

## SQA Advanced Unit specification

### General information for centres

**Unit title:** Renewable Energy Systems: Microgeneration Systems

**Unit code:** HR49 47

**Unit purpose:** This Unit has been designed to develop candidates' knowledge and understanding of small power renewable energy generation systems suitable for domestic or small community development. The Unit deals with all aspects of generating energy for the home or small business from planning, installation and running such systems. Candidates will have opportunities to develop a report on the energy conservation issues associated with using microgeneration on small scale ventures which can be their own home, business or community. Various technologies that can be used for this type of energy generation will be investigated mainly through using existing products available on the market but self designed systems can also be used. The financial and environmental impact of using microgeneration systems against using energy from the national grid will also be investigated.

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

- 1 Analyse the results from an energy audit.
- 2 Select a microgeneration system for a particular project.
- 3 Evaluate the effects and benefits of microgeneration from a financial and environmental point of view.

**Credit points and level:** 1 SQA Credit at SCQF level 7: (8 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:** It is recommended that candidates have a knowledge and understanding of energy issues and energy systems. This may be evidenced by possession of the SQA Advanced Unit HV48 47 *Renewable Energy Systems: Overview of Energy Use*.

**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:

- |                          |              |
|--------------------------|--------------|
| ◆ Problem Solving        | SCQF level 6 |
| ◆ Communication          | SCQF level 6 |
| ◆ Information Technology | SCQF level 6 |
| ◆ Working with Others    | SCQF level 6 |

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**Context for delivery:** This Unit has been developed for the SQA Advanced Diploma in Engineering Systems and the PDA in Renewable Energy Systems. 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:** The assessment strategy for this Unit is as follows:

Outcomes 1, 2 and 3 should be assessed by candidates undertaking an investigation into the introduction of a microgeneration system to a building and producing a report of 2,000 words plus diagrams and appendices based on their analysis of the issues involved in installing the microgeneration system(s).

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### **Unit specification: statement of standards**

**Unit title:** Renewable Energy Systems: Microgeneration Systems

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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**

Analyse the results from an energy audit

##### **Knowledge and/or Skills**

- ◆ Insulation systems for new build and existing buildings
- ◆ Energy saving techniques/systems
- ◆ Energy audit

#### **Outcome 2**

Select a microgeneration system for a particular project

##### **Knowledge and/or Skills**

- ◆ Types of Microgeneration Systems
- ◆ Microgeneration Systems: Selection and Justification Criteria

#### **Outcome 3**

Evaluate the effects and benefits of microgeneration from a financial and environmental point of view

##### **Knowledge and/or Skills**

- ◆ Metering/buy back
- ◆ Government grants
- ◆ Cost effectiveness comparisons
- ◆ Payback period
- ◆ Power/Energy output fluctuations
- ◆ Carbon reduction/emissions
- ◆ Energy/Power/Efficiency gains/losses

##### **Evidence Requirements**

All Knowledge and/or Skills items in Outcomes 1, 2 and 3 should be assessed.

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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

- ◆ Describe how the energy audit was conducted
- ◆ Detail the data gathered
- ◆ Evaluate the data gathered and described types of insulation and other energy saving methods to reduce energy wastage

### Outcome 2

Select **one** microgeneration system from Section A and apply all the Knowledge and/or Skills elements listed in Section B to this selected system.

#### Section A

##### Microgeneration Systems

- ◆ Wind Turbines
- ◆ Small Hydro
- ◆ Solar Photovoltaic (PV)
- ◆ Solar Water Heating
- ◆ Bio Mass — eg wood chip
- ◆ Ground Source Heat Pumps

#### Section B

##### Microgeneration Systems: Selection and Justification Criteria

- ◆ National guidelines/regulations
- ◆ Local planning regulations
- ◆ Building regulations
- ◆ Equipment costs
- ◆ Installation costs
- ◆ Domestic/small community installations
- ◆ Viable operating costs

Candidates will be expected to justify the microgeneration system selected for their particular investigation. The investigation should be based on the candidate's choice of building selected for assessment purposes in Outcome 1.

