

Construction and the environment

Introduction

Global warming is changing our environment. To reduce its effects, environment legislation in the UK – including current Building Regulations – is changing too. Domestic and commercial construction has now to be much more thermally efficient in order to save energy in the long term.

For thousands of years, we have exploited the natural resources of the world – coal, oil, gas, metals, gypsum and aggregate, to name but a few. All of these are used to produce construction materials for consumption. Today, there are many measures in place to protect the natural environment, from National Parks, to Acts of Parliament to environmentally protected green belts of land, and the efficient use of recycling techniques that save on further development of resources.

The government's recent initiative to redevelop brownfield sites (areas of land with existing buildings on them that have exceeded their life span) has reduced the need to develop greenfield sites.

The current emphasis is on the sustainable use of construction materials, so that they can be manufactured and used without having an effect on the resources required for future generations to enjoy. This may be as simple as buying materials manufactured locally, therefore saving on transport costs.

How you will be assessed

This unit is internally assessed by your tutor. A variety of activities is included in this unit to help you understand all aspects of construction and the environment.

After completing this unit you should be able to achieve the following outcomes:

- 1 Know the important features of the natural environment that need to be protected
- 2 Understand how the activities of the construction and built environment sector impact on the natural environment
- 3 Understand how the natural environment can be protected against the activities of the construction and built environment sector
- 4 Be able to select sustainable construction techniques that are fit for purpose

A graphic of a yellow sticky note with a blue and white patterned corner, containing the text 'Thinking points' and two questions.

Thinking points

Why is it important to protect our natural environment, including the Earth's resources?

How can we protect the natural environment and still develop construction activities, while saving valuable resources for future generations?

2.1 The important features of the natural environment that need to be protected

Features

Air quality

During the Industrial Revolution, first water then coal was the main source of fuel used to power pulleys and belts driving industrial machinery. There was no control over growth and pollution became a serious problem as the phenomenon known as smog developed over the large industrial cities of the UK.

Smog brought with it poor visibility as well as breathing difficulties for the cities' inhabitants as there was no clean air – smog depleted oxygen levels. Deaths from asthma, bronchitis and other lung diseases became common. The development of the petrol engine led to a further rise in pollution caused by lead-based petrol emissions. The governments of the day passed Acts to control waste emissions into the atmosphere. The first Clean Air Act of 1956 was one such form of legislation and its effect was to reduce the smog over large population centres.

Good air quality is vital for life and is an essential part of a healthy environment. Large factories tend to be sited away from population centres in order to prevent pollution entering the breathable atmosphere over towns and cities; indeed, large chimneys push the pollution further up into the atmosphere avoiding any fallout to local inhabitants. Today, emissions are strictly controlled to reduce the level of carbon dioxide (CO₂) that we now know adds to the effects of global warming. Tree and landscape planting improves the quality of air and is considered to be a sustainable part of any housing development.

Air quality obviously differs with geographical location. The centre of London or Birmingham compared to sparsely populated areas of Scotland or Wales will have different air qualities. Generally, the more population and industry in an area, the poorer the air quality.

Ozone quality

Ozone is a gas that occurs naturally in the Earth's upper atmosphere. It shields the Earth from harmful ultraviolet (UV) radiation. Without this ozone layer, there would be no life on Earth as we know it.

Over the past 60 years, chemicals such as chlorofluorocarbons (CFCs) have been used as a cooling gas in fridges and freezers and as a propellant in aerosols. When scientists spotted a hole opening up in the ozone layer above the Antarctic, they realised it was caused by ozone-destroying chemicals like CFCs. Since 1987, many of the world's governments have signed up to the Montreal Protocol on Substances that Deplete the Ozone Layer. As a result, CFCs have been steadily replaced with less harmful chemicals. Scientists now believe that the hole in the ozone layer is getting smaller.

Soil quality and natural drainage

The benchmark for soil quality is a difficult one to define. No two soils are the same and therefore there is no British Standard for a soil to be compared against, although recently, two environmental committees formulated up to 67 measured variables for soil quality. The **Soil Association** grades soils against a certain standard but this is for the organic growing of fruit and vegetables. Below are just a few of the categories against which soils may be measured:

- drainage properties
- texture
- acidity
- pH balance (see Figure 2.1)
- use
- level of contamination
- fertility
- mineral content
- organic content
- structural properties.

Extremely acid	4.3 or lower
Highly acid	4.3 – 4.8
Moderately acid	4.8 – 5.5
Mildly acid	5.5 – 7.0
Mildly alkaline	7.0 – 7.7
Moderately alkaline	7.7 – 8.5
Highly alkaline	8.5 or higher

▲ **Figure 2.1 pH range of soil**

Key Terms

Soil Association Organisation promoting healthy soils via a certification scheme that enables a producer to use the term 'organic' produce.

pH The measure of chemical balance that is acidic or alkaline. Remember litmus paper that changes colour with acids or alkalis? An ideal soil is somewhere in the mid range between red and blue.

In terms of construction, it could be said that a quality soil is one that will sustain life. We use soil to provide attractive and environmentally landscaped areas for the community to interact with. New housing schemes always include these areas as part of the government's sustainability policy.

The drainage of soils is a vital environmental consideration. One of the effects of global warming is flash floods. In poorer and underdeveloped countries, where trees have been cut down for use as fuel, there is no capture and absorption of water into the soil and it just runs off, with devastating consequences. Indeed, there are many parts of the UK that have been deforested since the Middle Ages. This leaves the soil unbound, as tree roots bind the soil together, and exposed to high levels of moisture that eventually runs off and sits on the surface. In small amounts this does not cause a problem,

but recent government planning policy has been to allow developments within flood plains. Overburden on a river's **levees** causes them to break and localised flooding to occur.

Soil drainage depends greatly on the structure of the soil, that is, how many pores or open voids are contained within it. The voids allow water to penetrate through the soil, eventually ending up within an **aquifer** below ground. Clay soils tend to resist the passage of moisture, whereas limestone rock allows the percolation of water through it. Therefore, geography and location play an important part in soil quality and drainage, along with the substrata of the rocks below the surface soils.

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Key Terms

Levees Natural banks of silt deposits which are left after a river floods. These are shaped into higher banks to control flood waters. In 2005, some of the levees protecting New Orleans in the USA broke and flooded the city.

Aquifer An underground storage area created naturally within the Earth's rock strata.

Landscape

The natural landscape of the British Isles is a valuable resource within easy reach of major towns and cities. From the highlands of Scotland to the Cotswolds, Cornwall, the Lake District and the Pennines, these are just some of the unique and diverse landscapes that are protected today. Local landscapes involve forests, rivers, streams, hills, topography and the unspoilt countryside. Urban landscapes also carry a unique signature, for example the slate-built houses of the Lake District to the sandstone buildings of Edinburgh. Inner cities can have a vertical landscape; London is becoming a rival to the buildings of New York with many multi-storey constructions such as the Swiss Re Gherkin. Leeds city centre is also developing vertically.

Our landscape is a valuable resource. Tourists travel to the UK to see its ancient history, which is reflected in the

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landscape. An attractive view with open spaces allows the use of the landscape for recreation purposes such as horse riding, fishing and hill walking. The coastal landscape is one that continually changes over time with erosion taking place by the action of the waves, as parts of the coastline move steadily inward. The different coastal rocks produce different landscapes, from the clay boulder slopes of the Yorkshire coastline to the chalk white cliffs of Dover.

The natural landscape of the UK has been changed by the ice ages that pushed millions of tons of ice southwards across half of Britain. This moulded and shaped the landscape beneath it, often leaving behind boulder clay and rocks.

Natural amenities

The facilities and services afforded by the natural environment cover a wide range of activities:

- Rivers – used for a variety of water-based sports such as fishing, angling and canoeing. Fishing is regulated under licence by the Waterways Environment Agency.
- Lakes – the Lake District, for example, is enjoyed by boating enthusiasts; a ferry service and pleasure craft attract a healthy tourist industry.
- Fenlands – the naturally occurring seasonal flooding areas of the fenlands and the Norfolk Broads produce large areas for migrating birds to feed upon during their annual migration from other climates. This enables the development of protected areas for wildlife conservation and the hobby of bird watching to flourish.
- Moors – the natural moors of the Yorkshire and Pennine regions are unique, although it may be said that humans have developed this environment by burning large areas for the promotion of grouse shooting as a sport. Large areas of the moors tend to be managed estates.
- Mountains – the Scottish and Welsh mountain areas offer hill walking and mountain climbing. Scotland also offers skiing facilities in winter.
- Natural forests – used to cover most of Britain during the Middle Ages, but they have been gradually cut down and used for fuel and ship building. There

are small areas of natural woodland that are now protected from felling. Natural woodlands provide a landscape that can be used for mountain biking, dog walking and exercise.

- The sea and beaches – Britain's coastal areas are unique and diverse. From the pebble beaches of the south coast to the sandy beaches of Norfolk and the rugged granite cliffs of parts of Cornwall and Scotland, beaches attract tourists during the summer months. Many are protected under an SSSI (site of special scientific interest). The sea is a valuable source of food, although stocks of fish are protected by European Union quotas.

Land use

The use of the land has been defined over hundreds of years and has been largely governed by the local population and the resources that were available at the time. Villages developed into towns and then major cities; expansion generally took place into the surrounding land. In order to feed the population, farming and agriculture developed in the fields surrounding the villages.

When the Industrial Revolution took off, resources of coal, oil, water and wood were developed and the industrial use of plots of land was born. The waterway network developed with a canal system that was later superseded by the railway network. Planning control eventually gave the community more selection in the choice of land use and limited development where it was considered inappropriate. For example, the expansion of out-of-town shopping developments has been reversed through government policy on strategic planning.

Land use can therefore be broadly categorised into:

- agricultural
- heavy industrial
- housing
- commercial
- natural landscape.

