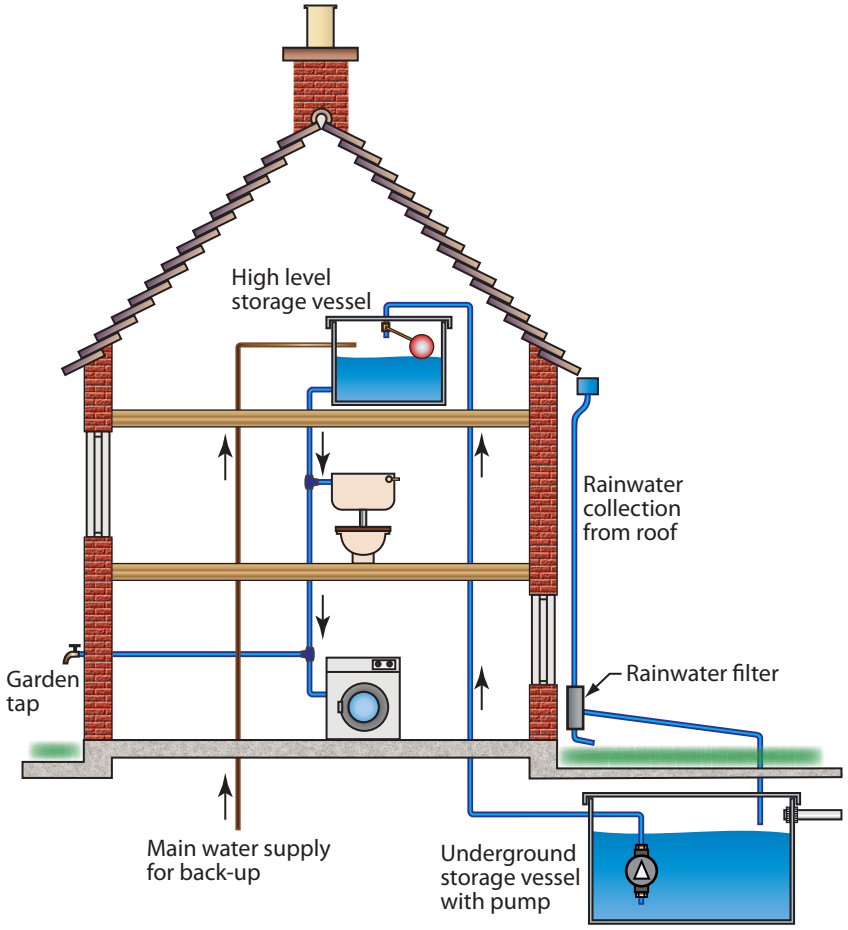
Level 3 Diploma in Installing Electrotechnical Systems & Equipment

C&G 2357

Unit 302 - Environmental legislation



B&B Training Associates Ltd
Learning Materials for the Electrical Industry

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Outcome 1: Understand the environmental legislation, working practices and principles which are relevant to work activities

Aims and objectives

By the end of this outcome you will have had the opportunity to:

1. Specify the current, relevant legislation for processing waste.
2. Describe what is meant by the term 'environment'.
3. Describe the ways in which the environment may be affected by work activities.
4. Identify and interpret the requirements for electrical installations as outlined in relevant sections of the Building Regulations and the Code for Sustainable Homes.
5. State materials and products that are classified as:
    a. Hazardous to the environment
    b. Recyclable.
6. Describe the organisational procedures for processing materials that are classed as:
    a. Hazardous to the environment
    b. Recyclable.

Range:

Current, relevant legislation

- Environmental Protection Act
- The Hazardous Waste Regulations
- Pollution Prevention and Control Act
- Control of Pollution Act
- The Control of Noise at Work Regulations
- Packaging (Essential Requirements) Regulations
- Environment Act
- The Waste Electrical and Electronic Equipment Regulations

Affect of work activities:

- Land contamination
- Air pollution
- Pollution of water courses.

1: Environmental protection legislation

Specify current, relevant environmental legislation.

Describe what is meant by the term 'environment'.

Legislation has defined what is meant by the term 'environment'. The Environmental Protection Act 1990 defines the environment as follows:

> The "environment" consists of all, or any, of the following media, namely, the air, water and land; and the medium of air includes the air within buildings and the air within other natural or man-made structures above or below ground.

That same act defines other terms that would be worth considering.

Term	Definition
Pollution of the environment	Pollution of the environment due to the release (into any environmental medium) from any process of substances which are capable of causing harm to man or any other living organisms supported by the environment.
Harm	Harm to the health of living organisms or other interference with the ecological systems of which they form part and, in the case of man, includes offence caused to any of his senses or harm to his property; and "harmless" has a corresponding meaning.
Process	Any activities carried on in Great Britain, whether on premises or by means of mobile plant, which are capable of causing pollution of the environment and "prescribed process" means a process prescribed under section 2(1) of the Act.
Substance	Shall be treated as including electricity or heat and "prescribed substance" has the meaning given by section 2(7) of the Act.

Environmental Protection Act 1990

The Environmental Protection Act 1990 (EPA) was the replacement act for much of the Control of Pollution Act 1974. The EPA deals with a number of environmental issues:

Part 1 – Integrated Pollution Control. This part of the act provides a system whereby a license or Authorisation is required if a prescribed process is being carried out.

This part has been replaced by the **Pollution Prevention Act 1999** and the **Environmental Permitting Act 2010**

Part 2 - Waste on Land. This part of the act introduced a new system of covering the management and disposal of waste. Under Section 33 of the Act, it is an offence to dispose of, treat or store controlled waste without a waste management license. Part 2 also places a duty of care on anyone who produces, imports, keeps, carries, disposes of or acts as a broker of controlled waste.

When controlled waste is carried in or deposited from a motor vehicle, the person who is in control of the vehicle shall be treated as knowingly caused the waste to be deposited whether or not he gave the instructions.

A person who breaks the rules for waste disposal is committing an offence, unless it is found that they took all reasonable precautions to avoid the offence. Or it was done in an emergency to protect human health.

It is the duty of care of any person who imports, carries, keeps or disposes of controlled waste or who controls waste to make sure that as far a reasonable care is taken;

- To prevent the breaking of any regulations or permits dealing with environmental waste
- To prevent the escape of waste from his control or that of anyone else
- To transfer waste, to only an authorise person, or someone authorised to transport waste and that there is written documentation describing the waste.

Part 2a – Contaminated Land. This part of the Act has been brought into force through the Contaminated Land (England) regulations. This was added to the act in 1995
Local authorities have a duty to inspect land to identify whether any contamination has taken place.
Contaminated land is land which;
Appears to be in such a condition caused by substances on the land to which;

- Significant harm is being caused
- Pollution of water is or is likely to be caused

Construction sites can contribute to contamination through;

- Polluted water being put down drains
- Chemicals substances not sent to licensed sites for disposal
- Leaking drums
- Unsecured items blown in the wind
- Waste not sorted and sent to unlicensed sites

Part 3 – Statutory Nuisance. This part of the Act defines the following statutory nuisances:

- Smoke emitting from premises
- Fumes or gases emitted from domestic premises
- Noise emitted from premises
- Noise that is prejudicial to health and is emitted from or caused by a vehicle
- Machinery or equipment in a street
- Any dust, steam, smell or other effluvia arising on industrial, trade or business premises
- Any other matter declared by any enactment to be a statutory nuisance

Hazardous Waste (England and Wales) Regulations 2005

The Hazardous Waste (England and Wales) Regulations 2005 came into force on 16 July 2005. The Regulations implemented the requirements of the EC Hazardous Waste Directive (91/689/EEC). These regulations were further amended in 2009

Hazardous waste is essentially waste that contains hazardous properties that may render it harmful to human health or the Environment. The European Commission has issued a Directive on the controlled management of such waste (91/689/EEC) and hazardous waste is defined on the basis of a list, the European Waste Catalogue, drawn up under that Directive.

Some everyday items such as computer monitors, TVs, refrigeration equipment and some batteries may be hazardous waste as well as more obvious materials such as asbestos and oil. Hazardous waste therefore comes from a wide range of sources, including households, businesses of all types, and public services, such as the health service, schools and universities.

The Department for Environment, Food and Rural Affairs (DEFRA) has issued a strategy for hazardous waster management in England. The Strategy comprises:

- Six high level principles for the management of hazardous waste. These principles include amongst others:
    - The waste hierarchy,
        (a) Prevention
        (b) Preparing for re-use
        (c) Recycling
        (d) Other recovery, e.g. energy recovery and
        (e) Disposal.
    - Infrastructure option,
    - Reduce reliance on landfill, and
    - No mixing or dilution.
- A set of outline decision trees to assist waste producers and waste managers to make the right decisions about the management of their waste and the investment in infrastructure to help move hazardous waste management up the waste hierarchy.

- A timeline of action on issues relating to the introduction and implementation of the strategy.
- A list of guidance relating to the treatment of hazardous waste.
- An updated summary of facility need.

Pollution Prevention and Control Act

Pollution Prevention and Control (PPC) is a regulatory regime for controlling pollution from certain industrial activities. From 6 April 2008 it has been incorporated into the framework of the Environmental Permitting Regulations (EPR).

The Environmental Permitting (England and Wales) Regulations 2010 came into force on 6th April 2010. They replaced the original 2007 version of the Regulations which had replaced the previous Pollution Prevention and Control Regulations 2000.

An environmental permit allows you to carry on various activities which may have an impact on the environment and human health and says what restrictions there are to minimise damage to the environment and human health. Guidance on environmental permitting may be found at www.defra.gov.uk/environment/policy/permits/documents/ep2010booklet.pdf.

Control of Pollution Act

The Control of Pollution Act 1974 (as amended) is an Act to make further provision with respect to waste disposal, water pollution, noise, atmospheric pollution and public health; and for purposes connected with these matters.

Much of this Act has been replaced by the Environmental Protection Act 1990.

The key aspect of the Control of Pollution Act is that it forbids a person from depositing controlled waste, such as may be created by electrical installation work, on any land or cause or knowingly permit controlled waste to be deposited on any land.

Environmental Permitting (England and Wales) Regulations 2010

An environmental permit is a document prepared by a regulator - either the Environment Agency or your local authority. It has conditions which you must follow to prevent your business from harming the environment or human health.

There are two main types of environmental permit -

Standard permits

The Environment Agency issue standard permits to operators whose activity is able to comply with a set of standard rules. They are cheaper, quicker and easier to apply for than bespoke permits.

Bespoke permits

Bespoke permits contain site-specific conditions written for your activity. They are generally more expensive and take longer to process than a standard permit because the environmental risks and impact of the activity or operation must be assessed.

Waste (England and Wales) Regulations 2011 and the Waste (Miscellaneous Provisions) (Wales) 2011 Regulations.

If you produce, transport or receive hazardous waste, you will be regulated by the Hazardous Waste regulations.

List of typical hazardous wastes

- Acids
- Alkaline solutions
- Batteries (Lithium and NiCad chemistries)
- Cathode ray tubes (TV's and Computer Monitors)
- Fluorescent tubes
- Fridges
- Industrial solvents
- Pesticides
- Pharmaceutical compounds
- Waste oils
- Wood preservatives.
- Asbestos

As a waste producer you have a duty of care to ensure your waste is managed lawfully. When you transfer it to someone else you must make sure:

- You check the person can take it. Ask them to produce evidence that they are authorised to carry waste. If they can't do this do not give them your waste,
- Ensure the waste goes to a proper site, licensed or exempt.
- Give the person a transfer note. This must include a full description of the waste and be signed by both of you. The description must include details of anything present that could affect the future handling of the waste, such as asbestos, plasterboard or chemicals.
- Keep copies of your transfer notes for a minimum of two years.
- Ensure that from 28 September 2011 a declaration is signed on the transfer note to indicate that the waste management hierarchy of options has been applied.
- If you transport building or demolition waste yourself, you must be registered as a waste carrier and you must make sure you transfer it only to an authorised site operator.

The environment can be affected by your work, below is a list of some ways that you could reduce pollution.

Recycle when possible

- Don’t put paint, oil, cleaning fluids etc down drains
- Don’t allow chemicals to seep into the ground
- Prevent rubbish blowing around the site or neighbourhood.
- Dispose of hazardous materials to approved sites or collectors.
- Keep the noise to a minimum.
- Keep any smells that are produced to a minimum
- Make sure any mobile or other lights are positioned where they are not causing a nuisance

Other ways of reducing waste in the electrotechnical industry

- using leftover materials from one job on the next one
- look for the shortest cabling route whenever possible - making sure you comply with wiring regulations
- avoid over ordering
- reduce your packaging
- recycle where you cannot eliminate or reduce waste
- take steps to protect completed work so others cannot damage it
- reduce tails to a minimum and don't install more lights and sockets than are needed
- encourage the use of low-energy lighting
- keep stores secure, dry and organised - bad storage can result in damage and waste

Recycle where possible

- broken out concrete
- scrap metal
- copper cable
- plasterboard
- timber
- Paper.

Scrap metal and cables can fetch quite a lot of money

Exposure to noise will lead to problems with hearing. A number of noise control regulations and codes of practice have been introduced over the years; however in January 1990 the Noise at Work Regulations came into force and provided a framework for managing the exposure to noise whilst people are at work or members of the public affected by the work activity; these regulations have been superseded by the Control of Noise at Work Regulations 2005.

The Noise Regulations 2005 require employers to prevent or reduce risks to health and safety from exposure to noise at work. Employees have duties under the Regulations too.

- The Regulations require you as an employer to:
- assess the risks to your employees from noise at work;
- take action to reduce the noise exposure that produces those risks;
- provide your employees with hearing protection if you cannot reduce the noise exposure enough by using other methods;
- make sure the legal limits on noise exposure are not exceeded;
- provide your employees with information, instruction and training;
- carry out health surveillance where there is a risk to health.

