

IMPORTANT INFORMATION



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NEBOSH SPECIALIST DIPLOMA IN ENVIRONMENTAL MANAGEMENT

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INTRODUCTION

This Supplement has been prepared to update, amend and augment your study material. It contains important information and you should read it carefully, in conjunction with your existing study material:

- The first section consists of updating material relating to two new pieces of legislation that are relevant **to all students**. Do remember that NEBOSH state that legislation becomes examinable in detail six months after its date of introduction. Although candidates are expected to be essentially up to date at the time of the examination, a detailed knowledge will not be expected, but reference to new or impending legislation, where relevant to a question, will be given credit.
- The second section provides additional material for **students aiming for the December 2008 exams onwards** (please see the following notes).

Candidates for Examinations From December 2008 Onwards

It is important that you are aware that NEBOSH are about to issue a new syllabus that will take effect from the December 2008 exams. This syllabus is in the process of being released and the structure of the course will be changing to:

Element	Title	Study Hours
1	Principles of Environmental Risk Management	12
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3	Control Strategies for Environmental Risk	10
4	Monitoring, Review and Audit	7
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NEBOSH have not yet finalised the syllabus revision, but we have been working with a draft version so that we will be in a position to update course material as soon as the final version is available. We will be issuing a full supplement in August, in which we will highlight all the key changes and any new topics that are included in the revised syllabus. At this stage we do not anticipate that there will be any significant changes to the assessment requirements, but we will be able to confirm this as soon as NEBOSH release the final syllabus.

It is important that you appreciate at this stage that much of the syllabus revision is a question of the restructuring of the existing content, and many of the topics in the content are unchanged. However, NEBOSH have indicated that the updated syllabus will include a new element: Energy Use and Efficiency. In order to give you as long as possible to study this element, we have included a **draft version** as part of this supplement. It may be necessary to make minor changes to the content of this element when we have the new syllabus, but in the meantime you can begin to familiarise yourself with the contents. You will be notified of any necessary amendments in the August supplement.

Please remember that it is only students who plan to take their examinations from the December examinations onwards who are affected by these syllabus changes.

ENVIRONMENTAL PERMITTING (ENGLAND AND WALES) REGULATIONS 2007

The **Environmental Permitting (England and Wales) Regulations 2007 (EP)** came into force on 6 April 2008. These regulations combine the **Pollution Prevention and Control (England and Wales) Regulations 2000 (PPC)** and the **Waste Management Licensing (WML) Regulations 1994**. There are therefore no longer separate regulatory regimes for waste management and PPC activities, with both being regulated by Environmental Permits. For installations that were previously regulated by the PPC regime, there will be minor changes to the way activities are undertaken.

An Environmental Permit is required for the following types of activity:

- An installation (which carries out the activities listed in Schedule 1 to the Regulations and any activities that are technically linked).
- A waste operation.
- A mobile plant (carrying out a Schedule 1 activity or a waste operation).

Regulators for the regime are the **Environment Agency** and **local authorities**. The Environment Agency will regulate installations identified in Schedule 1 of the EP Regulations that are:

- Part A(1) installations.
- Part A(1) mobile plant.
- Waste operations (see below for exemption).

The relevant local authority will regulate installations identified in Schedule 1 of the Regulations that are:

- Part A(2) installations.
- Part B (Local Air Pollution Prevention and Control).
- Part A(2) and Part B mobile plant.
- Waste operations undertaken as part of the Part A(2) or Part B installations or Part A(2) and Part B mobile plant.

If an organisation already has a PPC permit or a Waste Management Licence the permit or licence will automatically become an Environmental Permit. There will be no need to reapply and the regulator will not reissue a permit. The permit will identify equivalent conditions.

A **waste operation** is defined in Regulation 2 of the EP Regulations and is classed as a recovery and disposal operation as stated in the **Waste Framework Directive**. Any recovery or disposal of waste is a waste operation and requires an Environmental Permit, unless the waste operation is explicitly excluded or **exempt** from the requirement to have an Environmental Permit. In order for a waste operation to be exempt it must:

- Be listed in a paragraph in Part 1 of Schedule 3 of the EP Regulations,
- Be in compliance with the objectives in Article 4 of the Waste Framework Directive,
- Be registered, and
- Not involve the storage of hazardous waste or in most cases the storage or treatment of waste electrical and electronic equipment (WEEE).

Organisations are required to register with the appropriate regulator if carrying out or planning to carry out an exempt activity. The exemption system is a far less stringent regime with the major objective of supporting low risk waste recovery operations, so is much less onerous on industry than environmental permitting, and there are significantly fewer requirements on the regulator in ensuring compliance.

Unlike previous regimes, an Environmental Permit can cover more than one regulated facility. A single Environmental Permit can, however, only be granted for more than one regulated facility where:

- The regulator is the same for each facility,
- The operator is the same for each facility, and
- All the facilities are on the same site (with the exemption of mobile plants).

For those facilities that applied for a PPC permit or waste management licence before the Regulations came into force, the application will be determined under the original regimes. If granted, the PPC permit or waste management licence will become an Environmental Permit the day after the last day that an appeal could be made against the permit conditions.