Green belts

These are areas of green land that surround communities and provide open parkland for the

community to enjoy away from the industrial use of the land. Green belt land is protected and no development is permitted. It provides an attractive and aesthetic area that breaks up the large conurbations which formed as villages, grew into towns and cities, swallowing up all the available surrounding land. The green belt provides a buffer zone between different land uses and maintains a clean, fresh and naturally growing land use that all of the community can experience and enjoy.



Thinking points

In 2006, over 300 applications were made to develop on areas of green belt. The Office of the Deputy Prime Minister (now Communities and Local Government) approved 150 of these!

Agriculture

This is the use of land that has been developed to produce food. It can be classified into two broad areas:

- Arable – the growing of crops.
- Livestock – the raising of animals.

Arable farming in the UK includes cereal crops such as wheat and barley and horticulture, which is the growing of fruit and vegetables. There has recently been a drive for organically grown crops which are produced without the use of chemicals. Livestock includes the production of meat and milk from cattle, and sheep and pigs for meat production.

Agriculture plays a significant part in developing the fertile regions of the landscape by ploughing the land and adding fertilisers to grow crops. This alters the natural landscape from its raw state into a condition that can be used for food production. Large areas each side of a major river are the most fertile for this use, as the river floods depositing minerals and materials that feed nutrients into the soils.

Assessment practice

A large plot of land has come on to the market and has obtained outline planning consent for housing development. You live in a local village adjacent to this land and are a parish councillor. The community is outraged at the decision to allow development on this piece of unspoilt, green landscape. In order to help fight an objection to full planning consent, you have been asked to identify and describe the features of the natural environment that must be considered at the planning stage, which could be used to defend development.

List five features of the natural environment with descriptions against each.

P1 ary

Forestry

The use of land for forestry can be divided into:

- naturally occurring, established woodlands which are hundreds of years old and are carefully managed
- plantations which are areas of land that have been deliberately planted for the growth and harvesting of timber resources.

In Britain, natural woodlands are limited to small pockets. There is a national forest at Nottingham, but a lot of woodland was cleared for industrial development, ship building and to use as fuel. Forests also provide an opportunity for recreation, offering an ideal environment for walking, bird watching, horse riding and biking.

The UK government's Forestry Commission looks after many of the forests and protects them as well as developing and expanding the use of timber as a resource. Timber, unlike oil, gas and coal, is a renewable resource that is not finite.

Countryside

The British countryside tends to be the region that is not developed in strong concentrations, unlike the major towns and cities and high conurbation areas such as

London and Manchester. Small villages and settlements such as farms are surrounded by green areas of farming or natural landscape which we call 'the countryside'. These areas are green due to high concentrations of rainfall; in hotter climates they would be brown.

There are very distinctive areas of countryside, for example the Wolds of Lincolnshire, the Lowlands of Scotland and the South Downs of Dorset.



Remember!

The countryside is an area of green scenery that is clean, attractive and unique within easy reach of major living areas.

Heritage

Britain has been inhabited by humans for thousands of years. Over this period, we have developed an enviable and unique heritage that has required protection. Heritage encompasses not just the land but the structures created upon it and could include the following:

- battlefields
- ancient monuments and icons
- castles
- manor houses
- streets
- archaeological sites
- bridges
- parks and gardens.

Castles are an important part of
British heritage



Theory into practice

Find out more about listed buildings in England at English Heritage's website, www.english-heritage.org.uk; for information on listing in Scotland, see Historic Scotland's website, historic-scotland.gov.uk.

It is vital that these are taken care of for future generations to enjoy. They are part of our culture and stand out as distinctive structures, for example the stone circle of Stonehenge. A system of **listing** important buildings has protected many of them, as has the National Trust which owns and runs some of the historic locations in the UK.

Key Term

Listed building A building of special architectural or historic interest in the UK. Alterations to these buildings must be carefully considered before they are made.



Remember!

Our heritage attracts a substantial tourist industry, especially from the USA, Japan and other countries, which substantially adds to our economic well-being. It is vital that it is protected.

Water resources

Over the past 100 years, we have developed the need for water as a resource. It is used not just for drinking but for washing, flushing toilets, cleaning and bathing. A dishwasher and washing machine are now considered essential items in many homes. Indeed, the growth in hot tubs now puts even more strain on the distribution systems that supply the water.

Water resources include the extraction of water above and below ground. Above ground, water is captured in reservoirs or by damming a river supply, extracting from rivers, or in hot climates by desalination plants from seawater. Below ground, boreholes are sunk within permeable rocks to extract the water by pumping. Water is a valuable commodity – a licence is needed to extract it and it must be protected from contamination through pollution leaking into the soils and rocks.



Remember!

The Earth has the same body of water as the day it was created; nothing has been taken away or added. The water cycle continues to convert seawater to fresh water and back via rivers.

Water quality

Water for human consumption is extracted from reservoirs, rivers and boreholes. It then has to be treated to enable it to be classified as drinking water. Water is

distributed around the UK using a system of pipework, which is then rated or metered as the consumer uses it. Water cannot contain any harmful elements such as bacteria, as this would affect our health and safety. Pure, fresh and clean water is often extracted at source and bottled as a mineral water. Non-drinking water supplies tend to be used in European countries where water is in short supply; we, for example, use drinking water to flush toilets in the UK.

Water quality is often determined by the material through which it percolates during its journey to the aquifer, which is an underground storage area created naturally within the Earth's rock strata, for example limestone.

Marine environment

The marine environment covers many aspects, including:

- harbours
- the sea
- estuaries
- marshes
- beaches
- cliffs.

The marine environment differs from the river environment in that it is salt-water based and not fresh water, but it is worth noting that several rivers are tidal. The tides are a gravitational effect caused by the moon's influence on the Earth. Along the coast there will be high-tide and low-tide marks. It is said that global warming is steadily adding to the rise in sea levels through the melting of polar ice, which is threatening many cities of the world, for example London and Venice. Hurricanes and the storm surges that arrive with them are a real threat, as the flooding and devastation of New Orleans in 2005 shows.

Marine wildlife is extensive in its range and biodiversity; indeed, the surface of the Earth is covered with a great deal of salt water, much of which has not been explored, and there is still a great deal to discover about this environment. Britain's coastline differs depending on the surrounding rock structures that meet the sea – soft rocks and clays are easily washed away by the action of the waves, whereas igneous rocks take longer to be broken down into fine sands.



Theory into practice

Look up 'biodiversity' using an Internet search engine and in no more than 20 words write your own definition.



Remember!

Biodiversity evolves; there are many species and micro-organisms that have yet to be discovered.

Wildlife

Wildlife is the native life that exists within a geographical location, but wildlife does migrate with the seasons, for example the swallows of North Africa that visit Britain each year. Wildlife, as the name suggests, is *wild* in that it has not been tamed by human interference, for example horses, pigs and sheep.

We have a wide range of wildlife in Britain, from birds, seals, whales, fish, snakes to otters, all of which is left alone to develop and establish itself within the landscape. Our agriculture industry does have an effect on wildlife. The crops that we grow and the land that we clear for cattle have an effect on wildlife diversity and its location.

Native wildlife tends to be unique to its area, for example the colonies of birds that congregate in certain areas, like the Dartford warbler, or ospreys in Scotland. Humans have to be very careful to avoid disturbing wildlife or this may tragically mean extinction for some species.

Biodiversity

This can be defined as the range of biological species that is present within the environment. It can span from micro-organisms to wildlife such as ducks and swans. It is the amount of living biological matter present within a geographical area. Biodiversity is an essential item for our eco-systems; if an imbalance develops, then one species takes over predominantly, for example rats and mice infestation.

Any activity humans undertake has an effect on biodiversity. For example, if you purchase a plot of green belt land and construct a building upon it, you have taken away the area of the footprint of the building, although it can be traded off with the external landscaping that can be undertaken with a new building.

Natural habitat

Habitat may be defined as the place where any living thing lives. Natural means that it is naturally occurring. Some people say that there are no areas of natural habitat left in Britain. Most of our country was originally covered in woodlands, which have been removed for the construction of buildings and as a fuel source.

Natural habitats are some of the heaths, meadows, limestone pavements and moorlands, as these are areas that have not been interfered with by humans. For example, grazing sheep on land destroys the natural habitat. We have lost so much of the natural habitat that there is now a move by environmentalists to restore many of the natural habitats in Britain. For example, we have lost nearly half of our ancient woodlands, and almost three-quarters of our ponds; this has a detrimental effect on biodiversity with some species already extinct. Humans have had a considerable impact on British natural habitats, which now require more protection than ever, so those that remain can be enjoyed in the future.

Assessment practice

A small area of green belt land has unexpectedly come on to the market and is expected to be granted outline planning permission with the sale. Many members of the local community have voiced their opposition to the development. To assist with fighting this cause, undertake an assessment of the potential environmental impact a proposed construction project will have on such a piece of land and on the local natural environment. **M1**

2.2 How activities of the construction and built environment sector impact on the natural environment

Globally

Greenhouse gases and global warming

Everyone in the world needs a roof over their heads to protect them from the environment they inhabit. In the UK, the winter is colder than in the warmer climates and so more substantial buildings are required, instead of simply using locally growing resources such as palms.

The construction industry uses raw materials, for example limestone and clays for cement and brick manufacture. Both these and many other processes require energy. The energy can be in the form of gas or electricity supplies. The process of turning the raw materials into a construction product releases carbon

emissions into the atmosphere, which is a greenhouse gas. Similarly, we have cut down many trees in order to process the timber from them for construction. Trees absorb carbon and through photosynthesis produce oxygen as a by-product.

The construction industry cannot be blamed solely for global warming. The production of cars and the fuels they burn along with air conditioning and several other sources add to the problem.



Remember!

A natural layer of greenhouse gases – water vapour, carbon dioxide, methane, nitrous oxide and ozone – surrounds the Earth and keeps it warm. Without this layer, temperatures on our planet would be much cooler and life on Earth, as we know it, would not exist.

