SQA Advanced Unit specification

General information for centres

Unit title: Renewable Energy Systems: Overview of Energy Use

Unit code: HV48 47

Unit purpose: This Unit has been designed to provide candidates with knowledge and understanding of current issues and trends in the production and use of energy. The Unit will also allow candidates to gain an understanding of the need for sustainability and the adoption of renewable energy sources in order to limit global environmental damage. In all cases, arguments are primarily developed on the basis of quantitative data, though qualitative social factors are also considered. The Unit is largely theoretical in nature and does not consider the technology of renewable energy systems, and as such, the Unit may be considered applicable to disciplines out with Engineering.

On completion of the Unit the candidate should be able to:

1 Describe global energy uses and trends.
2 Explain environmental effects associated with energy production and use.
3 Analyse the costs of different sources of energy.
4 Compare the advantages and disadvantages of alternative energy sources.
5 Explain the concepts of efficiency and energy saving in buildings, transportation and power generation.
6 Analyse the benefits and drawbacks of applying renewable energy and efficiency improvement techniques to a specific problem.

Credit points and level: 2 SQA Credits at SCQF level 7: (16 SCQF credit points at SCQF level 7*)

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from National 1 to Doctorates.*

Recommended prior knowledge and skills: Entry to this Unit is at the discretion of the centre. However candidates should be competent in reading and writing Communication skills, Numeracy and Information Technology. These competences may be evidenced by possession of the following SQA Advanced Unit: HP4A 47 *Communication: Practical Skills*; SQA Advanced or NQ Units that have embedded within them the Numeracy Core Skill and/or the Information Technology Core Skill at SCQF level 5.

Core Skills: There are opportunities to develop the following Core Skill and Core Skill components in this Unit, although there is no automatic certification of Core Skill or Core Skills components:

- Communication SCQF level 6
- Information Technology SCQF level 6
- Numeracy SCQF level 6
- Problem Solving SCQF level 6

Context for delivery: This is one of 10 dedicated renewable energy Units that together comprise a specialist thread within the SQA Advanced Diploma in Engineering Systems framework. The Unit should be considered as an introduction to the topic of Renewable Energy Systems. The Unit has been designed to put the need for and importance of renewable energy in a rapidly developing world into a global context. It provides underpinning knowledge for the specialist technological Units that make up the remainder of the group, and offers a fundamental justification for developments in the field of renewable energy. An emphasis on quantitative data and the reliance on empirical calculation to guide decision making makes for an approach different in nature to the treatment of the subject that might be encountered within other fields of study. For this reason, the Unit must be delivered in a quantitative way with a strong emphasis on cost, trends and objective evaluation, with the adoption of a clear engineering approach to problem situations. Candidates may progress to the Unit HV5N 48 *Renewable Energy Systems: Technology* (2 SQA Credits, SCQF level 8) for an overview of the technology relevant to renewable energy systems and/or to specialist Renewable Energy Units (eg Wind, Wave/Tidal, Hydrogen etc).

In the Unit the importance of energy for economic and social development will be considered. Energy reduction through improved efficiency is certainly realisable, but current trends still show increased energy consumption. The environmental effects and limited supply of fossil fuels will be described as an argument for sustainability. The costs and potential of alternative energy sources will be examined. The effect of the application of alternative energy to systems or devices currently supplied by traditional means or subject to traditional and possibly inefficient design will be examined.

Candidates may benefit from observing or examining real renewable energy devices, either in the laboratory or through field trips, although such observations are not mandatory.

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

Assessment: Unit assessment is left for each centre to decide although the following assessment strategy is strongly recommended:

Outcomes 1, 2, 3, 4 and 5

Two assessments of the following form:

Assessment 1

A multiple-choice assessment paper designed to cover all knowledge and/or skills items in the five Outcomes and lasting 1hr 30 min. This assessment paper should be conducted under controlled, supervised, closed-book conditions.

