

Cambridge TECHNICALS LEVEL 3

APPLIED SCIENCE

Cambridge
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Unit 15

Sustainability and renewable energy

L/507/6162

Guided learning hours: 60

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UNIT 15: Sustainability and renewable energy

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Guided learning hours: 60

Essential resources required for this unit: none

This unit is internally assessed and externally moderated by OCR.

UNIT AIM

Renewable energy is a key element in the energy mix of nations. It is a key government tool in tackling climate change but is not without controversy.

In this unit you will explore the different technologies that produce renewable energy, you will explore the drivers for change and the different arguments about renewable energy. You will determine the environmental impact of different forms of energy production and suggest suitable mitigation and energy production activities.

You will learn how to measure energy transfer and calculate energy efficiencies of energy sources using real data sources and scientific equipment to take measurements such as voltage; current; mass; temperature; time.

TEACHING CONTENT

The teaching content in every unit states what has to be taught to ensure that learners are able to access the highest grades.

Anything which follows an i.e. details what must be taught as part of that area of content. Anything which follows an e.g. is illustrative, it should be noted that where e.g. is used, learners must know and be able to apply relevant examples in their work, although these do not need to be the same ones specified in the unit content.

For internally assessed units you need to ensure that any assignments you create, or any modifications you make to an assignment, do not expect the learner to do more than they have been taught, but must enable them to access the full range of grades as described in the grading criteria.

Learning outcomes	Teaching content
The Learner will:	Learners must be taught:
1 Understand the impacts of energy consumption	<p>1.1 Types of fossil fuel extraction i.e.:</p> <ul style="list-style-type: none">• coal• oil• gas• shale gas <p>1.2 Impacts of energy production i.e.:</p> <ul style="list-style-type: none">• carbon emissions• pollution• loss of finite resources <p>1.3 Human activity and behaviour i.e.:</p> <ul style="list-style-type: none">• energy consumption (e.g. household appliances, labour saving devices, leaving equipment on standby)• transportation (e.g. fuels for vehicles, use of public transport)• manufacturing (e.g. importing manufactured goods, exporting goods) <p>1.4 Energy use i.e.:</p> <ul style="list-style-type: none">• increasing human population and globalisation• industrialisation of developing countries

Learning outcomes	Teaching content
The Learner will:	Learners must be taught:
<p>2 Be able to measure energy transfer and calculate energy efficiencies of energy sources</p>	<p>2.1 Energy sources, i.e.:</p> <ul style="list-style-type: none"> • wind • solar • hydro • fossil fuel <p>2.2. Collect data from primary or secondary sources, i.e.:</p> <ul style="list-style-type: none"> • set up scientific equipment to take measurements (e.g.: voltage; current; mass; temperature; time) • Work accurately and safely, individually and with others, when collecting first-hand data. • Use the relationships between: <ul style="list-style-type: none"> ○ voltage, current, power ○ voltage, current, resistance ○ power, energy, time ○ specific heat capacity, mass, temperature change, energy ○ energy input, useful and wasteful outputs and efficiency <p>2.3 Mitigation vs prevention i.e.:</p> <ul style="list-style-type: none"> • what is inevitable • what can be prevented • targets in climate change legislation
<p>3 Understand renewable energy technologies</p>	<p>3.1 Scientific principles of renewable energy technologies i.e.</p> <p>Biological:</p> <ul style="list-style-type: none"> • biomass • biogas (e.g. anaerobic digestion, gas powered generator, scrubbing of biogas, Injection into grid) • bioethanol (e.g. fermentation plant, drying plant, uses) <p>Chemical:</p> <ul style="list-style-type: none"> • photovoltaic (e.g. structure of a PV cell, effect of sunlight, power output) • hydrogen fuel cells (e.g. construction, operation, uses) <p>Physical:</p> <ul style="list-style-type: none"> • wind (e.g. design, gearbox vs direct drive, location, onshore vs offshore) • hydro (e.g. Archimedes screw, water turbine, dam, river, Pumped storage) • marine (e.g. wave, tidal)

Learning outcomes	Teaching content
The Learner will:	Learners must be taught:
<p>4 Be able to recommend sustainable solutions to meet energy demands</p>	<p>4.1 Differences between Renewable and Low Carbon i.e.:</p> <ul style="list-style-type: none"> • nuclear energy • energy from waste • carbon capture and storage <p>4.2 Considerations of sustainable energy solutions i.e.:</p> <ul style="list-style-type: none"> • costs of renewable energy (e.g. Construction, Running) • predictability and reliability • percentage contribution made by the renewable energy technologies • contingency (e.g. non-renewable energy source) <p>4.3 Renewable energy as part of an energy strategy i.e.:</p> <ul style="list-style-type: none"> • energy security • localised energy production • energy infrastructures <p>4.4 Human activity and behaviour i.e.:</p> <ul style="list-style-type: none"> • energy consumption (e.g. household appliances, labour saving devices, leaving equipment on standby) • transportation (e.g. fuels for vehicles, use of public transport) • manufacturing (e.g. importing manufactured goods, exporting goods) <p>4.5 Energy use i.e.:</p> <ul style="list-style-type: none"> • increasing human population and globalisation • industrialisation of developing countries