The Noise Regulations require you to take specific action at certain action values. These relate to:

- the levels of exposure to noise of your employees averaged over a working day or week; and
- the maximum noise (peak sound pressure) to which employees are exposed in a working day.

The values are:

- lower exposure action values: – daily or weekly exposure of 80 dB; – peak sound pressure of 135 dB;
- upper exposure action values: – daily or weekly exposure of 85 dB; – peak sound pressure of 137 dB.

There are also levels of noise exposure which must not be exceeded:

- exposure limit values: – daily or weekly exposure of 87 dB; – peak sound pressure of 140 dB.

These exposure limit values take account of any reduction in exposure provided by hearing protection.

Packaging (Essential Requirements) Regulations

The regulations aim to minimise the amount of waste packaging created and ensure that packaging can be reused, recovered or recycled.

They are enforced by trading standards departments of local authorities

The regulations state that;

- The amount of packaging must be the minimum required to ensure the safety and hygiene of the packed product and to be acceptable to the consumer.
- Packaging has a minimal environmental impact after it is disposed of.
- Packaging does not contain high levels of noxious or hazardous substances.
- The amount of heavy metals (cadmium, mercury, lead and hexavalent chromium, or any combination of these) does not exceed 100 parts per million by weight.

Evidence is kept that the packaging complies with the regulations

Reuse or recycle your packaging.

Environment Act

The Environment Act 1995 is an Act to provide for the establishment of the Environment Agency (EA).

The Environment Agency's stated purpose is, "to protect or enhance the environment, taken as a whole" so as to promote "the objective of achieving sustainable development" (taken from the Environment Act 1995, section 4). Protection of the environment relates to threats such as flood and pollution. The vision of the Agency is of "a rich, healthy and diverse environment for present and future generations".

The Environment Agency is the principal flood risk management operating authority. This means it has the power to undertake land drainage or flood protection work. It has the power to manage flood risk from certain rivers and the sea, and is responsible for making the public aware of flood risk.

The Environment Agency is also the main regulator of discharges to air, water and land. It does this through formal consents to discharge or, in the case of large, complex or potentially damaging industries, by means of permit.

The Environment Agency is the regulator for the release of pollutants into the air from large and complex industries. It is also has a duty to maintain and improve the quality of surface waters and groundwater's, and as part of that duty monitors the quality of rivers, lakes and the sea. The EA is also responsible for the use and conservation of water. It also is a regulator of angling, selling over 1 million rod licences per year and navigation, being responsible for over 630 miles of rivers.

Waste Electrical and Electronic Equipment Regulations

The Waste Electrical and Electronic Equipment Regulations 2006 (as amended) (WEEE), implement the main provisions of the European Parliament and Council Directive on waste electrical and electronic equipment (as amended)(the WEEE Directive).

Waste Electrical And Electronic Equipment (WEEE) is one of the fastest growing waste streams in the UK and the EU.

Some EEE (Electrical and electronic equipment) contains hazardous substances and parts such as;

- mercury in some switches,
- lead in solder,
- cadmium in batteries.

Heavy metals are particularly harmful to the environment because they accumulate through the food chain and can cause serious health effects in humans. Other items are also potentially damaging such as plasticizers which can leach into the soil caused toxicity in wildlife.

The aim of WEEE is to reduce the amount of electrical and electronic equipment being produced and to encourage everyone to reuse, recycle and recover it.

Every year an estimated 1 million tonnes of WEEE items are discarded by householders and companies in the UK.

WEEE includes most products that have a plug or need a battery

Typical WEEE items include

- Large household appliances e.g. fridges, cookers, washing machines
- Small household appliances e.g. vacuum cleaners, irons, toasters and clocks
- IT and telecommunications equipment – e.g. personal computers, copying equipment, telephones and pocket calculators
- Consumer equipment e.g. radios, televisions, hi-fi equipment,
- Lighting equipment e.g. straight and compact fluorescent tubes and high intensity discharge lamps
- Electrical and electronic tools – e.g. drills, saws and electric lawnmowers
- Toys, leisure and sports equipment e.g. electric trains, games consoles and running machines
- Monitoring and control equipment e .g. smoke detectors, thermostats and heating regulators
- Automatic dispensers e.g. hot drinks dispensers and money dispensers

The broad aim of the Directive is to address the environmental impacts of EEE when it reaches the end of its life and to encourage its separate collection, subsequent treatment, re-use, recovery, recycling and environmentally sound disposal. It also seeks to improve the environmental performance of all operators involved in the lifecycle of EEE.

An electrical installation is outside the scope of WEEE as are large-scale industrial machinery, household luminaires (but not luminaires used in non-household installations), and filament lamps and implanted and infected medical devices.

Consumers of EEE do not have any obligations under the Regulations. The WEEE Directive aims to encourage consumers who use EEE to participate in the separate collection of this equipment at the end of its life.

Consumers can use a UK-Wide collection network which enables the return of WEEE free of charge. WEEE can be discarded at specific civic amenity (CA) sites around the country. There may also be further collection facilities available locally.
All distributors of EEE for household use in the UK have a take-back obligation under the Regulations when they sell a new product of similar type and functionality to the one being replaced, either by providing or contributing to adequate and available facilities for the return of WEEE; or by offering in- store take-back services,
Consumers are not entitled to free collection of WEEE from households. A distributor, local authority or a producer may, however, offer collection as part of their customer service either free of charge or on payment of a reasonable fee to cover transport and handling costs.

All distributors of EEE for household use have an obligation to provide information in writing to householders about the separate collection facilities available for WEEE. Electrical and electronic equipment that requires appropriate disposal will have a waste bin crossed out symbol.

Householders are entitled to ask their local retailers of EEE about the separate collection of WEEE including what facilities are available in their area.

2: Building Regulations

Describe Building Regulations for England and Wales.
Describe Building Standards in Scotland.
Describe Building Regulations in Northern Ireland.

Building Regulations in all parts of the United Kingdom set standards for the design and construction of most new buildings and many alterations to existing buildings and structures.

The responsibilities for standards in buildings are as follows:

Country	Responsible body	Website
England and Wales	Department for Communities and Local Government (DCLG)	www.communities.gov.uk/planningandbuilding/buildingregulations/
Scotland	Scottish government	www.scotland.gov.uk/Topics/Built-Environment/Building/Building-standards
Northern Ireland	Department of Finance and Personnel	www.buildingcontrol-ni.com/sections/?secid=5

Building Regulations for England and Wales

The Building Regulations 2000 and The Building (Approved Inspectors etc.) Regulations 2000, and all amendments to both were revoked from 1 October 2010, and are therefore no longer in effect. Reference should be made to the Building Regulations 2010 and the Building (Approved Inspectors etc.) Regulations 2010, and their regulation numbers.

The 2010 Regulations in both cases consolidate the Building Regulations 2000 and the Building (Approved Inspectors etc.) Regulations 2000 incorporating all of the amendments made since 2000. Both sets of the 2010 Regulations have been renumbered and reordered to make them easier to use and with a more logical structure.

The Building Regulations requires a building notice or plans to be deposited by a person who intends to:

- carry out building work;
- replace or renovate a thermal element in a building to which energy efficiency requirements apply;
- make a change to a building's energy status; or
- Make a material change of use.

There is a material change of use where there is a change in the purpose for which or the circumstances, in which a building is used, so that after the change:

- the building is used as a dwelling, where previously it was not;
- the building contains a flat, where previously it did not;
- the building is used as an hotel or a boarding house, where previously it was not;
- the building is used as an institution, where previously it was not;
- the building is used as a public building, where previously it was not;
- the building is not a building described in classes 1 to 6 in Schedule 2, where previously it was;
    - Examples of exempt buildings include amongst other greenhouses, buildings where people do not normally go, temporary buildings not intended to remain erected for more than 28 days.
- the building, which contains at least one dwelling, contains a greater or lesser number of dwellings than it did previously;
- the building contains a room for residential purposes, where previously it did not;
- the building, which contains at least one room for residential purposes, contains a greater or lesser number of such rooms than it did previously; or
- the building is used as a shop, where previously it was not.

Where there is a material change of use of the building, such work that is carried out must be done in such a way that the building complies with the applicable requirements of Schedule 1 of the Regulations. These include:

- Part A Structure
- Part B Fire Safety
- Part C Site Preparation and Resistance to Contaminants and Moisture
- Part D Toxic Substances
- Part E Resistance to the Passage of Sound
- Part F Ventilation
- Part G Sanitation, Hot Water Safety and Efficiency
- Part H Drainage and Waste Disposal
- Part J Combustion, Appliances and Fuel Storage Systems
- Part K Protection from Falling, Collision and Impact
- Part L Conservation of Fuel and Power
- Part M Access to and Use of Buildings
- Part N Glazing – Safety in Relation to Impact, Opening and Cleaning
- Part P Electrical Safety.

The DCLG has issued guidance for each part listed above in the form of Approved Documents. Approved documents demonstrate a means whereby the requirements of the Building Regulations might be met. They are guidance and not the legislation itself.

These Approved Documents can be accessed from the DCLG from the link above.
Whilst there are other requirements of the Building Regulations that impact the electrical industry, such as Part A for construction and Part B for fire safety, it is Part P that is directly concerned with the safety of electrical installations.

Part P

Part P of the Building Regulations for England and Wales requires:

Approved Document P recognises the role of BS 7671 (the IEE Wiring Regulations) as a way of satisfying the requirements of Part P.

Reasonable provision shall be made in the design and installation of electrical installations in order to protect persons operating, maintaining or altering the installations from fire or injury.

The requirements of this part apply only to electrical installations that are intended to operate at low or extra-low voltage and are:

a) in or attached to a dwelling;
b) in the common parts of a building serving one or more dwellings, but excluding power supplies to lifts;
c) in a building that receives its electricity from a source located within or shared with a dwelling; and
d) in a garden or in or on land associated with a building where the electricity is from a source located within or shared with a dwelling.

The following work need not be notified to a building control body.

Work consisting of:
Replacing any fixed electrical equipment (for example, socket-outlets, control switches and ceiling roses) which does not include the provision of any new fixed cabling
Replacing the cable for a single circuit only, where damaged, for example, by fire, rodent or impact[a]
Re-fixing or replacing the enclosures of existing installation components[b]
Providing mechanical protection to existing fixed installations[c]
Installing or upgrading main or supplementary equipotential bonding[d]

[a] On condition that the replacement cable has the same current-carrying capacity and follows the same route.

[b] If the circuit's protective measures are unaffected.

[c] If the circuit's protective measures and current-carrying capacity of conductors are unaffected by increased thermal insulation.

[d] Such work will need to comply with other applicable legislation, such as the Gas Safety (Installation and Use) Regulations.

Work that is not in a kitchen or special location and does not involve a special installation and consists of:
Adding lighting points (light fittings and switches) to an existing circuit[e]
Adding socket-outlets and fused spurs to an existing ring or radial circuit[f]
Work not in a special location, on:
Telephone or extra-low voltage wiring and equipment for the purposes of communications, information technology, signalling, control and similar purposes
Prefabricated equipment sets and associated flexible leads with integral plug and socket connections

A special location and installation is defined in Approved Document P as:

Special locations
Locations containing a bath tub or shower basin
Swimming pools or paddling pools
Hot air saunas
Special installations
Electric floor or ceiling heating systems
Garden lighting or power installations
Solar photovoltaic (PV) power supply systems
Small scale generators such as microCHP units
Extra-low voltage lighting installations, other than pre-assembled, CE-marked lighting sets

[e] Only if the existing circuit protective device is suitable and provides protection for the modified circuit, and other relevant safety provisions are satisfactory.

[f] Only if the existing circuit protective device is suitable and provides protection for the modified circuit, and other relevant safety provisions are satisfactory.

Specific examples are listed by Approved Document P of work which is notifiable. These include:

a) New circuits back to the consumer unit, and extensions to circuits in kitchens and special locations are notifiable.
b) Replacement, repair and maintenance jobs are generally **not** notifiable, even if carried out in a kitchen or special location or associated with a special installation.
c) Consumer unit replacements are notifiable.
d) In large bathrooms, the location containing a bath or shower is defined by the walls of the bathroom.
e) Conservatories and attached garages are **not** special locations. Work in them is therefore not notifiable unless it involves the installation of a new circuit or the extension of a circuit in a kitchen or special location or associated with a special installation.
f) Detached garages and sheds are **not** special locations. Work within them is notifiable only if it involves new outdoor wiring.
g) Outdoor lighting and power installations are special installations. Any new work in, for example, the garden or that involves crossing the garden is notifiable.
h) The installation of fixed equipment is within the scope of Part P, even where the final connection is by a 13 A plug and socket-outlet. However, work is notifiable only if it involves fixed wiring and the installation of a new circuit or the extension of a circuit in a kitchen or special location or associated with a special installation.
i) The installation of equipment attached to the outside wall of a house (for example security lighting, air conditioning equipment and radon fans) is **not** notifiable provided that there are no exposed outdoor connections and the work does not involve the installation of a new circuit or the extension of a circuit in a kitchen or special location or associated with a special installation.
j) The installation of a socket outlet on an external wall is notifiable, since the socket-outlet is an outdoor connector that could be connected to cables that cross the garden and requires RCD protection.
k) The installation of prefabricated, “modular” systems (for example kitchen lighting systems and armoured garden cabling) linked by plug and socket connectors is not notifiable, provided that products are CE-marked and that any final connections in kitchens and special locations are made to existing connection units or points (possibly a 13 A socket-outlet).

l) Work to connect an electric gate or garage door to an existing isolator is not notifiable, but installation of the circuit up to the isolator is notifiable.

m) The fitting and replacement of cookers and electric showers is **not** notifiable unless a new circuit is needed.

n) New central heating control wiring installations are notifiable even where work in kitchens and bathrooms is avoided.

