

Higher National Unit Specification

General information for centres

Unit title: Energy Utilisation and Efficiency

Unit code: DP14 34

Unit purpose: The purpose of this unit is to provide the candidate with an understanding of the environmental consequences of energy utilisation in buildings and the implications of energy efficiency.

The unit indicates how gains, both environmentally and economically, can be achieved by cutting down on waste and maximising the efficient use of energy.

As concern for global issues relating to the environment increases, the role of the building services engineer becomes even more important in the design and operation of buildings and their energy usage.

This unit is recommended for those candidates who need to identify the opportunities that exist for improving the effectiveness with which energy is used

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

- ◆ Recognise the environmental impact and contribution to global warming resulting from the energy utilisation of buildings and their services
- ◆ Identify and evaluate the use and sustainability of alternative energy sources
- ◆ Produce an appraisal of the energy efficiency for proposed building services installations at the design stage and predict target energy performance indicators for a range of buildings and services
- ◆ Undertake energy audits on buildings and building services installations
- ◆ Evaluate heat recovery and energy minimisation methods for use within building services installations.

Credit points and level: 1 HN 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 Access 1 to Doctorates.*

Recommended prior knowledge and skills: It would be an advantage for candidates to have a basic understanding and knowledge of building services engineering science and technology.

Such understanding and knowledge may be evidenced by the possession of a National Certificate in Building Services Engineering or a related subject.

General information for centres (cont)

The unit includes all the basic principles necessary to allow candidates possessing other qualifications or experience to succeed in this unit.

Core skills: There may be opportunities to gather evidence towards core skills in this Unit, although there is no automatic certification of core skills or core skills components.

Context for delivery: This unit was developed for the HNC in Building Services Engineering. If this Unit is delivered as part of another group award(s), it is recommended that it should be taught and assessed within the context of the group award(s) to which it contributes.

Assessment: It is possible to assess candidates either on an individual Outcome basis, combinations of Outcomes or by a single holistic assessment combining all Outcomes. The assessment paper/s should be composed of an appropriate balance of short answer, restricted response and structured questions. Assessment should be conducted under supervised, controlled conditions. A single assessment covering all outcomes should not exceed 2 hours in duration. It should be noted that candidates must achieve all the minimum evidence specified for each Outcome in order to pass this Unit.

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.

Higher National Unit specification: statement of standards

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The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence requirements are mandatory.

(If you think holistic assessment is the best assessment strategy for the Unit and you wish to state *Knowledge and/or Skills* and *Evidence requirements* for the Unit as a whole, please add the following statement here: ‘Please refer to *Knowledge and/or skills for the Unit* and *Evidence requirements for the Unit* after the Outcomes.’)

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

Recognise the environmental impact and contribution to global warming resulting from the energy utilisation of buildings and their services.

Knowledge and/or skills

- ◆ Global environmental issues
- ◆ Energy/environmental conservation and reform

Evidence requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ explain how energy is derived, generated and transported
- ◆ identify the harmful emissions associated with the combustion of fossil fuels and describe the interrelationship with environmental impact issues
- ◆ summarise the objectives of international and national environmental agreements, protocols and programmes.
- ◆ explain the need for energy/environmental conservation and reform and the role of the building services engineer in meeting the objectives of the climate change programme.

In any assessment of this Outcome **all** knowledge and/or skills items should be included. Candidates must provide a satisfactory response to all items.

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring textbooks, handouts or notes to the assessment.

Assessment guidelines

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions.

Higher National Unit specification: statement of standards (cont)

Unit title: Energy Utilisation and Efficiency

The assessment for this outcome might be combined with that for Outcomes 2, 3, 4, 5 to form a single assessment paper.

Outcome 2

Identify and evaluate the use and sustainability of alternative energy sources.

Knowledge and/or skills

- ◆ Principle of sustainability
- ◆ Application of renewable energy

Evidence requirements

Candidates will need evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ summarise the principles of sustainability regarding the generation and utilisation of energy and water
- ◆ evaluate the suitability of renewable energy sources and active and passive solar energy systems for commercial and industrial building applications
- ◆ explain the principles of using aquatherms as an energy medium for heating and cooling applications or for domestic water usage
- ◆ evaluate and apply water recovery or grey water schemes within the design of domestic water services installations
- ◆ evaluate the viability and suitability of CHP for given commercial applications.

In any assessment of this Outcome **all** knowledge and/or skills items should be included. Candidates must provide a satisfactory response to all items.