Where the regulator and operator are the same, a **single Environmental Permit** can be granted to an operator for numerous mobile plants. Mobile plants do not have to be operating on the same site in order to be included in a single permit. The Regulations allow the regulator to replace environmental permits with a **single permit** covering the same facilities. This single permit would contain the same conditions as the permits which are replaced.

The EP Regulations also allow for a **standard permit** to be issued by the Environment Agency. A standard permit consists of a single condition that refers to fixed measures known as **standard rules**.

Implementation of the EP Regulations is the first phase of DEFRA's Environmental Permitting Programme (EPP). The main objective of the next phase of the EPP is to further integrate other environmental permitting regimes and therefore it may involve:

- Water discharge consenting.
- Groundwater authorisation.
- Water abstraction.
- Radioactive substances regulation.
- Some waste carriers and brokers.

NON-HAZARDOUS WASTE PRE-TREATMENT

The requirements to implement the **EU Landfill Directive (1999/31/EC)** in English and Welsh law have been transferred to the **Environmental Permitting (England and Wales) Regulations 2007**. They were formerly implemented by the **Landfill (England and Wales) Regulations 2002**, which have now been revoked.

Previous requirements of the Directive that have been transposed into UK law include the prohibition of disposing of hazardous and non-hazardous waste in landfill together and the disposing of waste tyres.

From 30th October 2007, under the **EP Regulations** (formerly the **Landfill Regulations**), organisations are required to ensure that all non-hazardous waste (both commercial and industrial) is pre-treated before being taken to landfill, implementing a further requirement of the Landfill Directive. This requirement has been brought into force as treatment is seen to be environmentally beneficial as it assists in determining separate waste streams that may be recycled and decreases the environmental impact of waste when it must be landfilled.

Whatever method of pre-treatment is chosen it must comply with the following:

- Change the nature of the waste ensuring that it:
 - Decreases its volume.
 - Decreases its hazardous nature.
 - Assists in waste handling.
 - Improves waste recovery.
- Be a thermal, physical or biological process.

A simple and effective way to pre-treat waste at source includes source segregation, which is segregating out recyclable materials on a waste producer's site and arranging for their recycling. Alternatively a waste contractor could take a waste producer's waste and transport it to a Material Recycling Facility or Waste Transfer Station. At such facilities the waste will be sorted and part of it recycled, with the non-recyclable portion possibly being disposed of to landfill.

Other more complex treatment options will also ensure compliance with the Regulations including, where relevant for the waste type, anaerobic digestion and mechanical biological treatment.

Landfill operators have a legal responsibility to ensure that waste has been treated prior to arrival at a landfill site. This could be done by communicating with the waste producer with regard to pre-treatment of the waste which may have been carried out, examining load paperwork and auditing the waste producer's treatment system.

ELEMENT 15: ENERGY USE AND EFFICIENCY

As explained earlier, the new element which follows is only required by those students who plan to sit their examinations from December 2008 onwards.

NEBOSH Diploma in Environmental Management

Management of Environmental Risk

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Management of Environmental Risk

Element 15 | Energy Use and Efficiency

Learning Outcomes

When you have worked through this element and answered the revision questions, you will be able to:

- Explain the environmental aspects of and legal requirements for business use of energy.
- Describe strategies and actions to reduce overall energy use and manage carbon emissions.

BUSINESS USE OF ENERGY

Sources of Energy and Advantages/Disadvantages

Fossil and nuclear fuels are classed as non-renewable energy sources; this is because although they are available in very large quantities they are finite and so will 'run out' in the future.

Energy sources such as hydropower and wind power are two examples of **renewable** energy sources, as they are replaced by natural processes. There has been a significant increase in the use of renewable energy sources as their use results in no, or few, greenhouse gas emissions and they therefore do not contribute to global climate change.

Renewables

Biomass

As you may be aware photosynthesis involves the conversion of atmospheric carbon dioxide and water into carbohydrates in the leaves and stems of plants. This is known as **biomass** and may be used as an energy source (biofuels).

If wood fuel forests are re-planted at the same rate as they are removed, then biofuels are sustainable as the CO₂ absorbed in growing replacement trees is the same as the CO₂ given off when they are burned. When combustion is not complete, however, such as in open fires, other gases involved in combustion are produced, such as methane, that have a higher global warming potential per unit than CO₂. Significant quantities of particulates in the form of smoke are also emitted.

On an industrial scale bioenergy power plants offer a clean, efficient combustion of straw, forestry wastes or wood chips. The heat that results from burning can be used directly or for generating power, and in some cases in both ways.

Hydropower

Hydropower currently provides some 2.3% of world primary energy. The source of hydropower is the hydrological cycle. Heating of the oceans causes water to evaporate from them. This results in clouds, and precipitation from clouds flows down into streams and rivers, where its flow can be used to power turbines to form electricity. On a small scale, hydropower does not result in any significantly adverse environmental impacts.

Some hydropower plants have, however, been built on a very large scale, involving the construction of large dams and the flooding of massive areas. This often requires the relocation of indigenous residents. Other impacts include:

- Negative impacts on fish and other wildlife.
- A decrease in nutrients used in agriculture downstream.
- Increased prevalence of disease in the water.
- Trees and other vegetation trapped below water when a reservoir is flooded decaying 'anaerobically' (i.e. in the absence of oxygen) and producing methane, a powerful greenhouse gas.

