Post Validation Document

G8LP 48

Professional Development Award

in

Renewable Energy Systems

at

SCQF level 8

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Contents

1 Introduction

This new Professional Development Award (PDA) is a consortium-development involving a partnership between a group of educational institutions and the SQA. One of the key drivers for this development has been to fill a gap in the current SQA provision, namely the lack of HN Units and a named Group Award in Renewable Energy Systems. As a result a suite of HN Units have been written and these have been grouped together into the PDA in Renewable Energy Systems.

In broad terms the PDA in Renewable Energy Systems has been designed to provide candidates with knowledge and understanding of current and future trends in energy production, sustainability and energy conservation issues and the role that Renewable Energy Systems technologies may play in meeting energy demands and in limiting global environmental damage. The PDA will also allow candidates to gain a broad knowledge and understanding of the physics and engineering of many Renewable Energy Systems technologies so that they can make accurate, valid comparisons between renewable technologies when solving energy related problems. Candidates will also be able to specialise in more depth in at least two specialist areas of Renewable Energy Systems by studying from optional Units in Biomass, Geothermal Energy, Hydroelectricity, Hydrogen, Microgeneration, Solar, Wave and Tidal Power or Wind Power.

As a result of studying the PDA, candidates will also be provided with opportunities to enhance their Core Skills in Communication, Numeracy, Information Technology, Problem Solving and Working with Others. The PDA also provides candidates with opportunities to develop important transferable skills such as analytical, evaluation, investigation and research, learning and study and planning skills.

2 Rationale for the award

The development of a rationale to support the new PDA in Renewable Energy Systems has included the following processes:

- Desk based research involving an analysis of the political, skills and education and technological and social-economic context for Renewable Energy Systems technologies.

- Consultations with Renewable Energy Systems technology stakeholders including employers and educational institutions.

Details of these two processes are presented in the following sections.

2.1 Desk-based Research

2.1.1 The Political Context

Renewable Energy Systems has risen high up on the agenda of many political parties and institutions. This is not surprising given that many experts now believe that the gases released when fossils fuels are burnt to produce energy contribute to changes in world climate and global warming.

Within a European context the European Commission has adopted a target of 12% of total energy consumption across member states should come from renewable sources by 2010[(1)]. The Commission has advised that all member states have policies in place to achieve this target.

At a United Kingdom level if obligations placed on suppliers of electricity are met, then by 2010, 10% of electricity supplied in the UK will be derived from renewable sources [(2)]. The present UK government is currently involved in a major consultation on how UK energy demands should be met in the future. Its own view appears to be that energy supplies should be met from a mixture of energy sources including nuclear but with an increasing role for Renewable Energy Systems generation.

In Scotland, which has a large potential in Renewable Energy Systems sources, developments in Renewable Energy Systems, particularly since 2000, have moved on rapidly. In their Programme for Government, the previous Scottish Executive set a target of 18% of electricity generation from renewables by 2010. This target has now been met. For example, the quantity of electricity generated by renewable sources as a percentage of total Scottish consumption rose from 14.3% in 2000 to 18.2% [(3)] in 2005 although it should be noted that the renewables share tends to fluctuate as hydroelectricity is highly dependent on levels of precipitation in catchment areas. Most of this Renewable Energy Systems still comes form hydroelectricity although it is interesting to note that the quantity of energy generated by wind and wave power increased by 60% between 2004 and 2005[(3)].

In the Scottish Executive Paper, 'Securing a Renewable Future: Scotland's Renewable Energy' the aspirational target was set for 40% of electricity in Scotland being generated from renewable sources by 2020. The Executive have taken various steps towards meeting this target. For example, they have introduced the Renewable Obligation (Scotland), or ROS, which places an obligation on electricity suppliers to provide an increasing amount of their electricity from renewable sources. In October 2003 the Executive also established the Forum for Renewable Energy Development in Scotland (FREDS) which has 'a key role in identifying, co-ordinating and facilitating actions to promote the development of Scotland's Renewable Energy Systems industry.[(2)]' FREDS is a partnership between industry, academia and government with the express aims of capitalising on Scotland's large natural energy resources and securing significant economic development opportunities for Scotland.

The Forum has released a number of important publications on Renewable Energy. In the context of this Validation Proposal Document the most important paper is 'Skills Group Report 2005: Developing Skills For Scotland's Renewable Energy Systems Workforce' which will be referred to extensively in the next section.

It is important to mention briefly the Renewable Energy policies of the Scottish National Party (SNP) as they are now in control of the Executive. The SNP has indicated a clear commitment to the building of no new nuclear power stations in Scotland. Instead they will meet much of Scotland's future energy needs by making use of 'Scotland's extensive Renewable Energy potential.[(4)]' Their Manifesto sets out the steps they will take to meet this approach. It is also understood that the new Executive will shortly engage in a major consultation exercise on Renewable Energy.

(1) Securing a Renewable Future – Responses – Business (2004)
(2) Securing a Renewable Future: Scotland's Renewable Energy (2003)
(3) Sustainable Energy – Percentage of Scottish electricity consumption generated from renewable sources in Scotland – Scottish Executive paper (2007)
(4) Scottish National Party Manifesto page 2 (2007)

In conclusion, from what has been discussed in the previous paragraphs, Scotland very much has a renewable energies future. Part of that future must involve the development of qualifications to educate and train personnel to work in the renewables industry.