Assessment 2

An assessment paper which is sat under controlled, supervised, open-book assessment conditions and lasts two hours. The assessment paper may comprise of four questions involving calculations based on the following knowledge and/or skills items:

- Future energy usage trends, energy balance, new energy sources
- Evaluation of the practicality and effectiveness of carbon sequestration methods
- Efficiency in buildings/transportation/power generation

Outcome 6

Candidates should be presented with a moderately complex, realistic energy problem and must assess the effect of the adoption of techniques to reduce energy use or reduce environmental damage through improved efficiency measures and the introduction of renewable energy sources. Candidates should provide evidence in the form of a written report. This report should be prepared in the candidates own time.

SQA Advanced Unit specification: statement of standards

Unit title: Renewable Energy Systems: Overview of Energy Use

Unit code: HV48 47

The sections of the Unit stating the Outcomes, Knowledge and/or Skills, and Evidence Requirements are mandatory.

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. Candidates 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

Describe global energy uses and trends

Knowledge and/or Skills

- Current energy use by sector
- Future energy usage trends
- Energy balance
- New energy sources
- Policies that impact on the adoption of Renewable Energy Systems

Outcome 2

Explain environmental effects associated with energy production and use

Knowledge and/or Skills

- Negative environmental effects of energy use
- Greenhouse effect and global warming
- Role of carbon dioxide and other gases
- Carbon sequestration methods

Outcome 3

Analyse the costs of different sources of energy

Knowledge and/or Skills

- Standard units of energy and power
- Production cost of energy from different sources
- Distribution and storage issues

Outcome 4

Compare the advantages and disadvantages of alternative energy sources

Knowledge and/or Skills

- Wind power
- Wave and tidal power
- Solar power
- Geothermal power
- Biomass and bioenergy
- Hydroelectricity
- New and emerging technologies

Outcome 5

Explain the concepts of efficiency and energy saving in buildings, transportation and power generation

Knowledge and/or Skills

- Efficiency and energy saving in buildings
- Efficiency and energy saving in transportation
- Efficiency and energy saving in power generation
- Current legislation

Evidence Requirements

All Knowledge and/or Skills items should be assessed.

A candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing the candidate is able to for:

Outcome 1

- Explain the current use of energy by sector
- Analyse future energy usage trends from available data
- Explain the concept of energy balance (ie supply must equal demand)
- Justify the need for new sources of energy
- Explain the role of current policies, such as those relating to planning, conservation etc, on the implementation of renewable energy systems

Outcome 2

- State the negative environmental effects of energy use such as oil spills, acid rain, atmospheric soot, nuclear waste, wind turbine noise, hydroelectric dam catchment flooding etc
- Describe the greenhouse effect and how it gives rise to global warming
- Describe the role of carbon dioxide and other gases in the greenhouse process
- Evaluate the practicality and effectiveness of carbon sequestration methods

Outcome 3

- State standard units of energy and power and conversion factors between different units of energy and power
- Explain the relative costs of producing electrical power from conventional and new sources of energy
- Explain the advantages and disadvantages of existing storage and distribution methods, and the role of hydrogen

Outcome 4

Compare the relative advantages and disadvantages of the following alternative energy sources:

- Wind power
- Wave and tidal power
- Solar power
- Geothermal power
- Biomass and bioenergy
- Hydroelectricity
- New and emerging technologies

Outcome 5

- Describe the principles of efficiency and energy saving in buildings
- Describe the principles of efficiency and energy saving in transportation
- Describe the principles of efficiency and energy saving in power generation
- State current legislation regarding energy use and schemes to promote energy efficiency

Regardless of whether the Outcomes are assessed on their own or in combination with each other all assessment should be carried out under controlled, supervised conditions.

Assessment guidelines

The assessment of Outcomes 1, 2, 3, 4 and 5 may comprise of the following two assessment papers.

Assessment 1

A multiple-choice assessment paper designed to cover all Knowledge and/or Skills items in the five Outcomes. The assessment paper may consist of 50 questions and may be sat under closed-book conditions in which candidates would not be allowed to bring any textbooks, handouts or notes to the assessment. The assessment may last 1hr 30 min. If 50 multi-choice questions are selected for the assessment paper the balance of questions across the five Outcomes may be as follows:

- Outcome 1–5 questions
- Outcome 2–12 questions
- Outcome 3–14 questions
- Outcome 4–15 questions
- Outcome 5–4 questions

Assessment 2

An assessment paper which is sat under open-book assessment conditions. The assessment paper should last two hours. The assessment may comprise of 4 questions involving calculations based on the following Knowledge and/or Skills items:

- future energy usage trends, energy balance, new energy sources
- evaluate the practicality and effectiveness of carbon sequestration methods
- efficiency in buildings/transportation/power generation

It is recommended that to pass Assessment 2 all calculations should be substantially correct with a maximum of four minor errors permissible.