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring textbooks, handouts or notes to the assessment.

Assessment guidelines

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions.

The assessment for this outcome might be combined with that for Outcomes 1,3,4,5 to form a single assessment paper.

Higher National Unit specification: statement of standards (cont)

Unit title: Energy Utilisation and Efficiency

Outcome 3

Produce an appraisal of the energy efficiency for proposed building services installations at the design stage and predict target energy performance indicators for a range of buildings and services.

Knowledge and/or skills

- ◆ Building Design
- ◆ Energy Performance Indicators

Evidence requirements

Candidates will need evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ evaluate a building envelope and design and provide recommendations on passively reducing the energy requirements
- ◆ determine and appraise the energy utilisation, performance and running costs for given commercial buildings
- ◆ estimate energy consumption and performance targets for proposed building projects
- ◆ evaluate a building's energy consumption and performance, environmental emissions with recognised consumption benchmarking data (kWh/m²) and (CO₂/m²)
- ◆ evaluate major building services systems energy performance with recognised consumption benchmarking data (kWh/m²).

In any assessment of this Outcome **all** knowledge and/or skills items should be included. Candidates must provide a satisfactory response to all items.

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring textbooks, handouts or notes to the assessment.

Assessment guidelines

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions.

The assessment for this outcome might be combined with that for Outcomes 1,2,4,5 to form a single assessment paper.

Outcome 4

Undertake **energy audits** on buildings and building services installations

Knowledge and/or skills

- ◆ Purpose and benefits of energy audits and surveys:

Higher National Unit specification: statement of standards (cont)

Unit title: Energy Utilisation and Efficiency

Evidence requirements

Candidates will need evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ explain the purpose and benefits of energy audits and surveys
- ◆ complete an energy audit and survey for a given building
- ◆ evaluate the findings of energy surveys and prepare the case for implementation for presentation to relevant managers.

In any assessment of this Outcome **all** knowledge and/or skills items should be included. Candidates must provide a satisfactory response to all items.

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring textbooks, handouts or notes to the assessment.

Assessment guidelines

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions.

The assessment for this outcome might be combined with that for Outcomes 1,2,3,5 to form a single assessment paper.

Outcome 5

Evaluate heat recovery and energy minimisation methods for use within building services installations.

Knowledge and/or skills

- ◆ Heat Recovery
- ◆ Energy Minimisation
- ◆ Plant Size and Performance
- ◆ Improved energy efficiency
- ◆ Minimisation of energy utilisation
- ◆ Improving system performance

Evidence requirements

Candidates will need evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ summarise the principles of the various heat recovery methods and techniques available.
- ◆ evaluate the suitability of various heat recovery techniques for given commercial building services applications.

Higher National Unit specification: statement of standards (cont)

Unit title: Energy Utilisation and Efficiency

Evidence for the knowledge and /or skills for this Outcome will be provided on a sample basis. In any assessment of this Outcome **four out of six** knowledge and/or skills items should be sampled. Candidates must provide a satisfactory response to all four items.

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring textbooks, handouts or notes to the assessment.

Assessment guidelines

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions.

The assessment for this outcome might be combined with that for Outcomes 1,2,3,4 to form a single assessment paper.

Administrative Information

Unit code:	DP14 34
Unit title:	Energy Utilisation and Efficiency
Superclass category:	TD
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Higher National Unit specification: support notes

Unit title: Energy Utilisation and Efficiency

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 is intended to develop a candidate's understanding of the environmental impact of energy utilisation in modern commercial buildings and to identify methods of reducing energy wastage. The unit is intended for those candidates who are, or will be involved in the design, operation or management of building services systems in commercial buildings.

The opportunity to provide evidence of the achievement of a range of key skills will feature strongly in both formative and summative assessments.

This unit links with the Project (Integrative Assignment) and the technology units in each occupational pathway.

Recommended time allocations to each outcome are given as guidance towards the depth of treatment which might be applied to each topic.

This guidance has been used in the design of the assessment exemplar material provided with the unit.

1 Environmental impact and contribution to global warming, energy utilisation of buildings and their services (8 hours)

Global environmental issues: principles, fundamentals and technology on how energy is derived, generated and transported. The inter-relationship between energy utilisation and environmental impact. Emissions from the combustion of finite fossil fuels. Impact of combustion emissions on the climate and environment, global warming, acid rain and pollution etc.