2.1.2 The Skills and Education Context

Skills

As noted in the previous section, FREDS commissioned a major study into the development of appropriate skills for Scotland's Renewable Energy Systems workforce. This work was undertaken by a Skills sub-group which included representatives from Scottish Enterprise, Highlands and Islands Enterprise, Careers Scotland, Higher and Further Education, relevant Sector Skills Councils, Renewable Energy suppliers and the SQA. The work of the Group was encapsulated in the Report 'Developing Skills for Scotland's Renewable Energy Workforce' which was published 2005.

With regard to demand for labour and skills in the Renewable Energy industry the report identifies the following important points:

(i) The labour requirements of the industry will be modest.

(ii) The evidence from the industry is that, to date, the supply of skills is not inhibiting growth.

(iii) Where there are currently recruitment difficulties or weaknesses in the skills of the workforce, they are not specific to the renewable sector and employers are addressing them through changes to recruitment practices and training.

With reference to point i) the report identifies that while the gross number of jobs generated across Scotland in the renewable sector will be quite small, there is a regional dimension to job creation. For example, most activity in renewables is likely to take place in remote, rural areas of Scotland where a comparatively small number of 'high quality jobs can be of disproportionate significance.[(5)]'

While the report observes that skills gaps and skills shortages in the renewable sector will be modest it does, nevertheless, identify some specific issues with regard to some renewable technologies. For example, the FREDs Biomass Group comments 'that the declining up take of engineering courses (e.g. degree and SVQ) may lead to a reduction in the available skills resources needed to support the supply chain infrastructure and development of the biomass industry.' Representatives from the FREDS Hydrogen Group 'have suggested that skills gaps exist at all levels of the hydrogen and fuel cell industry — for example, from technicians to install fuel cells through to PhDs needed to develop hydrogen and fuel cell technology further.'

However, perhaps the greatest area of concern exists around the future availability of senior electrical engineers who keep Scotland's electrical network running with approximately 25% of these retiring in the next 5-10 years and little sign of them being replenished.

(5) Developing Skills for Scotland's Renewable Energy Future page 6 (2005)

Education

The 'Developing Skills for Scotland's Renewable Energy Workforce' Report comments in some detail with regard to the contribution different sectors of education are currently making and may make in the future to providing qualifications relevant to the Renewable Energy sector. Of particular interest in this Validation Proposal Document are the contributions that HNC/HND awards are making in the area of energy production. On this the Report comments on page 13 as follows, 'A similar pattern emerges in the HNC/HND/NQ provision and a sample of available Units is provided in Annex D. The majority of these Units are focused on traditional energy sources and the distribution of energy rather than the methods by which the energy is produced. Similarly an investigation into the range of Units currently being offered in engineering suggests that no specific Units have been created for the Renewable Energy production sector.' The Report concludes on page 14 that 'it is the view of the Skills Group that existing provision of SQA qualifications does not yet meet the needs of the Renewable Energy sector, however there is provision for the traditional energy sectors and basic engineering, construction and electronics qualifications which can be revised and/or updated to include skills for Renewable Energy. Some of the skills sets within these frameworks will be transferable, however additional Units/Outcomes will be required to be added to the existing qualification suites to address the specific needs of the renewable market.'

The Qualification Design Team (QDT) believes that with regard to HNC/HND level qualifications it is addressing the issues raised in the previous paragraph in the following two ways:

(i) by producing 10 new HN Units in Renewable Energy Systems and a PDA in Renewable Energy Systems;

(ii) by incorporating the 10 HN Units in Renewable Energy Systems into the optional section of the new HND Engineering Systems award.

The HNC and HND Engineering Systems awards deliver a range of mechanical and electrical knowledge and skills, take a systems approach to the solution of engineering problems and, as such, can readily be contextualised to Renewable Energy Systems.

2.1.3 The Technological and Social Context

Technological

Some renewable technologies are now well established (although new innovations are still being introduced into these technologies) whereas others are still under active research and development (e.g. hydrogen/fuel cell technology, wave and tidal systems etc.). This has been taken into account in the writing of the Units. Units have been written in as generic a form as possible and writers have emphasised the need to take account of new technological developments as these emerge. It is recognised that both the Units and the PDA will have to be kept under regular review to take account of technological developments and the changing political, economic and social context. It is likely this will be done through the Qualifications Support Team (QST) for the HND Engineering Systems Award.

Social-Economic

The social-economic aspects of Renewable Energy Systems have not been neglected in the Units or the PDA. For example, in the Unit Renewable Energy Systems: Overview of Energy Use candidates are encouraged to investigate the social economic consequences of current energy supplies and trends (with, for example, the quantity of fossil fuels predicted to drop over the next century) not matching demand. They will also be able to analyse how alternative, clean, sustainable sources of energy can be used to meet a significant part of the demand for energy while contributing to the reduction in climate change and global warming. The Unit Renewable Energy Systems: Hydroelectricity includes a consideration of the social and economic benefits of existing hydroelectric schemes including job creation and leisure opportunities. There is also scope to consider the benefits of Renewable Energy Systems generation in small communities. For example, the formal assessment task for the Unit Renewable Energy Systems: Microgeneration may be applied to a small community building.