Outcome 6

Analyse the benefits and drawbacks of applying renewable energy and efficiency improvement techniques to a specific problem

Knowledge and/or Skills

- Interpretation of problem
- Formulation of proposals
- Evaluation of proposals
- Presentation of findings

Evidence Requirements

All Knowledge and/or Skills items in this Outcome should be assessed.

Candidates should be presented with a moderately complex, realistic energy problem and must assess the effects of adopting techniques to reduce energy use or reduce environmental damage through improved efficiency measures and the introduction of a renewable energy source(s). A proposal should be developed and a cost and functional analysis should be undertaken to determine both the benefits and drawbacks of the proposal. Findings should be presented in a report of 1,250 to 1,500 words plus diagrams and appendices. The report should include:

- an overview of the problem situation
- an assessment of the current situation
- a description of the proposals that may lead to improvement
- a quantitative evaluation of these proposals
- conclusions

The report should be referenced.

A candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing the candidate is able to:

- interpret a moderately complex problem situation concerning energy use
- develop a proposal to improve energy performance in accordance with legislation, energy efficiency and the use of renewable energy sources
- evaluate the proposal in terms of benefits and drawbacks over conventional approaches
- present findings as part of a well-structured report

Candidates should produce their reports in their own time. Centres should make every reasonable effort to ensure the report is the candidate's own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter. A checklist should be used to record oral evidence of the candidate's knowledge and understanding.

Assessment guidelines

Centres may wish to give candidates guidance on the best way to structure their reports or leave it to the candidates to decide how they will structure their reports.

Administrative Information

Unit code: HV48 47

Unit title: Renewable Energy Systems: Overview of Energy Use

Superclass category: XK

Original date of publication: November 2017

Version: 01

History of changes:

Version	Description of change	Date

Source: SQA

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

FURTHER INFORMATION: Call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our Centre Feedback Form.

SQA Advanced Unit specification: support notes

Unit title: Renewable Energy Systems: Overview of Energy Use

This part of the Unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 80 hours.

Guidance on the content and context for this Unit

This Unit has been written as one of the 10 renewable energy Units within the SQA Advanced Diploma in Engineering Systems award. These are:

- Renewable Energy Systems: Technology (2 credits, SCQF level 8)
- Renewable Energy Store: Hydrogen (1 credit, SCQF level 8)
- Renewable Energy Systems: Wind Power (1 credit, SCQF level 8)
- Renewable Energy Systems: Wave and Tidal Energy (1 credit, SCQF level 8)
- Renewable Energy Systems: Solar (1 credit, SCQF level 8)
- Renewable Energy Systems: Biomass (1 credit, SCQF level 8)
- Renewable Energy Systems: Geothermal Energy (1 credit, SCQF level 8)
- Renewable Energy Systems: Hydroelectricity (1 credit, SCQF level 8)
- Renewable Energy Systems: Microgeneration Systems (1 credit, SCQF level 7)

This 2 credit Unit *Renewable Energy Systems: Overview of Energy Use* provides an introduction to the subjects of energy usage and trends, environmental impact of energy use, and renewable energy sources from both a global and local perspective. The 2 credit Unit *Renewable Energy Systems: Technology* describes the basic technology associated with renewable energy devices. The remaining 1-credit Units take a specialised look at each of the technologies currently believed to be significant, and, as such, provide an opportunity for candidates to specialise in some of these technologies. It is important that all these Units are seen as providing an integrated programme of study covering energy issues with a focus on renewable energy systems. As such every opportunity should be sought to combine the delivery and assessment of the Units.