Notification

Building Regulations compliance certificates/ notices for notifiable work

A Building Regulations compliance certificate (issued by Part P competent person scheme installers), completion certificates (issued by local authorities) and final notices (issued by approved inspectors) are evidence that compliance with the Building Regulations has been achieved, and are issued on completion of notifiable works only. They are different documents than a BS 7671 installation certificate and attest compliance with all relevant requirements of the Building Regulations, not just Part P.

Where the installer is registered with a Part P competent person self-certification scheme

Installers registered with a Part P competent person self-certification scheme are qualified to complete BS 7671 installation certificates and should do so in respect of every job they undertake. A copy of the certificate should always be given to the person ordering the electrical installation work.

Where Installers registered with Part P competent person self-certification scheme, a Building Regulations compliance certificate must be issued to the occupant either by the installer or the installer's registration body, such as NICEIC, NAPIT etc, within 30 days of the work being completed. The relevant building control body should also receive a copy of the information on the certificate within 30 days.

The Regulations call for the Building Regulations compliance certificate to be issued to the occupier. However, in the case of rented properties, the certificate may be sent to the person ordering the work with a copy sent also to the occupant.

Where the installer is not registered with a Part P competent person self-certification scheme but qualified to complete BS 7671 installation certificates

Where notifiable electrical installer work is carried out by a person not registered with a Part P competent person self-certification the work should be notified to a building control body (the local authority or an approved inspector) before work starts. Where the work is necessary because of an emergency the building control body should be notified as soon as possible.

The building control body becomes responsible for making sure the work is safe and complies with all relevant requirements of the Building Regulations.

Where installers are qualified to carry out inspection and testing and completing the appropriate BS 7671 installation certificate, they should do so. A copy of the certificate should then be given to the building control body. The building control body will take this certificate into account in deciding what further action (if any) needs to be taken to make sure that the work is safe and complies fully with all relevant requirements. Building control bodies may ask for evidence that installers are qualified in this case.

Where the building control body decides that the work is safe and meets all building regulation requirements it will issue a building regulation completion certificate (the local authority) on request or a final certificate (an approved inspector).

Where installers are not qualified to complete BS 7671 completion certificates

Where such installers (who may be contractors or DIYers) carry out notifiable electrical work, the building control body must be notified before the work starts. Where the work is necessary because of an emergency the building control body should be notified as soon as possible. The building control body then becomes responsible for making sure that the work is safe and complies with all relevant requirements in the Building Regulations.

The amount of inspection and testing needed is for the building control body to decide, based on the nature and extent of the electrical work. For relatively simple notifiable jobs, such as adding a socket-outlet to a kitchen circuit, the inspection and testing requirements will be minimal. For a house rewire, a full set of inspections and tests will need to be carried out.

The building control body may choose to carry out the inspection and testing itself. This is not usual as very few building control departments have the necessary in-house skills. More commonly they will contract out some or all of the work to a specialist body which will then carry out the work on its behalf. Building control bodies will carry out the necessary inspection and testing at their expense, not at the householders' expense.

A building control body will **not** issue an Electrical Installation Certificate or Minor Electrical Installation Works Certificate as required by BS 7671, as these can be issued only by those carrying out the work, but only a Building Regulations completion certificate (the local authority) or a final certificate (an approved inspector).

Building Regulations for Northern Ireland

As is the case in the rest of the UK, Northern Ireland has a set of Building Regulations. The Building Regulations (Northern Ireland) (as amended) are legal requirements made by the Department of Finance and Personnel and administered by 26 District Councils. The Regulations are intended to ensure the safety, health, welfare and convenience of people in and around buildings. They are also designed to further the conservation of fuel and energy.

Guidance on how to do this can be found in Technical Booklets prepared by the Department of Finance and Personnel. Adherence to the methods and standards detailed in the Technical Booklets means that the work will be "deemed-to-satisfy" and must be accepted by Building Control as complying with the relevant Regulations.

The Northern Ireland Building Regulations do not currently contain any specific requirements for electrical installations.

3: Sustainable homes

Explain the requirements for sustainable homes.

The growing concerns regarding energy supplies and perceived global warming and the effect of carbon emissions has led many governments, including that of the UK to address the impact of energy usage in homes.

The Code for Sustainable Homes (as amended) issued by the Department for Communities and Local Government (DCLG) is a new non-statutory national standard whose aim is to guide industry in the design and construction of sustainable homes in a drive for continuous improvement and greater innovation in sustainable home building.

The Code complements the system of Energy Performance Certificates (EPCs) introduced in 2007, which requires all homes when they are sold or leased to have an EPC.

The Code measures the sustainability of a home against design categories, rating the whole home as a complete entity. The design categories within the Code are:

- Energy/CO_2
- Pollution
- Water
- Health and well-being
- Materials
- Management
- Surface water run-off
- Ecology
- Waste.

The Code uses a rating system, indicated by stars, to highlight the overall sustainability performance of a home. The rating system has a one star (*) to a six star (******) range, with one star set above the minimum Building Regulation requirements and six star reflecting exemplar development in sustainability terms.

It is highly unlikely that an electrician will be involved in the development of sustainable homes; however, it is perfectly reasonable to assume that a contractor would be expected to know what the requirements were for lighting, for example.

As an example, for CO_2 emissions the following applies:

Code levels for Mandatory Minimum Standards CO_2 Emissions (Ene1)	
Code level	Minimum percentage improvement in Dwelling Emission Rate (DER) over Target Emission Rate (TER).
Level 1 (*)	0 % - Compliance with Part L 2010 is required
Level 2 (**)	0 % - Compliance with Part L 2010 is required
Level 3 (***)	0 % - Compliance with Part L 2010 is required
Level 4 (****)	25 %
Level 5 (*****)	100 %
Level 6 (******)	Net zero CO_2 emissions

Energy and CO_2 emissions

To limit CO_2 emissions, arising from the operation of a dwelling and its services, in line with current policy. The more energy efficient the building is, the higher the rating it is given.

A sustainable home should have the following

- Low CO_2 emission rate
- Built with Energy efficient materials
- Space outside for drying clothes
- Any electrical equipment supplied should be energy efficient (A rated)
- Any outside lighting should use energy efficient bulbs, movement and daylight cut off sensors or timers.
- Use low or zero carbon technologies
- Have space to store bicycles
- Have devices to continuously display energy usage

Water

The aim of a sustainable home/ building is to reduce the consumption of water from all sources, including borehole and well water, through the use of water efficient fittings, appliances and water recycling systems.

Homes should have;

- Water efficient fittings, (low flush toilets, flow restrictors)
- Grey water systems
- Rainwater collection systems
- Soakaways
- Permeable paving
- Flood protection methods

Materials

A sustainable home/building should aim to use materials with lower environmental impact over their life-cycle.

They should also promote the specification of responsibly sourced materials for the basic building element, and to promote the specification of responsibly sourced materials for the finishing elements. (Skirting boards, windows, staircases etc.)

- 80% of the materials must be responsibly sources
- 100% of all timber must be legally sourced
- Materials should be reused where possible

Surface water run-off.

With the greater consumption of water in a modern home, sustainable homes are designed to manage the water, so that water is delayed or does not enter the sewers or water courses. Houses should not be built in high flood risk areas, and features should be included to reduce the impact in areas of medium risk areas.

The surface water can be controlled by;

- Soakaways
- Rainwater reuse
- Green roofs (roofs with grass or plants on them)
- Roof water directed to ponds
- Reed beds
- Underground water storage
- Using paving which the water can drain through

Waste

The government aims to reduce the amount of waste that goes to landfill. To achieve this, homes should be provided with adequate internal and external storage space for non-recyclable waste and recyclable household waste.

Provision should also be made for compost facilities to reduce the amount of household waste send to landfill.

Pollution

The homes need to constructed externally and internally of materials and equipped with items which will reduce the emission of gasses with high global warming properties. There also needs to be a reduction in nitrogen oxide (NO_x) into the atmosphere.

This can be achieved by using the following;

- Roofs insulated including loft access
- Walls insulated internally and externally including lintels and acoustic insulation
- Hot water cylinder/pipe insulated as well as other thermal stores
- Cold water storage tanks insulated where provided
- External doors and windows insulated or glazed to the appropriate standard
- Photovoltaic panels used
- Hydro-electric generators used if appropriate
- Wind generators used if appropriate

Health and well being

A sustainable home not only considers the building, but also the quality of life for those who will live in the house and those who will life next to or near them.

The lighting levels in the home should have good natural light to provide a god quality of life and to reduce the need for energy to light the home.

The houses should have good sound insulation to reduce the likelihood of complaints from neighbours.

Provision should be made for inclusive outdoor space which is at least partially private.

The homes should be constructed so that they can be adapted to suit all ages and abilities of the occupants.

- Houses should be built which cater of all people, meaning that they can be easily adapted for the elderly, infirm and those who use wheelchairs.
- Homes should be built which are easily accessible and can be adapted to suit current and future occupants (lifetime homes)
- Sufficient car spaces or drop off points.

Managment

To enable the occupants to get the best out of the homes which maybe contain unfamiliar equipment, a guidance pack should be given to each owner.
The homes should be designed in such a way that the occupants feel safe and secure.
The pack should also include ideas on how to get the best out of the local facilities.

Ecology

To protect sites that are of ecological value, sustainable homes should be built in areas that have limited value to wildlife.

- Not building on ecological sensitive sites
- Protect existing ecological features such as trees, hedges, watercourses and wetlands when constructing the houses
- Plant only native species on the site
- Limit the use of pesticides
- Install bird and bat boxes
- Plant wildlife gardens
- Use land efficiently to reduce the buildings footprint

Outcome 2: Understand how work methods and procedures can reduce material wastage and impact on the environment

Aims and objectives

By the end of this outcome you will have had the opportunity to:

7. State installation methods that can help to reduce material wastage.
8. Explain why it is important to report any hazards to the environment that arise from work procedures.
9. Specify environmentally friendly materials, products and procedures that can be used in the installation and maintenance of electrotechnical systems and equipment.

1: Waste reduction

State methods that can help to reduce wastage.
The importance of reporting hazards
Specify environmentally friendly products and procedures

The price of copper on the commodities market as of February 2011 was approximately $9500 per tonne; the price of aluminium was approximately $2500 per tonne; Brent crude oil was approximately $108 per barrel and nickel was approximately $28250 per tonne.
All of these products are widely used in the manufacture of electrical equipment, such as cables, stainless steel, plastics, connections, batteries and the like.
The seemingly insatiable demand of the world for resources has led to an inevitable rise in the cost of raw materials and hence the cost of the products that these materials are turned into. Reducing material waste means greater resource efficiency, less pollution and more profits. Each pound saved on raw materials costs, and the equipment that they go into making, goes straight to the bottom line.
Waste can be defined as anything that is not required, that is anything thrown away, scrapped, surplus to requirements, or broken.

Waste generation
Waste is generated in one of two ways:

- As a result of design and specification, and
- As a result of the construction activity itself.

The quantity of waste produced can be dependent on:

- Inaccurate or surplus ordering of materials that don't get used
- Handling damage
- Poor storage
- Poor coordination with other trades
- Poor quality of work requiring re-work
- Inefficient use of materials
- Temporary work materials.

These issues are the same for the electrical installation designer as for the construction designer. For example, inaccurate measurements from drawings will lead to an excess of cable which may not all return to base.

Cost of waste

The true cost of waste is not just the cost of paying a waste contractor to remove a skip from site, but a combination of costs that are generally paid for by the client, including material and labour costs. Contractors often underestimate the real cost of waste on a project as this is not an explicit cost, but a cost built into every trade package that covers traditional wastage rates. Because of this, clients often end up paying for new materials that simply get thrown away.

$$\begin{aligned} &True\ cost\ of\ waste \\ &\quad = Purchase\ cost\ of\ the\ delivered\ materials\ wasted \\ &\quad + Cost\ of\ waste\ storage, transport, treatment\ and\ disposal \\ &\quad + Loss\ of\ not\ selling\ waste\ for\ salvage\ or\ not\ recycling. \end{aligned}$$

Other costs associated with waste include:

- The labour cost of handling waste
- Poor packing or overfilling of skips requiring additional skips (a cost)
- Loss of reputation and failure to get future work
- Higher disposal costs due to poor waste segregation and management practices.

Indeed, one survey was carried out on the losses associated with one skip and it was approximately £1300. This was:

$$Skip\ cost = £85\ skip\ hire + £163\ labour\ cost + £1000\ unused\ material\ cost$$

Benefit to clients and contractors

Client benefit

The cost of waste management is part of the overall cost of a project. Any reduction in waste will inevitably lead to a reduction in cost to the client.

Contractor benefit

Cost savings accrued due to savings made on waste will lead to benefits shared between client, contractor and sub-contractors. Cost savings may not all return to a client but would be shared.

Sub-contractor

There are two key benefits for sub-contractors in reducing the wastage of materials:

- Saving costs on the project leading to reduced tender prices and improved commercial advantage.
- Increase in profit.

A further benefit to sub-contractors occurs when they are willing to cooperate with a main contractor in waste reduction measures leading to preferred bidder status.

10m tonnes of construction products are wasted every year, at a cost of £1.5 billion. Mush of this site waste is harmful to the environment.

Waste can be reduced by;

- Only ordering or taking from the stores what you need;
- Returning unused items to the supplier if possible or use them on another job
- Using recycled items if available?
- Asking suppliers to only use the minimum packaging
- Separating waste into colour coded containers or skips for reclaiming/recycling.
- Making your storage areas secure and weatherproof to prevent wind and rain damaging your materials?
- Covering or netting any loose materials to prevent them being spread and possibly causing pollution?

Environmental benefits

Product selection and waste management can be split into two aspects. These are recognised as:

- Minimising environmental damage – less landfill space used and reduced burden on raw material usage.
- Conservation of natural resources – recycling reduces demand for raw materials and stimulates demand for waste materials creating a virtuous cycle of waste recovery.