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### Outcome 3

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

Evaluate the benefits and drawbacks of the selected system over existing energy supply arrangements in terms of

- ◆ Metering/buy-back
- ◆ Government grants available to fund the system selected
- ◆ Any cost effectiveness comparisons
- ◆ Payback period
- ◆ Power/energy output fluctuations
- ◆ Carbon reduction emissions
- ◆ Energy/power/efficiency gains or losses

Candidate evidence should be presented in the form of a report. The report should be 2,000 words plus diagrams and appendices. The reports should be done in the candidate's own time. The report should include any necessary calculations and include evidence of analysis and evaluation and must be referenced. 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.

The report should be in three sections which relate directly to the Knowledge and/or Skills items in Outcomes 1, 2 and 3. Candidates should report on the energy audit of a building they have conducted, detail the issues involved in installing and running a selected microgeneration system and develop conclusions based on a thorough analysis of introducing the microgeneration system including benefits and drawbacks from a financial and environmental viewpoint.

The investigation could be based on a candidate's own house or small commercial premises or small community building.

### Assessment Guidelines

It is recommended that the report is written up in stages (ie Stage 1 is written up after the energy audit has been carried out on the building, Stage 2 after the microgeneration system has been selected and Stage 3 after a thorough evaluation of the benefits and drawbacks of the microgeneration system have been conducted).

The report may include the following headings:

- ◆ Introduction
- ◆ Planning and building regulations requirements (section 1)
- ◆ Equipment and installation costs (section 1)
- ◆ Selection and justification of a microgeneration system (section 2)
- ◆ Microgeneration System: technology and operation (section 2)
- ◆ Cost Effectiveness: metering, grants and payback (section 3)
- ◆ System efficiency: output fluctuations and power losses/gains (section 3)
- ◆ Environmental Impact (section 3)
- ◆ Conclusions including reflections on the benefits and drawbacks of microgeneration (section 3)

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Candidates must be encouraged to use appropriate software to produce the report and to prepare diagrams and drawings. 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 title page and 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.

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

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### Administrative Information

<b>Unit code:</b>	HR49 47
<b>Unit title:</b>	Renewable Energy Systems: Microgeneration Systems
<b>Superclass category:</b>	XK
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#### History of changes:

Version	Description of change	Date

**Source:** SQA

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### Unit specification: support notes

#### Unit title: Renewable Energy Systems: Microgeneration Systems

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 40 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 and the PDA Renewable Energy Systems award. These are:

- ◆ Renewable Energy Systems: Overview of Energy Use (2 credits, SCQF level 7)
- ◆ 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)

The figures in brackets indicate the SQA Credit value and SCQF level of the Unit respectively.

The double credit Unit HV48 47 *Renewable Energy Systems: Overview of Energy Use* is a basic generic introduction to the subject and aims to present both a local and global perspective of energy use. The Unit HV5N 48 *Renewable Energy Systems: Technology* describes the basic technology associated with renewable energy devices. The remaining Units take a specialised look at each of the technologies currently believed to be significant, and there is the opportunity to specialise. It is important that all these Units are seen as providing an integrated programme of study covering the energy issues with a focus on renewable energy systems. As such every opportunity should be sought to combine the delivery and assessment of these Units.

In designing this Unit, the Unit writers have identified the range of topics expected to be covered by lecturers. The writers have also given recommendations as to how much time should be spent on each Outcome. 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.

The list of topics is shown below:

#### 1 Analyse the results from an energy audit (6 hours)

Candidates should carry out a visual inspection of a building/house in which they identify where energy is being wasted through ineffective materials, draughts or poor insulation, a reduction in the energy being used by reassessing living conditions eg set lower temperature on thermostat, partly fill kettles, decentralised heating etc and identify methods or types of insulation which could make significant improvements to energy conservation in the home/building.



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For a new build, candidates can carry out a theoretical assessment of its design, the efficiency of the heating and ventilation system and the insulation being used for floors, walls, ceilings, windows, doors etc. They can then carry out a short comparison against older, less efficient properties.

### **2 Select a microgeneration systems for a particular project (26 hours)**

The working principles of **each** of the microgeneration systems should be taught as a matter of course, but candidates should select and justify at least one system to meet the needs of the building chosen in Outcome 1 (ie what systems are available on the market, analysing and evaluating them and selecting the most appropriate one)

Candidates should be provided with the opportunity to learn and understand the planning and regulation issues and the initial costs of installing micro generation systems. National and local regulations should be investigated, equipment and installation costs should be analysed.