The emphasis in all the 10 Units should be on allowing candidates to develop knowledge and understanding of the energy and environmental issues facing this country and others as well as giving them the knowledge and skills required to understand how renewable energy systems generate power as electricity or other energies/fuels. It is important that environmental as well as technological issues and developments are discussed as each has a bearing on the other. The 1 credit specialist Units will allow candidates to develop a deeper knowledge and understanding of how these systems work from an engineering systems perspective and should enhance the core Units in the SQA Advanced Diploma Engineering Systems award.

In designing this Unit, the range of topics expected to be covered by lecturers has been identified. Recommendations as to how much time should be spent on each Outcome has also been given. This has been done to help lecturers decide what depth of treatment should be given to the topics attached to each of the Outcomes.

Whilst it is not mandatory for centres to use this list of topics it is strongly recommended that they do so to ensure continuity of teaching and learning.

Outcome 1

Describe global energy uses and trends (10 hours)

Give some background information about fossil fuels in a historical context. Describe how energy is used by sector, making a clear distinction between domestic, industrial, air and road transport uses. Explain worldwide use of energy and trends in energy use. It would be helpful to present data graphically and encourage candidates to prepare graphs from tabular data. They may be introduced to spreadsheet software to assist with the production of graphs and trend calculations.

Describe the notion of an energy balance where the demand must be satisfied by supply. Describe the role of energy conservation in terms of reducing the demand side. Show that current supply (with the quantity of fossil fuels predicted to drop over the next century) cannot match demand. Explore the potential social and economic consequences. Explain that alternative sustainable sources of energy are required.

Consider the effect of increasing energy cost and how alternative energy production methods that are currently economically unfavourable may not be so in the future and that developments and research should not necessarily be based on current cost. Describe social economic reasons for introducing renewable energy (rather than purely environmental reasons).

If the assessment strategy is adopted as recommended in the General information for centres section and in the SQA Advanced Unit specification statement of standards section then it is recommended that 5 of the questions in **Assessment 1** should be drawn from the knowledge and/or skills items in Outcome 1. The first three knowledge and/or skills items may be assessed by one question in **Assessment 2**. It is desirable that this be a graphical question. For example, candidates may be presented with tabular data which they are asked to draw a graph of. They may then be asked to find the trend, consider the energy balance and calculate the energy needed to satisfy projected demand.

Outcome 2

Explain environmental effects associated with energy production and use (12 hours)

List the negative environmental effects of energy use. These include oil spills, acid rain, atmospheric soot, nuclear waste, wind turbine noise, hydroelectric dam catchment's area flooding, etc. Each should be quantified as far as possible (number of deaths, effect on health, social impact etc). Describe in some detail the process of global warming through the greenhouse effect. The greenhouse process and the effect of a variety of gases should be described qualitatively. Discuss the roles of CFCs. It is important to include a description of the way the Earth acts to reduce carbon dioxide concentrations through the response of plant life and the seas to increasing carbon dioxide concentration. Critically evaluate current predictions and the uncertainty in the current computer models. Describe worse case scenarios and actions taking place to reduce pollution, including the concept of the carbon footprint and carbon sequestration. Candidates should be encouraged to debate these issues whilst adopting an analytical approach to the issue based on real data that is currently available, rather than responding emotionally.

Discuss the difficulty in reducing energy use and the possible need to accept rather than prevent climate change.

If the assessment strategy is adopted as recommended in the General information for centres section and in the SQA Advanced Unit specification statement of standards section it is recommended that as Outcome 2 makes up a substantial part of the Unit content 12 questions in **Assessment 1** be drawn from this Outcome. If it is decided that a knowledge and/or skills item(s) be included in **Assessment 2**, the question may require the candidate to calculate the quantity of carbon trapped annually by a hectare of trees grown from seed, and how this compares to, for example, a typical motor car. The candidate may be asked to calculate if there are advantages in cutting down forests for new growth because of the variation in tree growth over its lifetime.

