shade.

Orientation

56. Most solar panels will be fixed in a position to provide maximum capture of solar radiation. Installers will calculate the best orientation but generally, in the UK, the panel should face roughly south, towards the sun, and at a tilt of between 30-50 degrees from the horizontal. Solar panels can be used for a building with a roof or wall that faces within 90 degrees of south, as long as no other buildings or large trees overshadow it. Where a south facing roof is not available or if an installation is not acceptable due to its impact on the character of the building; stand-mounted solar panels may be put up in a more optimal location.

57. Whilst it will generally be preferable for solar panels to be mounted to the rear of the property, it must be recognised that applicants will seek to put them on south facing roofs to maximise solar gain, regardless of whether this is a front or rear elevation. Solar panels can come in all different colours to suit the architectural design from contemporary designs to those attempting to match traditional tiles or slates. In contemporary designs consideration can be given to emphasising the sustainable elements and matching other roof materials to the solar panels.

58. Another consideration is that the roof must also be strong enough to hold the weight of the panels, especially if the panel is going to be placed on top of existing roof coverings.

Overshadowing

59. If the surface of the solar panel is in shadow for parts of the day, the output of the system decreases. Shadows from buildings, trees or other structures can significantly
reduce performance. However, building design and site conditions may help to optimise performance. Planners and developers should take reasonable steps to minimise overshadowing of the solar panels for example positioning to avoid the shadow of a chimney stack. Developers and planning authorities should also try to ensure that new buildings or extensions do not overshadow existing solar panels on neighbouring buildings.

Rooflines

60. Different roof designs may have more potential to conceal solar panels from view for example, valley roofs, double pitched roofs, roofs contained within parapets, low-pitched roofs not easily seen from the street, flat roofs and platformed roofs

61. The visually acceptable levels of roof coverage will vary with the technology, for example solar tiles, which have a similar appearance to traditional roof coverings, may cover a large percentage of the roof, whereas conventional flat plate collectors that look similar to roof lights will generally need to cover a smaller percentage of the roof, particularly where they are installed in traditional tiled roofs. Wherever possible solar panels should be flush with the roof and mounted at the same angle as the roof to minimise contrast.

Natural Heritage

62. The key natural heritage issue will be the landscape impact. Solar panels are an appropriate development within natural heritage designations as long as the siting and design advice is followed. Further information about natural heritage can be found in NPPG14 and PAN 60.

Historic Environment

63. Installation of a solar panel on a listed building or on another building or structure in its curtilage is likely to require an application for listed building consent. This will be so, even if specific planning permission is unnecessary. A high level of design quality will be required on listed buildings, in conservation areas and on scheduled ancient monuments. Sensitive siting and design will also be required if an application is submitted for the installation of solar panels close to a listed building or scheduled ancient monument. Historic Scotland will provide advice on solar panels proposed for scheduled monuments. Advice on Listed Buildings and Conservation Areas is given in their Memorandum of Guidance within Appendix 1, section 1.7.1. Solar panels have been successfully installed on even A-listed buildings.

Siting Opportunities

64. There are many situations in the built environment where solar panels can be installed to generate and promote renewable energy. Planning authorities will be aware that the levels of energy generated by PV schemes may be low but should recognise their value in terms of raising awareness to the technology.

65. PV cells can be added to the outside of existing buildings or south-facing roofs or walls. Service station canopy roofs can present a good opportunity for the installation of PV, particularly as it is frequently difficult to see the roof covering from the ground. PV can be used in a variety of roadside applications including motorway sound barriers, street lighting and street furniture. Planning authorities should consider how they can promote the use of solar panels on larger installations.

Case Studies

Midlothian: Crichton Castle

Crichton Castle, a scheduled monument in Midlothian is the first property in the care of Historic Scotland to be powered by renewable energy. Eight PV solar panels were installed which provide enough power to run lighting and a fax machine in the small shop and ticket office associated with the castle. The solar panels are about three square metres in size and are positioned on a roof slab on top of the remaining part of the original 14th century tower, where they are not visible to visitors.

The solar panels were chosen as an environmentally-friendly option which would not damage the structure of the ancient building. The panels replace previous systems of gas lighting and, more recently, a petrol generator. The latter had an adverse effect on the tranquillity of the monument and required regular deliveries of combustible fuel. The option of bringing a mains electrical supply to the site was ruled out on the grounds of cost and probable disturbance of important archaeological remains.