In recent times, manmade greenhouse gases – nitrous oxide, sulphur hexafluoride, hydrofluorocarbons, perfluorocarbons and chlorofluorocarbons (CFCs) – have been released into the atmosphere as a result of human activity and added to the natural greenhouse gas layer. The result has been global warming – heat which would normally escape through the greenhouse gas layer into space remains trapped, causing the temperature on Earth to rise. Scientists predict that the increase in temperature will have serious consequences for the environment, including a change in rainfall patterns and a rise in sea levels.



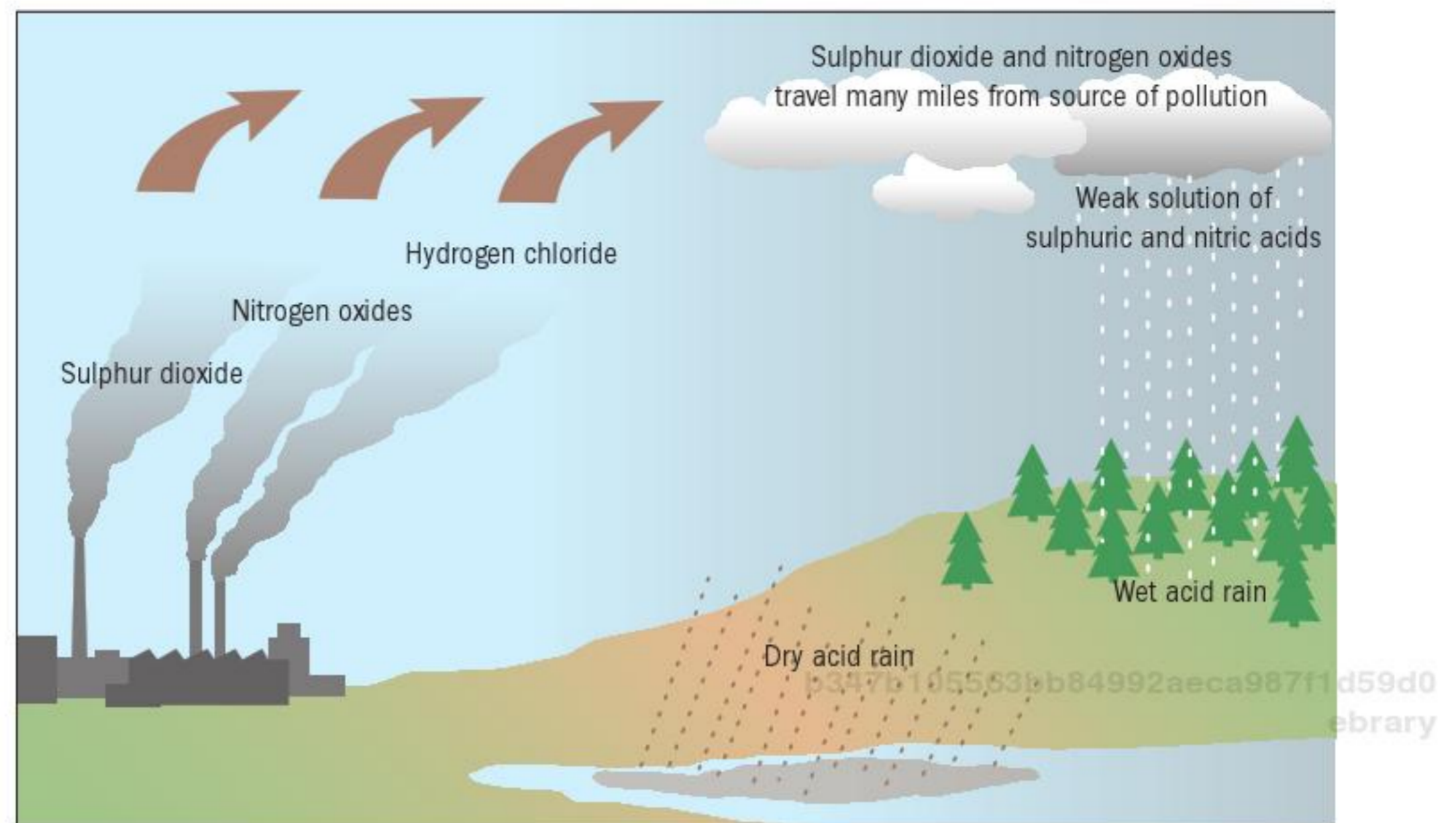
Theory into practice

The consequences of global warming are now a reality that is affecting all of us. Undertake a web-based search on the effects of global warming on the Earth and list three of the major causes and three consequences of this.

There are two sides to any discussion on global warming. Some scientists disagree that the Earth is entering a warmer phase; they point to the fact that the Earth was warmer in medieval times than it is now. Other factors influencing the Earth's climate could be:

- The sun's activity goes in cycles. During the last ice age, the sun was less active.
- The tilt of the earth is off centre and does move about this axis, which means that at certain times of the year some of the Earth is nearer the sun than other parts, which affects temperatures.
- A volcanic eruption on Earth throws dust into the atmosphere, which blocks sunlight. This can cause the Earth's climate to cool, sometimes for several years after the eruption.
- The Earth's orbit around the sun is elliptical, which means that it is sometimes closer to the sun than at others.

Figure 2.2 The acid rain cycle



Acid rain

Acid rain has an unusually high pH value. When the gases sulphur dioxide, nitrogen oxides and hydrogen chloride combine with water droplets in the atmosphere, weak solutions of sulphuric and nitric acids are formed (see Figure 2.2).

The gases come from two main sources: from hot magma ejected into the atmosphere during volcanic activity and from the burning of fossil fuels, namely oil, gas and coal. Sulphur dioxide and nitrogen oxides may not combine with water droplets until they are many miles from the initial source of pollution. They are carried by the prevailing winds, so the pollution of one country can seriously affect the environment of another.

The acid pollution can fall to the ground in two forms: wet and dry.

- Wet acid rain refers to precipitation, rain, fog and snow. It then affects plants, wildlife, trees and the area's biodiversity by upsetting the chemical balance of soils and the environment.
- Dry acid rain falls as a dust or a smoke that coats the ground, buildings, plants and the land. When it rains, these combine with the surface water to produce an acid water that has serious effects where it collects, especially in lakes and ponds and where it is taken up by tree roots.

Effects of acid rain

Acid rain can concentrate in thin soils and be extracted by trees and plants, causing slow growth and eventually death. It affects the water environment of lakes and rivers, killing fish and other aquatic life. Acid rain also causes damage to buildings where it destroys and reacts with some types of stone gradually removing the surface over time.



Remember!

Because acid pollution is carried by the wind, there is nothing the receiving country can do about the acid rain that falls upon its lands. Only a global agreement can try to prevent future contamination.

Ozone depletion due to CFCs

Chlorofluorocarbons (CFCs) are man-made chemicals that until recently were used in the following appliances:

- air conditioning units
- refrigerators
- cold stores
- freezers
- aerosols
- cleaning solvents
- foam products.

As mentioned on page 44, CFCs released into the atmosphere have damaged part of the protective ozone layer surrounding the Earth, increasing the amount of UV radiation reaching the Earth. UV radiation can:

- cause sunburn and lead to skin cancer
- affect the biodiversity and ecosystems of marine environments by killing certain micro-organisms
- lead to eye disorders such as blindness and cataracts.



Remember!

According to scientists, a single CFC molecule can destroy over 100,000 ozone molecules, so it does not take much of this product to have an effect. Despite the reduction in use of CFCs, they are still affecting the atmosphere as they gradually decay.

Over-extraction of water

The rise in the UK population has taken place over hundreds of years, and in order to house this growth we have expanded outwards turning villages into towns and towns into cities. This expansion is reflected in the increased demand for water resources. As we have seen, these are extracted by water companies from several sources. The growth in demand requires increased extraction. There are several ways to increase supply:

- Create more reservoirs.
- Reduce the level of wastage from distribution supply pipes.
- Install water meters.
- Increase pumping rates from boreholes.
- Increase extraction from rivers.

All these methods have a detrimental effect on the environment. Creating more reservoirs means turning suitable river valleys into lakes by damming, which floods valuable fertile agricultural land and any buildings in the area. Reducing the level of wastage by the distribution network is a sensible alternative. Water is wasted through leakage due to broken pipes and connections which have outlived their service life. Reduce this leakage and you increase the supply to consumers. Installing water meters has an immediate effect on consumption once end users realise that every

drop not used efficiently increases costs not only for the supply but also the disposal.

Increasing pumping rates from boreholes drops the level of water contained within the aquifer. Although this has no visible effect on the surface, the depth of the boreholes may have to be increased and the reduction in water level has to be replaced by rainfall or the borehole could run dry. Over-extraction of water from rivers can lead to environmental damage in the areas of wetlands within the UK. They dry out and their biodiversity and ecosystems change with the reduction in water levels. Indeed, during hot summers, rivers can run dry, which kills off all aquatic life.

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Fossil fuels and raw materials

Oil, gas and coal are the fossil fuels that were produced by the compression, that is, the force exerted from tons of plants piled on top of each other and then layers of rocks, of the detritus materials (plants) from forests over millions of years. They have to be extracted from below ground which has had a detrimental effect on the environment not only local to their source but also during transportation, for example the Torrey Canyon oil disaster of 1967 when the supertanker leaked thousands of gallons of oil onto the coast of Cornwall, and open cast mining of coal. All of these resources are *finite*, that is, when they run out they cannot be replaced. Only timber can be regrown and used again.

Oil extraction in the UK is mainly in small areas on land but is much more prevalent in the North Sea, for example the Brent oilfields off the coast of Scotland. The impact that oil has on construction and the environment is the distribution and storage facilities that are required to move it from the oilfield into tanks and then for processing into a range of products such as fuel oils and petrol. Heavier oils are imported using cargo ships that require docks and harbours for berthing and unloading. It is a similar situation with natural gas, which is extracted from the North Sea gasfields and, more recently, delivered by pipeline from Russia and Norway. Large areas are required to store gas and pump up to pressure for distribution using underground pipelines. The coal industry has recently undergone a decline in extraction of coal. This was due to industrial disputes

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and the pollution that is emitted from the burning of coal. There are two methods of coal extraction: underground mines and open cast. The first produces a substantial amount of waste that is landscaped into heaps and which alter the surrounding environment. The second involves the stripping of the overlying areas, the coal is excavated, the removed spoil is replaced and the land can be restored to a new use.