Outcome 3

Analyse the costs of different sources of energy (12 hours)

Having established in the first two Outcomes that alternative sources of energy are needed and that current energy production is damaging, it is now appropriate to consider the economic factors driving the development of new energy sources in particular and government energy policy in general. To undertake the work in this Outcome it is important to ensure candidates are familiar with the common units of energy and power and are able to convert between them. Describe primary energy sources and explain from where the energy ultimately originates. For coal, oil, gas, nuclear, wind, wave, geothermal, hydroelectric and solar, compare the cost of the production of 1 kWh of energy for each (including all capital cost). Describe how these costs are likely to change in the future for fossil fuels.

Describe the electrical distribution system. Consider the costs associated with energy distribution. This includes power losses in lines. Describe the losses associated with energy storage (eg pump storage) and supply balancing. Compare the advantages and disadvantages of local versus national power systems.

Describe the advantages of using hydrogen as an energy carrier, particularly the ease and efficiency of production by electrolysis. Explain the disadvantages of storage and distribution, as well as safety issues. Emphasise the role of hydrogen as an answer to significant distribution losses that currently exist, and the storage issues associated with the intermittency of many renewable energy sources.

If the assessment strategy is adopted as recommended in the General information for centres section and in the SQA Advanced Unit specification statement of standards section the Outcome should be entirely assessed through **Assessment 1** and it is recommended that 14 questions be drawn from this Outcome.

Outcome 4

Compare the advantages and disadvantages of alternative energy sources (16 hours)

Following on from the work on the costs of renewable energy sources compared with traditional energy sources it is now interesting to explore how the cost of renewable energy may alter in the future. This is best achieved by describing the current status of each of the renewable energy technologies, current research and development activities and how things may change in the future.

A key purpose of this Outcome is to emphasise that technological breakthroughs may quickly affect the current balance between the various renewable technologies and it is not wise to focus merely on one technology (eg wind power) merely because it is currently favoured. Note that a completely new technology may emerge, such as fusion or photosynthesis in the laboratory to make the currently favoured technologies obsolete.

In this Outcome more detailed information about the range of technologies available should be introduced. It is recommended that two hours should be allocated to each technology. Each technology should be introduced in simple descriptive terms, with an emphasis on any improvements that might be possible.

Wind Power — Describe the scaling paradigm of wind turbines manufacture and the problem with on and offshore placement. Describe the grid connection issues. Discuss whether performance can be improved by choosing microgeneration as an alternative in the future and the problems that have to be overcome (eg mounting problems and the improvement of efficiency by improved blade design). Discuss issues such as noise.

Wave and Tidal Power — There are serious problems with extracting energy from the sea paradoxically because the available energy is so great that it can readily damage equipment. Nevertheless there are many extraction techniques under consideration which can be described. State the stage of development and the commercial potential of each. It is important to convey the message that this is potentially one of the more promising sources of renewable energy. Distinguish between wave and tidal power as they have two very different origins (the nuclear and gravitational forces respectively), and there is a significant variation in available power and predictability.

Solar Power — Describe the emission spectrum of the sun and how much energy is incident on each square metre and how different techniques favour different energy bands from the spectrum. Present the photoelectric effect in photovoltaic arrays, solar hot water heating, and photosynthesis with the ultimate creation of fossil fuels as examples. Describe the efficiency of each method.

Explain the future potential of solar PV as new materials are developed with greater conversion efficiency, operating over a wider range of the spectrum, and lower production costs.

Geothermal Power — Explain how the temperature of the Earth varies with the depth into the ground and the sources of this temperature difference (nuclear fusion in the core of the Earth, pressure and the thermal inertia of the Earth). Describe how the temperature can be used as a reference point for a heat pump or by the direct extraction of energy at selected favourable points. Consider drilling costs and how these may change.

Biomass (and bioenergy) — Describe the production of energy by biological means. This includes the production of oil/diesel and the direct combustion of organic material. Describe the use of microorganisms to break down waste to produce combustible gases. Assess the role of this technology and its future potential. Explain that engines may have to be modified to consume bio-gasses efficiently.

Hydroelectric Power — Describe existing schemes, both large and small, and the advantages (reliable energy production at very low cost) and disadvantages (high construction costs and land loss behind the reservoir dam). Explain the main problems of finding suitable sites that have minimal social and environmental impact. As an example, consider the sites that are suitable in Scotland and the difficulty in exploiting these. Consider hydroelectric systems or bulk energy storage.