Solar Energy

Solar energy provides heat to support life on the earth's surface. The sun releases large quantities of energy into the surrounding space, with a small percentage intercepted by the Earth's atmosphere. If buildings are specifically designed to capture the sun's energy the requirement for extra heating and lighting can be significantly decreased.

Solar power can be captured via solar collectors to produce hot water for washing or space heating in buildings. Such collectors are in widespread use in sunny countries such as Spain and Italy.

Solar photovoltaics (PVs) are produced from layers of semi-conducting materials (e.g. silicon) and they directly generate electricity when the sun shines on them. PV modules are usually placed on roofs or walls of buildings and result in enough electricity for all, or a portion, of the building's needs. PVs are likely to make a large contribution to future energy needs, but at the moment their use is relatively small due to the relatively high cost of PV modules.

PVs are an example of direct collection and use of the sun's energy. However, the sun's energy can also be harnessed indirectly, such as via hydropower, wind energy and wave power.

Wave

When winds blow across the ocean they form waves which can have massive power. Various methods have been designed to capture wave energy. For example, **oscillating water columns** make use of the rise and fall of waves in a closed chamber to blow and suck air through an air turbine, which is connected to a generator which produces electricity.

Technologies for collecting tidal energy include construction of a low dam/barrage across an estuary. The barrage has inlets manufactured in its wall that allows the tide to rise up behind it. At the point of the highest tide, the inlets are closed and the impounded water flows back to the sea in a controlled manner via a generator system. A cutting edge tidal power system is the construction of underwater turbines (similar to wind turbines). These collect tidal currents that flow in certain coastal areas.

At present wave energy technology is not as developed as wind power or photovoltaics, but has great potential for generating large quantities of power in the future.

Wind

Solar radiation warms separate parts of the atmosphere to differing levels – most at the equator and least at the poles. As air flows from warmer to cooler area, this results in winds which can be used to power wind turbines to produce electricity. At present, most of these turbines have been installed on land. The UK has plans to introduce many offshore wind farms. The first two offshore wind turbines were constructed off Blyth Harbour in Northumberland in 2000, and sites have been identified at which to build 13 others in the coming years.

Geothermal

Geothermal energy harnesses the earth's internal heat, which is generated from the decay of long-lived radioactive elements. Geothermal resources which are most useful occur where underground bodies of water (aquifers) are heated by areas of volcanic or tectonic activity which brings the heat close to the surface. The resulting hot water, or in some cases steam, is used for electricity generation where possible. If geothermal heat is taken in a particular area at a rate that is not greater than the rate at which it is being replenished from the earth, it is a renewable energy source.

Non-Renewable

Fossil fuels are attractive as energy sources. Being very concentrated, they allow significant amounts of energy to be trapped in relatively small volumes. They also allow easy distribution.

Fossil fuels originate from the growth and decomposition of plants and organisms from the earth's distant past. Coal was produced when decaying trees and other vegetation became trapped under water and were subsequently compressed into concentrated layers below the surface of the earth. Oil and natural gas results from the decay of marine organisms that slowly formed into layers below oceans and were gradually transformed, through geological forces, into liquid and gaseous reserves. Incidentally, fossil fuels are composed of carbon and hydrogen, which is why they are called hydrocarbons.

- **Coal** combustion produces massive emissions of carbon dioxide (CO₂) compared with other fuels. It also results in sulphur dioxide and particulate discharges, although these can be reduced by using various abatement methods. Coal use for heating has now been superseded by natural gas, but significant quantities of coal are used for electricity generation.
- The combustion of **natural gas** produces lower CO₂ emissions in comparison to coal. The relative cleanliness and convenience of natural gas have made it the preferred fuel for heating and for electricity generation in Western Europe.
- **Oil** is the world's most used energy source. Its high energy yield and convenience of use ensure that it is the dominant fuel for transport. The combustion of oil results in reduced CO₂ per unit of energy released in comparison to the combustion of coal, but greater CO₂ than burning natural gas. World oil reserves are sufficient for about 40 years of use at current rates.
- **Nuclear energy** results from release of the large quantities of energy stored in the nuclei of atoms such as uranium-235 and plutonium-239. These are split (known as **fission**) to produce large quantities of energy. The fission of a kilogram of uranium-235 produces the same amount of energy as the combustion of around 3000 tonnes of coal. Nuclear fuels are highly concentrated sources of energy, even in comparison to fossil fuels. The heat resulting from nuclear fission is used to raise high-pressure steam which then drives steam turbines coupled to electrical generators.

Another nuclear technology is nuclear **fusion**. This involves the fusing together of deuterium (heavy hydrogen) nuclei. This is a similar process to the way in which energy is generated within the sun. In order to create fusion, however, it is necessary to create conditions in which hydrogen interacts in a very confined space at extremely high temperatures and this has only currently been achieved for a few seconds.

There are probably sufficient deposits of uranium to last for several centuries. In addition, **fast breeder reactors** (FBR) enable uranium deposits to be used even more effectively, thus extending the lifetime of reserves. Most nuclear reactors have operated safely, although there have been major accidents such as those at Windscale, (UK, 1957), Three Mile Island (USA, 1979) and Chernobyl (Ukraine, 1986). Such accidents have led to a low public image of nuclear power.

