203: Electrical installations technology  
**Handout 27: Micro-renewable energies**

**Learning outcome**

The learner will:

1. know requirements for different types of micro-renewable energies.

**Assessment criteria**

The learner can:

6.1 describe types of **micro-renewable energies**

6.2 identify **requirements** for installation of **micro-renewable energies**

6.3 identify advantages and disadvantages of **micro-renewable energies**.

**Range**

**Micro-renewable energies**: Solar thermal (hot water), ground source heat pump, air source heat pump, biomass, solar photo-voltaic, micro-wind, micro-hydro, micro-combined heat and power (heat led), rainwater harvesting, greywater re-use.

**Requirements**: Legal, regulatory, building location, building fabric.

**Micro-renewable energies**

So far we have discussed large-scale electricity generation. However, there are many means of generating electricity and energy conservation for individual consumers. This is referred to as micro-generation or micro‑renewable energies.

Most of these are relatively new technologies and it is important to determine the specific requirements for each one. These requirements include:

* legal
* regulatory
* building location
* building fabric.

|  |  |
| --- | --- |
| **Solar thermal (hot water)**  Solar thermal (hot water) is a renewable energy system for generating domestic hot water by using solar panels (known as ‘collectors’) fitted at an optimal angle on a south‑facing roof or other suitable surface.  Solar heat warms fluid, usually anti-freeze, in the collectors and this is then pumped to heat water stored in a hot water cylinder. | 01 solar thermal.png |

A boiler or immersion heater tops up the water to the temperature set by the cylinder’s thermostat (>60°C).

In England, Wales and Scotland, planning permission is not needed for most home solar water heating systems, as long as they are below a certain size, but you should check with your local planning officer, especially if the premise is a listed building, or in a conservation area or World Heritage Site.

Here are the benefits of solar thermal.

* It should work all year round during the day but consumers will probably need to heat the water further in winter months, using a boiler or immersion heater.
* It can save on fuel bills.
* It should be eligible for renewable heat incentives.
* It can cost a lot less to install than other micro-generation technologies.
* It does not cost more than £5,000.

|  |  |
| --- | --- |
| **Ground source heat pump (GSHP)**  Ground source heat pumps use pipes which are buried in the garden to extract heat from the ground. This heat can then be used to heat radiators and underfloor or warm air heating systems and hot water in your home.  A ground source heat pump circulates a mixture of water and anti-freeze around a loop of pipe – called a ground loop – which is buried in the garden.  Heat from the ground is absorbed into the fluid and then passes through a heat exchanger into the heat pump. | 02 Groundsource.JPG |

The ground stays at a fairly constant temperature under the surface, so the heat pump can be used throughout the year – even in the middle of winter.

The length of the ground loop depends on the size of the premises and the amount of heat needed. Longer loops can draw more heat from the ground but need more space to be buried in. If space is limited, a vertical borehole can be drilled instead.

In England, Scotland and Wales, domestic ground source heat pumps are generally allowed as Permitted Developments but check with your local authority to find out whether you need planning permission or not.

In Northern Ireland you must consult with your local authority regarding planning permission for ground source heat pumps.

Here are the benefits of GSHP.

* It could lower fuel bills, especially if replacing conventional electric heating.
* It could provide an income through the government’s [Renewable Heat Incentive](http://www.energysavingtrust.org.uk/../../../../Generate-your-own-energy/Financial-support/Renewable-Heat-Incentive) (RHI).
* It could lower the premises’ carbon emissions, depending on which fuel is being replaced.
* It doesn’t need fuel deliveries.
* It can heat the premises and provide hot water.
* It needs little maintenance – they are called ‘fit and forget’ technology.

|  |  |
| --- | --- |
| **Air source heat pump (ASHP)**  Air source heat pumps absorb heat from the outside air. This heat can then be used to heat radiators, underfloor heating systems or warm air convectors and hot water in the home.  An air source heat pump extracts heat from the outside air in the same way that a fridge extracts heat from inside itself. It can get heat from the air even when the temperature is as low as –15° C.  Heat pumps have some impact on the environment, as they need electricity to run, but the heat they extract from the ground, air or water is constantly being renewed naturally. | 03 Airsource.JPG |

Air source heat pump installations in Wales and Northern Ireland require planning permission.