You could reduce waste in an installation by:

- using leftover materials from one job on the next one
- look for the shortest cabling route whenever possible - making sure you comply with wiring regulations
- avoid over ordering
- reduce your packaging
- recycle where you cannot eliminate or reduce waste
- take steps to protect completed work so others cannot damage it
- reduce tails to a minimum and don't install more lights and sockets than are needed
- encourage the use of low-energy lighting
- keep stores secure, dry and organised - bad storage can result in damage and waste

The site waste Management Plans regulations 2008

The Site Waste Management Plans Regulations 2008 (SWMPS) require that large projects have a waste management plan. Amongst other things, SWMP requires that the plan

a) describes each waste type expected to be produced in the course of the project;
b) Estimates the quantity of each different waste type expected to be produced; and
c) Identifies the waste management action proposed for each different waste type, including re-using, recycling, recovery and disposal.

Hazards to the environment

The construction industry can produce hazardous products during the installation process. You have a duty of care under `The Environmental Act' to

- prevent the breaking of any regulations or permits dealing with environmental waste
- prevent the escape of waste from your control or that of anyone else
- transfer waste, to only an authorise person, or someone authorised to transport waste and that there is written documentation describing the waste

Reporting of environmental hazards

It is important that any hazards that arise from work activities to be reported immediately, so that they can be dealt with before any serious harm is done. A leaking drum or battery may not look much, but if it gets into the water course the consequences call be harmful to wild life or even yourself if it gets as far as the drinking water supply.

Rubbish blowing around can cause land contamination. Any activity that breaks 'The Environment Act' could result in fines for your employer.

Preventing pollution

- Don’t put paint, oil, cleaning fluids etc down drains
- Don’t allow chemicals to seep into the ground
- Prevent rubbish blowing around the site or neighbourhood.
- Dispose of hazardous materials to approved sites or collectors.
- Keep the noise to a minimum.
- Keep any smells that are produced to a minimum
- Make sure any mobile or other lights are positioned where they are not causing a nuisance.

Installing and maintaining electrotechnical systems

To comply with government policy, there is an increasing need to consider the environmental impact that the materials used and installed have. Due to concerns about the environment, and the cost of the energy which powers the installations, even more thought needs to be given to the installation design.

All materials need to be sourced locally if possible to reduce distance travelled, and where available, from manufactures who can guarantee that their goods come from sustainable sources, especially wood based products.

All appliances fitted should be of the highest energy saving possible, have thermostats and controls or time switches to prevent waste. Systems should be used that require little maintenance and offer a long life performance with reduced need to replace items.

Outcome 3: Understand how and where environmental technology Systems can be applied

Aims and objectives

By the end of this study book you will have had the opportunity to:

10. Describe the fundamental operating principles of environmental technology systems.
11. State the applications and limitations of environmental technology systems.
12. State the Local Authority Building Control (LABC) requirements which apply to the installation of environmental technology systems.

Range

- Solar photovoltaic
- Wind energy generation – both micro and macro
- Micro-hydro generation
- Heat pumps – both ground-source and air-source
- Combined heat and power (CHP, including micro-chp)
- Grey water recycling
- Rainwater harvesting
- Biomass heating
- Solar thermal hot water heating.

Few energy-saving schemes are installed for the sake of extending the life of the world's fuel resources. The fundamental principle is that while energy costs are seen to be high and rising, it makes good business sense to investigate energy-saving ideas.

Businesses will not simply rush into installing any alternative source of energy, such as solar power etc., unless a good business case can be made for its installation. A company will calculate:

a) The initial investment; that is the cost of buying the equipment and installing it.
b) The fuel costs for the chosen system. For example combined heat and power (CHP) installations require fuel to operate.
c) Other operating costs such as maintenance, materials, labour, service utilities, storage, handling and the like.

Governments can have a significant impact on the choices that a business or an individual makes. For example, where government wants to encourage the take-up of, for example, solar power, they might offer grants towards the capital costs or require distributors to buy the electricity that is generated under generous terms.

This outcome consider a number of alternative energy sources that are used within the U.K. Additionally, under the umbrella of being environmentally friendly, we will also briefly consider the retention and use of waste water, whether from direct rainfall or from water already used within the home or business.

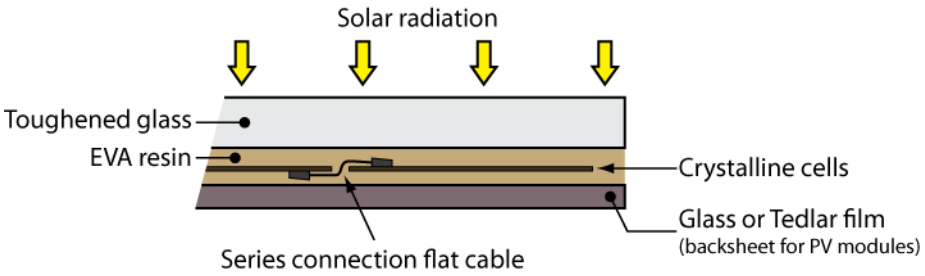
1: Solar photovoltaic generation

Describe solar photovoltaic generation

Light is energy. Plants use light in photosynthesis to grow, the earth's weather system uses heat from the sun to drive its processes and we can use both light and heat from the sun to either heat water directly through solar panels or generate electricity using solar cells.

Solar power is a clean, reliable form of renewable energy generated by converting energy from the sun's radiation into electricity.
Photovoltaic cells are grouped and connected together in a single frame called a panel or module.
These cells are comprised of special semi-conductive materials, which is most often a piece of silicon positioned under a layer of thin glass.
During the day, rays of sunlight shine on each of these photovoltaic cells. The silicon in each cell absorbs a portion of the sun's energy and releases particles, called electrons in the semiconductor, enabling them to flow freely.

Solar cells are manufactured from semiconductor materials such as silicon.



Solar panels

Whilst there is a wide range of solar panel types, all of them generate a direct current (d.c.) voltage. This d.c. supply is then converted to alternating current (a.c.) via an inverter or inverters.

When solar panels are installed within a property it is always necessary to have them aligned with the sun in such a way that the maximum amount of solar radiation will fall on the panels. For example, there is very little point in Britain of installing a solar panel array on a north-facing wall or roof. The amount of sunlight is severely restricted and the cost of installing the panels would never be recovered.

Panels in the UK should be installed on south and western (ideally south western) facing walls and roofs to maximise the solar energy received.

Panels on a roof or elsewhere will need to be carefully installed to maximise their efficiency.

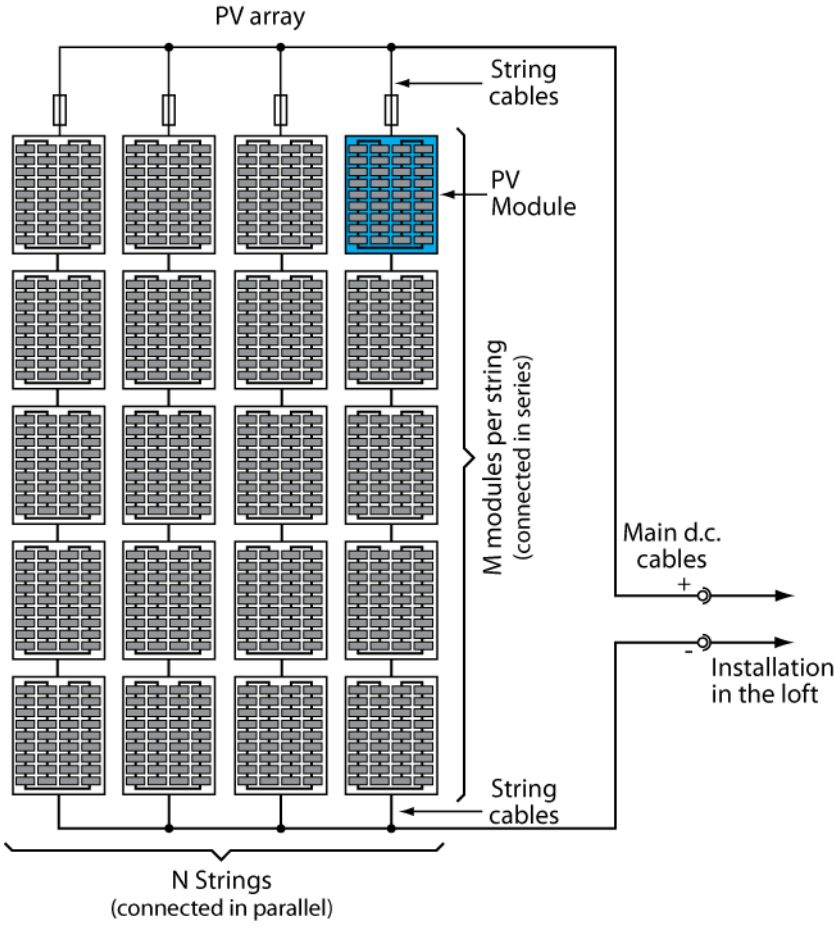
When the sunlight hits the cell some of it is absorbed into the semiconductor, this is converted into energy.

The energy loosens electrons allowing them to flow freely along a flat cable.

The electrons flow in a particular direction, based on one or more electric fields contained in the solar cells.

Small wires run along the top and bottom of each solar cell and harness these electrons to form an electric current when connected in a circuit

Solar panels are grouped into a series of strings. These strings are a series of interconnected solar panels connected in series.



This means that each individual voltage of each panel is added up. Therefore:

$$Series\ voltage = P1 + P2 + P3\ etc$$

Where it is desirable to increase the capacity of the solar panel array the strings can be connected in parallel thus increasing the current that can be drawn from the array.

Guidance on the installation of PV systems in buildings has been published by the DTI (was the Department for Trade and Industry). Photovoltaics in Buildings Guide to the installation of PV systems 2nd Edition is available for download.

In the UK most PV systems are connected to the distribution network. The Energy Networks Association (ENA) has issued guidance[g] in the form of Engineering Recommendations[h] on connecting generation, such as PV systems to the distribution network.

PV installation

The majority of PV installations in a domestic, or similar, setting are rated at not greater than 16 A. This rating of generation is called small scale embedded generation (SSEG) and the rules for connecting to the distribution network are not so onerous as they are when connecting larger supplies.

Regulation 22(2) of the Electricity Safety, Quality and Continuity Regulations 2002 (ESQCR) states:

"Sub-paragraphs (b) and (d) of paragraph (1) shall not apply to a person who installs or operates a source of energy which may be connected in parallel with a distributor's network provided that sub-paragraphs (a) and (c) of paragraph (1) are complied with; and

a) the source of energy does not produce an electrical output exceeding 16 amperes per phase at low voltage;
b) the source of energy is configured to disconnect itself electrically from the parallel connection when the distributor's equipment disconnects the supply of electricity to the person's installation; and
c) the person installing the source of energy ensures that the distributor is advised of the intention to use the source of energy in parallel with the network before, or at the time of, commissioning the source."

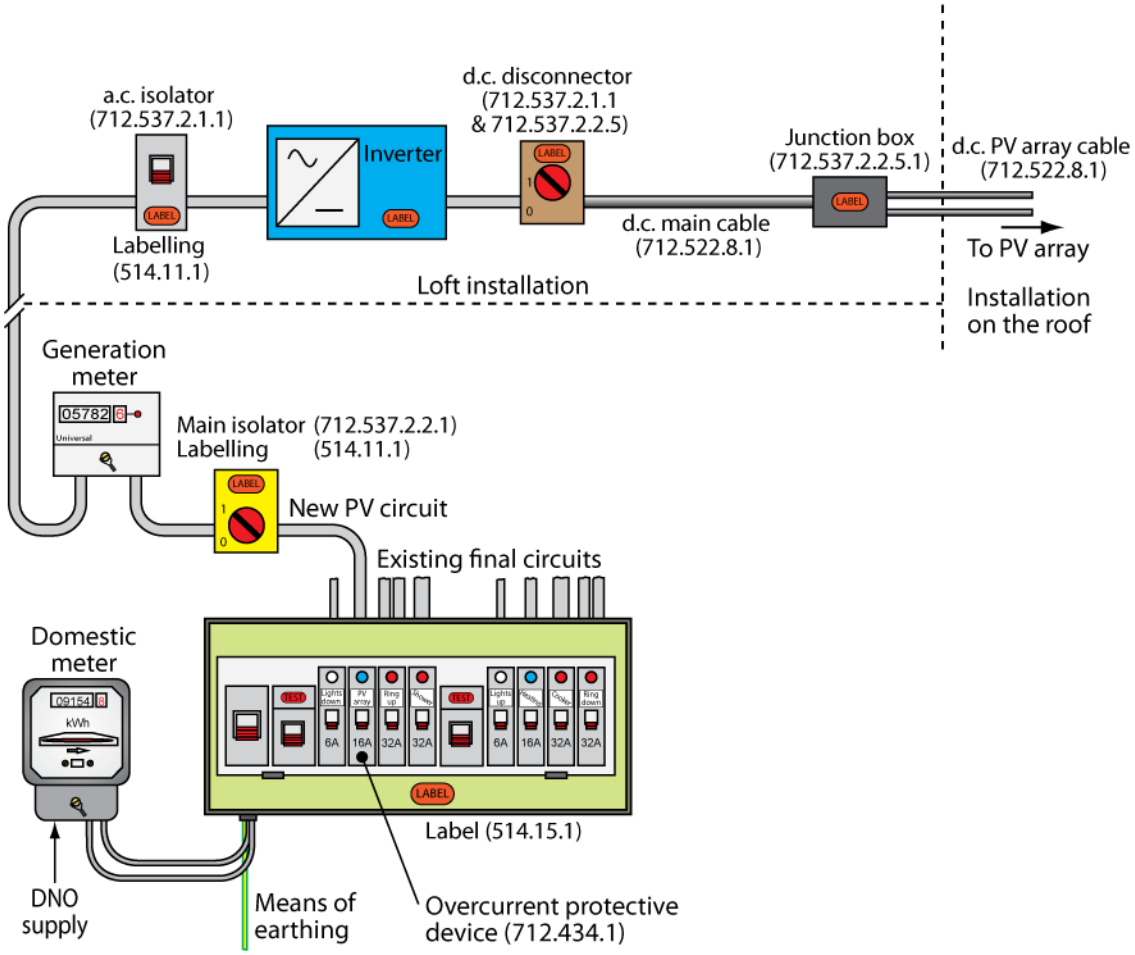
[g] Distributed Generation Connection Guide – A Guide for Connecting Generation that falls under G83/1-1 Stage 1 to the Distribution Network.