A distinct advantage of nuclear power is that no CO₂ emissions occur from its generation. Indirect emissions do, however, occur from uranium mining and the construction of nuclear power plants. Concern is often expressed about the continual emission of small quantities of harmful radioactivity that accumulate in the atmosphere and oceans from the

day-to-day operation of nuclear power plants, fuel manufacturing facilities and disposal operations. There are also problems with regard to the disposal of nuclear waste.

Despite these difficulties, the nuclear industry is attempting to develop more advanced types of nuclear reactor which, it claims, will be cheaper to build and operate, and inherently safer than existing designs. These are being promoted as an improved technological option for generating carbon-free electricity that is required if global climate change is to be mitigated.

Impact on the Environment of Burning Fossil Fuels in Vehicles, Buildings and Plant

The adverse environmental impacts resulting from the combustion of fossil fuels are significant, ranging from acid rain to effects on health and welfare.

Acid Rain

Acid gases resulting from fossil fuel combustion combine with water vapour to create acid rain which corrodes buildings, damages and kills trees and destroys life in rivers and lakes. Road transport produces around 51% of acidic oxides of nitrogen (NO_x) while power stations produce 72% of acidic sulphur dioxide (SO₂) and a further 28% of NO_x.

Smog

When gases from vehicle exhausts react with sunlight, smog is formed over cities, damaging trees and crops and affecting health. Road transport produces 90% of carbon monoxide (CO) which contributes most to this effect.

Dwindling Resources

Fossil fuels cannot be rapidly reproduced - it takes millions of years to produce coal, gas and oil and existing reserves will eventually run out. At current rates of consumption proven world reserves for fossil fuel are estimated to be 44 years for oil, 56 years for gas and 250 years for coal. It has been estimated that by 2020 energy consumption in the UK will be around 30% greater than in 1990.

Health and Welfare

Energy production from fossil fuels can have significant effects on health, particularly energy used by transport which results in traffic fumes. Such emissions have acute effects on certain people, e.g. streaming eyes, coughing, breathing difficulties and asthma attacks. Smog can irritate the lungs, cause bronchitis and pneumonia and decrease resistance to respiratory infections.

Deforestation

Carbon dioxide is taken from the air by vegetation, which helps regulate the amount of CO₂ in the atmosphere. Every year it is estimated that an area of tropical rainforest one and a half times the size of England is lost around the world. Some deforestation involves large scale burning, increasing global warming further. In addition to reducing the amount of CO₂, trees can help to reduce the energy demand of buildings by affording shelter from cooling winds.

Climate Change

A number of gases are emitted during the combustion of fossil fuels with the most significant being carbon dioxide, which traps heat in the earth's atmosphere. It has been estimated that over the past 150 years, the burning of fossil fuels caused a 25% increase in the quantity of carbon dioxide in the atmosphere. Fossil fuels also result in increased concentrations of atmospheric methane and nitrous oxide. Since the collection of reliable records in the later part of the 1800s, the world's global average temperature has risen by around 0.5° Celsius. The IPCC (Inter Governmental Panel on Climate Change) identified in a 1995 report that "this is unlikely to be entirely natural in origin" and that "the balance of evidence suggests that there is a discernible human influence on global climate". Scientists have predicted that if temperatures continue to increase sea levels will rise, as a result of glacial melting, leading to inundation of low lying areas such as coastal wetlands.

Thermal Pollution

Fossil fuel combustion for electricity production results in heat, which is used to generate electricity. As the process is relatively inefficient much of the heat is emitted to air or to water that is used as a coolant. Heated water can have effects on the aquatic systems to which it is released.

Vehicles

Motor vehicles emit pollutants from fuel combustion. As the combustion process is not fully efficient a part of the hydrocarbon fuel is partially burnt forming carbon monoxide and water. Some hydrocarbons are not combusted at all - these particulates may cause lung diseases. Additionally, at the temperature of combustion, which can reach 2500°C, oxygen and nitrogen react to form nitrogen oxides, which have an adverse impact on the environment. Transport also emits significant quantities of CO₂ with 28% of UK greenhouse gas emissions in 2005 resulting from transport, which is almost equal to the domestic and industrial sectors.

A **catalytic converter** can significantly reduce the production of nitrogen oxides and other pollutants for petrol-powered vehicles and all new cars sold in Britain from January 1993 onwards had to have catalytic converters fitted to exhausts. Another abatement method is **exhaust gas recirculation** which consists of exhaust air being returned to the fuel inlet, with a resultant decrease in maximum engine temperatures and emissions of nitrogen oxides from petrol vehicles. The use of electric transport produces no emissions, although pollution is produced during the power generation process. However, electric vehicles need to have batteries recharged on a regular basis and have a higher capital investment in comparison to petrol and diesel vehicles.

More fuel efficient vehicles are being marketed through the introduction of fuel efficiency labels for vehicles. The labels are similar to those displayed on fridges and other electrical goods and have been developed by the Low Carbon Vehicle Partnership (LowCVP). For car companies participating in the scheme it is mandatory to display the labels at the point of sale. In addition to identifying fuel efficiency the labels also provide information regarding the fuel costs of the vehicle per year and whether the car qualifies for a decrease in Vehicle Excise Duty.

New technology to reduce environmental impacts of vehicles should also be used with **management systems** to decrease traffic in urban areas, in addition to educating the public to use their cars less, and further research into alternative fuels that have a reduced environmental impact.

