Unit 8: Sustainability in Construction

Delivery guidance

This mandatory unit for the Diploma and Extended Diploma and optional unit for the Subsidiary and Foundation Diplomas will give learners an understanding of some of the challenges that face the construction industry in response to protecting the world for future generations.

Approaching the unit

In this unit learners will develop an understanding of the impacts of the construction industry on the environment, from the features of the environment that need to be protected through to the ways in which construction activities and developments affect the features of the environment.

This unit will then introduce learners to both energy-based and materials-based approaches that can be used to reduce the negative effects of construction activities on the environments. Learners will also develop an understanding of how alternative methods of site management and construction can reduce the amount of waste produced and also how the effects of developments overall can be minimised. This will be complemented by learners developing knowledge and understanding of alternative energy sources and production.

Delivery of the unit is likely to use a range of different methods, including a large proportion of tutor presentations and demonstrations, along with individual, paired and group work when carrying out research, practice assessment and problem-solving activities. On completion of the unit, learners will be able to reflect on approaches that could reduce the environmental impact of construction activities.

You could involve local employers in the delivery of this unit if there are local opportunities to do so – for example, through site visits where sustainable techniques are being used in a development or to visit renewable energy installations.

Delivering the learning aims

Learning aim A will begin by introducing learners to features of the natural environment that need to be protected including the land and finite resources. This will give learners a background understanding of the reasons why sustainability is important for the construction industry, which then give a focus for looking in detail at the impact of construction on the environment.

The impact of the actual construction activities can first be considered – for example, emissions associated with plant and equipment or the extraction and use of oil-based products. This can then be followed by introducing learners to the impacts of new developments on the environment such as the loss of spaces, increasing traffic or increased emissions.

Learning aim B will investigate the use of methods that can be used to produce sustainable designs for buildings including making buildings more efficient or by using materials and technologies that have lower negative impacts on the environment. Learners would benefit from opportunities to gain first-hand experience of some of these approaches, probably through the use of site visits or talks from visiting speakers.

Similar approaches could be used to introduce learners to ways in which waste can be reduced during construction activities and how the impacts of a development can be minimised. Site visits again could be used to good effect especially if traffic management schemes or surface water controls form part of the new development.

You could then introduce alternative energy in learning aim C by first considering the range of renewable methods for electricity production. Next, you could develop understanding of the concepts through the use of visits, visiting speakers or the use of video resources. Additionally, learners could be introduced to different approaches to heating and cooling; again, it would be useful for learners to gain experience of different approaches via either site visits or videos that demonstrate systems in operation.

Assessment model

Learning aim	Key content areas	Assessment approach
A Understand the impact of construction on the environment	**A1** Features of the natural environment that need to be protected **A2** Impact of construction activities on the environment **A3** Impact of new development on the environment	A report, presentation or booklet that examines the features of the natural environment that need to be protected and which suggests appropriate methods and approaches to minimise the impact of construction activities and development.
B Explore the methods of sustainable building design	**B1** Energy-based techniques **B2** Materials-based techniques **B3** Waste-based techniques **B4** Methods of minimising the impact of development	
C Examine alternative energy sources	**C1** Renewable methods of electricity generation **C2** Sources of heating and cooling	A report that examines and recommends alternative sources of energy for a proposed development project.

Assessment guidance

This unit is internally assessed with a maximum of two assignments being permitted. Assignment 1 should cover learning aims A and B, and Assignment 2 covering learning aim C. The assignment briefs should be set within the context of a construction development that has opportunities for sustainable construction methods to be used.

For Assignment 1, adequate details should be given about the location, the natural environment and the nature of the development, so that learners can carry out a suitable evaluation. The evaluation must relate to the project scenario given and should not be a generic response. Learners should include details about the impact of construction activities on the environment and to review the effectiveness of methods they suggest to minimise the effects of the project on the natural environment.

For Assignment 2, you should include details of the location, size and nature of a proposed development including natural resources and information about the local climate. This will allow learners to make judgements when making recommendations about alternative sources of energy for the proposed development. Learners must consider the production of electricity along with heating and cooling as part of their evaluations.

Submitted assessment evidence could be in the form of a project, presentation or report. Tutors could ask learners to include sketches, illustrations and a list of information sources used.

