

A2 LEVEL Section C

FACT FILES

Technology & Design

For first teaching from September 2011

For first award in Summer 2013

Environmental Issues



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design



Learning Outcomes

Demonstrate knowledge and understanding of environmental issues relating to product design to include;

- environmental impact at different stages of the product life cycle;
- climate change and greenhouse gases;
- reducing environmental impact by design,
- the 6Rs rethink, reuse, recycle, repair, reduce and refuse with practical examples;
- environmental audits and life-cycle assessment;
- reducing material use;
- renewable Energy sources to include wind, wave, solar, tidal, geothermal, biomass;
- new technology and environmentally friendly manufacturing processes;
- management of waste, the disposal of products and pollution control;
- examples of National government and EU influence
- develop product design proposals which reflect the potential impact on the environment.



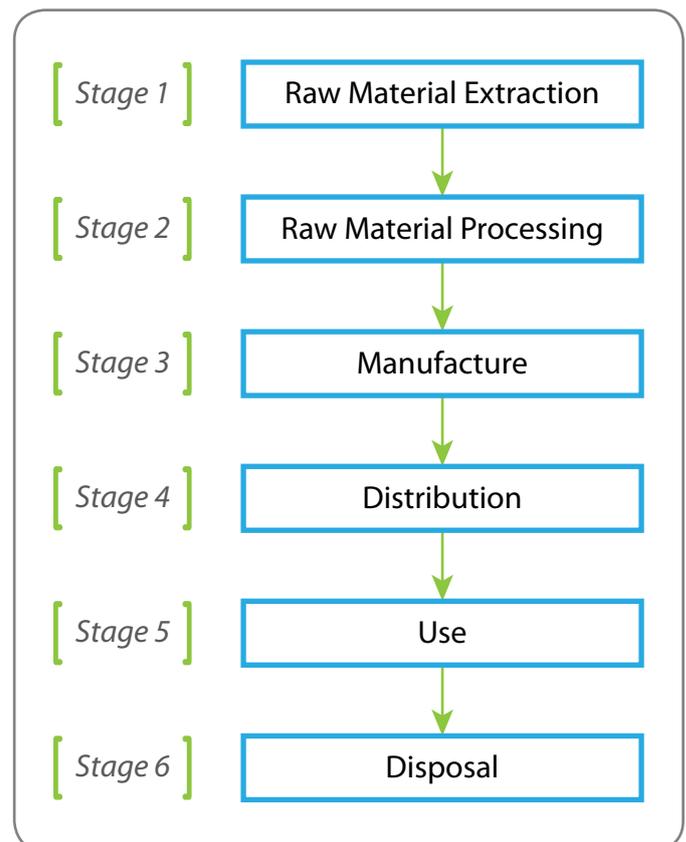
Course Content

Environmental Impact at Different Stages of the Product Life Cycle

The environmental impact of a product can be measured by using a life-cycle assessment. This is a technique that is used by manufacturers and designers to assess the potential environmental impacts a product has at each of the main stages of its life. Also commonly referred to as 'from the cradle to the grave' the purpose of carrying out a product environmental impact assessment is to identify and compare a products impact on the environment in order to improve processes, reduce waste and damage to the environment.

At different stages of a products life-cycle the material used may have different impacts on the environment and as a result it is important that designers and manufacturers consider this when designing and manufacturing new products.

The stages of a products life-cycle when products have an impact on the environment are illustrated in the diagram below:



The types of environmental impacts a product might make during its life are:

- **Raw Materials Extraction** – damage can be caused to the environment by the extraction of raw materials. E.g. mining for metals, de-forestation for wood , oil extraction etc.



- **Materials Processing** – process of turning raw materials into usable materials. E.g. refining crude oil into plastics, processing wood into paper and smelting metal ore into metal alloys. This can use up huge amounts of energy as well as producing by products and waste materials.



- **Manufacture** – making the product uses up huge amounts of energy while producing waste and scrap material, for example; transforming material into parts using moulds or tools; and combining parts into products.
- **Distribution** – packaging of products can take up large amounts of material while also taking up expensive cargo space in distribution vehicles.
- **Use** – Products are now being developed to waste less energy as part of legislation and consumer demand.



- **Disposal** – products which are not made of recyclable materials are thrown away in landfill sites.

Recyclable products however are broken down and their parts are re-used again for example the Dyson Hoover is collected by Dyson to shred the thermoplastic parts for re-use. Those products which can be re-used may be repackaged and used again.

Climate Change and Greenhouse Gases

Greenhouse gases are gases that trap and emit infrared radiation emitted from the earth into the atmosphere. The natural greenhouse gases in the Earth's atmosphere are water vapour, carbon dioxide, methane, nitrous oxide, and ozone. Other greenhouse gases such as gases used in aerosols are created exclusively by humans.