Industry

Fossil fuel combusting power plants are designed for large scale and continuous operation. A power plant must have rotating machinery that converts the energy of combustion to mechanical energy, which operates an electrical generator. Such 'prime movers' include steam turbines, gas turbines and reciprocating internal combustion engines.

Power plant by-products have to be considered in their design and operation. Waste heat can often be emitted to the atmosphere or to a river or lake. The flue gas that is emitted to the air contains a range of substances such as nitrous oxides, sulphur oxides, fly ash and mercury. Solid wastes include ash, which can be removed and recycled for use in some building materials.

Provision of Information Regarding Energy Efficiency

By law a European Community (EC) Energy Label has to be displayed on the following new household products for sale, hire or hire-purchase:

- Refrigerators, freezers and fridge-freezer combinations.
- Washing machines.
- Electric tumble dryers.
- Combined washer-dryers.
- Dishwashers.
- Lamps.
- Electric ovens.
- Air conditioners.

Advertisements and manufacturers' literature are required to have this information. It must be provided wherever these products are bought or hired.

'A' rated products are the most efficient and 'G' rated products the least efficient. The most efficient fridges and freezers can now be identified by new 'A+' and 'A++' markings on the large black arrow appearing against the green 'A' arrow.

Impact of Carbon Dioxide on the Climate

You will be aware that the causal factors for climate change include any process that affects the global energy balance from solar energy and energy leaving the Earth. Climate change is to a certain extent a natural phenomenon, but recently concern has been expressed regarding the effect pollution of the atmosphere could have on the global climate.

Greenhouse gases are all the gases in the atmosphere that, as a result of their molecular structure, absorb infrared radiation or heat. Natural greenhouse gases include water vapour, carbon dioxide, methane, nitrous oxide and even ozone. Additionally, human beings have emitted some new greenhouse gases with a high global warming potential such as chlorofluorocarbons (CFCs). CFCs also cause ozone depletion and have been banned, but they will persist in the atmosphere for 50 years. Their level in the atmosphere is relatively low but they have a thousand times the global warming potential in comparison to CO₂.

The Earth in its own right has a natural greenhouse effect that ensures that the earth's surface is at a greater temperature than it would be without it. Greenhouse gases trap heat that would escape to space. Human activities over the last 200 years have released greenhouse gases in massive quantities in addition to releasing new types of gases. Greenhouse gases trap heat and cause the earth surface to warm. It is thought that human intervention has caused an increase in temperature of around 0.5°C since the late 1800s. The human influence on the natural greenhouse effect is known as "global warming".

Revision Questions

1. What are non-renewable resources?
2. Identify four renewable energy sources.
3. List the adverse effects of the burning of fossil fuels on the environment.

(Suggested answers are at the end of this element.)

REDUCTION OF ENERGY USE AND CARBON EMISSIONS

Alternatives to Fossil Fuel as Sources of Energy

As we saw earlier there are a number of alternatives that can be used to replace fossil fuels as sources of energy; all have their advantages and disadvantages. As a reminder, the following alternatives emit little or no carbon dioxide or other pollutants during generation, and all, apart from nuclear power, are renewable sources of energy:

- Biomass.
- Hydropower.
- Solar energy.
- Wave power.
- Wind.
- Geothermal.
- Nuclear.

Energy Efficiency

Cost and Profit

There are many reasons for wanting to improve energy efficiency, but perhaps the most compelling for industry is that wasting energy costs money and this is reflected in the bottom line. Improvements can often be made at little or no cost, and involve making minor changes to the operation of a process or equipment in order to optimise its performance, rather than having to purchase expensive equipment.

Saving energy has many benefits, including:

- Reduced energy costs (increasing profits or releasing resources for other activities).
- Improved environmental performance due to reduced carbon dioxide emissions.
- Improved competitiveness of products or services.
- Enhanced public image with customers and other stakeholders.
- Reduced exposure to Government drivers such as the Climate Change Levy.

Companies in energy-intensive industries have an even greater incentive to improve performance: members of Climate Change Agreements (CCAs) need to demonstrate improved energy efficiency to continue to qualify for the 80% discount from the Climate Change Levy.

The five steps in the table below provide a strategy for successful energy management that can be used for reducing energy costs and associated environmental impacts within an organisation.

Step	Description
<p>Step 1 : Management Commitment</p>	<p>Gaining commitment from senior management of an organisation e.g. the managing director, highlights the importance of energy efficiency to the entire business. Such support empowers managers who are involved on a day to day basis in implementing the strategy.</p> <p>To gain commitment, senior management will require a clear understanding of the benefits of an energy saving programme. The most important of these is likely to be cost.</p>
<p>Step 2: Understand the Issues</p>	<p>This step involves determining and assessing current patterns of energy use as this will provide a benchmark to assist in tracking and measuring future improvements and identify energy saving opportunities.</p> <p>Organisational strengths and weaknesses should be assessed against six main areas of energy management:</p> <ul style="list-style-type: none"> • Policy — publication of an organisation-wide policy statement, issued by the most senior person in the organisation. • Organising — allocation of energy management roles and responsibilities. • Training — all employees must understand the benefits of energy management and be trained in the actions they can take. • Performance measurement —measure and monitor energy use and report performance. • Communication — all employees and stakeholders need to be kept informed of progress. • Investment — investing in energy saving activities and equipment can decrease energy costs.
<p>Step 3: Plan and Organise</p>	<p>Develop an energy policy</p> <p>An energy policy is should be developed to:</p> <ul style="list-style-type: none"> • Communicate the commitment of senior management to everyone in the organisation. • Raise awareness throughout the organisation. • Demonstrate commitment outside the organisation to key stakeholders (such as investors, customers and suppliers). • Provide a foundation for the organisation's energy strategy. • Provide a structure for the implementation of the strategy. <p>Set objectives and targets</p> <p>The majority of organisations will probably identify many actions to reduce energy. It is therefore of high importance to prioritise actions and set achievable targets. The following must be taken into account:</p> <ul style="list-style-type: none"> • Assessing waste reduction targets to calculate the cost and potential