2.2 Consultations with Renewable Energy Technology stakeholders

Throughout the development of the HN Units within the PDA, writers obtained helpful information and advice from various sources including experts in the field, technical papers, relevant websites etc.

In order to assess the demand for the Renewable Energy Systems Units and the PDA, the SQA undertook a major consultation exercise. A questionnaire was sent out to organisations that had an interest in the Renewable Energy technology area. From the analysis of the questionnaire showed a strong support (86%) for a specific award in Renewable Energy Systems.

The questionnaire also asked respondents to express their views on the specific Renewable Energy Systems Units that make up the PDA. The highest level of support was given to the Renewable Energy Systems: Overview of Energy Use (73%) with the Renewable Energy Systems: Technology receiving only slightly less support. This was reassuring as both these Units are core within the PDA.

2.3 Market demand for the PDA in Renewable Energy Systems

Based on the positive responses to the questionnaire survey and the wide range of jobs that are currently being advertised in the paper based and electronic media the QDT anticipate a significant candidate uptake for the PDA. The QDT are aware that at least one centre will be offering the PDA from August 2007 with other centres likely to follow on once the existence of the new PDA in Renewable Energy Systems is more widely known. The QDT would estimate that between 100 and 150 candidates per year may be entered for the PDA over time with significant numbers of other candidates taking individual units within the PDA to support, for example, their CPD.

3 Aims of the Award

3.1 General Aims of the PDA in Renewable Energy Systems

The general aims of the PDA award are to:

3.1.1 enhance candidates' employment prospects

3.1.2 enhance the prospects of local economies

3.1.3 support candidates' Continuing Professional Development and career development

3.1.4 enable progression within the SCQF (Scottish Credit and Qualifications Framework)

3.1.5 develop candidates' Core Skills

3.1.6 develop candidates' transferable skills

3.2 Specific Aims of the PDA in Renewable Energy Systems

The specific aims of the PDA award are to:

3.2.1 provide candidates' with an opportunity to develop knowledge and understanding of the broad issues that are impacting on energy production and use now and in the future

3.2.2 provide candidates with a knowledge and understanding of the physics and engineering of a wide range of equipment designed to extract energy from renewable sources with a view to allowing candidates to make accurate, valid comparisons between renewable technologies when solving energy related problems

3.2.3 allow candidates opportunities to specialise in two areas of Renewable Energy Systems

3.3 How the General Aims are met in the PDA in Renewable Energy Systems Structure and Content

Aim No.	How it is met in the PDA
3.1.1	As noted in Section 2.1.2 employment opportunities in the near future are likely to be modest in the Renewable Energy industry. Nevertheless, as was also pointed out in Section 2.1.2 the creation of even a few high quality jobs in remote, rural areas may have a disproportionately beneficial effect on a local economy. Furthermore, scope for job creation may occur as existing Renewable Energy technologies are expanded and/or new technologies are introduced. A review of paper based and electronic media advertising jobs in the Renewable Energy industry suggests that candidates successfully achieving the PDA may be able to find employment as electricians, instrument engineers, maintenance engineers, service engineers, technicians, health and safety officers/engineers, development officers, development managers, project officers, Renewable Energy consultants, lecturers and marketing co-ordinators.
3.1.2	As mentioned above even a comparatively small number of 'high quality jobs can be of disproportionate significance for a small local economy. Such jobs can bring much needed income into a small economy. There may also be the additional 'spin offs' of creating new employment opportunities as those in the high quality jobs employ local people in various capacities. On a social level new high quality jobs can help to raise the status, confidence and self-esteem of people living in the local community. It may also encourage people in the local community to use Renewable Energy technologies, instead of more traditional energy generation methods, to meet their energy requirements.
3.1.3	It is anticipated that the PDA may be used by some employers as a way of delivering Continuing Professional Development to their employees (a few employers indicated that this may be the case in their responses to the SQA questionnaire consultation). The PDA would certainly lend itself to being a CPD award. It can be delivered in a notional time length of 240 hours by various modes of delivery (e.g. on a part-time basis, partly in college and partly in the workplace). Over time it may also be possible that large parts of the PDA may be delivered by open and distance learning and/or on-line learning. From a candidates' perspective the PDA provides both a broad overview of Renewable Energy systems and an opportunity to specialise in a few Renewable Energy technologies in some depth. This may well suit candidates who have professional and career aspirations to move into the Renewable Energy area.