Case study

The UK coal industry in its era of maximum production produced many thousands of tons of coal each year. Most of this was extracted by underground mining. As part of the extraction process large areas of land had to be filled with the waste product that was removed with the coal, which ended up in slag heaps. This used large areas of land. The coal product was produced mainly for the UK electric generation industry where it was burnt to produce steam that drove turbines which generated electric current. This also has consequences for the environment.

Divide yourselves into teams and undertake research into the two areas identified above which are:

- the land use associated with coal extraction
- the environmental effects of burning coal.

(Hint: There are many coalfields present within the South Yorkshire region.)

Increased energy consumption and electricity generation

Since the reliance on fossil fuels, such as coal, that have been used to produce electricity has declined, there has been a net increase in burning gas, a cleaner fuel, to produce electrical energy. Energy consumption has increased with the modern consumer market that requires electricity to power the variety of electrical items we buy, from flat screen TVs to microwave ovens, all of which may be left on stand-by, using energy. Nuclear power still exists and produces energy in the

UK, but public opinion on its use is influenced by green issues.

The problem with increasing energy consumption to supply this demand is the balance that has to be maintained between the limit on fossil fuels and the increase in greenhouse gases. In order to start to address this issue, energy is now being generated from renewable sources. The current sources used in the UK are:

- Wind power developed from wind turbines sited on land or at sea.
- Wave power produced from the action of the waves which forces air to drive a turbine.
- Hydro-electric power produced by damming rivers and directing water into turbines.
- Landfill gas that is tapped and burnt to produce heat, steam and electric turbine energy.
- Sewage sludge digestion that produces a flammable gas which is combusted to produce steam.
- Combustion of waste to produce gas which is converted into steam.
- The growing of crops to produce biofuels.
- Solar heating where the sun's rays warm water in coils of pipes.
- Geothermal aquifers, where the magma energy of the Earth's crust is used to produce steam.
- Solar voltaic, which is the production of electricity using photo cell panels that convert the sun's energy to electricity.

More and more of these renewable energy sources will have to be used to produce electricity if we are to reduce the effect of global warming. The reduction of energy using energy saving technology, for example low voltage light bulbs, also contributes to saving valuable energy that would be wasted and extends the life of the fossil fuels that we have.

Deforestation

The tropical areas of the world are hot and humid and provide ideal conditions for the growth of natural rain forests. These have developed over thousands of years. The location of the rain forests coincides with countries whose infrastructure and therefore economic wealth is

only just developing. The rain forests are disappearing for a number of reasons.

- Slash and burn agriculture where trees are cleared and the land used for the growing of crops until its natural fertility dies and the area is left to recover slowly.
- Hardwood timber is important to economic wealth and therefore the forest is seen as a resource to help the government.
- Expansion of towns and cities.
- Trees are used for firewood.
- Illegal logging.
- Clearing for cattle production.
- Forest fires.

The UK was once covered in deciduous forests which have nearly all been cleared and the timber used for fuel, house building and ship building.

So what impact will deforestation have on the natural environment?

- The water cycle may be affected as the tropical areas absorb a large volume of moisture and water which will be reduced with the loss of the trees that absorb it.
- The amount of carbon within the atmosphere will increase as trees absorb this and give out oxygen via photosynthesis.
- As the trees and ground covering are stripped, rainfall can now erode the surface of the soil.
- Following this erosion, soil is deposited in rivers, lakes and ponds which may eventually silt up.
- The change in environment may result in a desert being formed from the lower moisture levels.
- With the loss of this habitat, species contained within it become extinct.

Loss of natural habitat

Some people say that Britain has lost all of its natural habitats as humans have touched every part of the country from the infrastructure of roads, railways, canals, airports, buildings and agriculture to name a few. Try to name a few unspoilt natural habitats and you will struggle. As our population has expanded, so

has the industry to provide wages and agriculture to supply food. The balance has favoured humans until recently.

The loss of natural habitat also includes the loss of biodiversity and the species associated with it. These are not recoverable. The loss of natural habitat in one area may also have an effect on another with mammals and animals that migrate between habitats finding that they no longer have a migrational home to complete the natural cycle between environments.

Reduction in biodiversity

The process of natural selection, the way different species rely on one another, the predator and the prey, are all examples of how biodiversity is linked between species. Take one out and the result could be a plague of a more dominant species. For example, rats are now becoming resistant to the poisons used to control them; this will affect other species populations.

Biodiversity provides many natural resources from clean air to clean water allowing crops to propagate and fruit. To damage such an environment always has a reaction somewhere in the food chain.



Remember!

Interfering in a biodiverse environment could lead to the creation of a virus that could kill humans.

Assessment practice

The managing director of your construction company wants the company to have a green policy that relates to all its activities. You have been tasked with research on this topic and have initially to identify the forms of global pollution and describe how each may harm the local environment of the UK where the company operates. **P2**

Locally

Air pollution by combustion products and volatile organic compounds

Combustible pollutants are compounds produced by burning a fuel. For example, petrol or diesel engines combust to produce exhaust gases that pollute and affect the quality of air. Smoking also burns a compound that gives off pollutants such as nicotine, which is addictive, and tar, which causes cancer. The harmful combustions are carbon monoxide, nitrogen dioxide, carbon dioxide and water vapour.

Combustion products can be dangerous to our health and in concentrated doses can damage respiratory tissue which leads to lung diseases and death through asphyxiation. Local combustion products can enter your home and affect you via several sources:

- gas boilers
- gas fires
- leaving a car engines running beside an open window
- through ventilation from traffic on busy roads
- smoking indoors.

Volatile organic compounds (VOCs) are given off by certain solids or liquids. Take a look at some of the products stored under your kitchen sink. Many will contain VOCs. Spirit-based paints contained VOCs; these are now gradually being replaced by water-based paints which do not contain the harmful compound. VOCs are more concentrated indoors due to the lack of ventilation within most homes. At work, VOCs are still present in photocopiers, inks, cleaning materials, and many other products. Local exhaust ventilation (LEV) in offices and workshops removes these to the atmosphere.

Polluting discharges to water by communities

Whatever water we use for drinking or an industrial process exits the building as a waste product. The sewer system of the UK is either combined or separate. If it is a separate system, then the surface rainwater and foul are separate drains. In this way, the rainwater does not have to be treated. Foul drainage requires treatment before its discharge into rivers or sea outlets, or landfill, to remove

solids and to bring the discharge water up to a quality standard. The alternative to connecting to the main sewer is a septic tank which contains the solids with the water draining into a ditch or reed bed.



Thinking point

Some of London's water supply has passed through the human body three times!

So what are the problems with our ageing nineteenth-century sewer system? Capacity is the main problem as the system was not designed for today's large towns and cities. When there is heavy rainfall the sewer system is unable to hold all of the sudden water input. The water then backs up and floods the area where it escapes with the environmental health consequences associated with raw sewage.

The other modern problem has been hard landscaping for off road parking. Before the increase in personal transport, many of our driveways were grassed and unpaved areas. Since the boom in the motor car, many of these areas have been paved over to provide parking. Any rainfall therefore does not soak into the ground but runs off the driveway and into the road gullies, thus entering the sewer system. Further contamination occurs from car washing detergents, petrol and coolant liquid leaks which are washed into the drainage system, all of which add to the pollution problem.

Industrial pollution also takes several forms. The first is the heavy metals that have been used in the past such as cadmium and mercury; these collect in lakes and can sometimes affect drinking water supplies. The other pollution is through micro-organisms such as cryptosporidiosis in water that can cause sickness and upset stomach problems. These enter via back syphonage into the system and from water leaks, and if the conditions are right, grow and multiply. The only remedy is to boil the drinking water supply. In developing countries, where water supply is from wells only, then cholera and typhoid diseases can easily spread.

Industry and agriculture

Industry and agriculture impact greatly, both locally and globally, on the built environment. Both require land for their processes, for example the conversion of sugar beet into sugar granules or the conversion of crude oil into petrol requires factories to be built. These factories then have other environmental links to global warming, energy usage and pollution.

Agriculture takes up vast areas of land and has changed our natural landscape through ploughing, the use of fertilisers and so on. Industry has tended to concentrate within certain areas and regions, from the steel industry of Sheffield to the Humber estuary, where a number of factories use the river for export and import of goods. Industry tends to be located where there is a workforce available along with easy access to raw materials.

Contaminated land

Our past human activity has often been unregulated and uncontrolled. The Industrial Revolution of the eighteenth and nineteenth centuries led to rapid expansion where natural resources, power and transportation could be connected. Industry set up next to the raw materials, using whatever method was needed to produce a finished product. This often involved using chemicals to process the raw material. At the time no one realised that chemicals used in the petro-chemical, oil, paint and iron and steel industries would contaminate the soil and environment. The contamination took the form of arsenic, cyanide, acids, alkalis and various other toxins.

These sites of previous use have been classified as brownfield sites by the government and developers are encouraged to use these rather than take large areas of **greenfield land**. When we build on a brownfield site the soil below has to be tested for contamination and suitable action taken to prevent the contamination coming into contact with the occupants, which could eventually cause ill health. This may involve removing the pollutants to licensed tips or treating the contamination in the ground by adding another chemical to it till the pH of the soil is balanced. Soil

barriers can be inserted to prevent the contamination spreading causing problems for local residents.

Key Term

Greenfield land Area which is undisturbed by previous construction – in effect, a green field.

Waste disposal

As the population of the UK has grown and expanded, so has the demand for consumables. These generate waste in the form of packaging, food, paper, cardboard and plastics. There are only a few methods of dealing with this waste, which is collected by the local council.