	<p>return on investment.</p> <ul style="list-style-type: none"> • Building on management strengths and identifying any gaps in resources. • Expressing objectives and targets in ways that provide incentives for people at all levels in the organisation. <p>Senior management should agree objectives to ensure they are given high status and receive sufficient funding and staff resources.</p> <p>Produce an action plan</p> <p>Following agreement of objectives and targets tasks should be defined in an action plan.</p> <p>To be effective, the action plan should be produced with agreement and approval by the appropriate level of line management. Relate actions to individual objectives and targets, which should come in turn from specific policy commitments.</p>
<p>Step 4: Implementation</p>	<p>Following identification of all the actions an implementation plan should be developed, based on the organisation's priorities.</p> <p>Short-term and low-cost measures are usually a good way to begin as they can make an immediate impact and generate interest. Planning must, however, also be in place for longer-term actions, as these can often have significant savings potential and sustain the momentum of the initiative.</p>
<p>Step 5: Control and Monitor Energy Management and Performance</p>	<p>Assess the programme</p> <p>Many organisations include management assessments as part of their energy policy, by ensuring that progress is measured on a regular basis and results reported to senior management. This allows unsatisfactory performance to be identified immediately, before it begins to have a detrimental impact.</p> <p>Planning and reporting</p> <p>Designing the reporting procedure is crucial to understanding energy use, and to be able to note changes, season to season, year on year.</p> <p>Monitoring and targeting</p> <p>An ongoing energy strategy will involve collecting and analysing consumption data, such as from meter readings. This process is called monitoring and targeting (M&T). Ongoing monitoring may identify both improvements and areas of weakness. There should be a plan to undertake regular, detailed M&T assessments. How frequent these are depends on the nature of the organisation - M&T can be straightforward or involve complex analysis.</p>

For any new equipment purchases a tax break may be available from the Government's enhanced capital allowance scheme (ECA). The ECA enables a business to claim 100% first-

year capital allowances on their spending on qualifying energy-saving plant and machinery. Further information is available at the website - <http://www.eca.gov.uk/eti/default.htm>.

The Carbon Trust supports the development of low carbon technologies, and helps business cut carbon emissions; they also provide many free high quality and easy to understand good practice guides. These are available at their website <http://www.carbontrust.co.uk>.

International Control Strategies for Carbon Dioxide Emissions

The **Kyoto Protocol** was agreed in December 1997 by the treaty parties in Kyoto, Japan and came into force in February 2005. By November 2007 175 countries had ratified the treaty; 36 developed countries have to reduce greenhouse gas emissions to the level in the treaty, whilst 137 developing countries, such as Brazil and China, have no emission reduction targets other than monitoring and reporting of emissions.

The Protocol requires developed countries to reduce their emissions by **5.2% compared to a 1990** baseline. However, in comparison to 2010 emission levels without the Protocol, this represents a 29% reduction. The main objective is to lower the emission level of six greenhouse gases (known as the 'basket' of gases) - carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, hydrofluorocarbons, and perfluorocarbons (averaged over 2008-2012).

National emission limits have been set and include:

- EU – 8%
- Japan – 6%
- Russia – 0%
- Australia – allowed increase of 8%
- Iceland – allowed increase of 10%.

The Protocol amends the United Nations Framework Convention on Climate Change (UNFCCC), developed at the Earth Summit in Rio de Janeiro in 1992.

The Protocol is based on a '**cap and trade**' mechanism which imposes national caps on the emissions of developed countries. Such caps constitute national-level commitments, but the majority of countries have passed targets to individual industrial sites, such as a power plants. One example of a 'cap and trade' system is the 'EU ETS' (see later).

Clean Development Mechanism (CDM) and **Joint Implementation (JI)** projects act as sources of credits which can be accrued by developed countries. The CDM enables the collection of new carbon credits by participating in emission reduction projects in Non-Annex I (developing) countries. JI allows project-specific credits to be converted from existing credits within Annex I countries.

Some non-Kyoto carbon markets are also in existence such as the Chicago Climate Exchange and the State of California carbon reduction targets.

The UK is a key signatory of the Kyoto Protocol and has developed many climate change initiatives, e.g. the draft Climate Change Bill was developed from the Energy White Paper 2003, with the aim of providing a framework for a mandatory 60% decrease in carbon emissions from the UK by 2050 in comparison with 1990 levels, and a target of 26% to 32% by 2020.

The UK is currently on course to meet its Kyoto aim for the limitation of the basket of greenhouse gases. Although the UK's emissions of these gases have decreased, annual net carbon dioxide emissions have risen by around 2%.