In England and Scotland they may be considered Permitted Developments, in which case planning permission is not required, but the criteria are complex so it is always a good idea to check with your local planning office.

Here are the benefits of ASHP.

* It could lower fuel bills, especially if replacing conventional electric heating.
* It could provide an income through the government’s Renewable Heat Incentive (RHI).
* It could lower the premises’ carbon emissions, depending on which fuel is being replaced.
* It doesn’t need fuel deliveries.
* It can heat the home and provide hot water.
* It needs little maintenance – they are called ‘fit and forget’ technology.
* It can be easier to install than a ground source heat pump, though efficiencies may be lower.

Unlike gas and oil boilers, heat pumps deliver heat at lower temperatures over much longer periods. During the winter it generally needs to be on constantly to heat the home efficiently. The radiators won’t feel as hot to the touch as they might do when using a gas or oil boiler.

|  |  |
| --- | --- |
| **Wood-fuelled heating**  Wood-fuelled heating systems – also called **biomass** systems – burn wood pellets, chips or logs to provide warmth in a single room or to power central heating and hot water boilers.  A stove burns logs or pellets to heat a single room and may be fitted with a back boiler to provide water heating as well.  A boiler burns logs, pellets or chips and is connected to a central heating and hot water system. A wood-fuelled boiler could save nearly £600 a year compared to electric heating. | 04 Wood fuelled heating - small.PNG |

Here are the benefits of wood-fuelled heating.

* **Affordable heating fuel:** although the price of wood fuel varies considerably, it is often cheaper than other heating options.
* **Financial support:** wood-fuelled boiler systems could benefit from the Renewable Heat Premium Payment and the Renewable Heat Incentive (RHI).
* **A low-carbon option:** the carbon dioxide emitted when wood is burned is the same amount that was absorbed over the months and years during which the plant was growing. The process is sustainable, as long as new plants continue to grow in place of those used for fuel. There are some carbon emissions caused by the cultivation, manufacture and transportation of the fuel but, as long as the fuel is sourced locally, these are much lower than the emissions from fossil fuels.

A flue which meets the regulations for wood-burning appliances will be needed: a new insulated stainless steel flue pipe or an existing chimney – although chimneys normally need lining to make them safe and legal.

You may not need planning permission, but you should always check. All new wood heating systems have to comply with building regulations.

|  |  |
| --- | --- |
| **Photo-voltaic (PV)**  These are gaining widespread popularity in the UK with incentive schemes for consumers to have them installed.  Solar panel electricity systems – also known as solar photo-voltaics (PV) – capture the sun’s energy using photo-voltaic cells. These cells don’t need direct sunlight to work – they can still generate some electricity on a cloudy day.  The cells convert the sunlight into electricity, which can be used to run household appliances and lighting. | 05 Photovoltaic - New.png |

Apart from reducing the consumer’s electricity bill by supplementing the electricity supply, the customer can ‘sell back’ surplus electricity to the electricity supplier via a ‘smart meter’ using a feed‑in tariff.

Whilst the equipment is relatively expensive to install initially, the payback over a number of years will benefit the consumer. Additionally, as photo‑voltaic is another example of renewable energy source, the consumer’s carbon footprint is greatly reduced.

In England, Wales and Scotland, planning permission is not required for most home photo-voltaic systems – as long as they are below a certain size – but you should check with your local planning officer, especially if the premises are a listed building, or in a conservation area or World Heritage Site.

Here are the benefits of photo-voltaic.