- Disposal to landfill sites – this is now subject to a landfill tax levied to prevent waste and encourage recycling.
- Incineration – waste is managed as a fuel and burnt to produce electricity.
- Reduction by recycling valuable components such as cardboard, newspaper, metals, plastics and glass.
- Composting into mulch – this involves composting green waste from gardens into a useful compost.

Suitable sites for waste disposal are becoming increasingly difficult to find. We must try to reduce the amount of wastage produced by using recycling. Current local authority levels of recycling are at 40 per cent; European legislation will further increase this percentage. New technology is also helping with plants now capable of recycling fridges and freezers.



Remember!

The more we recycle and conserve, the fewer finite resources we will need to use, and the more beneficial it will be for the construction and built environment and global warming.

Existing site dereliction

Many old buildings become derelict. This may be because:

- The cost of refurbishing the building is too high.
- The building has exceeded its life expectancy.
- The building has been damaged by fire and/or vandalism.
- The occupier has gone bankrupt or ceased trading.
- The economy of the local area is in decline.

Often these buildings are listed and have to be preserved in the condition in which they were built. This prohibits any change of use and alteration to the exteriors; they have a recognised English Heritage status.

Empty buildings are a sitting target for vandalism and destruction. Any valuable item is removed and the exteriors are boarded up to prevent entry. When a derelict building becomes a dangerous structure the local authority building control officers become involved in making the structure safe so that it does not injure any member of the public

Comfort disturbance

Your comfort within your home or working environment can be disturbed by:

- too little or excessive heat
- poor ventilation
- noise
- unpleasant smells
- lack of cleanliness.

Disturbance from traffic relates not only to noise but also to nuisance from vibration, which can severely shake buildings causing cracking and structural damage. The exhaust from traffic congestion has an environmental impact in developing countries when it mixes with the midday heat plus other combustion products to form a smog over large city areas. This affects the respiratory system causing breathing problems such as asthma.

While many people like to live in cities, city life has its downside. Uncollected refuse on the streets is

unsightly and can be smelly. Sewer systems may not be able to cope with the large demand. Noise is another disturbance associated with a densely populated area. Noise emanates from human occupation, not just from people playing music, or arguing but also from the large volume of traffic that the city has to cope with during rush hours.

The industrial part of any city often causes a dust and dirt problem. This does, to a certain degree, depend on the local climate, for example a hot climate is dustier than a wetter climate which washes down areas of the local environment.



Thinking points

Litter is a common sight in our towns and cities. Think of ways to keep our streets and environment cleaner.

Increased pressure upon existing services and infrastructure

With 60 million people now living in the UK, many of our towns and cities have expanded into huge conurbations. With this expansion has come increased pressure on the following types of infrastructure:

- The road network – for example, the M25 was built with four lanes in some places, but is now full to capacity at times.
- The railway network – increasingly passengers have to stand for their journey due to the sheer volume of people using the network services.
- Air traffic numbers – these have increased dramatically with the rise of low cost airlines offering budget fares.
- The water supply network – some areas of London struggle with inadequate supplies and water pressure.
- Gas supply – more demand has meant obtaining supplies from continental Europe and Russia.

Specification of hazardous materials

Lead and asbestos are two harmful materials that were historically installed in a building's structure without determining the possible causes to the health of the occupants. Lead is present in old water pipes, some gas pipes and in paint and can be absorbed into the blood stream through ingestion from the drinking water supply. It can also be inhaled through burning off old paint during redecoration. Lead was also a constituent in petrol as a lubricant and entered the atmosphere as a result of combustion.

Asbestos is present in old vinyl tiles, pipe lagging, roof sheeting, latex and many other materials. Asbestos causes lung disorders and can lead to cancers and eventual death. As a result of this, asbestos is steadily undergoing a removal process during alterations and refurbishments where it is taken to licensed tips and disposed of safely in controlled conditions.

Extraction of raw materials

There are many raw materials that are mined, quarried or extracted by drilling in the UK, including:

- coal, e.g. the Selby coalfield in Yorkshire
- oil and gas from the North Sea and some inland sites
- gold – there is still a small gold mine in Wales
- gypsum to form plasterboard and plasters
- various rocks for crushing into hardcore
- roofing materials such as slates
- various minerals.

The effect on the environment depends on the method of extraction used to obtain the raw product. Coal mining where seams of coal are taken out of the ground can cause long-term settlement to the ground above, along with the disposal issue of the unwanted material that is brought to the surface and tipped. Open cast mining requires the **overburden** to be removed so the raw material can be mass excavated and removed, and when the mine is exhausted the overburden is replaced. Ground levels are subsequently a lot lower than originally and the environment has to recover from this change.

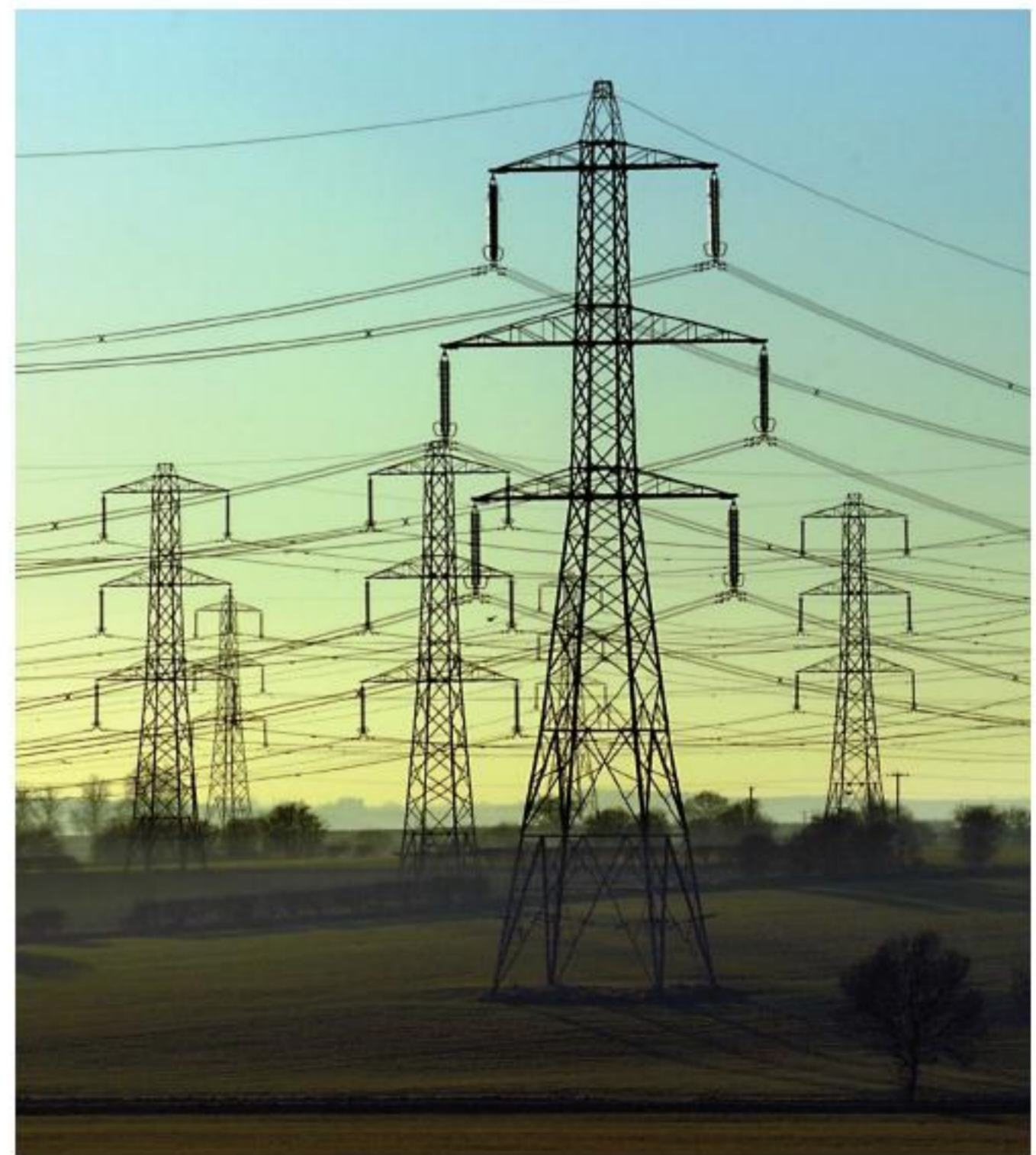
Key term

Overburden The worthless layer of material that has to be removed to get at the minerals beneath.

Electromagnetic radiation from overhead power lines

We transport electricity using pylons as this is the cheapest method rather than burying the cables across miles of countryside. Electromagnetic radiation is formed from the conduction of electricity along the power line. There have been several studies published that may prove a link between an increased risk of childhood leukaemia and the proximity to power lines, but this is subject to confirmation from long-term studies as there may be other factors involved.

The electricity companies tend to try to site pylons away from high centres of population or bury them beneath the surface once the pylon nears a town or city, as they are also an eyesore.



▲ Pylons transport electricity across the countryside

Sick building syndrome

This refers to a building that is causing the occupants to feel ill. It can take the form of headaches, flu-like symptoms, ear, nose and throat problems, nausea and tiredness. When the occupants leave the building their health improves so that the building then carries the stigma of 'sick building syndrome'. There could be several factors causing the syndrome:

- Lack of cleaning causing a build-up of dust particles.
- Chemicals that have been released through use into the atmosphere, e.g. photocopier toner.
- Pollution entering the office spaces from outside.
- Damp, dark conditions causing the growth of mould and bacteria that release spores into the atmosphere.
- Lack of the natural light needed for normal active health.
- Lack of fresh air from inadequate ventilation.
- Poor, dirty conditions.

- High humidity which can cause breathing problems.
- High temperatures that cause discomfort.

Good design and appreciation of the importance of the health of the occupants go together. If staff become sick through ill health caused by the structure that houses them, then this will have a detrimental effect on the financial side of the business, through sickness benefit and potential claims for ill health.