The 2007 United Nations Climate Change Conference took place in Bali. Representatives from over 180 countries attended, in addition to observers from intergovernmental and nongovernmental organisations. The conference included meetings of several bodies, including the 13th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 13), and the 3rd Meeting of the Parties to the Kyoto Protocol (MOP 3 or CMP 3). The conference resulted in the adoption of the **Bali Roadmap**, which includes a number of decisions that represent the various tracks that are essential to reaching a secure climate future. The Bali Roadmap includes the **Bali Action Plan**, which charts the course for a new negotiating process designed to tackle climate change by 2009.

International and National Control Strategies for Carbon Dioxide Emissions

Part L of the Building Regulations

Part L of the Building Regulations (in England and Wales) was introduced in April 2006, and concerns the implementation of energy efficiency measures in buildings. These Regulations raise the energy efficiency of new buildings by 40% in comparison with Part L 2002 requirements. They also improve compliance by introducing new energy performance requirements for building services within all new buildings.

The new Part L requirements require reasonable provision for the fuel and power conservation in buildings by limiting heat losses through the fabric of the building, and excessive solar gains and heat gains from pipes, ducts and vessels used for space heating, space cooling and hot water storage. The Regulations also provide for energy efficient and properly commissioned fixed building services with suitable control mechanisms identifying to the owner information regarding the building services so that the building can be operated and maintained in such a way that it consumes no more fuel and power than is reasonable in the circumstances.

Directive 2002/91/EC on Energy Performance in Buildings

The principal objectives of this Directive are:

- To promote the improvement of the energy performance of buildings within the EU through cost effective measures.
- To promote the convergence of building standards towards those of Member States which already have ambitious levels.

The Energy Performance of Buildings Directive as implemented in England and Wales has four principal provisions. The first stipulates minimum requirements for the energy performance of all new buildings, and the second for large existing buildings subject to major renovation (these provisions are starting to bed down into the day-to-day life of the construction industry). The third provision requires inspection for air-conditioning systems and boilers for all major buildings, which will not impact until January 2009 when all buildings with air conditioning systems over 250kW will have to be inspected. The fourth requires Energy Performance Certificates (EPC) for most new buildings based on an assessment of their construction and services (also known as asset rating).

Energy Performance of Buildings (Certificates and Inspections) (England and Wales) Regulations 2007

The **Energy Performance of Buildings (Certificates and Inspections) (England and Wales) Regulations 2007** contains the main requirements for energy performance certificates (EPC) such as their content and the set up of an accredited assessors scheme. It is being implemented for domestic and business buildings to the following timetable:

April 2008	EPCs required on construction for all dwellings. EPCs required for the construction, sale or rent of buildings, other than dwellings, with a floor area over 10,000 m ² .
1 July 2008	EPCs required for the construction, sale or rent of buildings, other than dwellings, with a floor area over 2,500 m ² .
1 October 2008	EPCs required on the sale or rent of all remaining dwellings. EPCs required on the construction, sale or rent of all remaining buildings, other than dwellings. Display certificates required for all public buildings >1,000 m ² .
4 January 2009	First inspection of all existing air-conditioning systems over 250 kW must have occurred by this date.
4 January 2011	First inspection of all remaining air-conditioning systems over 12 kW must have occurred by this date.

(Source: Communities and Local Government)

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Building and Approved Inspector (Amendment) Regulations 2006

The **Building and Approved Inspector (Amendment) Regulations 2006** require in most cases a certificate for the calculation of CO₂ emissions from buildings to be given to the local authority when a building is erected. The CO₂ calculation must include:

- The target CO₂ emission rate for the building; and
- The calculated CO₂ emission rate for the building as constructed.

The certificate and CO₂ calculation must be produced by an accredited assessor, i.e. someone who is registered by FAERO Limited or BRE Certification Limited.

The Regulations also amend Part L (conservation of fuel and power) of the Building Regulations setting maximum carbon dioxide emissions (based on heating, ventilation, hot water and lighting) for whole buildings with a view to increasing energy efficiency by 20% for dwellings and up to 27% for other buildings. Existing buildings with a floor area of over 1000m² that are undergoing major renovation must upgrade to the requirements as far as is possible. Transitional arrangements enabled buildings for which approved approval has been received before 6 April 2006 to comply with Part L requirements so long as building work started before 1st April 2007.

Home Information Pack Regulations 2006

The **Home Information Pack (HIP) Regulations 2006** apply if a domestic property is physically complete before the first point of marketing for sale. If this is the case then an

energy performance certificate for the property is required where there is no home condition report. Additionally if an EPC is gained after the initial production of the HIP it must be included in the HIP.

Climate Change and Sustainable Energy Act 2006

The Climate Change and Sustainable Energy Bill received Royal Assent on 21st June 2006. The purpose of the Act is to:

- Enhance the UK's contribution to combating climate change.
- Improve fuel poverty.
- Secure diverse and viable long-term energy supplies.

The Act requires the Secretary of State to **report on the levels of greenhouse gas emissions** and the steps taken by Government Departments to reduce them. Where possible, this will include input from local authorities in an effort to increase micro generation and energy efficiency. Targets will be set between 1st November 2008 to 31st March 2009 for the number of microgeneration systems installed in the UK. The Act will also make it easier for microgenerators to sell excess energy to large suppliers.