Getting started

This give you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

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Introduction

In the delivery of this unit, there are opportunities for you to develop links with a range of local organisations including construction companies and developers, utilities providers and local government departments. These organisations may be able to give information about the local environment or allow visits to construction sites or renewable energy installations that would give learners a better understanding of the topics covered in this unit.

Centres may consider working along with an industry partner for the delivery and assessment of learning aims A and B where an existing or proposed development could form the basis for covering each of the various topics related to the impact of construction on the environment and sustainable methods of construction.

For learning aim C learners will need to have an understanding of each of the alternative energy sources listed in the specification. However, visits to local facilities will give more focus to the technologies they are likely to experience as part of local or regional developments.

Where possible you should apply the learning to existing projects and encourage the involvement of local construction organisations where possible.

Learning aim A – Understand the impact of construction on the environment

- You could introduce this learning aim by questioning learners to assess their understanding of what they consider the natural environment to be and how they think construction activities could affect the environment.

Learning aim A1

- This could be followed by introducing learning aim A1 with a group discussion to consider the natural environment. You could expand on features that learners suggest and develop these as appropriate.
- Learners could be divided into small groups and asked to research one of either air, water or ozone quality. Findings could be presented to the class as a whole and then shared as a resource.
- You could introduce learners to the various features of land that would need to be taken into account when considering sustainability. If site visits are possible, these could be used. However, it is likely that the use of video resources will be needed to introduce learners to the full range of the content.
- Moving on, you could discuss with learners issues associated with light – for example, visibility and the night sky. This could also include discussions about light pollution from urban developments.
- Once learners have a clear understanding of the natural environment you could discuss with learners finite resources. Learners could then be divided into small groups to research either fossil fuels, ores and minerals, or raw materials. They could present back to the class how the extraction and use of these finite resources impacts the environment.

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Learning aim A2

- When learners have an understanding of why the environment needs to be protected, you could move on to consider the impacts of construction activities with the class.
- You could first introduce learners to airborne emissions. Learners could be divided into pairs to examine sources of airborne pollution and emissions, and produce brief reports that can be shared among learners.
- At this point, there is an opportunity to involve outside speakers who are specialists in airborne pollution – especially when considering the impacts on the local and global environments.
- Next, you could introduce learners to water-based pollution, including the causes and consequences of such pollution. The use of video resources would be beneficial for learners to visualise the effects of water pollution.
- This could be followed up by dividing learners into small groups to investigate the impact on soil quality, groundwater quality and drinking water for given types of pollutant. These resources could be shared among learners as revision notes.
- A similar approach could be taken when introducing learners to impacts on the land and landscape of the range of activities listed in the unit content. Learners could work in pairs to investigate one of the factors – for example, drainage and flooding – and produce a brief fact sheet that includes the impact on the visual amenity, soil quality, habitat and ecosystem. These should make suitable links to the local environment.
- You could discuss with learners issues related to light pollution and the impacts of this on both the population and wildlife. You could invite specialist speakers in to give learners a thorough understanding of the issue.
- Once learners have an understanding of the various types and causes of pollution you could introduce them to the wider impacts associated with the use of finite resources both during construction and the longer-term impacts on the environment and society.
- You could set learners research tasks to investigate given types of finite resources and then use their notes to carry out a discussion about the impacts of the use of finite resources in construction.

Learning aim A3

- When learners have a good understanding of the effects of construction activities on the environment you could introduce them to the wider impacts of developments on the environment once they are completed. Again, video resources or site visits would help learners to understand the wider impacts of construction in areas they are less familiar with.
- You could lead a discussion that covers the four main areas of impact on the environment (increased traffic density, increased surface water run-off, loss of land and green space, and increased greenhouse gases and emissions).
- Learners could then work in small groups to research and present information about one of the four impacts on the environment. These could be collated and used as a shared resource for learners to use.