Aberdeen: Bridge of Don Academy

Aberdeen City Council has constructed one of the largest solar panel installations in the UK to heat the community swimming pool at Bridge of Don Academy. The 180 square metre installation covers the entire roof of the pool with 60 state-of-the-art, low maintenance solar hot water panels, using evacuated tube technology. The panels are not visible from ground level. Solar water heating was considered for thisproject due to the large area of suitable roof space which would allow a large solar array.

The City Energy Conservation Department has started work on a carbon emissions reduction pilot in the school. For educational purposes, the project will have a public display facility, which will show throughout the year the level of solar energy input to the pool.

Motherwell: UK's First Wind and Solar Powered Bus Shelter

A state-of-the-art bus shelter, has been located in Airbles Road, Motherwell, as part of a pilot scheme promoted by North Lanarkshire Council and bus shelter company Adshel. It is the UK's first wind and solarpowered bus shelter, using these sources of renewable energy to power the interior courtesy light in the shelter and to illuminate the advertising panel, which requires a power supply of 200 watts. The solar panel is located on the roof of the shelter, while the 5m high wind turbine pole is discreetly positioned in foliage two metres from the shelter. A battery stores the power generated by the solar panel and the wind turbine, which produces energy even on calm, cloudy days. A gentle breeze will generate some power, while a strong breeze with a wind speed of 22mph will generate 340 watts. As well as increasing passenger safety it reduces the disruption normally experienced when roads are excavated and power cables lain.

Edinburgh: Dumbeg Park

Assist Architects, won an open design competition to develop a sustainable housing development for Prospect Community Housing at Dumbeg Park, Westerhailes, Edinburgh. This development of 18 flats and houses incorporates solar hot water panels as well as utilising passive solar gain. Whilst the angle of the roofs on which the solar panels are positioned is not at the maximum tilt to maximise solar energy, a lower pitch was chosen on aesthetic design grounds.

4

Heat Pumps

66. A heat pump moves heat from one place to another. Heat flows naturally from a higher to a lower temperature. Heat pumps, however, are able to reverse the natural flow of heat and force the heat flow in the other direction, using a relatively small amount of drive energy. Heat pumps can transfer heat from natural heat sources such as the air, ground or water, to a building.

67. Heat pumps are named after their source of heat:

- ground-source heat pumps get their heat from ground below the frost line;
- air-source heat pumps get heat from the outdoor air; and
- water-source heat pumps get heat from water, usually well water.

68. Even at temperatures considered to be cold, air, ground and water contain useful heat that is continuously replenished by the sun. By applying a little more energy, a heat pump can raise the temperature of this heat energy to the level required.

69. Most heat pumps have two main parts; the outdoor unit and the indoor unit. The outdoor unit includes the outdoor heat exchanger, the compressor and a fan. This is where the heat from the air outside is picked up during the heating season, and where the heat from inside the house is rejected during the cooling season. The indoor unit contains the indoor heat exchanger and the fan that distributes heated or cooled air to the distribution system of the house. Some systems have a second indoor cabinet that contains the compressor. By reversing the heat pump it can also be used for cooling.

Ground Source Heat Pumps

70. The average ground temperature just below the surface, in the UK is between 8ºC and 13ºC, this temperature remains constant throughout the year. Ground source heat pumps (GSHP) are a means of tapping into and utilising this resource. GSHP were invented more than 50 years ago, and continuous development has greatly improved their efficiency and reliability. It is now a proven, cost-effective, safe and environmentally friendly alternative to fossil fuels, that is cost-effective for certain commercial and domestic applications, particularly where mains gas is not available.

71. The market for GSHP is currently small but growing – they are currently more common in the USA and the rest of Europe. The total number of existing installations in the UK is estimated at around 600-700 units. The principal market for GSHP are domestic housing, commercial properties not connected to the natural gas network and commercial industrial properties with stable heat demand. It is estimated that there is the potential for the number of installations to increase.

72. GSHP are most likely to be an option where there is no access to natural gas and so the alternative may be oil or direct electric heating (storage heaters). Heat pumps ground loops can be laid in the ground or in water such as rivers, lakes or ponds.

