# Unit 51: Sustainability

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<tr>
<th>Unit code</th>
<th>Y/615/1519</th>
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<tr>
<td>Unit level</td>
<td>5</td>
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<td>Credit value</td>
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## 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 $\text{2}^\circ\text{C}$ climate change obligation
Carbon capture and sequestration
Pollution, pollution prevention and management
Carbon trading
Eco-systems and habitat

Resources:
Food, water and energy

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
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

**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, 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

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

Textbooks

Websites
http://www.carbontrust.com Carbon Trust Carbon footprinting (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)

Links
This unit links to the following related units:
Unit 4: Managing a Professional Engineering Project
Unit 35: Professional Engineering Management