Higher National Unit specification

General information

Unit title: Energy Overview

Unit code: H4J5 34

Superclass: QB

Publication date: July 2013

Source: Scottish Qualifications Authority

Version: 01

Unit purpose

The Unit is designed to enable learners to develop knowledge and understanding in a range of energy related matters. Historical, current and future (projected) energy demand, production by source (fuel) and consumption by sector are included. Learners will also be introduced to the potential impacts of climate change and why more sustainable energy sources are required together with energy efficiency measures. The operational processes of traditional and more sustainable energy production technologies together with the advantages of each will also be described.

The Unit is optional for learners in Engineering related HN Awards. It could also be used as a stand-alone Unit where appropriate.

Outcomes

On successful completion of the Unit the learner will be able to:

1 Examine global energy trends and scenarios and the requirement to produce energy from more sustainable sources.
2 Examine national factors relating to energy consumption, electricity generation, greenhouse gas emissions and energy security.
3 Investigate current energy efficiency measures, technologies and policies specific to the building and transportation sectors in relation to reduced CO_2 emissions.
4 Describe traditional and more sustainable industrial sized power plants in terms of operational process and advantages of each.

Higher National Unit specification: General information (cont)

Unit title: Energy Overview

Credit points and level

1 Higher National Unit credit at SCQF level 7: (8 SCQF credit points at SCQF level 7)

Recommended entry to the Unit

Whilst entry is at the discretion of the centre, learners would normally be expected to have attained the entry requirements specific to the HNC/HND award.

Core Skills

Opportunities to develop aspects of Core Skills are highlighted in the Support Notes for this Unit specification.

There is no automatic certification of Core Skills or Core Skill components in this Unit.

Context for delivery

If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

The Assessment Support Pack (ASP) for this Unit provides assessment and marking guidelines that exemplify the national standard for achievement. It is a valid, reliable and practicable assessment. Centres wishing to develop their own assessments should refer to the ASP to ensure a comparable standard. A list of existing ASPs is available to download from SQA's website **(http://www.sqa.org.uk/sqa/46233.2769.html)**.

Equality and inclusion

This Unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website **www.sqa.org.uk/assessmentarrangements**.

Higher National Unit specification: Statement of standards

Unit title: Energy Overview

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the Knowledge and/or Skills section must be taught and available for assessment. Learners should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Examine global energy trends and scenarios and the requirement to produce energy from more sustainable sources.

Knowledge and/or Skills

- Historical global energy production by source (primary fuel)
- Historical global electricity consumption by method of generation
- Potential scenario's for global energy demand over the short to longer term
- Potential scenario's for global energy mix by primary fuel and production method to meet demand over the short to longer term
- Generation of CO_2 from the combustion of fossil fuels and range of factors responsible for the historical increase in global CO_2
- Greenhouse gas effect and the potential impacts of Climate Change
- Finite lifespan of fossil fuel based technologies

Outcome 2

Examine national factors relating to energy consumption, electricity generation, greenhouse gas emissions and energy security.

Knowledge and/or Skills

- Historical energy consumption by primary fuel input basis
- Historical energy consumption by end user (energy supplied basis)
- Historical electricity generated and supplied by method of production
- Historical greenhouse gas (CO2e) emission trends by sector (end user)
- Energy security and status as a net source (fuel) importer/exporter (energy supplied basis)

Higher National Unit specification: Statement of standards (cont)

Unit title: Energy Overview

Outcome 3

Investigate current energy efficient measures, technologies and policies specific to the building and transportation sectors in relation to reduced CO_2 emissions.

Knowledge and/or Skills

- Measures and Technologies to improve energy efficiency in buildings
- Policies, Measures and Technologies to support more sustainable transportation.

Outcome 4

Describe traditional and more sustainable industrial sized power plants in terms of operational process and advantages of each.