Learning aim B – Explore the methods of sustainable building design

Learning aim B1

- You could introduce learning aim B through a class discussion about ways in which the environment can be protected by using sustainable building design. The discussion could cover each of the approaches in learning aim B.
- This could be followed by introducing learners to the idea of buildings that are more energy efficient.
- Learners could then work in pairs or small groups to research efficient heating and ventilation systems that would be suitable for new buildings in the local area. This could be supported by site visits where such installations are used.
- You could demonstrate to learners construction methods that lead to high quality walls, floors and roofs that reduce the amount of heat loss/gain from buildings.
- This could then lead naturally to a discussion about air-tightness of buildings. Learners could work in pairs to research approaches to keeping a building airtight such as windows and doors and also methods of ventilation.
- Learners could share their research with the whole class and notes be collated into a reference file.
- You could move on to consider renewable and alternative sources of heat and power. Where possible this could be supported by visiting an installation or using video resources to demonstrate how they work to learners.
- Learners could be given one of the four types of installation to research and then produce a presentation that can be shared with the remainder of the class.

Learning aim B2

- Once learners have a good understanding of using energy-based techniques to reduce the impact of buildings on the environment you could move on to introduce learning aim B2.
- You could begin by discussing ways in which the selection and use of materials can impact on the sustainability of new buildings. Encourage learners to think not just about the use of materials, but also how they are produced and their lifespan.
- Learners could be given one of the six types of renewable materials to investigate, as listed in the unit content. Then they could produce a single-sided fact sheet about their material, which could be collated into a shared reference file.
- You could introduce the concept of embodied energy of materials and ways in which this could be minimised. Learners could then be given examples of construction materials to research their embodied energy through the different stages of production.
- A further class discussion could be used to consider other approaches to more sustainable uses of materials. You could tell learners that some materials are more durable and long lasting than others, and then discuss the benefits this would bring to the building.

Learning aim B3

- Learning aim B3 could be introduced by showing learners a video of offsite prefabrication of parts of a building. You could use this as a starting point for a discussion about how waste can be reduced from construction activities.
- Learners could be divided into small groups to investigate offsite prefabrication methods. They could use their research to produce a brief illustrated report that explains the benefits of prefabrication.

- You could arrange for a site visit where prefabrication or modular construction methods are being used, or other modern methods of construction. Alternatively, you could arrange for an outside speaker who works on a development where these approaches are used.
- You could use this speaker to introduce modern methods of construction to learners including the use of plant and equipment. Learners could investigate how modern methods of construction can reduce waste on site.
- With learners having an understanding of how to reduce waste, you could then introduce them to the idea of waste planning. You could discuss the reasons for waste planning and ask learners to produce a list of benefits of waste planning on site.

Learning aim B4

- Once learners have a good understanding of ways in which the construction phase can be made more sustainable, you could introduce methods of minimising the impacts of a development as a whole for learning aim B4.
- You could carry out a visit to an urban or town centre location to see how traffic is managed and the facilities that have been provided. This could then be used to discuss ways in which traffic can be managed to improve the sustainability of development of towns and cities.
- You could give learners a group activity to develop a traffic management plan for a local area that would reduce the impact of road traffic.
- With learners having a good understanding of traffic management you could then move on to introducing sustainable urban drainage systems (SuDS) either through visits or the use of a video.
- Learners could then work in small groups to research the use of delaying dispersal of surface water run-off. They could produce a short presentation and share their findings with the whole class.
- You could then demonstrate methods that are used as temporary surface water storage. If possible, a site visit to see some of the features would be beneficial for learners.
- Next you could investigate the use of rainwater harvesting, both for domestic and industrial use. You could consider approaches used locally that learners will be more familiar with.
- Finally, you could lead a class discussion about carbon offsetting including the ways in which it can be done and the benefits that it brings to areas of development.

Learning aim C – Examine alternative energy sources

Learning aim C1

- You could introduce learning aim C by reviewing the use of renewable and alternative sources of heat and power introduced in learning aim B1.
- You could then discuss with learners the five main types of renewable methods for electricity generation. This could be supported by an external speaker if available. There is an opportunity here to make links with local electricity generation organisations that might specialise in renewable electricity.
- Learners could then investigate solar power generation and how it is used in the local area or region. They could work independently to produce a short report on the benefits and drawbacks of solar power generation.