Assessment practice

Residents of a local housing association have complained about some local pollution issues. You are asked to visit the site and establish what their concerns are. Identify some forms of local pollution that could be affecting them and describe how each may harm the local environment around the housing development.

P3

2.3 How the natural environment can be protected against the activities of the construction and built environment sector

Legislation

The Environmental Protection Act 1990 was a powerful, single piece of legislation introduced to protect the environment of the UK. In 1995, the Environment Agency was set up (see below). These are the main Acts of Parliament that protect the environment:

- Water Act 1989
- Control of Pollution (Amendment) Act 1989
- Environmental Protection Act 1990
- Land Drainage Act 1991
- Water Resources Act 1991
- Environment Act 1995.



Theory into practice

Find out more about the legislation above at the Office of Public Sector Information website:
www.opsi.gov.uk.

The following is a list of legislation types that has been taken from the Environment Agency's website (2007) – www.environment-agency.gov.uk (follow the links to the English legislation section):

- air
- chemicals
- conservation
- energy
- land
- noise and statutory nuisance
- pollution prevention and control (PPC)
- plant protection
- radioactive substances
- waste
- water.

Environmental regulations developed from Acts of Parliament include the End of Life Vehicle Regulations 2003 and Agricultural Waste Regulations 2006. European directives stem from the European Parliament and there are hundreds of these concerning the environment. Each member country then has to develop regulations from these directives.



Thinking points

Legislation protects the environment by allowing people and individuals to be brought to court and prosecuted when they have caused damage to the environment. Is this too late?

Control

Health & Safety Executive

The Health & Safety Executive (HSE) has powers to enforce the legislation produced by the government. Its role is primarily to look after safety and it is this particular aspect that the HSE would investigate in environmental issues, for example are you wearing the correct personal protective equipment (PPE) to clean up a spillage and have you completed a risk assessment for that work? Should a breach of a safety regulation occur, then the HSE has the power of prosecution. The HSE has very little input into the environmental side of the law apart from the nuclear directive that governs releases of radiation into the environment.

Environment Agency

The Environment Agency (EA) is a public body whose role is to protect the environment. Its chairman, John

Harman, says: 'We are the leading public body for protecting and improving the environment in England and Wales. It's our job to make sure that air, land and water are looked after by everyone in today's society, so that tomorrow's generations inherit a cleaner, healthier world' (Environment Agency website, 2007). The EA also prosecutes offenders and gathers evidence in support of cases going to court. It undertakes many checks including air and water quality monitoring.

Local authorities

Local authorities have many powers under the departments listed below.

■ Planning

The planning department establishes the **local plan** under planning legislation. This enables the control of the erection and alteration of buildings, the removal of trees and hedges and the construction of roads and other hard landscaped areas. Development is restricted to areas earmarked for category developments which are contained within the local plan, for example industrial, residential, commercial, so that much of the environment can be protected and maintained.

Key Term

Local plan The document that sets out and controls the planning policy for the local authority's area. It sets out where the authority wants industry and housing to grow.



Theory into practice

Visit your local authority's website to find out the local plan.

■ Environmental services

It is the responsibility of local authorities to provide the local community with the following environmental services:

- municipal waste collection and disposal
- recycling
- pollution control
- noise control
- clean air
- public health
- commercial waste
- food safety.

All of the above can be legally enforced through prosecution and fines.

■ Building control

This department controls the demolition, alteration and erection of both commercial and domestic buildings. The environmental aspects covered by building control include drainage, the thermal properties of a dwelling and hence carbon emissions and reduction, heating, power and lighting and ventilation. Building control is often enforced through the checking of plans on conformity and by visual site inspections. Again, this department can legally enforce the regulations.

Assessment practice

A new housing developer has purchased the field next to your row of houses. Development work has started on site and there have been several complaints by you and your neighbours. These have been about the size of the properties being constructed, how near they are to your boundary and the noise levels during construction. Describe how legislation and control may be used to reduce the environmental impact of the construction of these houses.

P4

Design and specification

Good design is essential to protect the local and global environment. The orientation of buildings, for example, can harness the sun's energy, providing natural light instead of artificial, thereby saving energy. Good quality design to a high standard, using sustainable construction techniques, will pay dividends for the environment. Sourcing local materials reduces transport effects and using low carbon footprint materials and renewable resources are just some of the ways in which designers can help to protect the environment.

Time spent on thermal design will save energy in the long term and hence reduce the effects of global warming. This has been further backed up with changes to Part L of the **Building Regulations** which deals with the thermal efficiency of buildings. If you specify better quality materials and spend more initially, in the long term you save resources on the building maintenance.

Key Term

Building Regulations These are produced under the Building Act 1974 and control many aspects of construction so as to ensure that energy saving measures are built into new and existing designs.

selling price and a long payback period.

Renewable energy sources are a rapidly developing technology. Examples in the UK include wind turbines, wave power, geothermal, and hydroelectric power. These harness renewable aspects of the environment but do have an effect upon it, for example hydroelectric reservoirs require large areas of land to be taken up with water; similarly, wind farms require large areas of land exposed to the strong winds with enough distance between the wind turbines.



Case study

You live in the countryside region of the east coast, which is an area that receives a high and constant wind speed from the North Sea. The village where you have lived for the past 20 years is an area of natural beauty and has unspoilt views of the Lincolnshire Wolds. You are a member of the local parish council. It has just received an application for outline planning permission for ten wind turbines to be built in a field just outside the village. The council is outraged and plans to object strongly.

Discuss on what grounds the council could object to this electricity production development.

Reduction in energy usage

The longer we can extend the life of our finite resources, the better for all. To accomplish this, we need to save energy. This can be achieved through:

- energy saving measures
- renewable energy measures.

We can save energy in a building in many ways. Switching off appliances on standby, using grade A appliances, using low energy light bulbs, only filling a kettle with enough water for its use – these are just the tip of the iceberg. All rely on the education of the UK population and their willingness to accomplish these measures against the cost involved. For example, solar panels on a new house have a heavy initial cost on the

Minimisation of pollution

Pollution has a marked effect upon the environment and on our health and well-being. Pollution can be reduced in several ways. Fume scrubbers fitted to chimney outputs from factories and power stations and any other discharge to air process remove solids and any pollutant chemicals that would be released into the air. Water treatment of foul drainage before it is discharged into sea outfalls reduces the effects on the marine environment. Minimising wastage by recycling construction products such as timber, metal and bricks reduces pollution dumped into landfill sites. Developments in technology such as biofuels and low sulphur fuels provide cleaner emissions released during combustion of engines.

Reduction in embedded energy

There is a close relationship between the energy we use and the effects on global warming by utilising it. We can therefore try to reduce the amount of energy we use in construction by specifying materials that have lower **embedded energy** within them. Natural timber products are excellent examples as they take in carbon during growth and cost little in conversion into a useable construction product. Cement-based products, on the other hand, contain high levels of energy in their manufacture and careful consideration should be given to their use or replacing them with alternatives.

Key Term

Embedded energy This is the amount of energy used to produce the material or product and is often expressed in terms of how much carbon has been released into the atmosphere during its manufacture and transport.

Environmentally friendly, renewable materials

Sustainability has become the normal approach to specifying materials as architects, designers and clients consider the effect that their development will have on the environment. Green issues are an essential environmental consideration in selecting the materials to incorporate into a building. Products need to be environmentally friendly, in that they will reduce the amount of damage that is caused to the environment. An example would be timber cedar boarding which lasts a long time, requires no treatment and is environmentally friendly in its use. Natural insulation products developed from newspaper and sheep wool are examples of green products used in a unique way to reduce energy consumption.

Reuse of existing buildings and sites

Earlier in this unit, we mentioned the term brownfield site. This is a site for development that has had a

previous commercial use and where the buildings may have been left standing or demolished. Often the ground is contaminated with pollutants that will require cleaning up to provide a safe environment for any future use. The question that must be asked before considering a development opportunity would be, is it better to reuse a plot of land than to develop on virgin land?

Reuse of buildings is often called refurbishment or adaptation. This is a useful technique and will save energy and materials in the long run. Buildings of any merit are conserved under English Heritage's listing scheme.

Assessment practice

Select a material that is low in embedded energy, contains some elements of recycling and contains low carbon. Assess, evaluate and judge how well it achieves these objectives. Select a material by searching for the term 'green building materials' on the Internet.

D1

Management

Simple environmental impact assessments

If the management of an organisation takes a strategic view on the environmental impact of its business, a simple environmental impact assessment (EIA) will enable a clear picture to be produced of the effect the organisation is having on the environment. An EIA is normally a checklist of items to be considered.

For example:

- waste disposal
- thermal efficiency
- water discharges
- heat discharges
- water vapour discharges

would need careful assessment.



Remember!

Once completed, environmental impact assessments need to become part of an action plan. Left in a file, there will be no benefit to the environment.

There are now a large number of companies that can undertake EIAs on more complicated projects such as wind farm locations where the EIA may stretch into many volumes of paperwork.

Improved management of construction sites

The site manager is instrumental in protecting the environment. It is illegal for spillages to be released into the soil or for silts to be pumped into drainage. Double bunded tanks for fuel oils, spillage kits and silt tanks can be deployed by an effective site manager.

Waste should be sorted during the construction process to ensure materials can be recycled, for example:

- a metal skip where all waste metals can be melted down and reused in steel products
- a wood skip where the waste timber can be manufactured into mdf or chipboard products
- the use of plasterboard skips to recycle off-cuts back to the manufacturer
- cardboard and paper skips.

Avoiding the double handling of a material, that is, only moving it once, reduces fuel costs. The purchasing of raw materials locally such as gravels for drainage helps to reduce the effects of transport on the environment.

As you can see, there are many ways for an able, environmentally aware, site manager to provide added value on a construction project to the local and global environment.

Clear policies and objectives

A construction company that has clear policies and objectives on reduction of wastage, increase in recycling, noise management and dust and dirt control makes a statement to all its employees and customers that it

cares about the environment. For example, a large UK oil producer and fuel manufacturer actively promoting a greener fuel through its activities and advertising will send a clear message to its customers and helps the environment.