[h] Engineering recommendations are documents that set out standards and guidance on technical requirements.

This legislation, therefore, permits a domestic SSEG having a maximum rating of 16 A to be connected in parallel with the normal supply where two conditions are met:

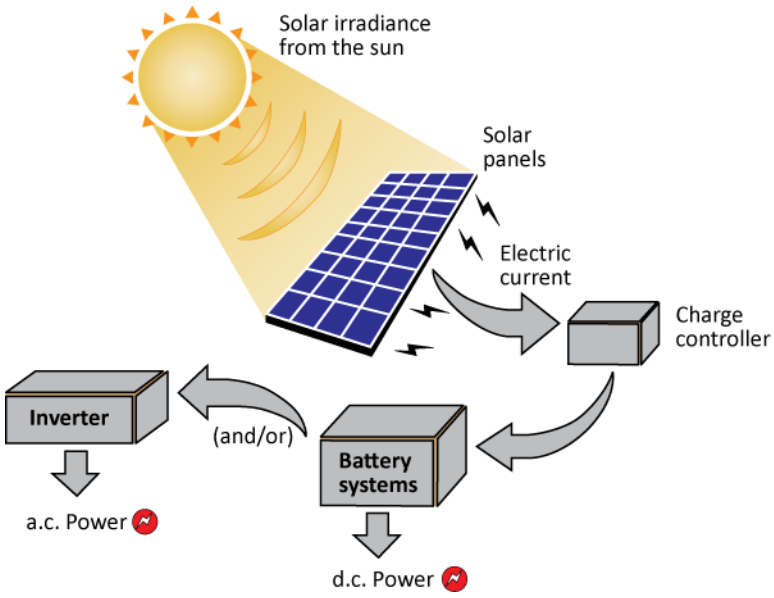
1) The SSEG disconnects when the normal supply disconnects, and
2) The distributor is informed that the installation is operating in parallel with the normal supply.

BS 7671 (IEE Wiring Regulations) details the regulations for the installation of PV systems.



Using the power

The current can be passed through the inverter which converts the electricity from dc, to the type of power used to run appliances (ac). It could also be stored in as energy in batteries The current, in combination with each cells voltage, defines the power output the photovoltaic cells can produce.



Uses of solar power

There are advantages and disadvantages to using solar power

Some advantages are that the energy from the sun is free meaning there is no fuel or waste and pollution. Solar power can be used in remote areas where there is difficulty in getting an electricity supply. For the domestic consumer it is handy for low power usage such as solar powered garden lights and battery chargers. Local government is increasingly using PV to operate street lights and road signs.

Disadvantages are that they don't work as efficiently at night. PV Power stations are still expensive to build as large quantities of panels are needed to produce enough electricity.

Planning permission

In many cases, fixing solar panels to your roof is likely to be considered 'permitted development' under planning law with no need to apply for planning permission.

If your property is a listed building installation it is likely to require an application for listed building consent, even where planning permission is not needed.

All solar installations are subject to the following conditions. Panels on buildings should be sited, as far as is practical so that they minimise the effect of the appearance of the building. They should also be sited so they don't spoil the appearance of the area. If the panels are no longer required they should be removed as soon as possible.

Roof and wall mounted solar panels should not be installed above the roof line and should not stick out more than 200mm from the wall or roof.

If your property is in a conservation area, planning consent is required if they are visible from the road.

Planning permission should be check before installing any panels to make sure you are not breaking any local planning conditions.

Building regulations

If you wish to install solar panels to the roof of your building, building regulations will normally apply.

The ability of the existing roof to carry the load (weight) of the panel will need to be checked and proven. Some strengthening work may be needed.

2: Alternative energy sources

Describe:

- Wind energy generation – both micro and macro
- Micro-hydro generation
- Heat pumps – both ground-source and air-source

In the past the methods of generating electricity burnt fuel to provide the energy to drive a generator. This used fossil fuels, - coal, oil or gas - or nuclear fuel.

Using fossil fuels creates pollution, such as oxides of sulphur and nitrogen which contribute to acid rain and carbon dioxide which contributes to global climate change.

This session considers three alternative sources of power generation or heat generation. Electricity from the wind has been an available resource for many years. More recently small-scale wind turbines have become more popular in rural locations or on high-rise buildings.

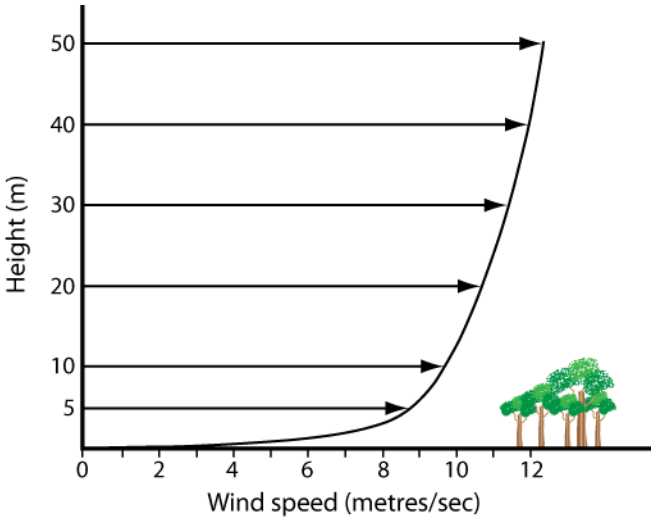
Wind turbines

Quite simply, a wind turbine converts the kinetic energy of the wind (the principle that air moves) into mechanical energy (the rotation of the arms around a central shaft). Where the mechanical energy drives a mechanical load we have a windmill; where the mechanical energy drives a generator to produce electricity we have a wind generator.

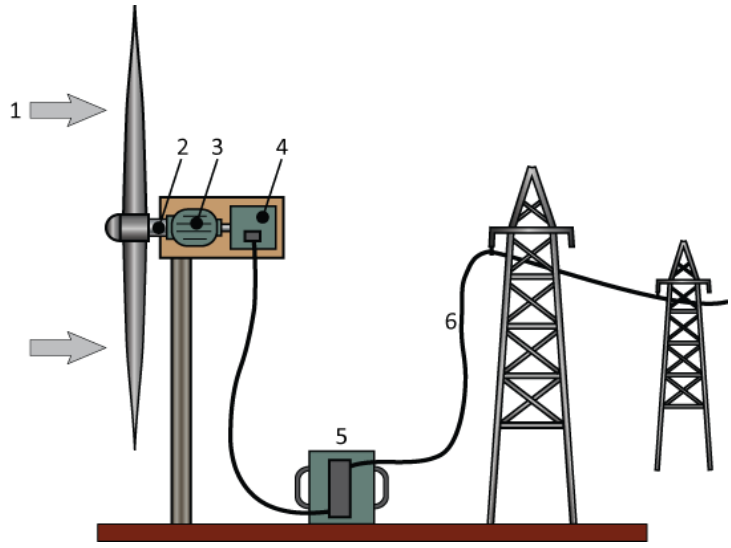
There are a range of types of wind generator:

1) Horizontal axis wind turbines (HAWT)
2) Savonius vertical axis wind turbine (VAWT)
3) Giromill/Darrieus vertical axis wind turbine (VAWT).

The power available from the wind is a function of the cube of the wind speed. Therefore a doubling of the wind speed gives **eight** times the power output from the turbine. All other things being equal, a turbine at a site with an average wind speed of 5 m/s will produce nearly twice as much power as a turbine at a location where the wind averages 4 m/s.



To this end the positioning of wind turbines is critical. Where the turbine is too near to the ground, the wind speed is reduced due to ground drag. Where turbines are in close proximity they may interfere with one another's air flow.



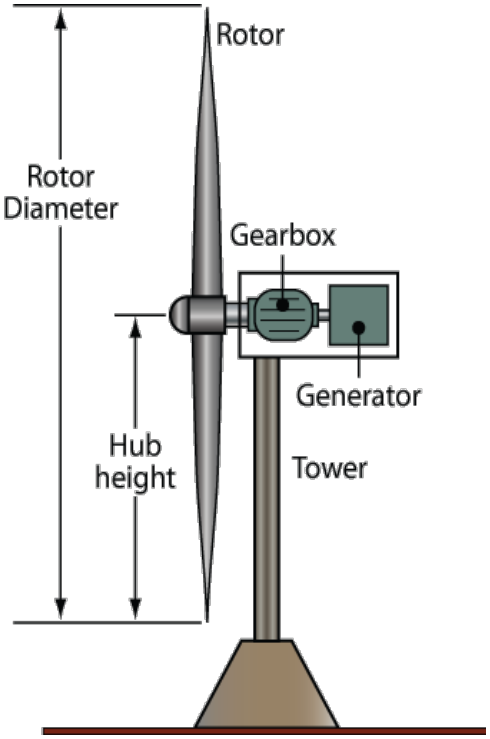
How wind turbines work

1. The wind blows on the blades
2. The blades turn a shaft
3. The shaft goes into a gear box
4. The generator convents the rotational energy into electrical energy
5. The power output goes to a transformer, which converts the electricity coming out of the generator at around 700 V, to the right voltage for the distribution system, typically 33,000 V.
6. The national grid transmits the power around the country**.**

Horizontal axis wind turbine

The modern HAWT looks very familiar to many. It usually has three arms (although this can be just one or two) set at an equal distance from one another (typically 120° for a three blade arrangement)

Wind turbines rotate at between 10 and 30 revolutions per minute. For large turbines this translates to a blade tip speed of around 91 m/s. Commercial wind turbines range from a few hundred kilowatts to over 2 megawatts. Smaller scale domestic turbines can generate just a few kilowatts.



- The rotors can be up to 80 m in diameter
- They can have one, two or three blades, usually three
- Blades are made out of fibreglass reinforced polyester or wood
- Power is controlled as the wind speed varies
- They are stopped at very high wind speed to prevent damage
- Yaw mechanisms can turn the blades to face the wind
- Most towers are cylindrical and are painted grey
- The longer the rotor blades the greater the energy output.

Macro energy production (wind farms)

The UK is the windiest country in Europe; it is thought we could power our country several times over using this free fuel. A modern 2.5 MW turbine in a reasonable site will generate 6.5 million units of electricity each year, enough to meet the annual needs of over 1,400 households.

The government's Renewable Energy Strategy states that, the target of generating 15% of all the UK's energy from 2020 means that 35-45% of electricity will have to come from green sources. Most of this will have to be wind.

Micro generation (small scale)

There are two types of domestic-sized wind turbine

Mast mounted. These are free standing and are erected in suitably exposed positions; they are around 2.5kW to 6kW in size.

- Roof 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

Most wind turbines generate direct current (d.c) electricity. A converter changes it to alternating current (a.c.) so it can be used in the home. Micro wind turbine systems can either be connected to the national electricity grid, or connected to a battery.

There are safety issues concerned with installing a micro generator.

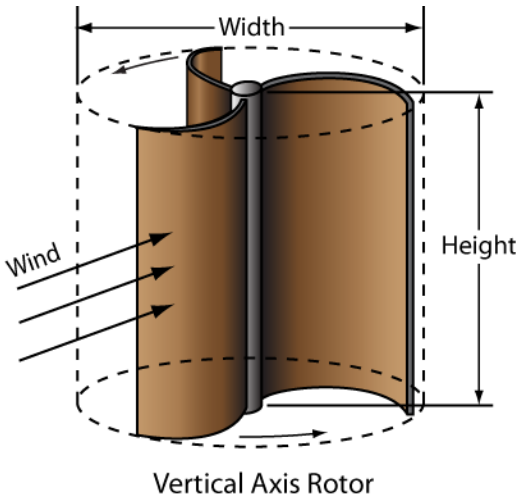
- There must be warning labels that show the installation includes a microgenerator so that precautions can be taken to avoid electric shock.
- Both the mains supply and the microgenerator must be securely isolated before electrical work is performed. If the turbines are turning electricity will be produced.
- Live parts need insulating or have an earthed or insulated enclosure
- Metallic enclosures of a class 1 microgenerator needs to be connected to a cpc.

Vertical axis wind turbines

Vertical axis wind turbines (VAWTs) come in a range of types:

- Darrieus
- Savonius
- Combinations of darrieus/savonius.

Savonius type



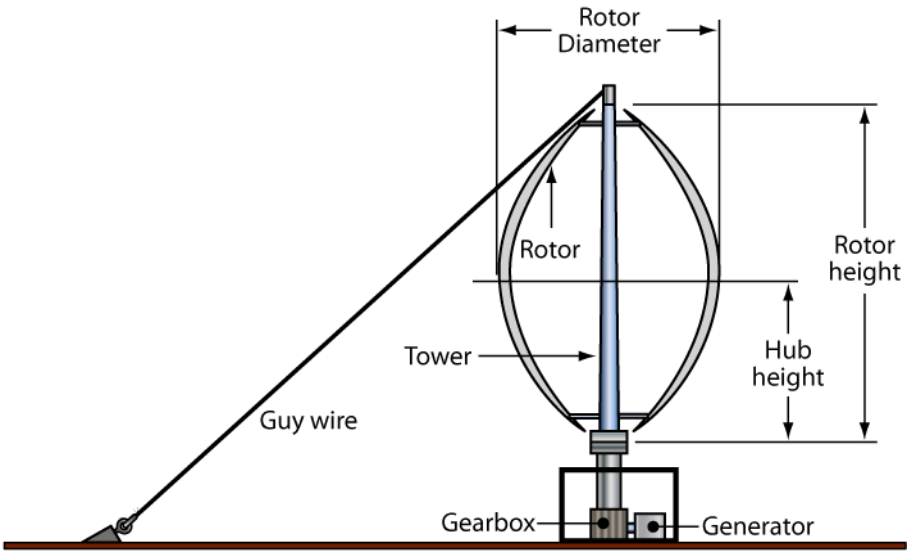
Vertical Axis Rotor

The Savonius wind turbine is the simplest type of wind turbine. They operate as a drag-type device like an anemometer. They are not efficient and are not always self-starting.