New Technologies — Describe any new technologies that may have emerged since the publication of this Unit specification.

If the assessment strategy is adopted as recommended in the General information for centres section and in the SQA Advanced Unit specification statement of standards section the Outcome can be entirely assessed through **Assessment 1** and it is recommended that 15 questions be drawn from the Outcome.

Outcome 5

Explain the concepts of efficiency and energy saving in buildings, transportation and power generation (10 hours)

In this Outcome the focus shifts to the demand side with a concentration on energy conservation. Energy is wasted through its inefficient use in buildings, transportation and even in electrical generation. In this Outcome candidates should be encouraged to learn what methods should be adopted to minimise or even eliminate energy losses.

In buildings, explain how insulation and the incorporation of renewable energy systems that are most appropriate to the environment should be introduced at the early design stage. Emphasise the importance of monitoring and control so that losses can be quickly detected. In transportation, discuss the efficiency of machines and how this varies over the transport spectrum. Explain methods for improving efficiency. In power generation, show how waste heat associated with any thermodynamic cycle can be reused. Consider how energy use in homes may reduce in the future.

It is important that candidates are made aware of all current UK and European legislation applicable to energy conservation and the use of renewable energy sources so that they are able to advise others.

If the assessment strategy is adopted as recommended in the General information for centres section and in the SQA Advanced Unit specification statement of standards section candidates should perform efficiency calculations for the first three knowledge and/or skills items. They may be asked to compare the efficiency of directly burning gas to heat a home and the use of electric heating from a gas-powered power station. Realistic figures should be presented (including transportation costs). There may be one or two questions in **Assessment 2** related to this Outcome. The knowledge and/or skills items in this Outcome may be assessed by 4 questions in **Assessment 1**.

Outcome 6 Analyse the benefits and drawbacks of applying renewable energy and efficiency improvement techniques to a specific problem (20 hours)

This Outcome draws together all the work from the previous Outcomes.

The problem selected for assessment must not be too complex at this level (given the time limitation) and should be realistic so that the candidate can see how the content of the Unit is readily applicable to day-to-day situations.

A typical problem might be to ask if the use of two 1.5 kW micro wind turbines is appropriate to replace the supply of energy to a typical home from oil central heating and mains electricity. The first task would be to get specifications and costs for turbines currently available and determine how the output should be converted to 230VAC. A specific turbine may be selected having considered environmental, siting and legislation issues, and the mean annual wind strength at that location.

A calculation of the cost benefit or penalty for the turbines running should be included, but an estimation of how increasing fossil fuel costs and reducing turbine costs (as a result of large-scale production) may alter the balance in future should also be considered.

The problems of balancing should be highlighted and how energy should be stored when the turbine output is too low. The use of hydrogen and putting the output from the turbines directly onto the grid should be considered.

Candidates must be encouraged to used appropriate software to produce the report (including the preparation of diagrams and graphs). Hand-written submissions should be discouraged. It may be necessary to provide some assistance with formatting and the selection of an appropriate style, and the candidate should be encouraged to include a contents list to the document.

The candidate should be introduced to the concept of formal report writing and the necessity of logical development and clarity. Unsubstantiated comments should be avoided.

The difference between plagiarism and referencing the work of others should be made clear and a standard method of referencing should be adopted. As the assignment may include a significant amount of research, it is important that candidates have access to appropriate resources. It should be made clear that only credible internet sites should be referred to (and referenced).

Guidance on the delivery and assessment of this Unit

This Unit may be delivered by a combination of lecturing, group work, investigation (including the use of the internet), class discussion/debate and case studies. The internet contains a rich and varied range of materials relating to energy usage and trends, environmental issues and renewable energy systems.

Industrial visits may prove useful in allowing candidates to observe a range of renewable energy systems in operation.

In Outcome 6 candidates will have opportunities to develop basic investigation and research skills. However, at this stage the research activity should be directed as candidates may have little research experience and may be unsure of how to proceed. Candidates should be encouraged to express their views, but must be shown that these views must be consistent with the available evidence and that data should not be used selectively.