GRADING CRITERIA

LO	Pass	Merit	Distinction
	The assessment criteria are the Pass requirements for this unit.	To achieve a Merit the evidence must show that, in addition to the Pass criteria, the candidate is able to:	To achieve a Distinction the evidence must show that, in addition to the pass and merit criteria, the candidate is able to:
1. Understand the impacts of energy consumption	*P1: Discuss impacts of energy production on the environment.	M1: Explain how industrialisation and increased globalisation impacts on finite resources	D1: Discuss how changes in human behaviour could have a positive impact on energy consumption
	*P2: Describe how human activity impacts on the use of energy.		
2. Be able to measure energy transfer and calculate energy efficiencies of energy sources	*P3: Conduct safety assessments of field activity and laboratory activities		
	*P4: Carry out investigations, to collect qualitative and quantitative data relevant to energy transfer	M2: Select and manipulate equations to calculate energy efficiencies	D2: Evaluate the efficiency of energy sources
3. Understand renewable energy technologies	*P5: Describe a range of renewable energy technologies	M3: Evaluate the potential contribution each renewable energy technology could make to energy demand.	
4. Be able to recommend sustainable solutions to meet energy demands	*P6: Carry out an investigation into the use of renewable energy alternatives to traditional energy sources	M4: Evaluate the potential of renewable energy in meeting the energy demand and recommend solutions	D2: Analyse the economic, environmental and social benefits of using renewable energy

ASSESSMENT GUIDANCE

For learning outcomes 1, 2 and 3 learners need to complete research using a range of literature sources, and produce a report for a specific audience or purpose.

Learners will need to carry out extensive research and practical work which could take place in a local, regional, national or international location. For LO4 learners will need to carry out an investigative project which could be linked to a work placement or local business or even the school/college in which they are based.

Feedback to learners: you can discuss work-in-progress towards summative assessment with learners to make sure it's being done in a planned and timely manner. It also provides an

opportunity for you to check the authenticity of the work. You must intervene if you feel there's a health and safety risk.

Learners should use their own words when producing evidence of their knowledge and understanding. When learners use their own words it reduces the possibility of learners' work being identified as plagiarised. If a learner does use someone else's words and ideas in their work, they must acknowledge it, and this is done through referencing. Just quoting and referencing someone else's work will not show that the learner knows or understands it. It has to be clear in the work how the learner is using the material they have referenced to inform their thoughts, ideas or conclusions.

For more information about internal assessment, including feedback, authentication and plagiarism, see the centre handbook. Information about how to reference is in the OCR Guide to Referencing available on our website: <http://www.ocr.org.uk/i-want-to/skills-guides/>.

SYNOPTIC LEARNING AND ASSESSMENT

It will be possible for learners to make connections between other units over and above the unit containing the key tasks for synoptic assessment. Please see Section 6 of the Qualification Handbook for more details. We have indicated in the unit where these links are with an asterisk.

Name of other unit and related LO	This unit:
Unit 1 Science fundamentals LO6 Understand the structures, properties and uses of materials	LO2 Be able to measure energy transfer and calculate energy efficiencies of energy sources (P3, P4) LO4 Be able to recommend sustainable solutions to meet energy demands (P6)
Unit 2 Laboratory techniques LO1 Understand the importance of health and safety and quality systems to industry	LO2 Be able to measure energy transfer and calculate energy efficiencies of energy sources (P3, P4)
Unit 3 Scientific analysis and reporting LO1 Be able to use mathematical techniques to analyse data LO2 Be able to use graphical techniques to analyse data LO4 Be able to analyse and evaluate the quality of data LO5 Be able to draw justified conclusions from data LO6 Be able to use modified, extended or combined laboratory techniques in analytical procedures LO7 Be able to record, report on and review scientific analyses	LO2 Be able to measure energy transfer and calculate energy efficiencies of energy sources (P3, P4) LO4 Be able to recommend sustainable solutions to meet energy demands (P6)

Name of other unit and related LO	This unit:
<p>Unit 13 Environmental surveying</p> <p>LO1 Understand environmental impacts of human activity and natural processes</p> <p>LO4 Be able to analyse and present and environmental survey findings</p>	<p>LO1 Understand the impacts of energy consumption (P1, P2)</p> <p>LO3 Understand renewable energy technologies (P5)</p>
<p>Unit 14 Environmental management</p> <p>LO1 Understand principal characteristics of environments</p> <p>LO3 Understand how legislation, regulation and agreements impact on managing natural and built environments</p> <p>LO4 Understand environmental management assessment</p>	<p>LO1 Understand the impacts of energy consumption (P1, P2)</p> <p>LO3 Understand renewable energy technologies (P5)</p> <p>LO4 Be able to recommend sustainable solutions to meet energy demands (P6)</p>

To find out more
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