Darrieus type

The Darrieus type wind turbine utilises two or more aerofoils, as might be seen on an aircraft wing. The change in pressure across the surface of the blade causes rotational movement.

One of the original Darrieus type wind turbines used straight aerofoils: this is called the Giromill or H-bar design.



The other variant of the Darrieus type wind turbine looks more like an egg-beater, with the blades connected at the top and bottom of the shaft. Such a wind turbine is not generally self-starting and will usually require either mechanical brakes or other means of speed control as at a certain velocity resonance builds up leading to stress fractures.

Advantages of wind power

- The wind is free and with modern technology it can be captured efficiently.
- Once the wind turbine is built the energy it produces does not cause green house gases or other pollutants.
- Although wind turbines can be very tall each takes up only a small plot of land. This means that the land below can still be used. This is especially the case in agricultural areas as farming can still continue.
- Remote areas that are not connected to the electricity power grid can use wind turbines to produce their own supply.
- Wind turbines are available in a range of sizes which means a vast range of people and businesses can use them. Single households to small towns and villages can make good use of range of wind turbines available today

Disadvantages of wind power

- The strength of the wind is not constant and it varies from zero to storm force. This means that wind turbines do not produce the same amount of electricity all the time. There will be times when they produce no electricity at all.
- Wind turbines can be noisy. Each one can generate the same level of noise as a family car travelling at 70 mph.
- Many people see large wind turbines as unsightly structures and not pleasant or interesting to look at. They disfigure the countryside and are generally considered ugly.
- When wind turbines are being manufactured some pollution is produced. Therefore wind power does produce some pollution.
- Large wind farms are needed to provide entire communities with enough electricity.

Planning Permission

The planning regime for installing wind turbines is complex and evolving.

At present in most cases you will need to apply for planning permission from your local authority to add a domestic wind turbine to your house, or grounds surrounding your home.

It is up to each local authority to decide what information you may need to provide with your application. It may be helpful to contact your authority before applying to discuss the following planning issues:

- Visual impact
- Noise
- Vibration
- Electrical interference (with TV aerials)
- Safety

Building regulations

If you wish to install a wind turbine which will be attached to your house building regulations will normally apply.

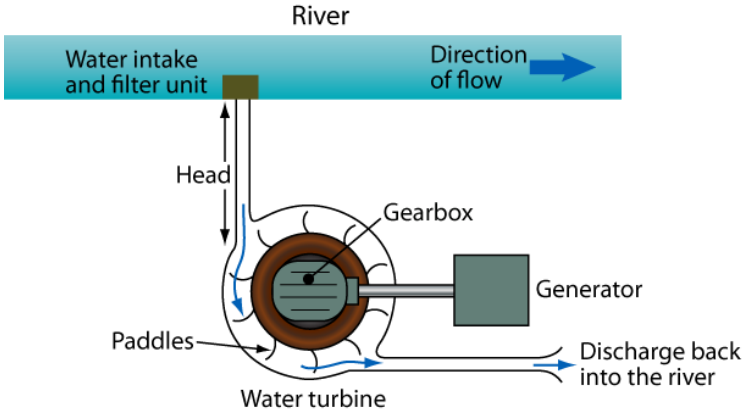
Size, weight and force exerted on fixed points would be considerable.

Building regulations also apply to other aspects of the work such as electrical installation.

If the wind turbine is not attached to your house, then only the electrical installation and connection will be a concern of the building regulations.

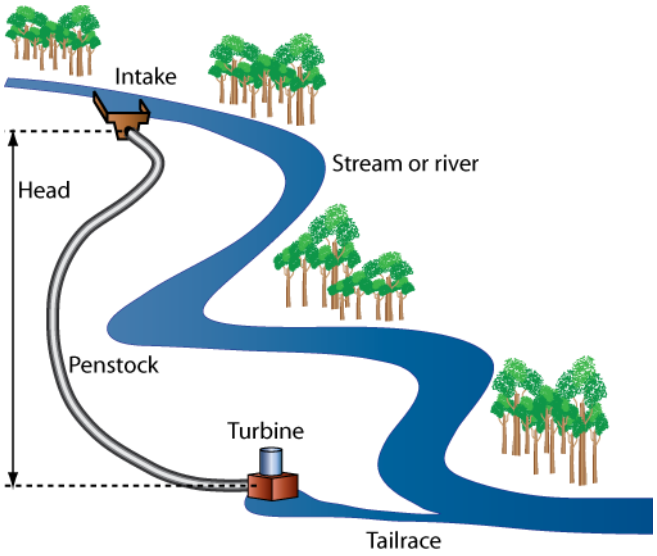
Hydro electricity

Hydro electricity is produced on a large scale by damming a lake or river. The water then flows through tunnels and the force of the water turns the turbines, which in turn drive generators which produce the electricity. The electricity is then fed into the national grid.



In this type of hydroelectric station, the water passes through the turbines that turn at 3000 rpm (revolutions per minute or 50 times a second). The water then passes out into a local river.

Micro-hydro generation



Hydropower systems that generate up to 100 kilowatts (kW) of electricity are often called micro-hydro systems.

Micro hydro systems use the energy in flowing water to produce electricity or mechanical energy the same way as large hydro systems, except they use a stream or river instead of a dam to turn the turbines.

A portion of a river or stream's water is diverted to a channel, pipeline, or pressurized pipeline that delivers it to a waterwheel or turbine. The moving water rotates the wheel or turbine, which spins a shaft.

The motion of the shaft powers an electric generator

Advantages

- **Efficient energy source**
  It only takes a small amount of flow (as little as two gallons per minute) or a drop as low as two feet to generate electricity with micro hydro. Electricity can be delivered as far as a mile away to the location where it is being used.
- **Reliable electricity source**
  Hydro produces a continuous supply of electrical energy in comparison to other small-scale renewable technologies. The peak energy season is during the winter months when large quantities of electricity are required.
- **No reservoir required**
  The water passing through the generator is directed back into the stream with relatively little impact on the surrounding ecology.
- **Cost effective energy solution**
  Building a small-scale hydro-power system relatively cheap, depending on site electricity requirements and location. Maintenance fees are relatively small.

- **Integrate with the local power grid**
  Surplus energy can be fed back into the national grid

Disadvantages

- **Suitable site characteristics required**
  In order to take full advantage of the electrical potential of small streams, a suitable site is needed.
- Factors to consider are: distance from the power source to the location where energy is required, stream size (including flow rate, output and drop), and a balance of system components — inverter, batteries, controller, transmission line and pipelines.
- **Low-power in the summer months**
  In many locations stream size will fluctuate seasonally. During the summer months there will likely be less flow and therefore less power output.
- **Environmental impact**
  The ecological impact of small-scale hydro is minimal; however the low-level environmental effects must be taken into consideration before construction begins.
- Stream water will be diverted away from a portion of the stream, and proper caution must be exercised to ensure there will be no damaging impact on the local ecology or other users of the water

Planning permission

The features of a hydro electricity scheme raise a number of important planning issues and planning permission will usually be needed.

The elements of a small-scale hydro electricity scheme create potential impacts on:

- landscape and visual amenity
- nature conservation
- the water regime.

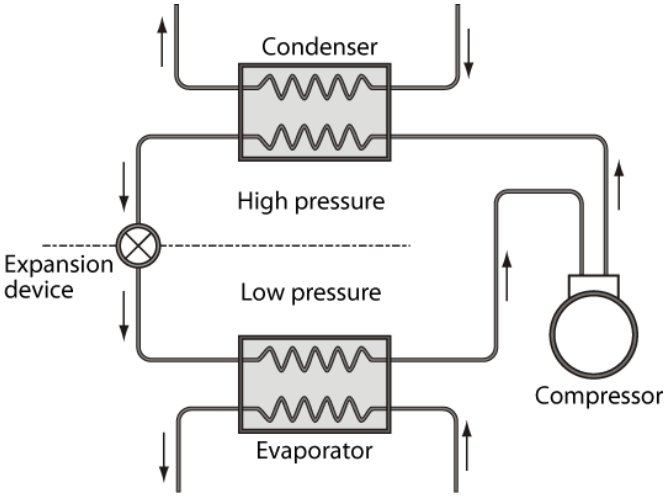
The planning application for any development that the planning authority considers likely to have a significant impact on the environment must be accompanied by an Environmental Statement.

It should be noted that the Environment Agency must also be consulted about water extraction licences because the water is not owned by the landowner.

Building regulations would also apply

Heat pumps

A heat pump is a refrigeration system where the concern is to use the heat rejected by the condenser rather than the heat supplied in the evaporator.



The majority of refrigeration systems are based on a machine which compresses and pumps refrigerant, such as R134a[i], around a sealed circuit where heat is absorbed at low pressure and temperature and rejected at high pressure and temperature in heat exchangers.

This is called the vapour compression cycle and is very common in domestic refrigeration and in heat pumps.

The vapour compression cycle consists of:

- A compressor
- A condenser
- An evaporator
- An expansion device.

1) The compressor pumps the refrigerant from a relatively low suction pressure to a higher head pressure. This process causes the refrigerant to enter a vapour stage.
2) The refrigerant at high pressure and temperature passes through the condenser where it 'gives up' its heat and becomes a liquid at high pressure.
3) The refrigerant passes through an expansion device to become a low pressure low temperature liquid. This drop in pressure causes the drop in temperature and the liquid then enters the evaporator.
4) The evaporator is placed within the heat source and the liquid enters this area as a low-pressure low-temperature mixture of liquid and vapour. This mixture then absorbs the heat within the area and the cycle begins again.

[i] Visit http://www.bis.gov.uk/files/file29101.pdf for guidance published by DEFRA on the regulations relating to refrigerants.

Ground source heat pumps

Ground source heat pumps take heat from the ground and release it in another location at a higher temperature.

Heat pumps can be used to heat your home and/or hot water Heat naturally flows from a warmer place to a cooler place.

Heat is removed from soil using a heat 'collection loop' buried 1meter or more in the ground and delivered to where it is needed.

Ground source heat pumps use buried lengths of plastic pipe in a horizontal trench dug to a depth of 1-2 metres.

The pipe is filled with a water/antifreeze mixture which circulates through the pipe absorbing heat from the ground. Using coiled piping reduces the amount of land needed.

Heat pump systems can be particularly effective when used to run under-floor heating. This will allow the pump to work at a consistent level over a period of time and to provide sufficient heat while operating at a lower temperature.

Heat pumps use a special fluid that constantly evaporates and condenses in a closed circuit controlled by valves and a compressor in order to reverse this natural process.

There are three main parts to any heat pump system:

1. A heat source and the means of extracting heat e.g. a ground loop.
2. A circuit of fluid in the heat pump and a power source.
3. A heat distribution system in the home e.g. the under-floor heating system.

The central component of a heat pump is the compressor. This is usually driven by an electric motor

As heat is absorbed from the ground the 'working' circulating fluid evaporates changing from liquid to gas.

This vapour is then compressed causing it to heat up.

The heat from this process is absorbed via a 'heat exchanger' into the home's heating system which means the vapour loses its heat and condenses back into a liquid.

This is then circulated through the heat source once more.

Advantages

- No boiler or fuel tank.
- No flue or ventilation requirements.
- Low maintenance once installed
- Unobtrusive and extremely quiet in operation.
- Good for underfloor heating systems

Disadvantages

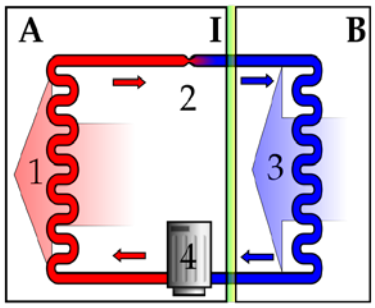
- Need large area of land to be effective
- Only suitable for well insulated homes
- Some heat pumps need high electrical currents to start up.
- Purchase and installation costs can be high
- Depending on the type of building, may need a backup system in cold weather.

Air sourced heat pump

Outside air at any temperate above zero, contains some heat. An air sourced heat pump, pumps some of this heat to provide hot water or space heating.

The main components of an air sourced heat pump are:

- A heat exchanger, over which outside air is blown, to extract the heat from the air.
- A compressor, which acts as a refrigerator only in reverse and raises the temperature from the outside air
- A way of transferring the heat into a hot water tank or heating system, such as radiators or under floor heating circuits



1. condenser
2. expansion valve
3. evaporator
4. compressor

a. indoors

b. out doors

I. insulation

Planning permission

Installing a ground or air heat pump does not usually need planning permission and should fall in the permitted development right. If you live in a conservation area or a listed building you should check with your council.

Building regulations

Installation of a ground or air source heat pump will have to comply with building regulations

3: Combined heat and power systems

Describe combined heat and power systems.