Knowledge and/or Skills

- Traditional: Coal, Gas, Oil and Nuclear
- Sustainable: Wind (onshore and offshore), Solar (thermal and photovoltaic), Hydro (catchment based and pumped storage), Wave, Tidal, Geothermal, Biomass and Waste

Higher National Unit specification: Statement of standards (cont)

Unit title: Energy Overview

Evidence Requirements for this Unit

Outcome 1

Evidence for the Knowledge and/or Skills in this Outcome will be generated through sampling. Each learner will need to provide evidence to demonstrate they can examine four of the seven factors relating to global energy trends and scenarios and the requirement to produce energy from more sustainable sources. The evidence should be responses to specific questions.

To ensure that learners will not be able to foresee all the items they will be questioned about, a new sample should be used on successive assessment occasions. The new sample may contain a maximum of two of the Knowledge and/or Skills used in the previous assessment occasion.

A learner's response can be judged to be satisfactory where the evidence shows that the learner can, subject to the sample used:

- identify historical global energy production by source (primary fuel).
- identify historical global electricity consumption by method of generation.
- describe a potential scenario for global energy demand over the short to longer term.
- describe a potential scenario for global energy mix by primary fuel and production method to meet demand over the short to longer term.
- explain the generation of CO_2 from the combustion of fossil fuels and range of factors responsible for the historical increase in global CO_2.
- describe the greenhouse gas effect and the potential impacts of climate change.
- describe the finite lifespan of fossil fuel based technologies.

Evidence should be generated through a closed-book assessment under supervised conditions.

Outcome 2

Evidence for the Knowledge and/or Skills in this Outcome will be generated through sampling. Each learner will need to provide evidence to demonstrate they can examine three of the five national factors relating to energy consumption, electricity generation, greenhouse gas emissions and energy security. The evidence should be responses to specific questions.

To ensure that learners will not be able to foresee all the items they will be questioned about, a new sample should be used on successive assessment occasions. The new sample may contain a maximum of one of the Knowledge and/or Skills used in the previous assessment occasion.

Higher National Unit specification: Statement of standards (cont)

Unit title: Energy Overview

A learner's response can be judged to be satisfactory where the evidence shows that the learner can, subject to the sample used:

- identify historical energy consumption by primary fuel input basis.
- identify historical energy consumption by end user (energy supplied basis).
- describe historical electricity generated and supplied by method of production.
- describe historical greenhouse gas (CO2e) emission trends by sector (end user).
- explain energy security and status as a net source (fuel) importer/exporter (energy supplied basis).

Evidence should be generated through a closed-book assessment under supervised conditions.

Outcome 3

All Knowledge and/or Skills should be assessed. Learners will need to generate evidence to show that they can investigate current energy efficient measures, technologies and policies specific to the building and transportation sectors in relation to reduced CO_2 emissions. The evidence should be in response to a given brief.

A learner's response can be judged to be satisfactory where the evidence shows that the learner can:

- describe the use of building fabric, building equipment and building control measures and technologies to improve energy efficiency in buildings.
- describe the purpose and content Energy Performance Certificates (EPC).
- describe policies, measures and technologies to support more sustainable transportation to include:
  - EU policy in regard to reduction targets on new car fleet average CO_2 emissions
  - fiscal measures to increase the sales of lower-emitting cars
  - technologies and measures to improve vehicle efficiencies
  - improvements to public transport networks to support a modal shift from private cars
  - electrification of the rail network including high-speed rail
  - the requirement for 'Transport Assessments' with regard to new housing and commercial developments.

Evidence should be generated through a report.

Outcome 4

All Knowledge and/or Skills should be assessed. Learners will need to generate evidence to show that they can describe traditional and more sustainable industrial sized power plants in terms of operational process and advantages of each. The evidence should be responses to specific questions.

Higher National Unit specification: Statement of standards (cont)

Unit title: Energy Overview

A learner's response can be judged to be satisfactory where the evidence shows that the learner can:

- explain the operational process of two traditional and two sustainable power plants from energy input through to energy output.
- describe four advantages of traditional power plants compared to sustainable power plants.
- describe four advantages of sustainable power plants compared to traditional power plants.

Evidence should be generated through a closed-book assessment under supervised conditions.