How the General Aims are met in the PDA in Renewable Energy Systems Structure and Content (continued)

Aim No.	How it is met in the PDA
3.1.4	All Units within the new PDA in Renewable Energy Systems have been levelled at SCQF levels 7 or 8. The new award also conforms to the SQA levelling requirements for PDA awards. It is worth emphasising that the new PDA will allow for vertical progression within the SCQF (e.g. someone studying at HNC level (level 7 within the SCQF) progressing to the PDA (level 8 within the SCQF). Alternatively, the PDA also allows for lateral progression within the SCQF (e.g. someone who has passed an HND (SCQF level 8) or ordinary degree (SCQF level 9) progressing to the PDA as a way of expanding her/his knowledge and understanding of Renewable Energy Systems.
3.1.5	There are many opportunities for candidates to develop a number of Core Skills and/or Core Skills components. For example, candidates will have opportunities to develop their Reading Communication Skills while reading materials on various forms of Renewable Energy technologies from paper based or electronic sources. Written Communication skills may be enhanced while candidates are providing written responses to questions in assessment papers or when writing reports. The Core Skill component Using Number may be developed while performing calculations in a number of the Units (e.g. when calculating future energy usage trends, energy balance, new energy sources, evaluating the practicality and effectiveness of carbon sequestration methods or efficiencies in buildings/transportation/power generation in the Unit Renewable Energy Systems: Overview of Energy Use). The Core Skill component Using Graphical Information may be developed while representing various forms of data in graphical format. The Core Skill Using Information Technology may be developed while candidates use Internet search facilities to access information on Renewable Energy issues and technologies. This Core Skill may also be enhanced while candidates use Excel to process data or produce word processed reports which include appropriate diagrams, drawings etc. produced by the candidates.

How the General Aims are met in the PDA in Renewable Energy Systems Structure and Content (continued)

3.1.5 (continued)	Opportunities to develop aspects of the Core Skill Problem Solving exist in nearly all Units in the PDA. For example, the Core Skill component Critical Thinking may be developed when evaluating options for solving a problem (e.g. in the Renewable Energy Systems: Microgeneration Unit evaluating the advantages and drawbacks of different microgeneration systems before selecting an appropriate system to meet a specified need). Planning and Organisation skills may be developed while candidates reflect on the best way to gather data, organise their arguments and structure their reports for different formal assignments in Units. Review and Evaluation skills may be developed while candidates evaluate the advantages and disadvantages of introducing a proposed system (e.g. a microgeneration system). While opportunities to develop the Core Skill Working with Others may be limited there may be occasions when candidates can enhance these skills when, for example, engaging in group discussions or doing laboratory work.
3.1.6	Opportunities also exist for candidates to develop important transferable skills. For example, as a result of studying the Units in the PDA candidates will learn new technology skills (e.g. hydrogen/fuel cell technology, wave and tidal systems, P-V technology etc.) Candidates will also learn analysis skills as they breakdown problems and issues into their various elements. As noted in the previous section (3.1.4) candidates will also learn to develop both planning and evaluative skills. As a result of studying Units in the PDA candidates may also develop investigation and research skills. At this level candidates may well need advice and support in structuring their investigations so that they derive the maximum benefit from undertaking such work. It is anticipated that as a result of studying the PDA, learning and study skills will be developed and enhanced by all candidates.

3.4 How the Specific Aims are met in the PDA Renewable Energy Systems Structure and Content

Aim No.	How it is met in the PDA
3.2.1	From the outset of the PDA development the QDT was keen that Renewable Energy Systems are not taught in isolation but rather were set within a broader context of global energy use and trends, the negative impact of current energy production methods and energy efficiency and sustainability issues. In this way the QDT believes that candidates' will gain a better understanding of the way in which Renewable Energy Systems fit into current and future energy generation and use. The mandatory Unit Renewable Energy Systems: Overview of Energy Use has been designed to meet this requirement. It contains Outcomes on energy usage and trends, environmental impact of current energy production methods (including climate change and global warming), an analysis of the costs of different sources of energy, advantages and disadvantages of alternative sources of energy and efficiency and energy savings in buildings, transport systems and power generation.
3.2.2	As well as providing candidates with an overview of current energy uses, trends and issues it is important that candidates are provided with an overview of many of the Renewable Energy technologies currently in use. The mandatory Unit Renewable Energy Systems: Technology has been designed to fulfil this task. The approach taken in the Unit is to introduce candidates to a wide range of technologies either individually or by reference to common or shared properties so that candidates will gain a level of technical knowledge and understanding that will allow them to make accurate, valid comparisons between different technologies and the ability to determine the potential effectiveness of a particular system or solution. Basic physics and engineering principles underpin descriptions of how equipment works and how energy transfer processes impact on efficiency and cost.
3.2.3	Within the 2 credit optional section of the PDA candidates are provided with opportunities to study two types of Renewable Energy Systems in greater depth. Candidates can choose from the following technologies: Biomass, Geothermal, Hydroelectric, Hydrogen, Microgeneration, Solar, Wave and Tidal Energy and Wind Power. It is recommended that candidates select the optional Units they wish to study on the basis of their own professional and career aspirations and on the requirements of local employers.

4 Recommended access to the award

4.1 Access requirements

Admission to the PDA in Renewable Energy Systems should be based on a broad approach to candidate selection but, at the same time, should ensure that candidates are chosen who have the potential and ability to complete the awards successfully. In this regard candidates would normally have a general knowledge and understanding of engineering systems and mechanical, electrical and electronic principles and technologies on entry to the PDA. The qualifications which best meet this requirement are as follows:

- HNC or HND Engineering Systems
- HNC or HND Mechatronics
- A suitable multi-disciplinary degree
- Other awards deemed equivalent to the above

Other HN Engineering qualifications in such areas as Electronics, Electrical Engineering, Mechanical Engineering and Manufacturing Engineering may partially meet the requirements but candidates may have to undertake an additional bridging programme in order to fill in gaps in their technical education prior to starting the PDA (e.g. a mechanical technician or engineer may find it beneficial to study electrical and electronic Units prior to studying the PDA).