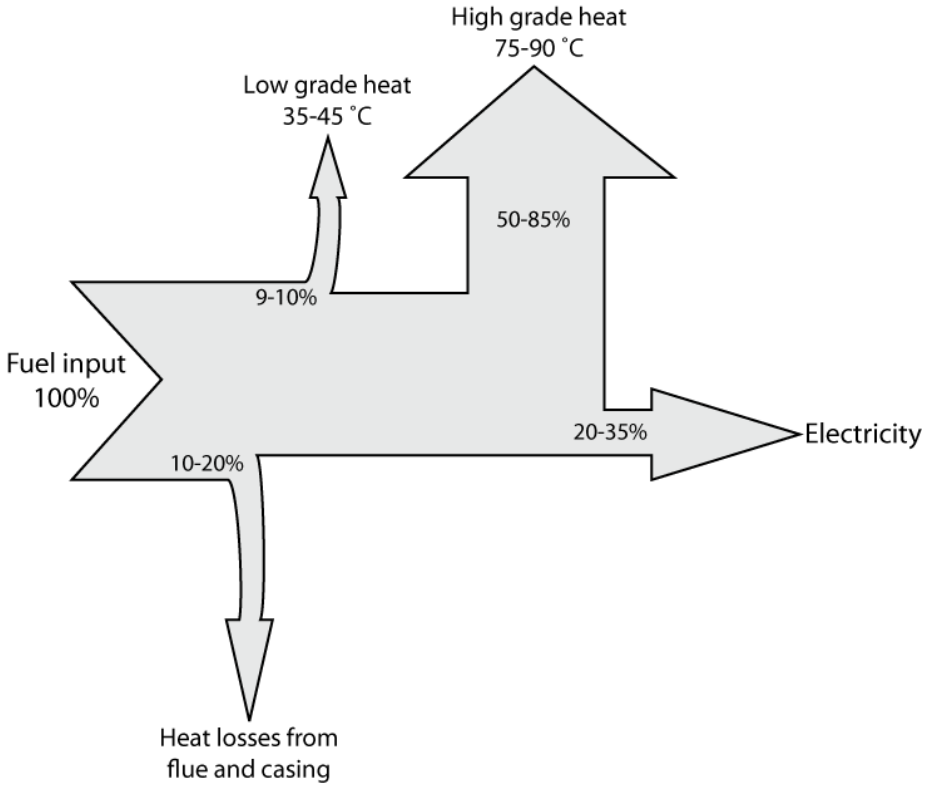
In any generation of electrical energy there are losses. Where power generation systems are used that utilise the burning of fuels then there will be waste heat. This heat is usually lost and forms part of the underlying losses associated with the generation of electricity.

CHP (Combined Heat and Power), is the simultaneous generation of useful heat and electricity through the process of combustion.

This generates electricity whilst retaining the by-product heat

To turn the waste into usable power a CHP plant needs a fuel source, which can be natural gas or biomass

Combined heat and power (CHP) systems have grown in use since the 1980s and generate electricity and use the waste heat to heat up an area. The heat is generally at a low level, but still sufficient for central heating or glasshouse purposes.



To give us some idea of the amount of energy wasted in the UK, it is estimated that the waste heat from the generated electricity capacity is sufficient to heat all the homes within the UK.

The majority of our electricity is produced using 'thermal' power stations. Thermal energy, in the form of heat is turned into useful electricity.

This leaves some heat waste which is released into the air via cooler or into the rivers or the sea.

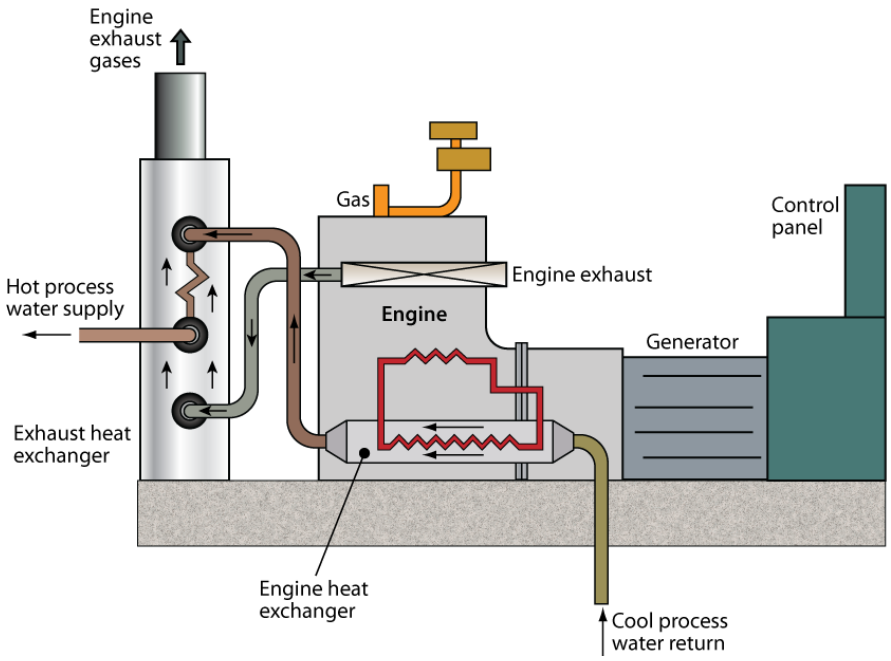
In a CHP plant this energy is recovered for use in a range of applications such as electricity and hot water.

Uses of CHP

When electricity is being generated the by product heat is stored in a heat recovery boiler and can be used to raise stem, to provide water heat. The electricity can be used for the electrical needs of a home or business.

It is estimated that micro CHP will be used in homes and will provide 20% of the UK's electricity generating capacity, substantially more than solar panels. There is ongoing research into differing fuel sources for CHP systems.

CHP Plant



A CHP plant requires;

- An engine
- Generator to produce electricity
- Heat Recovery system to obtain useable heat from the engine
- Cooling system –to get rid of the heat
- Combustion and Ventilation air systems - provide fresh air and remove exhaust air.
- Control System - maintain a safe and efficient operation
- Enclosure which will provide a physical barrier and a form of protection

To work the plant requires a Fuel Supply/ Generator**,** and a source of fuel a source of fuel.

For the process of combustion to occur, there needs to be a method of ignition, after ignition, the engine, will in turn activate the Generator. The generators create electricity by moving an electrical conductor through an magnetic field.

It also requires a Heat Recovery and Cooling System. The overall thermal efficiency may be as high as 90% for CHP schemes using this heat recovery technique. Heat produced from the Engine is transferred through a process of heat exchange via conduction and convection to the water pipes. Exhaust gases are then removed through a separate outlet

Industrial CHP is generally the largest of the CHP systems, ranging from small systems generating a few MW to large power plants, similar to conventional power stations you see plotted around the countryside. Much like traditional power plants CHP plants generate electricity, but further capture usable heat, which is usually lost or wasted through traditional power plants.

These large CHP power plants can provide heating and electricity to local communities or help large companies run their factories.

A CHP plant can reach an overall efficiency of 80 percent whereas a traditional coal powered plant would have an efficiency of around 40 percent

The benefits of industrial CHP are:

- Local generation of electricity.
    - Reduced transportation costs of fuel.
    - Reduced transmission costs
- Use approximately two-thirds of the waste heat.
    - Reduction in the amount of pollution.
- Improved national energy efficiency.
- Preservation of non-renewable energy reserves.
- Reduced dependence of imported fuels.

The problems associated with CHP are:

- A commitment to a set investment over a significant number of years.
- Changes in demand may affect the amount of electricity or heat required.
- Large capital costs including pipework etc.
- Maintenance costs.
- Noise and pollution.

Micro CHP

Micro CHP systems are primarily used to provide space heating and water heating requirements for the average home, while also generating electricity.

Micro CHP generates its energy from an energy source while a combustion engine, Stirling engine or fuel cell generates the electricity.

Once a CHP system has fully warmed up it can power all the lighting and appliances in a typical home, while any electrical generated not used can be exported back to the national grid.

Some Benefits of Micro-CHP

Unlike other renewable energy technologies micro CHP does not rely on building orientation or weather conditions to generate electricity.

- Generates electricity at times of peak electrical demand in the home
- Maximises greener and cheaper on-site use, helping to alleviate fuel poverty
- Reduces reliance on grid electricity
- No planning permission required
- Reduces carbon emissions

Disadvantages of micro CHP

- Cost remains higher than traditional condensing boilers
- Stirling engine CHP micro systems are generally suited to larger, older houses as they require higher and more consistent energy demands to be effective.
- May be ineffectual in responding to the requirements of users particularly **coping with seasonal variations**; often producing excess heat during the summer period.
- Smaller, better insulated homes may see reduced emission savings to **below 5%**, or under 100kg a year.

4: Solar thermal heating and biomass heating systems

Describe solar thermal heating systems. Describe biomass heating systems.

We have already looked at solar powered electricity

Solar thermal heating systems also use free heat from the sun to warm domestic hot water.

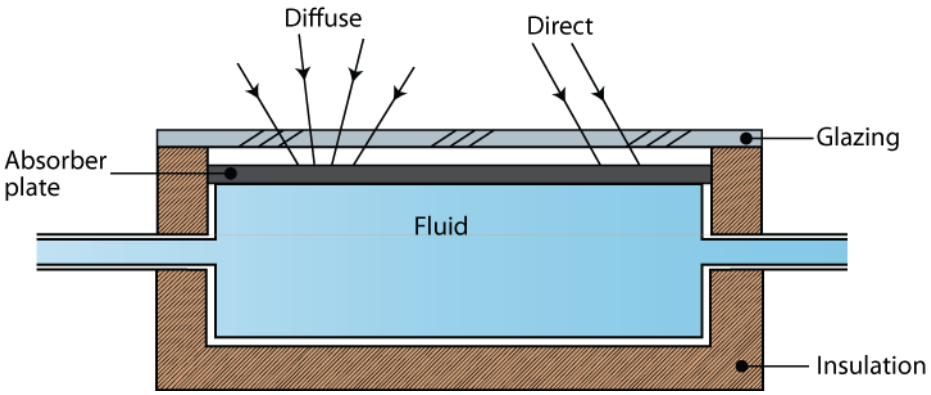
Solar water heater

Solar the sun to warm domestic water, this is done by placing panels on the roof, these panels need to be facing towards the south in the UK to get the maximum benefit from the sun.

The heating systems must also have freeze protection - if the water in a system freezes it can damage the solar collector.

There are two types of solar collectors are either glazed flat plate and evacuated tube collectors.

Flat plate



This is the most common panel for solar water heating

They consist of

- a thin metal box with insulated sides and back
- a glass or plastic cover (the glazing),
- a dark coloured absorber plate.

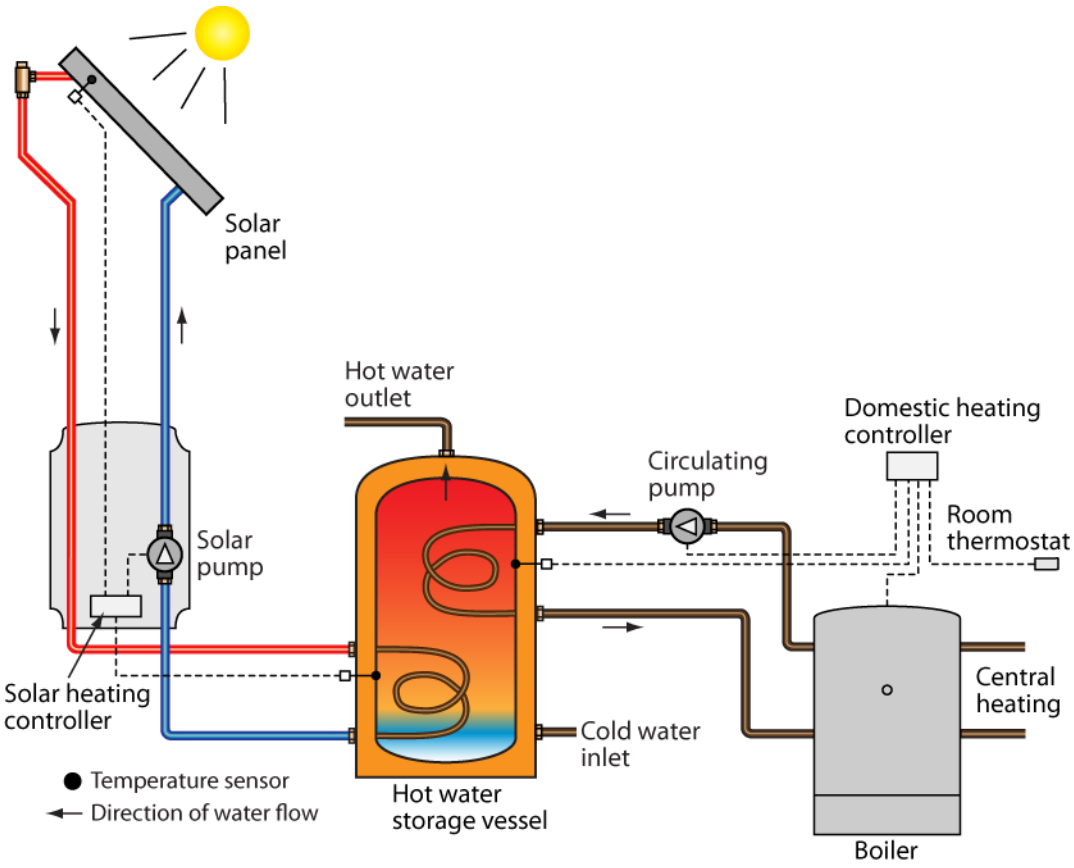
As the water 'absorbs' the heat – the heated water is then gathered into a larger collector pipe through which the water can be transported into the household's main hot water system.

A domestic flat plate collector will need to be around 3-4 m^2.

Evacuated tube collectors

These are more efficient design that can heat water to much higher temperatures and require less area, but they are more expensive. Instead of an absorber plate, water is pumped though absorber tubes gaining heat before going into the collector pipe.