Higher National Unit Support Notes

Unit title: Energy Overview

Unit Support Notes are offered as guidance and are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this Unit

The Unit is designed to raise awareness of the issues related to the production and consumption of energy on a global and national scale. In particular, the continued use of fossil fuel based technologies and the resulting CO_2 emissions are causing global warming leading to climate change. Additionally, the consumption of finite fossil fuel resources will eventually lead to a shortage of primary fuels and therefore energy supply is unlikely to meet energy demand. For these reasons, the need for energy production from more sustainable sources together with the implementation of energy efficiency measures are essential to reduce the impact of climate change, reduce energy demand and provide future energy security.

Outcome 1

Statistical and graphical data from authoritative sources such as the International Energy Agency (IEA) and the Intergovernmental Panel on Climate Change (IPCC) or similar data sources may be used to show historical trends and future scenarios. For energy production by primary fuel, trends should relate from around the industrial revolution (circa 1800) to present day. The significant increase around the middle of the 20th century and the continued rise should be explained. The period from around 1970 to present day (or the most recent available data) may be used in relation to electricity generation by method. Potential scenarios for global energy demand and energy mix should extend up to a point within the period between 2035 and 2050. Currently (2013) there are several authoritative projections up to 2035 and 2050.

The amount of CO_2 released through the combustion of various fossil fuels (coal, petrol, diesel, natural gas, etc) should be considered highlighting the typical ratio of 1 tonne fossil fuel to 3 tonnes CO_2. The link between energy production and CO_2 released during the 20th century and up to present day should be highlighted through graphical comparisons and in particular, the significant increase in CO_2 emissions during the latter half of the century. The factors responsible for increased CO_2 emissions during the latter half of the 20th century should be discussed from the point of view of increased energy demand. The increasing demand being a combination of factors including increasing population, greater demand for transport, greater wealth and technological advancement particularly in the electronics industry resulting in the production of many consumer based devices such as PCs, TVs and mobile devices.

The greenhouse gas effect should be explained. The potential impacts of climate change as a result of global warming should be discussed including the likelihood of increasing occurrences of weather extremes, increased risk of flooding, rising sea levels and land-loss, drought and famine leading to population migration and health issues. It should be noted some impacts will be regionally based.

The finite lifespan of fossil fuels in terms of longevity and the resulting need to generate energy using more sustainable fuels and methods should be discussed.

Outcome 2

This Outcome involves the use of national statistical and graphical data from recognised sources. For the UK, the Department of Energy and Climate Change (DECC) provides a wide range of data. Contained within the DECC website is the 'Digest of UK Energy Statistics' (DUKES) which provides sufficient data to meet most of the knowledge and skills required for this Outcome.

The energy consumption by primary fuel input basis includes any losses in conversion from primary to secondary fuels (eg power stations and oil refineries), energy lost in the distribution of fuels (eg transmission lines) and energy conversion losses by end user. The energy consumption by end user on the energy supplied basis measures the energy content of the fuels, both primary and secondary, as supplied to the end user. It is net of any fuel industry own use, conversion and transmission losses but does include end user conversion losses. Currently, DUKES historical data is available between 1970 and 2011 to enable learners to analyse and describe trends for both the primary fuel input basis and the energy supplied basis.

Electricity generated and supplied by production method is also available from DUKES for the period 1970 to 2011. This data can be used by learners to analyse and determine specific and overall trends.

Greenhouse gas emissions should be expressed as CO_2 equivalent (CO_2e). Currently in the UK, emissions are listed by national communication category and the nine end user categories include business, transport, residential and agriculture. DUKES data from 1990 to 2011 is currently available for all categories. This data can be used by learners to analyse and determine specific sectorial and overall trends.

The importance of energy security should be explained in terms of supply meeting demand, reliability of supply, financial variances and exports and imports of primary fuels and equivalents. Currently, DUKES historical data is available for the period 1970 to 2011 detailing the available supply in terms of production, import and export for coal, petroleum, natural gas and electricity. This data can be used by learners to analyse and determine specific fuel and overall trends.