How Do They Work?

73. To access thermal energy, coils or loops of special grade pipe need to be buried in the ground either in horizontal trenches or vertical boreholes. Horizontal trenches are a cheaper option and generally used where there is sufficient space. Where there is not enough land to do horizontal trenches, vertical boreholes can be used, these normally require to go down at least 60 meters and are the more expensive option, but will provide higher efficiencies since the temperature of the earth is higher at greater depths, and less power is needed to pump the fluid around the circuit. The length and size of ground loops is designed to match the heating needs of the property. The trenches or boreholes required for the ground loops can be dug and backfilled by a standard earth excavator.

74. Systems operate by circulating water (or another fluid) through pipes buried in the ground. The water in the pipes is lower than the surrounding ground and so it warms up slightly. This low grade heat is transferred to a heat pump, which raises the temperature to around 50°C. The heat pumps typically providing 4 units of energy from 1 unit of electricity.

75. The building plot will need sufficient land available for installation of the ground works. The dimensions of trenches or boreholes will vary between manufacturers. The ground above where heat pipes are installed can be used for open space or covered over with hard materials. Where there are existing lakes or ponds or where it is proposed to install Sustainable Urban Drainage Systems (SUDS), the opportunity to install ground source heat pumps beneath the surface of the water should be considered. Similarly in larger developments with open space requirements, ground source heat pumps could be laid beneath greeenspaces.

Planning Issues

76. The definition of development includes 'engineering operations' examples of activities held to fall within the definition of engineering operations include drilling of exploratory bore holes. Applicants should check whether planning permission is required with the relevant planning authority. Although, it should be noted that following the drilling and installation of heat pumps the ground can be returned to the previous state.

Archaeology

77. As the installation of ground source heat pumps will require the excavation of trenches or deep boreholes it is important to consider in advance whether archaeological remains exist on the development site and what the implications of the development might be. The needs of archaeology and development can usually be reconciled, and much potential conflict reduced. Further details on Archaeology can be found in PAN 42. Information on the location of scheduled monuments, listed buildings and other known archaeological sites is available on www.pastmap.org.uk

Contamination

78. Applicants should be aware that the construction or extraction of a borehole or well for the purpose of abstraction, or the abstraction or discharge to the water environment may require an authorisation from SEPA. Applicants should be advised to contact their local SEPA office for further details. Care should be taken when constructing boreholes to prevent contamination of the borehole itself and of the groundwater resource in general.

Water Source Heat Pumps

79. Water source heat pumps operate in a similar way to ground source heat pumps. The loop is submerged in water, typically a river or lake. They take heat from the water and convert it into a gas. The gas is condensed in a process which releases heat. This heat can be transferred to the heat distribution system in the building. The use of a water source such as a river or lake is likely to provide lower efficiencies due to the temperature of the source being more affected by the weather, but the advantage is the relatively cheaper installation cost achieved by avoiding any ground works.

Air Source Heat Pumps

80. Air source heat pumps, are often used in moderate climates, they use the difference in outdoor and indoor air temperatures to cool and heat the building. Air source heat pumps extract the heat in air and use a fan to draw air over coils that extract energy. This energy is then transferred to a home or building and used as part of a heating supply.

81. Although they are less efficient than ground source heat pumps, and likely to be more variable because air temperatures fluctuate both daily and seasonally. Even when the outside temperature drops, air source heat pumps can still produce 2-3 times as much energy as they use to run. However in cold weather the evaporator coil is likely to need defrosting. The air source heat pump does have advantages in terms of lower installation costs and the fact that no ground loop negates the need for trenching.

82. Air source heat pumps can be used for a wide variety of applications such as cooling for lofts, restaurant kitchens and hotel plant rooms where the hot water can easily be used for other applications. They can provide hot water using waste heat in the air. By using waste heat, they can also remove heat from an area, such as a loft space, where it is not needed.

83. Air-source heat pumps can be located in the roof space or on the side of the building. They look like air conditioning boxes. Where these are proposed for listed buildings or in conservation areas, it will be important that they are sensitively sited.