The levels of greenhouse gases trapped in the atmosphere have increased steadily over the last 200 years due mainly to the industrial revolution. As the world's population rises and its demands and reliance on fossil fuels for energy have increased the level of greenhouse gases in the atmosphere have risen dramatically. It is this dramatic rise of greenhouse gases found in the atmosphere that eventually leads to climate change.

Causes of Excess Greenhouse Gases

Burning Fossil Fuels



Most human made greenhouse gases come from energy use and this adds to the level of naturally occurring gases in the atmosphere for example when coal, oil and gas (fossil

fuels) are burned they produce greenhouse gases such as carbon dioxide and nitrous oxide. These fuels are burned to produce energy for example to heat our homes, cook our food, to run our cars, manufacturing products and so on. It is estimated that three quarters of human made carbon dioxide emissions over the last 20 years have been as a result of burning fossil fuels.

Deforestation

Deforestation is the cutting down of trees or forests for fuel, wood products or for alternative land use. When the trees are cut down they are not replaced and as a result this contributes to climate change and the increase in greenhouse gas emissions. Trees have a large store of carbon in them, when trees are cut down, and when they are burned, this carbon reacts with oxygen in the atmosphere and becomes carbon dioxide. It is estimated that deforestation contributes to at least 20% of all human carbon emissions.

By changing the way we design and manufacture products we can reduce our contribution to climate change.



Reducing Environmental Impact by Design

The purpose of Green Design is to reduce as much as possible the negative impact on the environment through good design and manufacture. Designers and businesses are now more aware than ever of the impacts on the environment that their products have during its entire life-cycle stage. Designing products which reduce the environmental cost the product has, is increasingly more important to businesses. Examples of two areas where the environmental impact of a product can be reduced by design are:

- By using recycled materials in a products manufacture or
- By lowering the products use of energy in either its manufacture or use.

A good example of this being achieved by a business is the Dyson Contra-Rotating Washing Machine. It uses a water jet system to reduce the amount of water used, reducing the time taken for each cycle and as a result reducing energy consumption. Other design methods used to reduce the negative impact a product has on the environment are:

- Ecodesign – using the environmental life cycle through the whole design and manufacturing process of a product.
- Sustainable Design – analysing an existing product and finding new ways of making the product more environmentally friendly for example: Replacing a tumble dryer with a hot press powered by solar panels.
- Sustainable Innovation – finding new ways of producing products that reduce the impact on the environment.

Reducing the environmental impact a product has, is an important part of the design and manufacturing stage of a products development. More and more designers and manufacturers are placing this concept at the forefront of their designs. An example of a product which was designed and developed with environmental impact at the centre of its design is the Smart car. The Smart car has won countless environmental awards and is viewed as a stylish environmentally friendly city car for amongst others the following reasons:

- **Engine** – made of lightweight aluminium.
- **Electronic Accelerator** – reduces waste fuel
- **Double Ignition** – ensures as much fuel is combusted as possible and results in lower emissions
- **Six Speed Automatic/Semi-Automatic Gearbox** – better fuel economy
- **Thermoplastic Body Panels** – lightweight, don't corrode, easily changed extending cars life cycle, can be recycled
- **Interior Panels** – can be changed easily extending cars life cycle
- **Upholstery** – fillings made of recycled fabrics, seat covers and carpets made of natural materials. All fabric is 95% recyclable.

The 6 R's

The 6 R's is a term given to 6 different ways designers, manufacturers, retailers and consumers can be more renewable. The 6 R's are:

- **Rethink** – When a product is being designed consideration should be given to the products environmental impact. Is it really needed and has it been designed with energy and material conservation in mind. Both designers and manufacturers should be making products that do the job more efficiently. Consumers should consider the question 'do I need this new car or Television?'
- **Reuse** – Designers and manufacturers should aim to produce products using materials that can be reused. A good example of products that are re-usable are printer ink cartridges. Designers and manufactures should also when possible use recycled materials in new products being produced.



- **Recycle** – Designers and manufacturers should aim to make products that can be easily recycled. A good example of recycled products are cardboard based products. It is the designers and manufacturers responsibility to make products that are easily separated, cleaned and re-manufactured for new products.
- **Repair** – Products should have the ability to be fixed easily and at a low cost. Products are now thrown away too easily and new ones are purchased without consumers thinking could the old one be fixed.
- **Reduce** – Designers and manufacturers should aim to reduce the amount of scrap and waste materials being produced, as well as reducing the amount of energy that is used during production and during a products life cycle. An example of a food company that has developed a sustainability strategy to encourage its consumers to purchase their more environmentally friendly products is Kraft Foods Kenco Coffee. This business created new type of packaging for its coffee product Kenco which uses 97% less packaging than the old packaging.

- **Refuse** – Designers and manufacturers should be looking to use renewable and recyclable materials in the manufacture of a product instead of non-renewable materials. Designers and manufacturers now have to think more about the types of materials they use in products and whether consumers will refuse to purchase them based on their reusability. An example of consumers not choosing a product based on the materials used in its manufacture are plastic bags, the reduction in the use of plastic bags by consumers has been helped by government plastic bag taxes. This tax has already been implemented in several countries for example the Republic of Ireland.