Energy/environmental conservation and reform: the need for conservation and reform. International environmental agreements and protocols including Kyoto agreement and the UK climate change programme. The role of the building services engineer in meeting the objectives of the climate change programme.

2 Alternative energy sources (8 hours)

Principle of sustainability: regard to the generation and utilisation of energy and water

Application of renewable energy: sources for commercial and industrial building applications, hydroelectric, wind, bio-fuels, waste incineration, and geothermal schemes. Application of active and passive solar energy schemes including photovoltaics and conventional solar applications. Use of aquatherms as an energy medium for heating and cooling applications or for domestic water usage. Use of water recovery or grey water schemes within the design of domestic water services installations. Principles and practices of combined heat and power (CHP) systems.

Higher National Unit specification: support notes (cont)

Unit title: Energy Utilisation and Efficiency

3 Energy efficiency for proposed building services installations and predict target energy performance indicators (8 hours)

Building Design: role of the building services engineer within the design team in improving the energy performance of the building envelope and design. Evaluation of building designs and methods for reducing energy requirements.

Energy Performance Indicators: principles and fundamentals on determining the energy utilisation, performance and estimated running costs for commercial buildings. Appraising the energy performance of buildings and the integral engineering services elements with recognised energy performance indicators and benchmarking yardsticks.

4 Energy audits (8 hours)

Purpose and benefits of energy audits and surveys: approaches and strategies for energy audits and surveys. Identifying the audit and survey needs within organisations and buildings. Techniques and procedures in planning completing and evaluating energy audits and surveys for various types of building.

5 Heat recovery and energy minimisation methods (8 hours)

Heat Recovery: integration of heat recovery techniques within the design of building services systems to improve system and building energy efficiency. Heat recovery techniques and principles for various central air ventilation systems ie plate heat exchangers, run around coils, thermal wheels, re-circulation, heat pipe, air to water recovery techniques – refrigeration etc. The opportunities of combining heat recovery from CHP with absorption refrigeration chillers.

Energy Minimisation: application of available technologies, energy conservation principles and techniques which can be incorporated into building engineering systems to improve energy efficiency.

Plant Size and Performance: the importance of suitably sized plant and the relationship of poor energy performance with oversized plant. The important role commissioning, hand-over procedures and maintenance has on energy performance of buildings and the integral services.

Improved energy efficiency: appraisal and selection of high efficiency plant and equipment ie condensing boilers, combination boilers, low NOx boilers, variable volume pumps, variable volume ventilation plant, instantaneous gas fired HWS heaters etc.

Minimisation of energy utilisation: lighting (and cooling load) requirements through the use of improved controls, daylight and movement sensors, application of low energy and high frequency techniques, incorporation within automatic and BMS controls systems.

Improving system performance: optimum use of building management systems and the application of free cooling strategies (enthalpy control) and nighttime cooling techniques.

Higher National Unit specification: support notes (cont)

Unit title: Energy Utilisation and Efficiency

Guidance on the delivery and assessment of this Unit

Opportunities for developing Core Skills

It is recommended that evidence for outcomes is achieved through well-planned course work, assignments and projects. Assessment may be formative and summative and both may feature as part of the process. Although assessments must be focused on the individual achievement of each candidate, group work and role-play activities may contribute to the assessment. Integrative assignments and project work will help to link this unit with other related units.

The volume of evidence required for each assessment should take into account the overall number of assessments being contemplated within this unit and the design of the overall teaching programme.

In designing the assessment instrument/s, opportunities should be taken to generate appropriate evidence to contribute to the assessment of Core Skills units.

Open learning

Given that appropriate materials exist this unit could be delivered by distance learning, which may incorporate some degree of on-line support. However, with 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/s were conducted under controlled, supervised conditions.

Candidates with additional support needs

This Unit specification is intended to ensure that there are no artificial barriers to learning or assessment. The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs*, which is available on the SQA website www.sqa.org.uk

General information for candidates

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On completion of this unit you should be able to :

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- ◆ Identify and evaluate the use and sustainability of alternative energy sources
- ◆ Produce an appraisal of the energy efficiency for proposed building services installations at the design stage and predict target energy performance indicators for a range of buildings and services
- ◆ Undertake energy audits on buildings and building services installations
- ◆ Evaluate heat recovery and energy minimisation methods for use within building services installations.

Evidence that you can satisfy the knowledge and skill elements of this unit will be obtained by assessment in controlled, supervised conditions to which you will not be allowed to bring textbooks, handouts or notes to the assessment.