* Sunlight is free so, after the initial installation, electricity costs will be reduced.
* The government’s feed-in tariffs pay the consumer for electricity generated, even if they use it.
* If the system is producing more electricity than needed by the consumer, or when they can’t use it, the surplus can be sold back to the Grid.
* You will cut your carbon footprint. Solar electricity is green, renewable energy and doesn’t release any harmful carbon dioxide or other pollutants. A typical home solar PV system could save over a tonne of carbon dioxide per year – that’s more than 30 tonnes over its lifetime.

|  |  |
| --- | --- |
| **Micro-wind**  Wind turbines harness the power of the wind and use it to generate electricity.  The UK is an ideal country for domestic turbines (known as ‘micro-wind’ or ‘small-wind’ turbines), as 40% of all the wind energy in Europe blows over it.  A typical system in an exposed site could easily generate more power than your lights and electrical appliances use. | 06 Micro-wind.png |

Wind turbines use large blades to catch the wind. When the wind blows, the blades are forced round, driving a turbine which generates electricity. The stronger the wind, the more electricity produced.

There are two types of domestic-sized wind turbine.

* Pole mounted: these are free-standing and are erected in a suitably exposed position, Often these are around 5kW to 6kW in size.
* Building mounted: these are smaller than mast mounted systems and can be installed on the roof of a home where there is a suitable wind resource. Often these are around 1kW to 2kW in size.

Wind turbines are eligible for the UK government’s feed-in-tariffs, which means that the consumer can earn money from the electricity generated by the turbine. Payments can also be received for the electricity not used by the consumer and exported to the local grid.

In order to be eligible, the installer and wind turbine product must be certified under the Microgeneration Certification Scheme (MCS).

If the turbine is not connected to the local electricity grid (known as off grid), unused electricity can be stored in a battery for use when there is no wind. **NB:** the feed-in tariffs scheme is not available in Northern Ireland.

Planning permission is required to install a wind turbine in Wales or Northern Ireland; contact your local authority for details.

In England and Scotland, a domestic wind turbine may be classified as Permitted Development, in which case planning permission will not be needed. However, the criteria are complex – and very different in England and Scotland – so we recommend that you contact your local planning office at an early stage to check whether planning is required.

For **building-mounted turbines**, the criteria include:

* the house is detached
* the top of the turbine blades is no more than three metres above the top of the house, or 15 metres above the ground
* all of the turbine is at least five metres from the edge of the householder’s property.

For **pole-mounted turbines**, the criteria include:

* the top of the turbine is no more than 11.1 metres above ground
* all of the turbine is at least 1.1 times the height of the turbine away from the edge of the householder’s property.

And for **both types of turbine**:

* there is no other wind turbine and no air source heat pump on the site
* the bottom of the blades is at least five metres above ground
* the turbine’s swept area is no more than 3.8m2
* the site is not on land safeguarded for aviation or defence purpose.

|  |  |
| --- | --- |
| **Micro-hydro**  Running water can be used to generate electricity, whether it’s a small stream or a larger river.  Small or micro-hydroelectricity systems – also called hydropower systems or just hydro systems – can produce enough electricity for lighting and electrical appliances in an average home. | 07 Micro-hydro.png |

All streams and rivers flow downhill. Before the water flows down the hill, it has potential energy because of its height. Hydropower systems convert this potential energy into kinetic energy in a turbine, which drives a generator to produce electricity. The greater the height and the more water there is flowing through the turbine, the more electricity can be generated.

The amount of electricity that a system actually generates also depends on how efficiently it converts the power of the moving water into electrical power.

Here are the benefits of micro-hydro.

* A hydro system can generate 24 hours a day, often generating all the electricity the consumer needs and more.
* If eligible, the consumer will get payments from the feed-in tariff for all the electricity generated, as well as for any surplus electricity sold back to the Grid.
* A hydro system may generate more electricity than needed for lighting the home and powering the electrical appliances – so the excess electricity can be used to heat the home and hot water too.
* Installing a hydro system can be expensive but in many cases it’s less than the cost of getting a connection to the National Grid if the premises do not already have one.
* Hydroelectricity is green, renewable energy and doesn’t release any harmful carbon dioxide or other pollutants.