The absorber tube is housed inside a glass tube, from which the air has been evacuated, forming a vacuum. The glass tube allows solar radiation through to the absorber tube where it can be turned into heat. The vacuum ensures that virtually all heat absorbed is transferred to the water. An evacuated tube collector plate needs to be only around $2m^2$ to be effective. This system needs an anti-boil control to stop the water getting too hot.



Advantages and disadvantages of solar heating

Advantages

- Hot water throughout the year, the system works all year round, although back up might be needed in the winter months.
- Reduced bills, sunlight is free, so once the initial installation is paid for, the hot water costs will be reduced.
- Low maintenance costs once installed
- solar hot water is a green, renewable heating system and can reduce carbon dioxide emissions

Disadvantages

- To heat the water further a boiler or immersion heater will be needed during the winter months.
- 5 m^2 of south/west facing roof space needed to be effective

Planning permission

In many cases fixing solar panels to your roof is likely to be considered 'permitted development' under planning law with no need to apply for planning permission.

The following limits apply to roof and wall mounted solar panels:

- Panels should not be installed above the ridgeline and should project no more than 200mm from the roof or wall surface.

If your property is a listed building installation is likely to require an application for listed building consent, even where planning permission is not needed.

Building Regulations

If you wish to install a solar panel on your roof building regulations will normally apply.

- The ability of the existing roof to carry the load (weight) of the panel will need to be checked and proven. Some strengthening work may be needed.
- Building regulations also apply to other aspects of the work such as electrical installation.

Check for local planning conditions before installing solar heating panels.

Biomass heating systems

Historically, biomass heating systems have either utilised wood from local areas and coal mined from the earth and peat dug from the land. These fuel sources are still utilised. However, the use of coal and peat both uses a finite source of energy and adds directly to the overall carbon dioxide that exists in the atmosphere. The use of wood as fuel, whilst not carbon neutral, is still more carbon friendly than using coal or peat, in that trees are planted to replace that which is burnt.

There are four general ways in which biomass is converted into usable heat. These are:

- Fully automated
- Semi-automated or 'surge bin'
- Pellet fired
- Combined heat and power

Biomass is material that is derived from living, or recently living biological organisms.

There are five basic categories of material:

- Virgin wood, from forestry and woodland activities or from wood processing
- Energy crops: high yield crops grown specifically for energy applications
- Agricultural residues: residues from agriculture harvesting or processing
- Food waste, from food and drink manufacture, preparation and processing, and post-consumer waste
- Industrial waste and co-products from manufacturing and industrial processes.

Biomass is a renewable, low carbon fuel that is already widely available throughout the UK.

Biomass is a sustainable fuel that can deliver a significant reduction in carbon emissions when compared with fossil fuels.

Benefits of using biomass as a sustainable fuel

- Biomass can be sourced locally, from within the UK, on an indefinite basis, contributing to security of supply.
- UK sourced biomass can offer local business opportunities and support the rural economy.
- The establishment of local networks of production and usage allows financial and environmental costs of transport to be minimized.
- There is no region in the UK that cannot be a producer of biomass

There are four main was of converting biomass into heat.

Fully automated

This type of system is used in large-scale installations and is more commonly found at power stations.

In fully automated systems chipped or ground up waste wood is brought to the site by delivery trucks and dropped into a holding tank. A system of conveyors then transports the wood from the holding tank to the boiler at a certain managed rate. The system automatically goes on and off to maintain the pressure and temperature within the boiler.

Semi-automated or "surge bin"

As with the fully-automated system, semi-automated or ‘surge bin’ systems are very similar to fully automated systems except they require more manpower to keep operational. This type of system have smaller holding tanks, and a much simpler conveyor systems which will require personnel to maintain the systems operation.

Pellet-fired

Pellets are a processed form of wood which, although they are more expensive than unprocessed wood, are much more condensed and uniform, and therefore are more efficient.

In commercial pellet-fired systems the pellets are commonly stored in a grain-type storage silo, and gravity is used to move them to the boiler. The storage requirements are much smaller for pellet-fired systems because of their condensed nature, which also helps cut down costs.

Combined heat and power

Combined heat and power systems are heating systems that generate both electricity and make use of the waste heat for heating purposes. In biomass systems wood waste is used to generate power, and heat is created as a by-product of the power generation system.

Such systems have a high cost because of the high-pressure operation. Because of this, the need for a highly trained operator is mandatory, and will further raise the cost of operation.

Another issue is that the production of heat is unavoidable and when it is not desirable for heat at certain parts of the year, the addition of a cooling tower is necessary, and will also raise the cost.

Domestic biomass heating

Wood fuelled heating systems generally burn wood pellets, chips or logs to power central heating and hot water boilers or to provide warmth in a single room.

There are two main ways of using wood to heat the home:

A standalone stove burning logs or pellets to heat a single room.

Some can also be fitted with a back boiler to provide water heating as well.

A boiler burning pellets, logs or chips connected to a central heating and hot water system.

Planning permission

Biomass Fuelled Appliances

Planning permission is not normally needed when installing a biomass system in a house if the work is all internal.

If the installation requires a flue outside, however, it will normally be permitted development if the conditions outlined below are met.

- Flues on the rear or side elevation of the building are allowed to a maximum of one metre above the highest part of the roof.
- If the building is listed or in a designated area even if you enjoy permitted development rights it is advisable to check with your local planning authority before a flue is fitted. Consent is also likely to be needed for internal alterations.

Building regulations

If you wish to install a biomass appliance, building regulations apply.

You should take into account factors such as ventilation, noise and general safety.

It is good practice to check local building regulations before installing any domestic bio mass appliances.

5: Waste water

Describe grey water recycling.

Describe rainwater harvesting.

The environmental impact of large populations is significant. In the United States the average water use per head of population is approximately 575 litres per day. In the U.K. that water usage falls to 149 litres per person per day and in the poorest places in the world this falls to below 20 litres per person per day.

You may think it rains a lot in the UK, but our water resources are under pressure.

A high volume of water is taken from the environment for human use.

Demand for water is rising because the population is increasing; lifestyles are changing and the impacts of a changing climate.

There are two ways we can help save water.

1. Reusing our household water
2. Collecting rain water to use in the home.

The increasing demand for water means that we should make more of an effort to save the water we have.

We can reduce the water we use in several ways; one of them is to fit water meters to encourage people to reduce the amount they use. By saving water we can reduce the amount we take from rivers and reservoirs to save the natural environment.

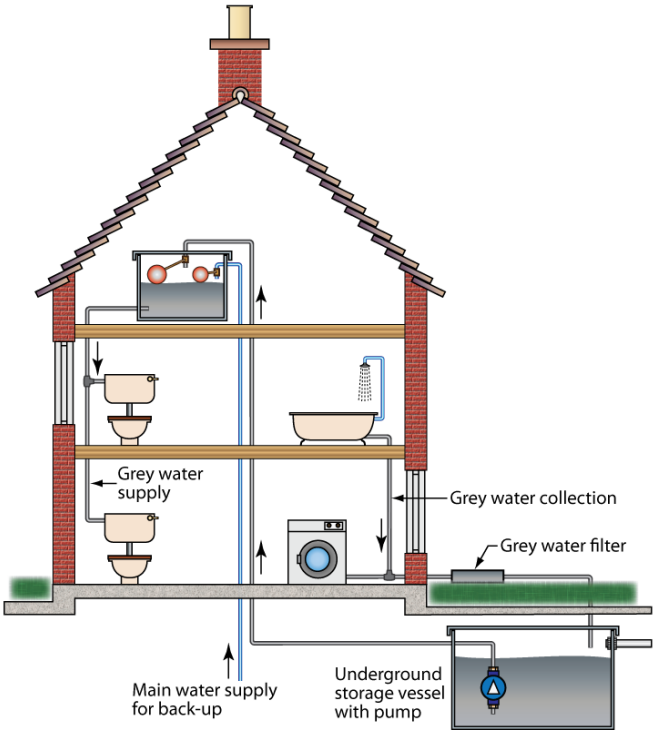
Grey water

Grey water is wastewater from showers, baths, washbasins, washing machines and kitchen sinks.

You can collect it from some or all of these sources, and after treatment, use can be made around the home for purposes that do not require drinking water quality.

If used for toilet flushing or gardening, a grey water system could potentially save a third of the mains water used in the home.

The greater the proportion of grey water used, the less mains water will be needed.



Grey water reuse systems vary significantly; however most have common features such as a tank for storing the treated water, a pump, a distributor system for transporting the treated water to where it is needed.

All systems that store grey water have to incorporate some level of treatment, as untreated grey water deteriorates rapidly in storage.

Grey water pipes should be black with green stripes.

It is important that the water we use is fit for purpose.

Treated grey water will not be of the same water quality as mains water so you should be aware of;

- the type of contamination;
- what the risks could be; and
- how clean the water needs to be.

Grey water from showers, baths and washbasins will often be contaminated with bacteria and viruses as well as debris such as skin particles and hair.

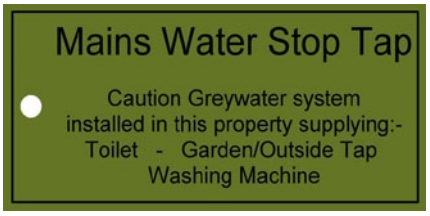
Grey water will also contain residues of soaps, detergents etc, that help bacteria develop.

Regulations

To make sure that there is no mistaking grey water from drinkable (potable) water there are regulations.

It is important that all pipework supplying reused water is readily identifiable to those who come across it for the first time.

- Pipework should be both recognisable and distinguishable from that supplying mains water.
- Pipes must be marked and labelled.



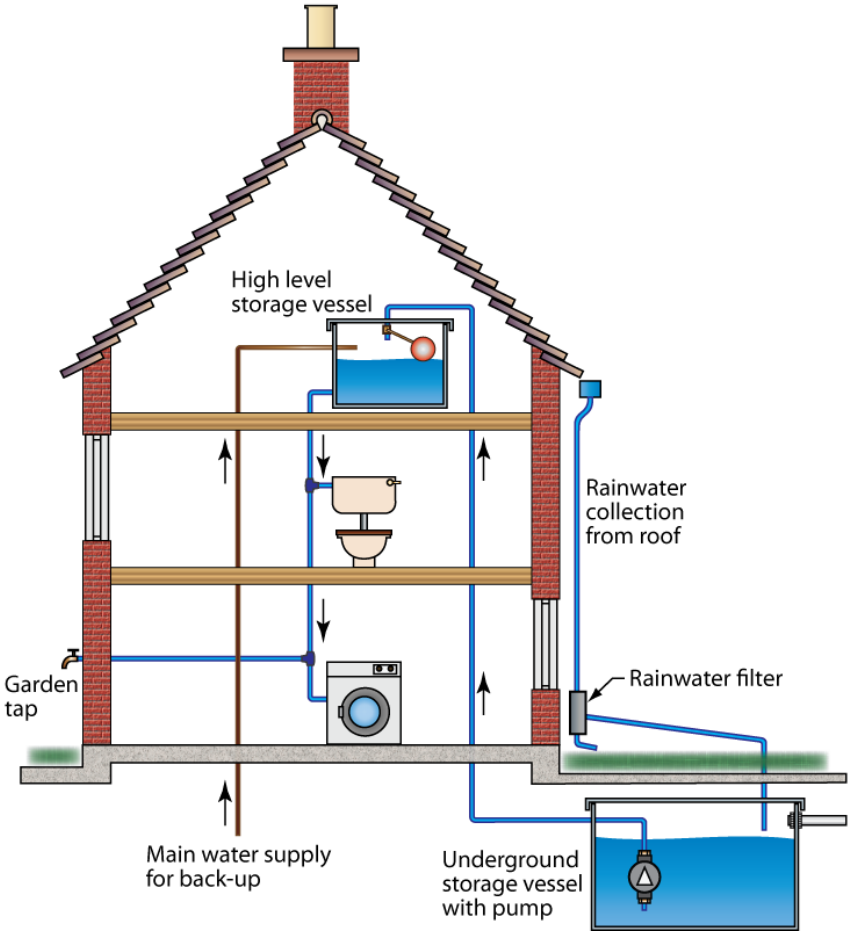
For greywater it is recommended that the pipework is black with green stripes.

Rain water harvesting

Rainwater harvesting is the accumulating and storing, of rainwater. It has been used to provide drinking water, water for livestock, and water for irrigation or to refill aquifers in a process called groundwater recharge. Rainwater collected from the roofs of houses, tents and local institutions can make an important contribution to the availability of drinking water. Water collected from the ground, sometimes from areas which are especially prepared for this purpose, is called storm water harvesting. It has been estimated that simply using the rainwater from the roof of a property can reduce water consumption by half.

Rainwater harvesting simply catches water that has fallen onto a building, tent and, as rainwater is not yet too contaminated, stored for use within a property.

Typically, rainwater is collected from the roof drainage system via the underground filter. This filters out the debris from the water and diverts about 95% of it into the storage tank. The remaining water goes to soakaway or storm drain in the usual manner, as does the excess water from the tank.



As water enters the tank it passes through a calmed inlet which calms the flow of water and prevents disturbance of the float switch and any sediments. Water is then supplied on demand by the submersible pump through a floating suction filter to specific outlets, usually WCs, washing machine and the like.

The pump is controlled by a combined pressure switch/flow controller, which turns the pump on and off when required and also gives dry-running protection to the pump if it should be necessary.

There are lots of ways of harvesting rain water but all systems have components to collect, filter and store the rainwater, a means to distribute the water to points of use. Generally there also mains water back up to ensure a continuous supply of water.

A filter is needed to keep the rain water clean; this prevents debris from entering the storage tank.

To maintain the quality of the water, the tank should have an overflow siphon which allows floating material to be removed. There also needs to be a rodent barrier to prevent rats or mice entering the tank. The extraction device needs to be just below the surface so that the rainwater can be taken from where it is cleanest.

Cutters should be cleaned regularly as birds and animal's faeces can pose a health risk.

A label needs to be visible to tell users that the water they are using is not fit for drinking.