Unit 51: Sustainability

Unit code	**Y/615/1519**
Unit level	**5**
Credit value	**15**

Introduction

Living and working in the 21st century will bring a range of sustainability challenges that our society has not seen before. For many people on our planet key resources such as food, water and energy will be in short supply, whilst the effects of climate change will be felt by everyone.

The Brundtland Commission of the United Nations on 20th March 20th 1987 defined sustainability as: "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Engineers will be in the frontline of the battle to overcome the challenges of creating a sustainable economy, but no single discipline will have the capability to tackle the problems alone. Sustainability is a multidisciplinary challenge, and engineers of the future will have to work collaboratively with a whole range of other stakeholders, such as scientists, politicians and financiers, if they are to be able to produce the practical and technological solutions required within the necessarily urgent time scales.

This unit is designed to support the Professional Engineering and Professional Engineering Management core units at Level 4 and 5. On successful completion of this unit the student with possess a wide range of knowledge and understanding of the issues and topics associated with sustainability and low carbon engineering.

Learning Outcomes

By the end of this unit students will be able to:

1. Determine the nature and scope of the technical challenges of ensuring sustainable development.
2. Articulate the importance of collaborating with other disciplines in developing technical solutions to sustainability problems.
3. Evaluate the use of alternative energy generation techniques in relation to their contribution to a low carbon economy.
4. Analyse a variety of data sources to estimate the carbon footprint of a socio-technical scenario.

Essential Content

LO1 **Determine the nature and scope of the technical challenges of ensuring sustainable development**

The scope and social context of sustainability:

Sustainable development

Brundtland definition

Global demographics, trends and predictions

Population growth

Standard of living, actual and expected

Urbanisation and the balance of urban/rural space

Sustainable design

Environmental issues:

Climate change, planetary energy balance, carbon cycle science, the 2^0 C climate change obligation

Carbon capture and sequestration

Pollution, pollution prevention and management

Carbon trading

Eco-systems and habitat

Resources:

Food, water, energy and raw materials

LO2 **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

UN Climate Change Conference (COP)

European Union Emissions Trading Scheme

Sustainable infrastructures:

Low carbon transport systems

Sustainable cities

Green building

Power storage and distribution

Sustainable logistics

Waste and recycling

LO3 **Evaluate the use of alternative energy generation techniques in relationship to their contribution to a low carbon economy**

Alternative energy resources:

Nuclear, solar, wind, tidal and wave, geothermal, biomass and bioenergy

Whole life cycle costing

Precautionary principle

LO4 **Analyse a variety of data sources to estimate the carbon footprint of a socio-technical scenario**

Types of carbon footprint:

Organisational

Value chain

Product

Carbon footprint science

Calculation methodologies: direct and indirect

System boundaries

Case study examples

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Determine the nature and scope of the technical challenges of ensuring sustainable development</td><td rowspan="2">D1 Critically analyse how the interrelationship between the three key areas of technical challenges can be managed systemically to ensure maximum sustainability</td></tr>
<tr><td>P1 Determine the nature and scope of the technical challenges of ensuring sustainable development, considering environmental, resource and demand issues</td><td>M1 Review existing sustainable development plans to identify the way technical challenges are met and overcome</td></tr>
<tr><td colspan="2">LO2 Articulate the importance of collaborating with other disciplines in developing technical solutions to sustainability problems</td><td rowspan="2">D2 Critically analyse how a systemic approach can be used to support interdisciplinary collaboration in developing sustainable infrastructures</td></tr>
<tr><td>P2 Articulate the interdisciplinary issues associated with the construction of sustainable infrastructures, with attention to the competing pressures within these infrastructures</td><td>M2 Analyse how political and economic issues can impact upon technical solutions</td></tr>
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Pass	Merit	Distinction
LO3 Evaluate the use of alternative energy generation techniques in relation to their contribution to a low carbon economy		**D3** Critically analyse the selection of alternative energy generation techniques for a low carbon economy within the wider socio-technical sustainability agenda
P3 Evaluate the issues that need to be considered when selecting alternative low carbon energy sources	**M3** Analyse the difficulties in the evaluation and selection of alternative energy generation techniques for a low carbon economy	
LO4 Analyse a variety of data sources to estimate the carbon footprint of a socio-technical scenario		**D4** Analyse the alternative types and methods available for calculating the carbon footprint of a sociotechnical scenario, and make justified recommendations, selecting a best-fit method for effective comparison of systems
P4 Evaluate a variety of data sources to estimate the carbon footprint of a number of socio-technical scenarios **P5** Describe the process of calculating a carbon footprint	**M4** Apply appropriate data from a range of options to calculate the carbon footprint of a socio-technical scenario	

Recommended Resources

Textbooks

BERNERS-LEE, M. (2019) *There Is No Planet B: A Handbook for the Make or Break Years* Cambridge University Press

BERNERS-LEE, M. (2010) *How Bad Are Bananas?* Profile Books.

BOYLE, G. (2012) *Energy Systems and Sustainability: Power for a Sustainable Future*. Oxford University Press.

FENNER, A. and AINGER, C. (2013) *Sustainable Infrastructures: Principles into Practice*. ICE Publishing.

HELM, D. (2015) *The Carbon Crunch: Why we are Getting Climate Change Wrong and How to Fix It*. Yale University Press.

HONE, D. (2014) *Putting The Genie Back: 2^0c Will Be Harder Than We Think*. Whitefox Publishing.

Websites

http://www.carbontrust.com	Carbon Trust Carbon foot printing (General Reference)
http://www.fern.org/	FERN Trading Carbon How it Works and Why it is Controversial (Ebook)
https://www.populationinstitute.org	Population Institute Demographic Vulnerability report (Report)
http://www.un.org/	United Nations Integrating Population Issues into Sustainable Development (Report)
http://www.unwater.org/	United Nations Water Annual World Water Development Report (Report)
https://sustainabledevelopment.un.org/	United Nations Sustainable Development Knowledge Platform (General Reference)

Links

This unit links to the following related units:

Unit 4: Managing a Professional Engineering Project

Unit 35: Professional Engineering Management