5

Biomass

84. The Scottish Executive is keen to encourage biomass as it offers both environmental and economic benefits. Biomass is a growing sector and offers significant potential for heat generation in Scotland. Background information on biomass and sources of biomass fuel is found in the main text of PAN 45 paras. 125-146. This Annex deals with the installation and siting of biomass systems and infrastructure rather than the effects of the crops which are usually greater and more widespread. Biomass has an advantage over intermittent renewable energy sources, such as wind and solar, as biomass can be stored and power generated when required. This makes it one of the most viable and reliable micro-renewable technologies. However, unlike other sources of renewable energy, biomass typically requires on-going payments to be made for the fuel.

85. Biomass is most effective when a local fuel source is used, thus reducing transport impacts ensuring that the carbon benefits from using biomass are not lessened by emissions created when transporting it, and also reducing the financial costs associated with transporting the fuel. Using a local source also results in local investment and employment, bio-energy also has the potential to create and sustain jobs in rural areas. At present, the principal market for domestic scale biomass heating is in more rural locations where there is the space to accommodate the boilers and easy access to biomass and where Smokeless Zone Regulations do not apply. Certain wood fuel boiler systems have been approved for use in areas covered by Smokeless Zone Regulations, a list of such technologies is available at www.uksmokecontrolareas.co.uk. Micro-biomass systems can be used in a wide range of situations to help fulfil energy needs, such as business and industrial areas and in new housing developments both flatted and non-flatted layouts.

Technology

86. There are a range of micro and small-scale biomass heating systems commercially available in the UK across a wide range of sizes, combustion technologies and fuel sources. Small scale biomass heating systems range from single room heaters hand fed with logs, through to industrial units with fully automated fuel handling systems using wood chips for large scale steam or combined heat and power (CHP) operation. Domestic biomass boilers require more room than standard boilers and are unlikely to fit into small properties. Exhaust gases require a flue vent that rises above the roofline of the building; planning permission may be required for this depending on the height above the roofline.

87. For domestic applications of biomass the fuel usually takes the form of wood pellets, wood chips or wood logs. There are two main ways of using biomass to heat a domestic property; stand alone stoves and boilers connected to the central heating and hot water systems.

Planning Issues

88. Many micro biomass schemes will not require planning permission as they are internal alterations. However, some micro-biomass schemes involve the construction of outhouses, areas to store the materials and in some instance will require the construction of a new means of access for service vehicles.

89. It is important to have sufficient storage space for the fuel, appropriate access to the boiler for loading and a local fuel supplier. There is considerable variation between the storage needs associated with different boiler systems and fuels such as wood pellets. Sufficient storage is needed to avoid frequent transport deliveries which would reduce the carbon savings generated from using biomass Where proposed, the hopper, which is used for storing wood fuel, can be attached to the outside of the building in a least sensitive, but accessible location, or in an underground lined pit. Details of proposed storage locations should be provided and clear information on how these are to be accessed by service vehicles.

90. Noise can occur due to operations at the plant (e.g. engines, boilers and handling equipment) and due to vehicle movements in and out of the site. Screening using landscaping or natural contouring can help reduce this impact. Further guidance on noise issues can be found in PAN 56 and Circular 10/1999, Planning and Noise.

Community Renewables Schemes

91. Community groups have increasingly been working to develop renewable energy scheme that provide energy to a range of local users. Examples of a community scheme include:

- a grouped housing installation such as a "solar street" where solar panels are fitted to the roof of every house in a street;
- incorporating solar water heating into a new civic building;
- installing a wind turbine to provide electricity to a school or hospital; or
- a community-owned wind turbine development.

92. Community owned renewable energy projects present the opportunity create a regular income stream which can be used to fund local improvements to enhance and strengthen the community. They can generate wider benefits such as investment into local communities, local jobs creation and raising local awareness and interest in other types of renewable energy. Additionally, by developing their own renewable energy schemes, communities can have more control over the scale and siting of local developments. They will need to establish a legal identity to progress their plans. However, planners should be aware that community ownership does not guarantee that objections will be eliminated, particularly from residents who are not part of the scheme or from competitive schemes.

93. Planning authorities should be able to assist communities in understanding the planning issues which need to be address when developing a micro-renewables project. Additional assistance is available from Planning Aid for Scotland, the Energy Saving Trust, the Highlands and Islands Community Energy Company, area based renewable energy groups, energy companies and manufactures and installers of micro-renewable devices. Some community groups will pursue proposals themselves, others may go into partnership with a private company, which allows them to be guided through the process without taking on the full financial risks and necessary work in preparing the scheme.