Hydropower is very site specific. Most homes will not have access to a suitable resource even if they have a water course running nearby. Assessing a hydro site properly is a job for a professional.

In order to be suitable for electricity generation, a river needs to have a combination of:

* **flow** – how much water is flowing down the river per second, and
* **head** – a difference in height over a reasonably short distance.

Developing a hydroelectric system can take a long time, mainly because of the need to obtain planning permission and an abstraction licence, and because of the number of organisations that may need to be involved in giving consent.

All new hydroelectric systems require planning permission and an abstraction licence.

**Micro-combined heat and power (micro‑CHP)**

|  |  |
| --- | --- |
| This technology generates heat and electricity simultaneously, from the same energy source, in individual homes or buildings. The main output of a micro-CHP system is heat, with some electricity generation, at a typical ratio of about 6:1 for domestic appliances.  A typical domestic system will generate up to 1kW of electricity once warmed up; the amount of electricity generated over a year depends on how long the system is able to run. Any electricity you generate and don’t use can be sold back to the Grid. | 08 Micro chp.png |

Domestic micro-CHP systems are currently powered by mains gas or LPG; in the future there may be models powered by oil or bio-liquids. Although gas and LPG are fossil fuels rather than renewable energy sources, the technology is still considered to be a ‘low carbon technology’ because it can be more efficient than just burning a fossil fuel for heat and getting electricity from the National Grid.

Micro-CHP systems are similar in size and shape to ordinary, domestic boilers and like them can be wall-hung or floor standing. The only difference to a standard boiler is that they are able to generate electricity while they are heating water.

Here are the benefits of micro-CHP.

* When the micro-CHP is generating heat, the unit will also generate electricity to be used in the home (or exported).
* By generating electricity on-site, the consumer could be saving carbon dioxide compared with using Grid electricity and a standard heating boiler.
* Micro-CHP is eligible for feed-in tariffs. Please note that the feed-in tariff is not available in Northern Ireland.
* For the householder, there is very little difference between a micro-CHP installation and a standard boiler. If the consumer already has a conventional boiler then a micro-CHP unit should be able to replace it, as it’s roughly the same size. However, the installer must be approved under the Microgeneration Certification Scheme (MCS).
* Servicing costs and maintenance are estimated to be similar to those of a standard boiler, although a specialist will be required.

**Rainwater harvesting**

Rainwater harvesting (RWH) is a practice of growing importance in the UK, particularly in the South-east of England where there is less water available per person than in many Mediterranean countries.

Rainwater harvesting in the UK is both a traditional and reviving technique for collecting water for domestic uses. This water is generally used for non-hygienic purposes, such as watering gardens, flushing toilets and washing clothes.

There is a growing demand for larger tank systems collecting between 1,000–7,500 litres of water. The two main uses for harvested rainwater are botanical uses (in gardening for plant irrigation) and domestic uses (flushing toilets and running washing machines).

Rainwater is almost always collected strictly from the roof and then heavily filtered by using either a filter attached to the down pipe, a fine basket filter or, for more expensive systems like self-cleaning ones, filters placed in an underground tank.

The velodrome of the London Olympic Park is designed to harvest rainwater.

|  |  |
| --- | --- |
| **Greywater re-use**  Greywater, or sullage, is wastewater generated from domestic activities, such as laundry, dishwashing and bathing, which can be recycled on-site for uses such as landscape irrigation and constructed wetlands.  Greywater differs from water from the toilets, which is designated sewage or blackwater to indicate that it contains human waste.  Most greywater is easier to treat and recycle than blackwater, because of lower levels of contaminants.  If collected using a separate plumbing system from blackwater, domestic greywater can be recycled directly within the home, garden or company and used either immediately or processed and stored. | 09 Grey water use.png |

If stored, it must be used within a very short time or it will begin to putrefy, due to the organic solids in the water.

Recycled greywater of this kind is never safe to drink, but a number of stages of filtration and microbial digestion can be used to provide water for washing or flushing toilets.