Eco-Design for Energy-Using Products Regulations 2007

The Regulations implement Directive 2005/32/EC and establish a mechanism for the setting of eco-design parameters for energy-using products (the "EUP Directive"). The Regulations have been developed to reduce the environmental impacts resulting from product production (processes and materials used), usage (energy/water consumption and emissions) and disposal (waste generation).

The Regulations state definitions of listed products (currently hot water boilers, household refrigerators, freezers and their combinations and ballasts for fluorescent lighting) that are covered under the Regulations and the requirements for such products. Additionally, restrictions covering the placing on the market of listed products are also identified. These restrictions apply to product manufacturers and their authorised representatives and to importers into the EU of listed products.

The statutory instruments to be revoked as a result of the implementation of the Regulations include:

- The Boiler (Efficiency) Regulations 1993 (SI 1993/3083).
- The Boiler (Efficiency) (Amendment) Regulations 1994 (SI 1994/3083).
- The Energy Efficiency (Refrigerators and Freezers) Regulations 1997 (SI 1997/1941).
- The Energy information and Energy Efficiency (Miscellaneous Amendments) Regulations 2001 (SI 2001/3142) – Regulation 11 only.
- The Energy Efficiency (Ballasts for Fluorescent Lighting) Regulations 2001.
- The Boiler (Efficiency) (Amendment) Regulations 2006 (SI 2006/170).

EU Emissions Trading Scheme

Emissions trading is viewed by the EU as a significant tool with which to decrease greenhouse gas emissions. Emission trading works on the theory that emission reductions are carried out

where the cost of the reduction is least and therefore lowering the overall costs of reducing climate change.

Emissions trading enables regulation of the amount of emissions in aggregate by setting an overall cap for the scheme. Companies are, however, given the power to determine how and where the emissions decreases will be undertaken.

Companies involved in the scheme are given allowances, with each allowance equivalent to a tonne of carbon dioxide equivalent. Emissions trading allows companies to emit above their allocation by purchasing allowances from the market. However, if a company emits below its allocation it can sell surplus allowances. When compared to regulation which places strict emission limit values on individual sites, trading of emissions allows companies to decrease emission according to their own individual plan.

The EU Emissions Trading Scheme (EU ETS) is a European scheme with the objective of reducing carbon dioxide emissions and mitigating climate change. EU ETS allocates a price on carbon that companies use and creates a carbon market. The scheme has been operating since 2005 and was the first scheme of its kind in the world. The scheme is the key policy of the European Union to assist it in meeting its Kyoto greenhouse emission reduction target of 8% compared to a 1990 baseline.

The scheme consists of phases and all Member States must produce a National Allocation Plan (NAP) approved by the EU. Such plans must set an overall 'cap' on the sum of emissions allowed from facilities included in the scheme. This is converted to allowances, with one allowance being equal to one tonne of CO₂. Installations included within the scheme must monitor and report emissions. At the end of the year they must surrender allowances to account for the installation's individual emissions. Installations have flexibility within the system; they can use all or part of their allocation, and can "trade" allowances by purchasing additional allowances or selling any extra they have accumulated by reducing emissions below their allocation.

Revision Questions

4. What are the benefits to an organisation in saving energy?
5. What are the five steps that are required to implement an energy management and reduction programme?
6. Briefly describe the theory of emissions trading.

(Suggested Answers are at the end of this element.)

SUMMARY

The key topics covered in this element were:

- The environmental aspects and legal requirements for the business use of energy:
 - Sources of energy and their advantages and disadvantages.
 - Impact on the environment of burning fossil fuels.
- Strategies and actions to reduce overall energy use and manage carbon emissions:
 - Energy efficiency.
 - International and national control strategies for carbon dioxide emissions.

ELEMENT 15: SUGGESTED ANSWERS TO REVISION QUESTIONS

1. Fossil and nuclear fuels are classed as **non-renewable** energy sources. Although they are available in very large quantities they are finite and so will 'run out' in the future.
2. Examples of renewable energy sources include wave, geothermal, wind, hydro and solar power.
3. The adverse effects of burning **fossil fuels** include:
 - Acid rain.
 - Smog.
 - Dwindling resources.
 - Health and welfare.
 - Deforestation.
 - Climate change.
 - Thermal pollution.
4. The benefits of **saving energy** include:
 - Reduced energy costs (increasing profits or releasing resources for other activities).
 - Improved environmental performance due to reduced carbon dioxide emissions.
 - Improved competitiveness of products or services.
 - Enhanced public image with customers and other stakeholders.
 - Reduced exposure to Government drivers such as the Climate Change Levy.
5. The five steps are:
 - Step 1: Management commitment.
 - Step 2: Understanding the issues.
 - Step 3: Plan and organise.
 - Step 4: Implementation.
 - Step 5: Control and monitor energy management and performance.
6. Companies participating in schemes are allocated allowances, with each allowance representing a tonne of carbon dioxide equivalent. Emissions trading enables companies to emit over their allocation by buying allowances from the market. Additionally, a company that emits below its allocation is able to sell surplus allowances. In comparison to regulation with strict emission limit values on particular sites, emissions trading gives companies the ability to reduce emissions according to their own specific plan.