Entry to the PDA for candidates with other technical and/or scientific qualifications should be considered on the basis of whether their knowledge and understanding of engineering is sufficiently well developed to allow direct access to the award or whether they need to do studies in engineering prior to entering the PDA.

4.2 Alternative Access Arrangements

The presenting centre may operate alternative access arrangements in cases where the candidate is convinced that she/he already has the required competences in a given area. These arrangements are as follows:

- Assessment on demand
- Credit transfer
- Accreditation of prior learning
- Relevant work experience

Individual presenting centres will require to outline their systems for each of these as a part of any approval procedure.

5 Structure of the award

5.1 PDA in Renewable Energy Systems (G8LP 48)

Mandatory Section (4 — credits)

Credit value	SCQF level	Product code	Product title
2	7	F1YL 34	Renewable Energy Systems Systems: Overview of Energy Use
2	8	F1YN 35	Renewable Energy Systems Systems: Technology

Optional Section (2 — credits)

Credit value	SCQF level	Product code	Product title
1	8	F1YG 35	Renewable Energy Systems Systems: Biomass
1	8	F1YH 35	Renewable Energy Systems Systems: Geothermal Energy
1	8	F1YJ 35	Renewable Energy Systems Systems: Hydroelectricity
1	8	F1YF 35	Renewable Energy Systems Store: Hydrogen
1	7	F1YK 34	Renewable Energy Systems Systems: Microgeneration Systems
1	8	F1YM 35	Renewable Energy Systems Systems: Solar
1	8	F1YP 35	Renewable Energy Systems Systems: Wave and Tidal Energy
1	8	F1YR 35	Renewable Energy Systems Systems: Wind Power

5.2 Conditions for the award

The conditions of award for the PDA in Renewable Energy Systems qualification are as follows:

A candidate will be awarded a PDA in Renewable Energy Systems on successful completion of 6 Unit credits based on the framework shown in Section 5.1. More specifically this award structure requires that candidates achieve the following:

- the 4 Unit credits from the Mandatory Section of the award structure shown in Section 5.1
- 2 Unit credits from the Optional Section of the award structure shown in Section 5.1

5.3 SCQF level of PDA

The PDA in Renewable Energy Systems has been levelled at SCQF level 8. The justification for this level is that at least half the credits in the PDA are at SCQF level 8 and this satisfies the SQA Design Principles that at least half the SCQF credit points in a PDA must be at the level of the Group Award.

5.4 Links between specific aims and Units in the PDA

For details of the way in which the specific aims of the PDA link into the Units see Section 3.4.

5.5 Link between National Occupation Standards and the PDA

At the time of preparing this Validation Proposal Document the QDT were not aware of any National Occupation Standards that aligned with the PDA in Renewable Energy Systems. However, in the fast moving field of Renewable Energy Systems it is possible that standards may emerge in the future. If this is the case, the PDA can be mapped into the relevant standards.

5.6 Articulation/Progression Opportunities

The PDA in Renewable Energy Systems articulates with the UHI Millennium Institute's BSc Engineering: Renewable Energy Systems. The advice has been given that the exact point at which a candidate will be able to enter this BSc will not only depend on successful achievement of the PDA but on what other qualifications the candidate possesses. This same advice is likely also to apply to any other degrees in Renewable Energy Systems that may be currently available, or be available in the future, in the United Kingdom. The QDT do anticipate that overtime the PDA may act as a stepping stone along an education route which might start with candidates doing the PDA followed by a degree in the Renewable Energy Systems area followed by a postgraduate degree in the Renewable Energy Systems area. This would be wholly consistent with candidates progressing between Levels 8 and 11in the Scottish Qualifications and Curriculum Framework.

Candidates may also wish to study individual units in the PDA as part of, say, a CPD programme to enhance their own specialist knowledge and understanding of a specialist area of Renewable Energy Systems. Such studies may be done in conjunction with other qualifications the candidate may be studying (e.g. a degree in engineering plus specialist studies in an area of Renewable Energy Systems).