94. Community groups interested in pursuing a micro-renewables project are encouraged to work with the development plan process, to ensure their proposal is in accordance with the plan when they submit their application.

Micro Renewables in New Developments

95. Most micro-renewable technologies have the potential to be integrated into new developments at the design stage. It is vital for the installation of micro-renewables to be considered early on the design process to minimise costs and take the greatest advantage of the renewable resources available. This will also allow developers to factor any added costs into their calculations. In general, more effort is required to add a micro-renewable system to an existing building than for a new build where it can be included at the development stage. In the latter case it can represent a small fraction of total development costs and be more easily absorbed.

96. Opportunities presented by a site's topography, aspect and landscape features should be taken into account when designing new developments. Such opportunities can include south facing aspects where solar technologies may be particularly suited or sites with a prevailing south-west wind where micro-wind systems would be particularly effective. It is also worth considering where existing planting could be used to screen wind turbines on towers.

Forward Planning

97. NPPG 6 encourages development plans to make positive provision for renewable energy developments. Micro-renewables can be considered as part of the overall design concept in major land releases and can be built into development plans, masterplans, design statements and planning briefs. The promotion of micro-renewables and the inclusion of generation capacity in new developments will be considered in SPP 6.

Other Regulatory Schemes

98. The requirements of other regulatory regimes such as Environmental Health and Building Standards, including standards for insulation should be met as appropriate. The forthcoming EU Directive, 'The Energy Performance of Buildings' will require Member States to take steps to make buildings more energy-efficient. One of the principal objectives of the Directive is to promote the improvement of the energy performance of buildings within the EU through cost effective measures. This reflects a key move towards reducing the energy demand from buildings and exploiting more sustainable energy sources. Through having lower energy demand micro-renewables will be able to make a greater proportionate contribution to the overall demand. Measures introduced under the Directive will include application of performance standards on new and existing buildings and certification schemes for all buildings. Proposals should also meet with environmental protection regimes regulated by SEPA.

Funding

99. Financial incentives are available to communities and householders to support renewable energy technologies. The Scottish Community and Householders Renewables Initiative is a one-stop shop which aims to raise awareness of the benefits of renewable technologies and also provides grants and expert advice to support the development of new community and household micro-renewable schemes, through a series of locally based advisors. SCHRI is funded by the Scottish Executive and managed jointly by the Energy Saving Trust and Highlands and Islands Enterprise. Further information on funding sources is available at www.est.org.uk/schri and www.hie.co.uk. Some local authorities also run funding schemes.

100. In addition to grant support for the capital outlay of installing a micro-renewable system, it may be possible to receive annual payments for the energy generated. The Renewables Obligation (Scotland) places a legal requirement on electricity supply companies to source a proportion of their supply from accredited renewable sources. Renewable Obligation Certificates (ROCs) are digital certificates which prove how units of electricity are produced and used. If energy companies have not managed to produce the required amount of green energy themselves they must buy accredited ROCs on the open market to make up their shortfall or fines can be imposed. To qualify for ROCs, renewable systems must generate at least 0.5 MWhrs per annum and be grid connected.

Enquiries

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A copy of this PAN is also available on the Scottish Executive website:
www.scotland.gov.uk/planning

Further copies of this PAN and a list of SPPs, NPPGs and PANs can be obtained by telephoning 0131 244 7543. Hard copies of documents can also be requested online.

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Solar and Wind Applications

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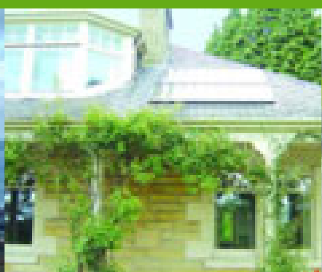

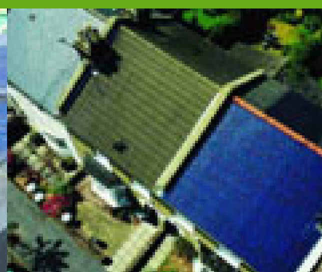


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