

Pearson BTEC Level _ Higher Nationals in Engineering (RQF)

Unit 51: Sustainability

Unit Workbook 2

in a series of 3 for this unit

Learning Outcome 2

Collaboration

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SAMPLE

INTRODUCTION

Articulate the importance of collaborating with other disciplines in developing technical solutions to sustainability problems.

- *Systems thinking and socio-technical systems:*
 - The politics and economics of sustainability.
 - Kyoto Protocol.
 - COP21.
 - European Union Emissions Trading Scheme.
- *Sustainable infrastructures:*
 - Low carbon transport systems.
 - Sustainable cities.
 - Green building.
 - Power storage and distribution.
 - Sustainable logistics.
 - Waste and recycling.

SAMPLE

GUIDANCE

This document is prepared to break the unit material down into bite size chunks. You will see the learning outcomes above treated in their own sections. Therein you will encounter the following structures;

Purpose

Explains *why* you need to study the current section of material. Quite often learners are put off by material which does not initially seem to be relevant to a topic or profession. Once you understand the importance of new learning or theory you will embrace the concepts more readily.

Theory

Conveys new material to you in a straightforward fashion. To support the treatments in this section you are strongly advised to follow the given hyperlinks, which may be useful documents or applications on the web.

Example

The examples/worked examples are presented in a knowledge-building order. Make sure you follow them all through. If you are feeling confident then you might like to treat an example as a question, in which case cover it up and have a go yourself. Many of the examples given resemble assignment questions which will come your way, so follow them through diligently.

Question

Questions should not be avoided if you are determined to learn. Please do take the time to tackle each of the given questions, in the order in which they are presented. The order is important, as further knowledge and confidence is built upon previous knowledge and confidence. As an Online Learner it is important that the answers to questions are immediately available to you. Contact your Unit Tutor if you need help.

Challenge

You can really cement your new knowledge by undertaking the challenges. A challenge could be to download software and perform an exercise. An alternative challenge might involve a practical activity or other form of research.

Video

Videos on the web can be very useful supplements to your distance learning efforts. Wherever an online video(s) will help you then it will be hyperlinked at the appropriate point.

As part of the agreements within the protocol, there are many emissions trading schemes which are used to help participating countries comply with binding commitments. Examples include the EU ETS, The Swiss Emissions Trading Scheme, The UK Carbon Reduction Commitment Energy Efficiency Scheme and The United States Regional Greenhouse Gas Initiative.

COP21 (The 21st Conference of Parties) was a conference held in 2015, located in Paris, as a result of this conference The Paris Agreement was initiated, (described in the previous workbook of this unit). It also served as a meeting of the parties of the Kyoto Protocol. At the time of the conference the levels of Carbon Dioxide Emissions across the world were as follows:

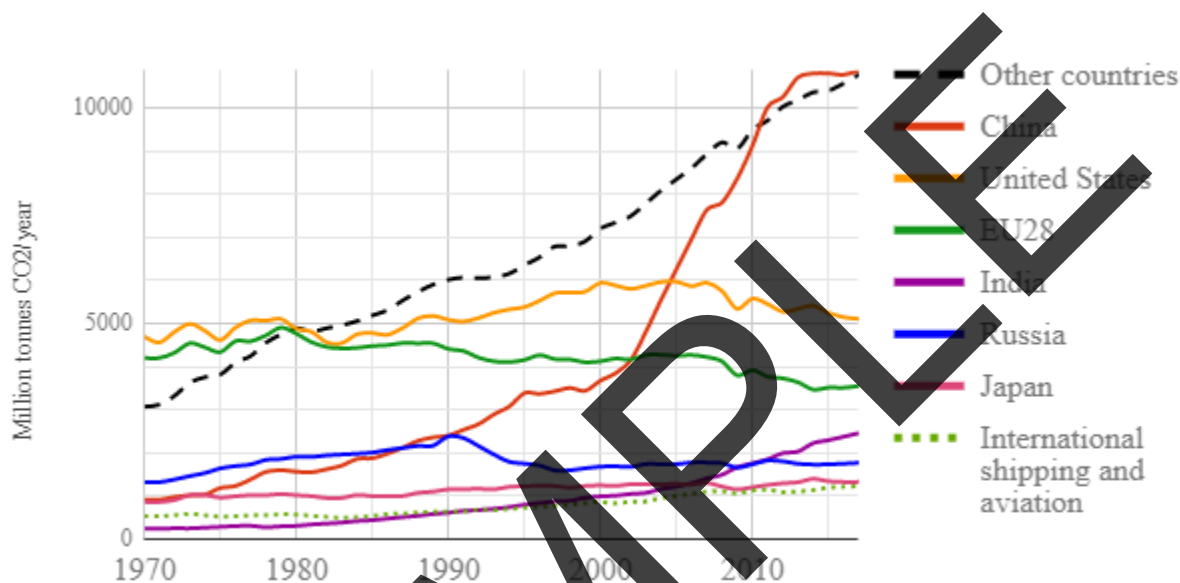


Figure 1.3: World CO₂ Emissions 2015

Sustainability is a global issue; the drivers of change are produced by the UN and individual responsibilities are delegated to countries based on their economy and state of development. Nonetheless, each individual country has a responsibility to take part in the global efforts of reducing greenhouse gases in order to reduce climate change to a sustainable level. Additionally, all countries are expected to cooperate and share technology in order to contribute to the overall sustainability goals.

For a reminder of the UN's seventeen sustainable development goals, see the following link:
<https://www.undp.org/content/undp/en/home/sustainable-development-goals.html>

Of course, in **politics**, the governments of countries will not always agree with how best to implement sustainable strategies and whether or not the UN's rules and regulations serve their own country's interests. Finally, many governments and individuals may not agree that these sustainable development goals are even achievable at all.

There are different pressures in developing and developed countries, China, for example currently produces almost all of the world's rare earth materials which are used in the production of technological goods, whilst they are also the largest producer of Carbon Dioxide. Other countries simply lack the financial resources to

plan and implement sustainable development, other times a country may be in the midst of a war so sustainable development is not likely to be a priority in these cases.

Natural disasters can affect a country's **infrastructure**, cutting off supplies to resources and energy sources, this can result in alternative supplies being sourced, for example the natural water supply may be cut off, resulting in a reliance on imported bottled water, or simply consuming from infected water supplies.

The government may also be in a conflict between making immediate profits to invest in increasing employment levels and investing in sustainable technologies. A key example can be seen in Poland where the government has invested heavily in coal-powered energy production in order to maintain and increase employment in this area, whilst providing reliable energy for its population, both of which result in winning votes to stay in power and an immediate, if short-term, increase in the well-being of its people.

Finally, there may well be corruption or a lack of compassion and understanding of the issue of sustainability. Some governments may consciously put in place some service fees for ministers, which means that in order for certain developmental project to be given the go ahead, ministers must be paid large service fees. This clearly puts an unnecessary additional financial cost on sustainable development.

There are a huge number of specific issues which put competing pressures on countries, when it comes to sustainable development. A useful key example is the country of Nepal, here there are social inequalities whereby corruption is prevalent at the governmental level and gender inequalities result in women working, only for sole access to wages to be granted to men.

1.2 Sustainable Infrastructures

Infrastructure is the accumulation of basic facilities and physical & organisational structures which are required for a society to operate. Examples of types of infrastructure include transportation facilities like roads and railway systems, telecommunication networks, sewage systems and water supplies. They are all of vital importance to the development of a country's economy and its prosperity and are usually under the control or at least regulated publicly by government, certainly on the larger scale. Smaller scale infrastructure can sometimes be produced privately or just locally.

Sustainable development of infrastructure benefits, not only the current generation but those to come, it is an investment that will pay off in the future. In terms of design, engineers and planners must work together in order to produce results that benefit people and the environment in which they live.

Existing infrastructure can be analysed in the long-term and then repaired, renewed, or replaced, as well as rehabilitated to change its sustainability impacts. New infrastructure implementation should also be analysed to ascertain its long-term impacts, taking into account all aspects from design, manufacture, transport, use and disposal.

Sustainable infrastructure helps to promote more effective and efficient use of resources, including financial, and as such it is a good practice to follow for the betterment of the planet as well as for profits.