It is inevitable that any discussion on renewable energy will highlight the conflict between local and global needs and the lecturer should encourage the candidate to establish a reasonable balance.

Opportunities for developing Core Skills

Access to and evaluation of complex technical information, using paper based and internet sources, will support knowledge and develop key skills in communication and information technology. Candidates should be provided with guidance on research techniques as well as advised on acceptable format, style and structure in report writing. They should be aware that technical accuracy of complex ideas and information should be supported by clearly annotated drawings and diagrams. Resources available could include appropriate software packages to process data, support accuracy and ensure the effective presentation of written and graphic information. Formative discussion on energy usage, applications and trends will provide opportunities for candidates to analyse issues, respond to questions and develop oral communication skills in a practical context.

Numeracy skills will be naturally enhanced, with the focus on the practical interpretation, application and presentation of complex numerical and graphical data. Skills in the Using Number component may be developed while performing calculations in such areas as future energy usage trends, energy balance, new energy sources, evaluating the practicality and effectiveness of carbon sequestration methods and efficiency in buildings/transportation/power generation. Skills in Using Graphical Information may be developed while representing energy and other data in various graphical formats.

All elements of the Core Skill of Problem Solving, that is, critical thinking, planning, organising, reviewing and evaluating, will be naturally developed and enhanced as candidates examine, interpret and develop a solution to the assessment problem outlined in Outcome 6. Identifying and analysing a complex range of factors impacting on the use of renewable energy candidates will seek solutions to theoretical and practical problems and issues in different applications. They fully examine the variables including sources, cost and environmental concerns. The effects, benefits and drawbacks of applying renewable energy and efficiency improvement techniques to a specific problem is identified, justified and evaluated in a comprehensive report.

Open learning

As this Unit involves a significant amount of knowledge and understanding it is suitable for delivery through open learning and online delivery. Assessments 1 and 2 may be presented online, and Assessment 3 may be a work-based assignment appropriate to the remote learner's field of work or expertise.

Where open learning is considered due regard to assessment planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangements would be required to be put in place to ensure that Assessment Papers 1 and 2 are done under controlled, supervised conditions.

For information on normal open learning arrangements, please refer to the SQA guide *Assessment and Quality Assurance of Open and Distance Learning (SQA 2000).*

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.

General information for candidates

Unit title: Renewable Energy Systems: Overview of Energy Use

This Unit is one of 10 Units on the very important subject of Renew Energy Systems. Unlike the other nine Units the main focus of this Unit is not the technology surrounding Renewable Energy Systems, rather the Unit has been designed to give a broad overview of the many energy and environmental issues that face the world today. These issues are leading some to believe that the use of renewable energy sources represents one way of meeting at least part of the world's energy demands while also helping to reduce the impact on the environment.

During the delivery of the Unit you will study such subjects as global energy uses and trends, environmental effects associated with energy production and use, the costs of different sources of energy, the advantages and disadvantages of renewable energy sources, and the concepts of efficiency and energy savings in buildings, transportation and power generation.

Delivery of the Unit will consist of lecturing, group work, investigation (including the use of the internet), classroom discussions/debate and case studies. The internet contains a rich and varied range of materials relating to such subjects as energy use and trends, environmental impact of energy usage, renewable energy systems etc. Your lecturers may also take you on industrial visits to examine different types of Renewable Energy Systems in operation.

Assessment in the Unit is likely to comprise of two assessments to cover the work of Outcomes 1, 2, 3, 4 and 5. The first assessment will be in the form of a multi-choice question paper lasting 1 hour and 30 minutes. The second assessment will comprise of an assessment paper lasting 2 hours in which you will have to answer four questions involving calculations based on the following subjects:

- future energy usage trends, energy balance, new energy sources
- evaluation of the practicality and effectiveness of carbon sequestration methods
- efficiency in buildings/transportation/power generation

Both assessment papers will be conducted under controlled, supervised conditions.

The assessment of Outcome 6 will consist of you being presented with a moderately complex, realistic energy problem in which you must assess the effects of adopting techniques to reduce energy use or reduce environmental damage through improved efficiency measures and the introduction of renewable energy sources. You will need to provide assessment evidence in the form of a written report which you will write in your own time.