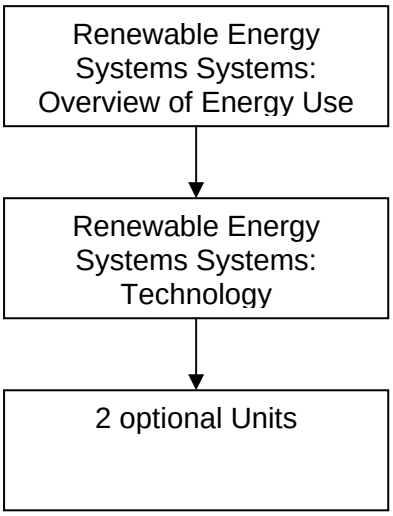
6 Approaches to delivery and assessment

6.1 Delivery

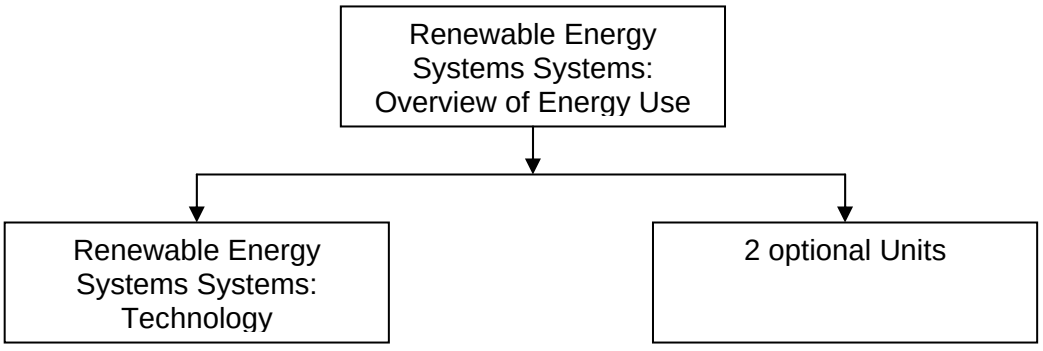
The PDA in Renewable Energy Systems has been designed principally for candidates employed in the Renewable Energy Systems industry or who are seeking employment in this industry. As such, the PDA can be delivered by modes of attendance that best suit the employment circumstances of such candidates and their employers. For example, the PDA may be delivered by a variety of part-time modes which can include day-release, block-release or evening class delivery. It would also be possible to deliver some or all parts of the PDA in a work-place environment providing, of course, that suitable accommodation (e.g. classrooms and laboratories) were available for the delivery of the award.

Centres have discretion as to the order in which they deliver the Units in the PDA. However, it is recommended that one of the following two options is used for delivering the award:

Option 1



Option 2



Option 1 has the possible attraction of being easier to timetable whereas using Option 2 may allow for easier integration of course content.

Centres are encouraged to integrate course content wherever possible so that Units are not delivered in isolation but as part of an integrated award. To this end the QDT have included in most Units the following paragraph:

This 2 credit Unit, **Renewable Energy Systems Systems: Overview of Energy Use** provides an introduction to the subjects of energy usage and trends, environmental impact of energy use, and Renewable Energy Systems sources from both a global and local perspective.

The 2 credit Unit **Renewable Energy Systems Systems: Technology** describes the basic technology associated with Renewable Energy Systems devices. The remaining 1 credit Units take a specialised look at each of the technologies currently believed to be significant, and, as such, provides 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 systems. As such every opportunity should be sought to combine the delivery and assessment of the Units.

A few examples of the way in which different topics can be integrated across Units are shown in Table 6.1.1. Lecturers are likely to identify other opportunities to integrate subject content and learning and teaching as they gain more familiarity with the Units.

The Units in the PDA may be delivered by a combination of lecturing, group work, investigations (including the use of the Internet), laboratory work and case studies. Centres may invite guest speakers from the Renewable Energy Systems industry to give lectures on the technology they are involved in and the work they do.

Laboratory work can be particularly important in reinforcing theory, acquainting candidates with some of the equipment involved in a particular technology and in some of the issues involved in operating a technology. For example, in the Unit Renewable Energy Systems Store: Hydrogen, the following advice is given on practical work; there should be a strong emphasis on practical work and the centre should ideally provide the equipment that will enable the candidate to become familiar with the production, storage, handling, distribution and consumption of hydrogen. A fully commissioned hydrogen laboratory with the necessary safety measures and safeguards in place would be ideal (with a variety of fuel cells featuring a wide range of power output), although the Unit requirements could be met using small reversible electrolysers/fuel cells connected to 1W PV cells and driving small dc motors. Safety issues must be emphasised and supported by the use of hydrogen detection devices for the detection of leaks. However, it is important that the dangers associated with the use of hydrogen are not exaggerated.'

Field visits to Renewable Energy Systems sites can be very useful in allowing candidates to relate theory to practice and in seeing 'live' systems in operation. Where possible such field visits should be structured with clear objectives for the visit. During the visit candidates should be allowed to observe plant in operation and speak to staff. Candidates should report back either orally or in writing on their findings.

Table 6.1.1 — Opportunities to integrate teaching and learning across Units in the PDA

Topic No.	Topic	Units	Outcome No.	Outcome
1	Environmental impact associated with energy production methods	Overview of Energy Use	2	Explain environmental effects associated with energy production and use
		Hydroelectricity	3	Explain the socio-economic and environmental impact of existing hydroelectric plant
		Microgeneration Systems	3	Evaluate the effects and benefits of microgeneration from a financial and environmental point of view
		Wind Power	2	Evaluate the economic performance and environmental impact of a turbine in a variety of locations

Table 6.1.1 — Opportunities to integrate teaching and learning across Units in the PDA (continued)