In the UK, the Committee on Climate Change (CCC) provides advice to the government about emissions targets and reports on greenhouse gas emissions reductions. They have reported that, as of 2017, the UK's greenhouse gases have experienced a reduction of 43% in comparison to the levels in the year 1990. The following graphic indicates the changes in greenhouse gas emissions for each emissions sector:

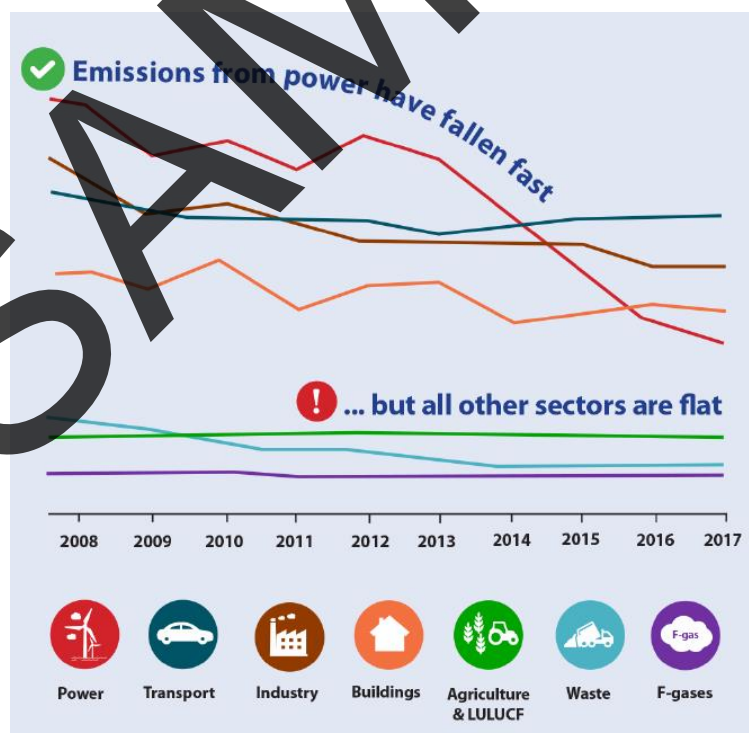


Figure 1.4: UK Greenhouse Gas Emissions by Sector

on through construction, operation, maintenance, renovation, and demolition. Collaboration between engineers, architects, scientists, contractors and the client are required at all of these stages.

Sustainably designed buildings have been proven to cost less to operate than typical comparably sized traditional buildings. There are several factors which can contribute to making a green building, such as efficient use of resources, use of renewable energy, waste reduction, re-use and recycling, indoor air quality, use of non-toxic, ethical and sustainable materials, environmental consideration in design, construction and operation, as well as an adaptable design based on a changing environment.

Sustainable and **green building** often features a certain amount of new and emerging technology. As with many pieces of new technology, the main negative factor is a relatively high price when compared to traditional methods. However, economically, a green building will payoff those initial high costs through its far superior energy efficiency.

Green building can refer to industrial, commercial and residential constructions and the benefits can be seen to fall within the three sustainable development areas of economic, environmental and social: A green building helps to reduce operating costs and improves the occupant productivity (economic), reduces water waste, conserves natural resources and protects biodiversity (environmental) and improves quality of life as well as occupant health and comfort (social).

1.2.4 Power Storage and Distribution

The national grid is the electric power network within Great Britain, and acts to connect power stations and sub-stations together for both the storage and distribution of this electrical power to satisfy demand. The cost of this electrical distribution is high, and the existing infrastructure of the grid has been historically inefficient. Improvements have been made over time, whereby generators are implemented in locations which are closer to high demand centres, this reduced distribution costs overall.

As renewable energy become more prevalent across the country, the integration of their generators into the national grid becomes more important and significant investment to facilitate this integration is required.

There are many different methods of current mass energy storage, ranging from mechanical methods such as hydroelectricity, compressed air and flywheels, to chemical forms like hydrogen, methane and biofuels, along with electrical methods like capacitors.