Local authorities' environmental services departments have a clear mandate from the government and the European Union (EU) to increase the percentage of municipal waste that is recycled so that there is a reduction of waste going to landfill sites. The EU has also taken steps to encourage car manufacturers to recycle 70 per cent of a car at the end of its life.

As with any policy, continual monitoring and review is necessary to ensure that there is a marked positive effect on the environment.

Sharing of good practice

Good practice on one site or within one organisation must be shared among the others for an even greater impact to be felt on the environment. Ignorance must be a thing of the past with all employees taking environmental considerations into account when undertaking the duties of the company. A good idea must be rewarded with recognition as to what has been saved so that it advertises this to the rest of the sites and other companies. Fresh innovative ideas must be shared freely and not sold for profit, for it is only through the individual efforts of everyone that the possible effects of global climate change can be reduced or halted.

Raising of awareness

Education of the people involved in the construction process is the first thing that must be accomplished in order to put into place the policies described earlier. If people are unaware of the effect they are having locally on a construction site with regard to protecting the environment, they are unlikely to participate in any policy or activity that you put into place. Companies can extend this further into local communities so everyone can be involved in the whole process, through school visits and organising activities at community centres, and through advertising green issues relating to the company's activities.

Communication of information

Communication as a protective environmental measure can be verbal and written. Inductions held on site for all employees can make them aware of any environmental considerations related to the project they are working on. **Tool box talks** can reinforce this message during the construction phase of any project. Communication must be top driven, that is, from the managing director

downwards, and must be two-way so that all levels of operatives and management are aware.

Key Term

Tool box talks A brief discussion of key issues with supervisors who then inform the rest of the workers.

Assessment practice

The board of directors of the design and build company you work for has revised its mission statement and strategy to move into green, environmentally friendly based projects. You have been asked to look at how good practice in:

- design
- specifying materials
- management of the sites

can greatly reduce environmental impact on the company's building projects.

P5

Select three methods that can be used to protect the natural environment and undertake a comparison of these. Look at each method in terms of financial cost, its effectiveness (how well it achieves protection) and its impact on the public (do people believe that the method achieves its goals?). You could do this by interviewing learners within your environment, or members of the local community.

M2

2.4 Selecting sustainable construction techniques that are fit for purpose

Fit for purpose

Sustainability is now a very real need. In the life of this planet, human beings have existed the equivalent of no more than two seconds of time compared to the billions of years Earth has existed. Yet what a statement we have created on the Earth in so short a time. We have been prolific in our gorging of the environment – clearing the natural landscape, extracting wantonly its resources, developing uncontrolled communities and not restricting our growth.

So now the Earth has awoken from its undisturbed slumber and is fast gaining momentum to fight back. Polar ice caps are receding, temperatures and sea levels are rising, hurricanes are increasing in numbers, flooding is increasing and areas are experiencing drought.

Do we, the human inhabitants, sit back and just watch? You have that choice and you alone can make it, but you must consider the present needs against the needs of future generations – this is sustainability.

Just look at it this way: go into your living room before you go to bed – is the TV on standby? What about the DVD player, the video and the digital TV box? And when you get ready to go out in the morning, are there thousands of cars on our roads and motorways driving somewhere with just one occupant? The answer is ‘yes’. The list of how we are using up the resources of our planet is endless. So, it’s now time to take a long, hard look at the protection of the environment. It must be fit for the current diverse economic, political and social needs of every country.

Techniques

Energy-based techniques

■ Reduction in energy consumption

This is the easy one to tackle. Reduce the amount of energy that we use by employing more efficient

technology, reducing waste and utilising alternative energy sources. This will make the finite resources we have last a lot longer with a reduced reliance and consumption. Electrical technology is now producing grade A appliances that require less electricity to run them. The cost of manufacturing low energy light bulbs has fallen and they are now available in a wide range of fittings. New buildings are subject to air leakage tests which reduces the amount of energy lost through unwanted ventilation.

■ Improved energy efficiency

Energy efficiency can be improved by the use of efficient boilers that take the heat out of exhaust gases, and by improved thermal insulation in housing that reduces the heat losses. Combined heat and power plants that produce electricity and heat are a third more efficient and are a growing technology that reduces our energy consumption. Heat pumps that extract waste heat from systems and harness it to heat water are a steadily developing technology.

■ Use of renewable energy and alternative sources of energy

Alternative sources of energy and renewable energy are the newer breed of energy sources that are starting to come on line. Examples include:

- wind turbines for home use – a leading DIY store is now providing a fixing service
- solar panels built into roof tiles format – so they look attractive and fit into the roof’s profile
- geothermal energy using heat within the soil – a trench is dug in your garden to capture latent heat
- biofuels – crops can now be grown to produce fuels when distilled
- wave turbines
- hydroelectric schemes
- hydrogen fuel cells.



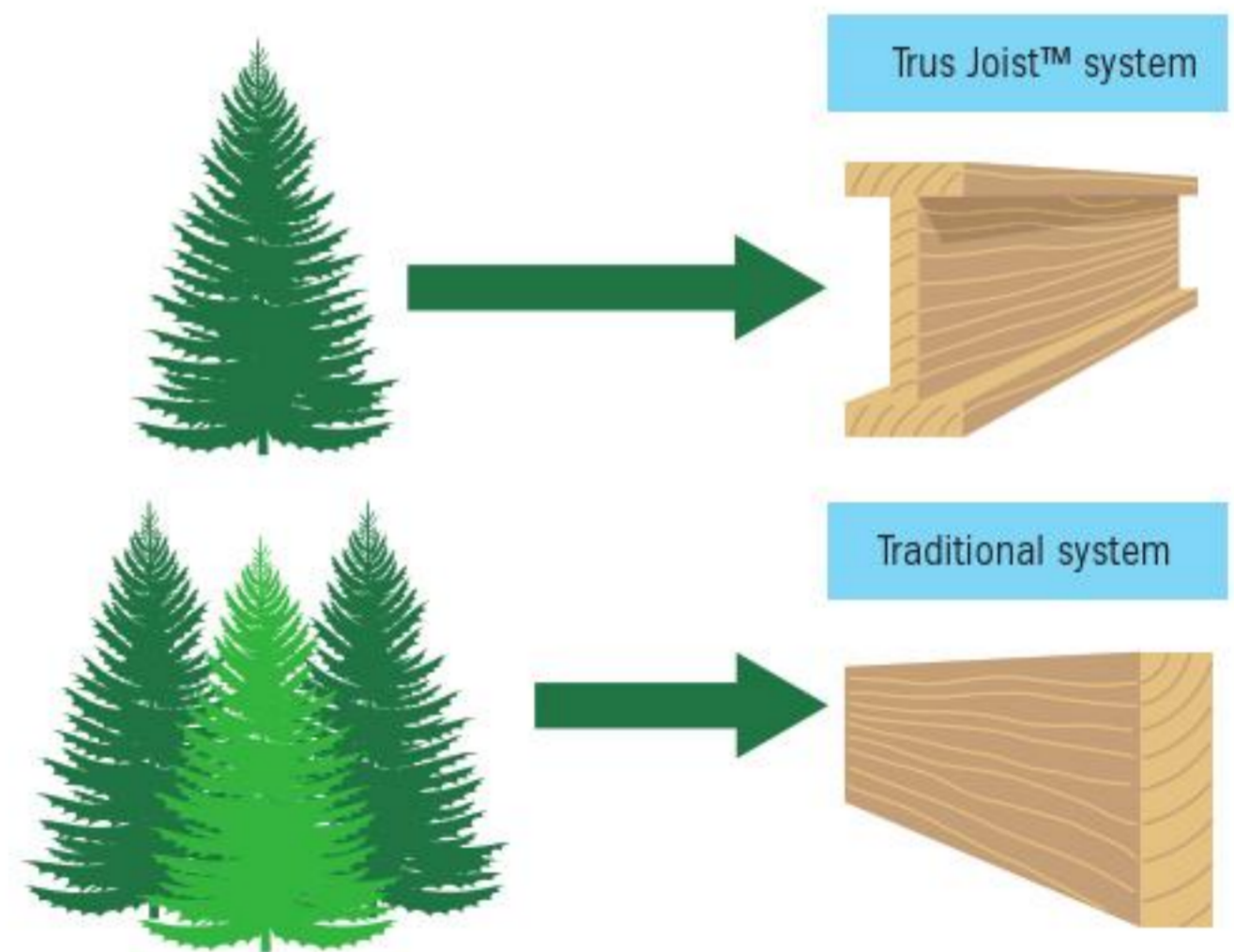
▲ **Wind turbines offer an alternative source of renewable energy**

All these energy sources save the Earth's finite resources and can be used over and over again – with maintenance and repair, they never run out.

Materials-based techniques

■ **Specification of renewable materials**

This technology in construction is slowly developing. Sheep's wool insulation is a natural product that is renewable, is very efficient at thermal insulation and breathes with humidity. Recycled newspaper and paper products can be used to form cellulose loose fill insulation for lofts. Cedar timber cladding is a renewable material that can be used on the exterior of houses, with excellent green properties. Green roofs that are manufactured from selected plants can now be used as a weatherproof covering that is natural and renewable. Timber engineering is taking strides in maximising the use of timber products to develop joists of the same depth, but using smaller sections of timber built up, that can cover large spans so replacing the use of concrete beams (see Figure 2.3). Timber beams using recycled timber boarding cores can now be used instead of solid



▲ **Figure 2.3 Timber engineering replaces the use of concrete beams**

timber joists. These use less timber in their manufacture and are considerably stronger.

■ **Embodied energy consideration**

Anything that can be used twice halves the amount of embodied energy used in its manufacture. Therefore,

concrete and brickwork from demolition can be crushed onsite and used as a hardcore base for buildings, which also saves transport costs.