Topic No.	Topic	Units	Outcome No.	Outcome
2	Efficiency and energy savings in buildings	Overview of Energy Use	5	Explain the concepts of efficiency and energy saving in buildings…….
		Technology	6	Analyse the heating requirements of buildings to reduce energy end-use
		Microgeneration Systems	1	Evaluate the results from an energy review (of a building)
3	Grid integration issues	Wind Power	2	Evaluate the economic performance and environmental impact of a turbine in a variety of locations
		Wave and Tidal Power	1	Identify and describe tidal power generation systems
			2	Identify and describe wave power generation technology
		Geothermal Energy	2	Explain the ways in which electricity can be generated from geothermal energy sources

Table 6.1.2 — PDA in Renewable Energy Systems – Core Skills Development Opportunities

Note: CT = Critical Thinking: P &O = Planning & Organisation and R and E = Reviewing & Evaluating

Unit title	Communication			Numeracy		Information Technology	Problem Solving			Working with Others
	Read	Write	Oral	Using Number	Using Graphical Info.	Using Information Technology	CT	P & O	R & E	Working with Others
Renewable Energy Systems Systems: Overview of Energy Use	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	
Renewable Energy Systems Systems: Technology	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	
Renewable Energy Systems Systems: Biomass	SCQF level 6	SCQF level 6	SCQF level 6							
Renewable Energy Systems Systems: Geothermal Energy	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	

Table 6.1.2 — PDA in Renewable Energy Systems — Core Skills Development Opportunities (continued)

Unit title	Communication			Numeracy		Information Technology	Problem Solving			Working with Others
	Read	Write	Oral	Using Number	Using Graphical Info.	Using Information Technology	CT	P & O	R & E	Working with Others
Renewable Energy Systems Systems: Hydroelectricity	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	
Renewable Energy Systems Store: Hydrogen	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	
Renewable Energy Systems Systems: Microgeneration Systems	SCQF level 6	SCQF level 6	SCQF level 6			SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6

Table 6.1.2 — PDA in Renewable Energy Systems — Core Skills Development Opportunities (continued)

Unit title	Communication			Numeracy		Information Technology	Problem Solving			Working with Others
	Read	Write	Oral	Using Number	Using Graphical Info.	Using Information Technology	CT	P & O	R & E	Working with Others
Renewable Energy Systems Systems: Solar	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	
Renewable Energy Systems Systems: Wave and Tidal Energy	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	
Renewable Energy Systems Systems: Wind Power	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6	

Table 6.1.2 shows opportunities to develop Core Skills in individual Units in the PDA. In general terms the Communication Core Skill component Reading may be developed while candidates are reading materials on energy issues and Renewable Energy Systems from various paper based and electronic sources. Lecturers may wish to ask candidates questions to check their understanding of the materials they have read. The Written Communication Core Skills component may be developed while candidates write extended response answers to assessment questions and when writing reports. Practical work can provide an environment in which to discuss, review and evaluate solutions, and enhance skills in oral communication of technical data using appropriate terminology and techniques.

The Core Skill component Using Number may be enhanced while candidates perform various calculations associated with energy use and Renewable Energy Systems (e.g. when performing calculations involving future energy trends, evaluating the practicality and effectiveness of carbon sequestration methods and efficiencies and energy savings in building in the Unit Renewable Energy Systems Systems: Overview of Energy Use). The Core Skill component Using Graphical Information may be developed while representing energy and other data in various graphical formats.

The Core Skill Using Information Technology may be developed while candidates undertake Internet searches, use a spreadsheet to process and analyse data and when word processing reports including the production of graphs, diagrams etc. produced by the candidates.

The Core Skill component Critical Thinking may be developed while candidates undertake formative and summative assessment involving interpreting problems and developing proposals for resolving problems. The Core Skill component Planning and Organisation may be enhanced while candidates plan approaches to resolving assignment problems and when preparing written reports. The Core Skill component, Review and Evaluation may be developed when, for example, candidates evaluate the benefits and drawbacks of a renewable technology over a conventional one.

While opportunities to develop the Core Skill component, Oral Communication and the Working with Other Core Skill may be limited there may be opportunities to develop these while candidates discuss issues, problems etc. in group work and when doing laboratory work.

6.2 Assessment

From the outset of this development the need to have an appropriate assessment strategy in place for the PDA in Renewable Energy Systems was recognised. This strategy is detailed below:

Aims

The aims of the strategy are to ensure that:

(1) Consistent, rigorous and efficient approaches are adopted to the development and administration of PDA assessment instruments which satisfy nationally agreed standards.

(2) The assessment load on candidates and staff is sensible and that assessment does not unduly detract from teaching and learning.

(3) As far as possible reliable and rigorous moderation processes are put in place in order to ensure that consistent national standards are achieved for all PDA assessments.

Objectives

Listed below are the measures that have been put in place to meet the aims:

(1) Plan to develop nationally at least one assessment exemplar pack for the two mandatory Units in the PDA in Renewable Energy Systems.

(2) Adopt a holistic approach to Unit assessment. The implications of this are as follows:

(i) Assessment instruments will normally be designed only to sample knowledge and skills in a Unit (this is consistent with the new HN Unit format).

(ii) A Unit assessment strategy will be adopted, where possible, to produce a single assessment instrument for the whole Unit. Where this is not possible the assessment strategy will seek to ensure that the minimum number of assessment instruments are required consistent with maintaining agreed national standards.