Higher National Unit Support Notes (cont)

Unit title: Energy Overview

Outcome 3

It is widely recognised that in order to meet future carbon reduction targets, the de-carbonising of the energy supply sector through the implementation of renewable production methods alone will be insufficient as dependency on fossil fuels (to meet energy demand) is likely to continue for several decades. Energy efficiency measures will therefore play a key role in reducing overall CO_2 emissions through reducing energy losses and therefore energy demand. Essentially this will lower an individual's overall carbon footprint. The building and transportation sectors are key sectors where the implementation of energy efficiency measures can have a significant impact on lowering energy consumption and related CO_2 emissions.

The building sector is a significant CO_2 emitter primarily through the energy demand for space heating and cooling.

Building fabric improvement measures include increased and/or more effective insulation (wall, loft and floor) and the use of more energy efficient windows and doors resulting in less heat loss and better draught proofing. Building equipment improvement measures include the use of low voltage lighting, the use of more energy efficient boilers for heating and the use of more efficient air conditioning Units for cooling. Building control measures include the use of time, occupancy and condition controls, sensors and monitoring devices. The Energy Performance Certificate (EPC) is used to raise awareness of the energy efficiency of a building.

To support the delivery of the building Knowledge and/or Skills item, it is suggested that reference to the following publications and/or websites could be made:

EU Directive 2002/91/EC, Energy Efficiency: Energy performance of buildings

EU Directive 2010/31/EC, Energy performance of buildings

Carbon Trust: Building for the future

Carbon Trust: Buildings energy efficiency

Governmental energy efficiency building related information

The transportation sector is also a significant CO_2 emitter primarily through the use crude oil derived products such as petrol, diesel and kerosene (aviation). Whilst in many developed countries total emissions are decreasing, in the EU27 countries, almost all transport emissions have risen significantly (1990 base) resulting in the percentage share of transport related emissions increasing. Additionally, the increasing demand for transport in developing countries is impacting on global transport CO_2 emissions. The electrification of the transport sector is recognised as a measure to reduce dependence on fossil fuels and CO_2 emissions however it should be noted that the major benefits of electrification will only be realised when the electricity is provided from sustainable production methods. In particular, road transport by car is the largest contributor to overall transport emissions and is likely to continue as car ownership rates continue to rise globally. EU national transport data is available from the European Commission's annual *EU Transport in Figures: 2012 Statistical Pocketbook*.

A number of policies, measures and/or technologies have been introduced and/or implemented by the European Parliament, National and Local Governments and vehicle manufacturers to reduce transport based CO_2 emissions.

The EU policy on new car average fleet emissions ($gmCO_2/km$) is a policy designed to set targets for a phased reduction of car CO_2 emissions. Fiscal measures supporting the sales of lower-emitting cars include road fund licence banding, company car tax liability, access to low-emission zones and congestion charging. Improvements to public transport networks to support a modal shift from private cars include access to increased park and ride facilities, development of transport hubs, new rail stations/routes, bus lanes and bus stop data displays, free on-board internet access and the development of tram and light-rail systems. The electrification of the rail network including high-speed rail is designed to improve reliability, reduce journey times and reduce CO_2 emissions. Technologies and/or measures to improve vehicle efficiencies include the introduction of hybrid and all-electric cars, biofuel for buses, stop-start technology, regenerative braking and low resistance tyres. Transport Assessments are now part of transport planning policies and are required when new housing and commercial developments are likely to have an impact on local transport. The objective is to ensure that new developments support the use of more sustainable methods of transport including walking, cycling and access to the public transport infrastructure.

Outcome 4

This Outcome is designed to introduce the traditional and renewables based technologies used to generate energy on an industrial scale (non-domestic). Additionally, the advantages and disadvantages of traditional and sustainable technologies should be highlighted.

Block diagrams may be used to show the power plant key stages in the energy conversion process from input through to output for each technology.

The advantages of traditional over sustainable and vice-versa may include reference to fuel longevity (finite or sustainable resource), fuel resource (national or import), fuel storage, ability to respond to sudden increases in demand, reliability of supply, CO_2 emission levels, financial costs (capital, operational and de-commissioning) and environmental impacts.

Guidance on approaches to delivery of this Unit

This Unit could be delivered at any point within the course delivery period. It is unlikely that it could be delivered through integration with other Units.

It would be beneficial if learners had classroom internet access, particularly to support the delivery of Outcomes 1 and 2.