Using high-performance, hardwood windows instead of upvc saves energy and oil in the long term, and timber is a renewable source. Steelwork can be recycled and used to produce new structures which reduces the amount of energy consumed in the production of the raw materials. Designers must be the principal driver of low embodied energy materials by specifying these materials within their designs and convincing clients of the benefit to the Earth of their inclusion.

Assessment practice

Look closely at your home. If you could rebuild it, what sustainable construction techniques could you use within it and its surroundings. Identify three techniques. Look at each of these techniques in turn and evaluate with justification if it would work.

D2

■ Low energy manufacture of materials and components

Any manufacturer of construction materials that can reduce the energy usage in the manufacturing process will save embodied energy within the product. This could be achieved in several ways. Waste heat can be recycled and taken out of exhaust gases and used to produce electrical energy which can be recycled back into the product. Many producers are starting up combined heat and power plants to gain the maximum benefit from their energy usage on site.

Waste-based techniques

■ Reduction of waste

Waste costs money, as it has to be dealt with, the only disposal being incineration or landfill. Waste can be reduced by several methods, including:

- recycling the materials back into the process, e.g. steelwork

- finding a processor for the waste product to use in their manufacturing process
- ordering the correct amounts of material and managing the use of raw materials efficiently
- using the waste as fuel for energy production
- careful packaging to prevent breakages
- training in the use of a material
- educating that waste costs the environment
- modular coordination of dimensions to standard lengths.

A reduction in wastage can often be brought about by education of the people using the materials into the environmental costs of wasting these materials. Incentive schemes could help along with a top-down management approach to reducing the effects of construction on the environment, for example the manager using a smaller company car, leading by example.

Recycling

In construction this has to be undertaken in certain ways; clients still want a brand new building, not one with certain reused elements within it. However, there are materials that can be reused as follows:

- Crushed concrete – this can be used as a fill material to raise levels.
- Facing bricks – when cleaned and reused in housing gives an aged appearance.
- Slates – these can be redressed or crushed and combined with an adhesive to form a reconstituted slate tile.
- Brick hardcore fill – this uses crushed bricks as a fill material.
- Glass – this can be melted and reformed.
- Structural steel – this uses recycled steel in its production.
- Plastics – these are used as timber-like products.
- Gabions – these are steel cages used as earth retainers which are filled with crushed concrete or brick.
- Timber – this can be engineered and recycled into structural products.
- Packaging of materials – suppliers can be encouraged to reduce the amount of packaging.

The possibilities are fast developing with new technologies and new products continually coming into the marketplace; recycling waste into materials is starting to take hold.

■ Offsite fabrication

This is recent development by UK manufacturers where a timber-framed house kit can be assembled offsite and delivered by lorries and site assembled using a crane to form the insulated internal skin of a complete house including the roof panels. The only additional elements are the cladding external finish, which can be in a brick skin or a timber-cladded product, and the roof tile installation. This type of construction is very thermally efficient, saves time and energy, uses timber renewable products and has relatively low carbon emissions in manufacture.

Offsite fabrication has been tried with house construction using modules that bolt together to form a house, but this has had limited success in domestic construction. Fast-food chains have taken this concept on board with modular units produced for site assembly.

■ Modern methods of production

Offsite fabrication of structural elements of commercial and domestic construction are the new approach to the production of houses and offices. Modules that simply bolt together are fast and efficient methods of producing a structure that is factory produced with minimal resulting wastage. This method is very efficient

and is aimed at producing affordable social homes in the current economic climate.

Just in time (JIT) construction is where all the materials for incorporation into the structure are delivered just at the point they are needed in the construction process. This avoids the need to store materials onsite for long periods, where they could be damaged, or moved around the site.

Precast concrete is returning as a modern method of construction enabling benefits from factory-produced concrete members that are site assembled with no waste or secondary support systems like formwork.

Assessment practice

The construction and built environment manager on a local housing development has asked your consultancy firm to assist in the selection of key sustainable construction techniques that could be incorporated into the new designs. Select and describe a fit for purpose sustainable construction technique to fit each of the following key issues from the company's strategic environmental policy:

- energy use
- materials recycling
- reduction of wastage.

P6

Compare the three techniques you selected above in terms of cost and performance in use. Use the Internet to help you in your research.

M3



Preparation for assessment

The local authority planning department has undertaken a revision to its local planning strategy policy, involving identifying potential sites that could be considered for light industrial and housing development. You have been recruited as a consultant to identify and describe the features of the natural environment that must be considered at the planning stage. Identify the environmental features that should be considered on these areas of land. **P1**

Your local authority is becoming increasingly conscious of the amount of pollution that is affecting the local environment from global sources. Identify some forms of global pollution that could be causing this disturbance and describe how each may harm the local environment within the region. **P2**

Staff in a construction head office have complained to the office manager about the local environment surrounding the office. Identify forms of local pollution that could be affecting the office environment, externally and internally, and describe how each may harm the local environment. **P3**

A new construction site for a community centre has started next door to a local school. Several of the parents have complained about the effect this is having on the built environment surrounding the development. Describe how legislation and control can be used to reduce the environmental impact of the construction development. **P4**

The local community is increasingly concerned about the new dual carriageway proposed to be built as a bypass around their village. They have called for a public meeting to discuss and raise their concerns. They wish to know how good highway design, specification and management of the project will reduce the local environmental impact. Produce discussion points for the local authority to allay their fears. **P5**

The local authority in partnership with a housing association has commissioned the demolition and rebuilding of 300 houses. The policy for this prestigious project is sustainability, which has to be built into the new construction techniques that will be used. You have been asked to select a fit for purpose construction technique under each of the following headings:

- Energy
- Material
- Wastage.

Describe how each will assist the goals of the project. **P6**

A large retail chain has been given outline permission to undertake a feasibility study on an area of 'out of town land'. This will be a large development with several retail units and the proposed site is 'greenfield' in its classification. The local authority has asked for an environmental audit to assess the potential impact of the proposed construction project.

Produce a short report in no more than 300 words identifying and describing the environmental features that may need considering at this stage. **M1**

The following are three methods currently being used to protect the natural environment. Compare each in terms of cost, effectiveness and how the public perceives them.

- Legislation
- Landfill taxation
- Low sulphur fuels **M2**

Your company is proposing to use the following sustainable construction techniques in its current building programme:

- The use of recycled bricks
- Timber-framed construction
- Cedar cladding the first floor external walls.

Compare each of the techniques in terms of relative cost and performance in use. **M3**

The following are three methods proposed to protect the natural environment from a property development.

- Sites of special scientific interest (SSSIs)
- Tree preservation orders (TPOs)
- The construction of a reed-bed lake within the development to contain water run-off from rainwater goods and driveways.

Appraise the above methods used to protect the natural environment against the potential environmental impact of the proposed property development. **D1**

Consider each of the examples in D1 above, and analyse it by justifying how well it achieves the protection of the natural environment. **D2**



Grading tips

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You are required to assess the potential environmental impact of a development. A real-life local area could be used to provide evidence for this. Important environmental points need to be identified, described and assessed. You should state what effect they will have on the local environment. Can they be measured, gauged, weighed up or calculated? **M1**

You should make some comparison between the methods of protecting the environment, that is, how effective one method is over another, which you consider is the most expensive, which the general public likes or prefers. You can source methods from the Internet or local newspapers. **M2**

You have to undertake a comparison between some selected sustainable methods. This means comparing one against another. You need to look at the costs

associated with them by undertaking some research. Finally, a comparison of their performance in use must be established. This could be aesthetics, thermal properties or maintenance. **M3**

You should look at the potential environmental impact of the sustainable methods when used on a real or virtual construction project. Appraise (i.e. evaluate, assess, judge) what effect these methods have on this project. How well do they protect the environment when applied to your construction project? **D1**

You will need to justify (i.e. evaluate, judge, defend, give a reason for) the selection of appropriate sustainable construction techniques for use in the 'real or virtual' construction project. You have to answer: does this technique work on this particular project? **D2**

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Knowledge check

- 1 Name three sources of drinking water.
- 2 What are the consequences of burning fossil fuels?
- 3 Identify three forms of air pollution.
- 4 What is SBS?
- 5 What does EPA mean in legislation?
- 6 What is embedded energy in a material?
- 7 How can we reduce the amount of construction waste produced during a project?
- 8 Identify five techniques that can be used within domestic housing to reduce energy consumption.
- 9 What is an EIA?
- 10 Name three products that can be recycled back into building materials.
- 11 What is sustainability?
- 12 How can we generate electricity using environmentally friendly techniques?

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Grading criteria~: Unit 2		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
<p>P1 identify and describe four different features of the natural environment that must be considered at the planning stage Assessment practice pages 47, 71</p> <p>P2 identify two different forms of global pollution and describe how each may harm the local environment Assessment practice pages 55, 71</p> <p>P3 identify two different forms of local pollution and describe how each may harm the local environment Assessment practice pages 60, 71</p>	<p>M1 assess the potential environmental impact of a proposed construction project, either real or virtual, on the local natural environment Assessment practice pages 50, 71</p>	<p>b347b105563bb84992aeca987f1d59d0 ebrary</p>
<p>P4 describe how legislation and control are used to reduce the environmental impact of the construction and built environment sector Assessment practice pages 62, 71</p> <p>P5 describe how good practice in design, specification and management can reduce the environmental impact of the construction and built environment sector Assessment practice pages 66, 71</p>	<p>M2 compare the four key methods used to protect the natural environment in terms of cost, effectiveness and public perception of the construction and built environment sector Assessment practice pages 66, 71</p>	<p>D1 evaluate methods used to protect the natural environment against the potential environmental impacts of a tutor-specified 'real or virtual' construction project Assessment practice pages 64, 72</p>
<p>P6 select and describe a fit-for-purpose sustainable construction technique for each of the following issues: energy, materials, and waste Assessment practice pages 70, 71</p>	<p>M3 compare selected sustainable construction techniques in terms of relative cost and performance-in-use Assessment practice pages 70, 71</p>	<p>D2 justify their selection of appropriate sustainable construction techniques for a tutor-specified construction project Assessment practice pages 69, 72</p>