### **3 Evaluate the effects and benefits of microgeneration from a financial and environmental point of view (8 hours)**

This Outcome will involve a combination of investigation/research and conventional learning methods. Candidates should be able to investigate using the internet, books or journals the effects that microgeneration systems have on the environment. Candidates will also be required to learn about issues relating to metering and payback (these could be handled on a prepared spreadsheet to help candidates with their evaluations). Candidates will be expected to draw conclusions which are based on facts but they will also be given the opportunity to write part of the report based on their own views of using microgeneration systems as against national grid systems.

The nature of this assessment will involve the candidate working on their own, it maybe therefore prudent to set milestones for audit where assessors can monitor candidate's progress and provide feedback at regular intervals before final submission of the report.

## **Guidance on the delivery and assessment of this Unit**

It is important that emphasis throughout the Unit is placed on an integrated approach to generating energy.

This Unit may be delivered by a combination of lecturing, group work, investigation (including the use of the internet) and case studies.

The internet contains a rich and varied range of materials relating to microgeneration. The use of case studies can be a particularly powerful tool in illustrating the applications of microgeneration systems.

Site visits may prove useful in allowing candidates to observe microgeneration system operating systems.

Candidates will have opportunities to develop their investigation and research skills throughout this Unit by, for example, analysing a range of data and evaluating issues relevant to the introduction of microgeneration systems. Candidates will be able to form conclusions based on the evidence they have obtained and also give a more personal reflective view point on small scale methods of generating energy.

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### **Opportunities for developing Core Skills**

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 the requirements of generating energy for the home or small business. Identifying and analysing a complex range of factors from planning to the installation and running of such systems candidates conduct an energy audit and seek solutions to several theoretical and practical problems and issues. They fully examine the variables including legislative, financial and safety concerns. The benefits and limitations of microgeneration from a financial and environmental point of view are identified, justified and evaluated in a comprehensive report.

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 the style, format and structure of Investigative reporting. They should be advised 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 support accuracy and the effective presentation of written and graphic information. Input from the assessor at various stages of report writing can provide opportunities for candidates to discuss issues, respond to questions and feedback and develop oral communication skills in a practical context.

If formative work involves group approaches to Problem Solving candidates could be encouraged as a group to practise the skills needed for working with others, including listening skills, in an analysis of microgeneration systems requirements. They could agree the nature and scope of team goals, roles and responsibilities in planning, installing and running particular systems. They could be asked to explain or demonstrate methodology and resources selected. Although such an approach to the unit is not essential it could be particularly valuable in the context of site visits in helping candidates to review and evaluate their potential contribution to a workplace environment.

### **Open learning**

The delivery of this Unit will normally require a low level of lecturer/candidate interaction and support for Outcomes 1 and 3. In contrast, Outcome 2 will normally require a high level of interaction between candidates and lecturer when dealing with microgeneration system principles and operations. Thus, it may be possible to deliver Outcomes 1 and 3 by open or distance learning but it is not recommended to deliver Outcome 2 by such delivery modes.

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.

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](http://www.sqa.org.uk/assessmentarrangements).

### General information for candidates

#### **Unit title:** Renewable Energy Systems: Microgeneration Systems

Microgeneration (involving renewable energy sources such as wind, solar, geothermal etc) systems provide an increasingly attractive way of providing energy to the home, small communities etc.

In this Unit you will evaluate the results of an energy audit. You will use this information to select an appropriate microgeneration system(s) for the building taking into account the relevant regulations pertaining to the installation of such a system and the costs associated with the system. You will also evaluate the effects and benefits of the microgeneration system from a financial and environmental point of view.

The Unit is likely to be delivered by a combination of lecturing, group work, investigation (including the use of the internet) and case studies. The internet contains a rich and varied range of materials relating to microgeneration. Your lecturer may take you on site visits to observe microgeneration system in operation.

Formal assessment will comprise of a single assessment covering all three Outcomes involving an investigation into the introduction of a microgeneration system to a building and producing a report of 2,000 words plus diagrams and appendices based on your analysis of the issues involved in installing the microgeneration system(s).