It is suggested that around 9 hours should be allocated to each of Outcomes 1, 2 and 4. Outcome 3 should be allocated around 3 hours as learners would be expected to carry out research outwith class delivery.

Higher National Unit Support Notes (cont)

Unit title: Energy Overview

Guidance on approaches to assessment of this Unit

Evidence can be generated using different types of instruments of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners. Outcomes 1 and 2 should be assessed on a sample basis.

Centres are reminded that prior verification of centre devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

The Unit may be assessed on an Outcome by Outcome basis or through a combination of Outcomes.

Outcome 1

This Outcome may be assessed individually or in combination with Outcomes 2 and/or 3. Evidence should be generated through a closed-book assessment under supervised conditions.

Outcome 2

This Outcome may be assessed individually or in combination with Outcomes 1 and/or 3. Evidence should be generated through a closed-book assessment under supervised conditions.

Outcome 3

This Outcome should be assessed individually. Evidence could be generated through a report of around 1,200 words.

Outcome 4

This Outcome may be assessed individually or in combination with Outcomes 1 and/or 2. Evidence should be generated through a closed-book assessment under supervised conditions.

Opportunities for e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at **www.sqa.org.uk/e-assessment**.

Higher National Unit Support Notes (cont)

Unit title: Energy Overview

Opportunities for developing Core and other essential skills

Some Core and essential Skills may be developed through the delivery of this Unit.

Information and Communications Technology (ICT) may be developed in all Unit Outcomes and in particular, the use of the internet to search for global and national statistical data relating to energy and also in Outcome 3 in relation to the investigation and production of the report. Numeracy may be developed in Outcomes 1 and 2 in relation to the identification of trends from graphical and tabular data. *Communication* may be developed in Outcome 3 through the production of the report.

Citizenship through effective contribution may be developed in Outcome 3 through raising awareness of an individual's energy consumption (carbon footprint) and the aspiration to reduce consumption thereby contributing to the reduction of CO_2 emissions.

History of changes to Unit

Version	Description of change	Date

General information for learners

Unit title: Energy Overview

This section will help you decide whether this is the Unit for you by explaining what the Unit is about, what you should know or be able to do before you start, what you will need to do during the Unit and opportunities for further learning and employment.

This section will help you decide whether this is the Unit for you by explaining what the Unit is about, what you should know or be able to do before you start, what you will need to do during the Unit and opportunities for further learning and employment.

The Unit is designed to raise awareness of the issues related to the production and consumption of energy on a global and national scale. In particular, the continued use of fossil fuel based technologies and the resulting CO_2 emissions are causing global warming leading to climate change. Additionally, the consumption of finite fossil fuel resources will eventually lead to a shortage of primary fuels and therefore energy supply is unlikely to meet energy demand. For these reasons, the need for energy production from more sustainable sources together with the implementation of energy efficiency measures are essential to reduce the impact of climate change and also reduce energy demand.

The Unit is optional for learners on related HN Engineering Awards. It could also be used as a stand-alone Unit where appropriate.

Outcome 1 has been designed to raise awareness of historical global energy trends and potential scenarios for future demand and how this demand may be met. You will also learn the reasons for the continued and increasing use of fossil fuels and how this is contributing to climate change. The finite lifespan of fossil fuels will also be explained.

Outcome 2 has been designed to raise awareness of historical national energy trends and CO_2 emissions. Energy security and import/export of primary fuels will be included.

Outcome 3 has been designed to raise awareness of energy efficiency policies, measures and technologies specific to the building and transportation sectors.

Outcome 4 has been designed to raise awareness of traditional and more sustainable energy production methods. In addition, the advantages of each method will be described.

In order to achieve this Unit, all Outcomes must be achieved. Two types of assessment will be used for this Unit. Outcome 1, 2 and 4 will be assessed by responses to structured questions under closed-book conditions. Outcome 3 will be assessed by submission of a report from a given brief.

There is no automatic certification of Core Skills or Core Skill components in this Unit.

The Unit has been designed to support articulation routes to degree programmes and also to support employment opportunities in the energy sector.