- This could be followed by whole class activities using case studies to investigate the use of wind power. Groups could look at various different types of wind power installation and then discuss these as a class.
- You could then introduce learners to hydroelectric, and tidal and wave power generation. These types of power generation methods may be less common to learners. Therefore, the use of video presentations to explain what they are could be beneficial.
- A further activity could be to divide learners into small groups to investigate where hydroelectric and tidal power generation schemes have been successful.
- You could follow this up by introducing learners to biomass power stations and the associated benefits and drawbacks of these. Learners could investigate the differences between small-scale power generation and industrial scale that is used to feed power into the distribution network.
- Learners could be given a scenario and asked to suggest two possible types of renewable electricity generation that would be suitable for the location and to evaluate the benefits and drawbacks of each.

Learning aim C2

- You could introduce learning aim C2 by discussing with learners the sources of heating and cooling. Again, this could be linked back to learning aim B and the source of heat and cooling considered at a small scale for individual buildings.
- Learners could be introduced to ground source heating and the different types of heat pumps available. This could naturally lead on to air source pumps and how these can be used for both heating and cooling. You could introduce learners to geothermal heating at this stage, as there are links between the concepts.
- Learners could be divided into small groups to investigate district heating schemes. This would make an interesting site visit for learners if such a scheme is available. Alternatively, you could show learners a video of a scheme in urban areas.
- You could discuss biomass boilers with learners and progress on to considering combined heat and power (CHP) installations. Learners could research the range of CHP installations used locally and report on the benefits they bring.
- You could prepare learners for their assessment by giving them a number of scenarios where they need to select and justify their choice of a heating or cooling system.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

This unit links to:

- Unit 1: Construction Technology
- Unit 2: Construction Design
- Unit 3: Construction Science
- Unit 21: Building Services Science
- Unit 25: Building Service Control Systems
- Unit 26: Heating, Ventilation and Air Conditioning Design
- Unit 27: Plumbing and Fluid Behaviour in Building Services Engineering
- Unit 33: Offsite and Onsite Construction Methods
- Unit 34: Planning the Built Environment

Resources

Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Journals

Elsevier, *Renewable Energy: An International Journal* – this gives access to a range of articles and case studies of renewable energy projects around the world

Visit the Molecular Diversity Preservation International (https://www.mdpi.com/) website and search for 'Sustainability' in the 'Journals' section. This can be filtered by locations and countries to find articles applicable to sustainability in general and specialist articles on sustainability in construction both locally and internationally.

Textbooks

Halliday S, *Sustainable Construction*, Routledge, 2018 ISBN 9781315514796 – covers a range of considerations for sustainable construction including a number of case studies of developments

Jenkins N, *Renewable Energy Engineering,* Cambridge University Press, 2017 ISBN 9781107028487 – this book includes chapters on a range of renewable sources of electricity generation

Kibert C, *Sustainable Construction: Green Building Design and Delivery*, John Wiley & Sons, 2016 ISBN 9781119055174 – a useful resource that looks at modern methods of construction, materials and the design of sustainable buildings

Ma U, *No Waste: Managing Sustainability in Construction*, Gower, 2012 ISBN 9781409459255 – a practical guide to managing sustainability in construction that looks at sustainability from site practice through to company policies

YouTube videos

'7 principles for building better cities | Peter Calthorpe' – TED talk on principles for building better cities, including with respect to sustainability

'COWI "Just imagine" district heating & cooling from Denmark' – heat recovery district heating and cooling scheme in Denmark

'Ever wondered where the rain goes? Sustainable drainage animation' – animated overview that introduces the concept of Sustainable Urban Drainage Systems

'Hydroelectric power' – introduction to hydroelectric and wave power electricity generation

'Renewable Energy 101 | National Geographic' – National Geographic video about renewable energy sources

'Time lapsed construction of a 2 storey house' – a short video showing construction of a steel framed building

'Urbanization and the future of cities – Vance Kite' – TED talk that introduces the concept of urbanisation and the impacts on the environment of development

'Verbus Africa CIMC animation' – steel modular building construction using container-sized modules from factory build to onsite installation

'What is Prefabricated Construction? | ModSpace' – this video introduces pre-fabrication construction of modular buildings

Websites

Visit the GO construct website and search for blogs about sustainability in construction; the site also has topical articles related to construction in general

Visit the National Geographic website and search 'Renewable energy 101' for article on renewable energy sources

Visit the Student Energy website and search 'Renewable energy'; this learner-friendly website discusses a range of different types of renewable energy

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling students to access them through the school/college intranet.