(3) Actively encourage centres to work in partnership in producing Unit assessment materials, which meet nationally agreed standards reducing, in turn, the workload on staff in individual centres.

(4) Ensure that consistent and rigorous internal and external moderation procedures operate through HN Unit assessment processes. This places a clear responsibility on both centres and the SQA.

Integration of assessment

It may be possible to integrate assessments across Units. For example, Outcome 3 in the Renewable Energy Systems Systems: Technology Unit may be integrated with assessments in the Hydroelectricity, Wave and Tidal Energy and Wind Power Units. Likewise, Outcome 5 in the Technology Unit may be integrated with assessments in the Solar Unit. It is likely that lecturers will identify further opportunities to integrate assessment when they become more familiar with the Units.

Formative Assessment

Formative assessment should be used throughout the delivery of Units to reinforce learning, build candidates' confidence and prepare candidates for summative assessment.

Open and Distance Learning

Advice on the use of open and distance learning is given in individual Unit specifications. However, where it is used with regard to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangement would be required to be put in place to ensure that the assessment or assessments were conducted under the conditions specified in the Unit specification. For example, in the case of a Unit which involved an assessment paper(s) a centre would have to make arrangements for the assessment(s) to be conducted under controlled, supervised conditions. Likewise, where a Unit involves a practical based assessment, a centre would have to make arrangements for candidates to come into the centre to undertake the assessment under the conditions specified in the Unit specification.

It should be noted that the same requirements as specified in the previous paragraph apply where part or all of a Unit is delivered on-line.

7 General information for candidates

Introduction

Most experts believe that the gases released when fossil fuels are burnt to produce energy are contributing towards changes in world climate and global warming. One way of reducing dependency on fossil fuels is to make greater use of Renewable Energy Systems technologies such as wind farms, hydroelectric schemes, wave and tidal barriers etc. Such technologies are certainly making a greater contribution to energy production across the world and in Scotland. However, Renewable Energy Systems is certainly not without its detractors. Some doubt that such technologies can supply base energy loads believing instead that nuclear power stations are required for this purpose. Furthermore, while Renewable Energy Systems technologies are clean (i.e. do not contribute to CO_2 emissions) they are not without their environment problems (e.g. noise from wind turbine generators, dangers to wild life from hydroelectric schemes and wave and tidal energy schemes etc.).

Content

In the Professional Development Award (PDA) in Renewable Energy Systems you will be provided with an opportunity to study world energy uses and trends, the harmful effects on climate of current fossil fuel energy production methods and the steps that are being taken to reduce these harmful effects including the use of Renewable Energy Systems technologies, energy conservation in buildings, transport and power generation and carbon sequestration schemes. You will also have an opportunity to learn about the physics and engineering of a range of Renewable Energy Systems technologies so that you can make accurate, valid comparisons between renewable technologies when solving energy related problems. You will also be able to specialise in more depth in any two of the following technologies: Biomass, Geothermal Energy, Hydroelectricity, Hydrogen, Microgeneration, Solar, Wave and Tidal Energy or Wind Power.

Teaching and Learning

The PDA is likely to be delivered by a combination of lecturing, class discussions/debates, group work, case studies, investigations (including the use of the Internet) and laboratory work. As part of your course you may also be taken on field visits to Renewable Energy Systems sites to see systems in operation and to talk to staff about Renewable Energy Systems technologies and the work they are involved in.

Assessment

The assessments in the PDA have been designed to meet national standards. The award has been designed to optimise assessment so that sufficient time is available for you to learn about the issues surrounding Renewable Energy Systems technologies.

Unit assessment will normally consist of assessment papers and/or assignments. The latter will include the preparation of reports. Your lecturer should tell you at the start of the Unit what form Unit assessment will take.

Entry requirements

No artificial barriers should be placed in the way of candidates wishing to study the PDA in Renewable Energy Systems. However, it would be unfair to enrol a candidate into the PDA who did not have a realistic chance of successfully achieving the award. The following qualifications are recommended for entry into the PDA:

- HNC or HND Engineering Systems
- HNC or HND Mechatronics
- A suitable multi-disciplinary degree
- Other awards deemed equivalent to the above

If you have another HN Engineering qualifications in an area such as Electronics, Electrical Engineering, Mechanical Engineering or Manufacturing Engineering you may partially meet the requirements but you may have to undertake an additional bridging programme in order to fill in gaps in your technical education prior to starting the PDA (e.g. if you have an HNC in Mechanical Engineering you may find it beneficial to study electrical and electronic units prior to taking the PDA).

If you have other qualifications you may be considered for entry to the PDA on the basis of whether your knowledge and understanding of engineering is sufficiently well developed to allow you direct access to the award or whether you need to do studies in engineering prior to entering the PDA.

Progression

On completion of the PDA you can progress to the UHI Millennium Institutes degree entitled BSc Engineering: Renewable Energy Systems. The exact point at which you are able to enter the B.Sc. will not only depend on successful achievement of the PDA but on what other qualifications you possess. Opportunities for candidates who successfully achieve the PDA to enter other degree programmes in the Renewable Energy Systems area may also be possible.