Renewable Energy

Renewable energy is energy which comes from natural resources such as sunlight, wind, rain, tides, geothermal heat and biomass all of these are naturally replenished.

Types of Renewable Energy Sources

Wind

The wind in the air is used to power wind turbines and generate electricity.

Advantages – non-polluting, freely available and efficient.

Disadvantages – turbines can be unattractive and noisy.



Wave

Waves from the sea are used to drive turbines which generate electricity.

Advantages – non-polluting and relatively cheap.

Disadvantages – turbines are unattractive and the waves are unreliable therefore there is not a constant supply of energy.

Solar

Energy used from the sun.

Advantages – renewable and nonpolluting.

Disadvantages – The amount of solar energy available depends on the location, panels are expensive and efficiency can be reduced due to weather (e.g. clouds).



Tidal

Energy from tides/tidal movement used to generate electricity.

Advantages – cheap and the tide is constant therefore it does not depend on weather

Disadvantages – does not produce a lot of electricity



Geothermal

Natural heat from the earth's crust.

Advantages – cheap, renewable, will not run out, nonpolluting.

Disadvantages – only available in certain locations, geological instability, water extracted can be polluted (e.g. with sulphur).



Biomass

Biomass is the material from living things which can be burned to produce heat.

Advantages – renewable, readily available, can use waste material.

Disadvantages – not environmentally friendly, when burned produces carbon dioxide.



Environmental Audits

An environmental audit is a term given to a regular procedure that measures the environmental performances of businesses. They have become more common with organisations for several reasons:

- Changes in government policies towards a greener and more sustainable outlook;
- Profitability;
- Accountability;
- Efficiency;
- Public Relations.

An environmental audit will help identify:

- Where processes are working;
- Where they need improved;
- Potential risks.

Some of the main aims of an environmental audit are to assess that a business has:

- Conformed to environmental legal requirements;
- Met all agreed environmental policies.

New Technology and Environmentally Friendly Manufacturing Processes

A good example of how technology developed for a product can help reduce the negative impact on the environment society has, is the technology that has been developed to run the Hybrid Car. A Hybrid car is a vehicle which runs on both a petrol engine and electric-battery motor. When compared to the efficiency of conventional cars the fuel consumption and emissions are considerably reduced. Honda and Toyota are two car manufacturers that have developed versions of these car's, the hybrid engine allows

the car to work off the electric motor at slow speeds and then when higher speeds are reached the car switches to the petrol engine while at the same time charging the electric motor. The benefit of working off the electric motor is that there are no emissions while having the petrol engine allows for features to be included such as stereos, air conditioning and so on.



Other developments in the energy and fuel sector that have had positive impacts on the environment in comparison to their conventional equivalents are as follows:

- Bio Diesel is diesel made by chemically reacting lipids for example the vegetable oil extracts from crops with an alcohol. Bio diesel is carbon neutral because the carbon dioxide it absorbs as a crop is equal to the carbon dioxide produced when the material is burned.



- Hydrogen Fuel Cells convert hydrogen and oxygen into water in an electrochemical energy conversion. The conversion produces electricity which can drive electric motors in cars.



Waste Management, Disposal and Pollution Control

Waste Management – deals with the collection, transport, processing, recycling and disposal of waste. The main focus of waste management is the effect waste is having on the environment and how we can reduce this.

Landfill – Is a method of burying waste in empty unused sites for example in old quarries. Landfills can produce a common by-product gas (methane and carbon dioxide) but some landfill sites have inserted gas extraction systems, which turns this gas into electricity.



Incineration – when waste is combusted (burned) to turn the materials from solid products to gas products. The by-product created can be used to generate heat, steam and electricity.

Recycling – Is the reusing of waste materials. Most homes will separate plastic from glass and aluminium tins etc. By doing this it allows this material to be reprocessed and used again in another product.



Pollution – pollution comes from many sources such as car emissions, chemical plants, oil plants, and incinerators. These by products can effect human health and the environment therefore they need to create solutions is becoming more and more necessary.

The main purpose of control is to recycle by transforming by products into useful things for example electricity and heat.



Revision questions

1. Give **two** examples of factors contributing to climate change.
2. How can we reduce the environmental impact on the earth through the design process?
3. There are six stages in a products environmental life cycle. Name each stage and give an example for each of a current environmental impact.
4. How can a company evaluate and analyse their environmental impact?
5. Within design we need to consider the 6 R's when developing and manufacturing a product. Identify the 6 R's and how a company can change their processes to include them.
6. Name a product that has reduced its environmental impact and explain how.
7. **Essay Question** - 'The environment cannot continue to sustain bad design' Discuss how product designers can have an influence on improving the environmental impact of the products the design.