Currently, whenever demand for electricity increases, non-renewable solutions are implemented to meet that demand, a common example is the gas 'Peaker' plant which is usually called upon during peak energy demand periods. Alternative, **sustainable** methods of energy storage are being developed, for example, in 2018, Tesla produced and installed a 1-Gigawatt energy storage project, essentially in the form of a gigantic rechargeable battery. Additionally, the company has also developed a battery and solar system which can be used for an individual residential building to provide specific electricity requirements. Battery technology has improved immensely throughout the years and stands to play more of an important role in the **sustainable** future of the Earth. Hydroelectric dams also provide a very efficient and reliable store of energy, particularly compared to other renewable sources such as solar and wind. Although as with much of the technology within this sector, there are developments occurring rapidly, in fact, thermal energy storage can reliably be achieved through the use of molten salts in solar power stations.

The UK has recently formed connections with Norway to help to cut carbon emissions by ‘plugging in’ to the country’s hydroelectricity network. In 2019, the UK stands to produce more electricity from zero-carbon sources than from fossil fuel sources, whilst in May 2019 the country recorded its first ever ‘coal-free’ fortnight.

More about the UK’s electricity grid and its moves towards lower carbon processes can be read about in the below report:

<https://www.nationalgrid.com/group/news/britains-clean-energy-system-achieves-historic-milestone-2019>

1.2.5 Sustainable Logistics, Waste & Recycling

Logistics moves products through the supply chain, extending from the raw material source, through the planning, design, production, and distribution phases, all the way through to consumption and disposal. It involves the coordination of freight and transport, as well as storage and the management of inventory, along with materials handling and the processing of associated information.

As always, with the subject of sustainable development, the three main principles should be considered: Economic, environmental and social, with specifics considered below those main levels, as shown below:

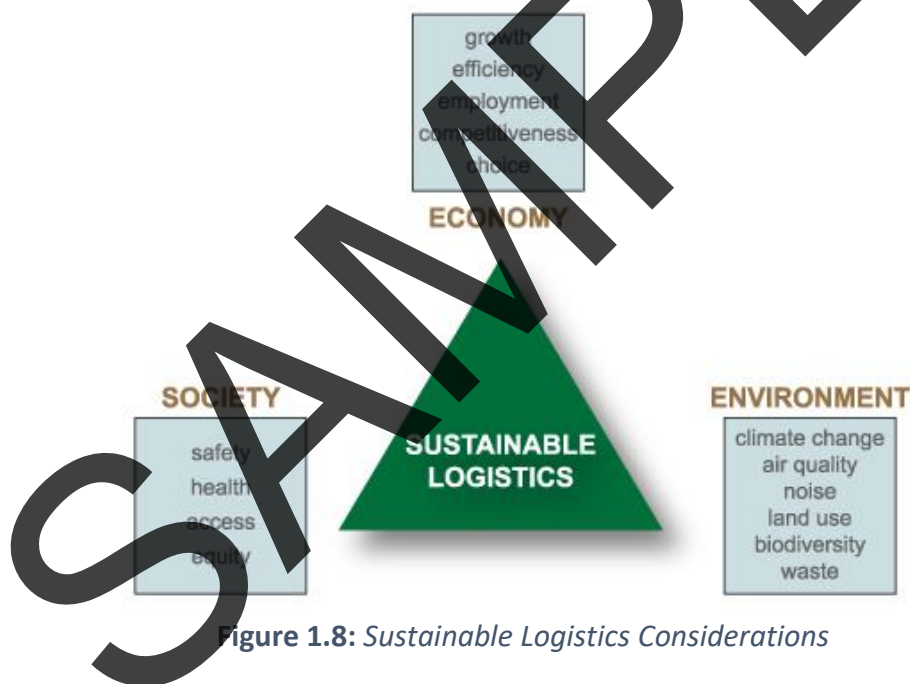


Figure 1.8: Sustainable Logistics Considerations

There are several sustainable practices that logistics companies have adopted, such as reducing emissions, waste products and the amount of energy consumed, whilst increasing awareness amongst employees and customers. Whilst these may involve some active practices, many companies also take part in ‘carbon-offsetting’, whereby they simply invest in external climate protection projects. An example company is DHL, they actually offer recycling and waste management services, along with disposal and end-of-life services for a variety of business, whilst they have invested in their own independent carbon-offsetting project and have purchased CO₂ credits.

Collaboration between businesses results in greater sustainability advancements the supply chain can be looked at as a whole, where synchronised and integrated partnerships lead to a reduction in environmental