University of the West of Scotland Module Descriptor

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Title of Module: Sustainable Energy: Sources & Storage

Code: ENGG11053	**SCQF Level: 11** (Scottish Credit and Qualifications Framework)	**Credit Points: 20**	**ECTS: 10** (European Credit Transfer Scheme)
School:	School of Computing, Engineering and Physical Sciences		
Module Co-ordinator:	Andy Durrant		

Summary of Module

It has been widely acknowledged that fossil fuels which are the main source of energy for the world today are highly unsustainable and directly related to air pollution, land and water degradation and climate change. To counter this, the use of low-carbon and renewable energy sources is already growing. Renewable energy depends on diverse sources like wind, solar, geothermal, , hydro, and biomass, while the widespread use of nuclear technology has done much to displace fossil fuels. Moreover, this must be associated with applying different techniques to derive better energy efficiency from existing systems and to store the generated energy and/or any captured carbon dioxide in different forms. Storage systems include fuel cells, supercapacitors, and batteries, as well as schemes to prevent CO2 from combustion reaching the atmosphere.

The main aim of this module is to outline the fundamentals and the up-to-date technologies associated mainly with Biomass and Energy storage systems and compare them to more long-established but less sustainable systems. Also sources such as wind, solar, bio-energy, nuclear and hydro energy will be included. As mentioned before an overview of the storage systems that are popularly linked to the renewable energy resources and different types of fuel cells systems, supercapacitors and batteries will be studied.

Evaluation techniques such as Energy Returned over Energy Invested and Carbon Emission Pinch Analysis (CEPA) are used to target efforts in replacing energy generation and for carbon capture and storage (CCS)

Different applications and case studies will be investigated and strength and weakness of each case will be clarified. The cases studies include diverse geographical and economic situations. Discussion regarding common technical and non-technical barriers and issues limiting the wide spread use and dissemination of renewable energy will also be covered. The limits of available technology and of the potential of new and emerging technology will be discussed.

- During the course of this module students will develop their UWS Graduate Attributes (https://www.uws.ac.uk/current-students/your-graduate-attributes/). Universal: critical thinking and analytical & inquiring mind and research-minded. Successful : autonomous, driven and resilient. Work- ready: effective communicator.

Module Delivery Method

Face-To-Face	Blended	Fully Online	HybridC	HybridO	Work-based Learning
			✓		

Face-To-Face
Term used to describe the traditional classroom environment where the students and the lecturer meet synchronously in the same room for the whole provision.
Blended
A mode of delivery of a module or a programme that involves online and face-to-face delivery of learning, teaching and assessment activities, student support and feedback. A programme may be considered "blended" if it includes a combination of face-to-face, online and blended

modules. If an online programme has any compulsory face-to-face and campus elements it must be described as blended with clearly articulated delivery information to manage student expectations
Fully Online
Instruction that is solely delivered by web-based or internet-based technologies. This term is used to describe the previously used terms distance learning and e learning.
HybridC
Online with mandatory face-to-face learning on Campus
HybridO
Online with optional face-to-face learning on Campus
Work-based Learning
Learning activities where the main location for the learning experience is in the workplace.

Campus(es) for Module Delivery						
The module will **normally** be offered on the following campuses / or by Distance/Online Learning: (Provided viable student numbers permit)						
Paisley:	Ayr:	Dumfries:	Lanarkshire:	London:	Distance/Online Learning:	Other:
✓						

Term(s) for Module Delivery					
(Provided viable student numbers permit).					
Term 1	✓	Term 2		Term 3	

Learning Outcomes: (maximum of 5 statements)

On successful completion of this module the student will be able to:

L1. Outline the fundamentals associated with both current energy sources and storage systems and their likely, sustainable replacements.
L2. Critically evaluate all of the studied energy technologies and storage systems, comparing them to each other in term of sustainability, capacity, durability and cost.
L3. Evaluate the limits of available technology and of the potential of new and emerging technologies in different geographical and socioeconomic environments.
L4. Evaluate the technical and non-technical barriers that are limiting the wide spread of renewable energy.

Employability Skills and Personal Development Planning (PDP) Skills	
SCQF Headings	During completion of this module, there will be an opportunity to achieve core skills in:

Knowledge and Understanding (K and U)	SCQF Level 11. Critical understanding of sustainable energy in the global context and the underlying key theoretical positions, principles and concepts. Critical understanding of the inherent challenges faced by environmental issues. Extensive, detailed and critical knowledge and understanding of the benefits of sustainable energy. Critical awareness of challenges facing sustainable energy.
Practice: Applied Knowledge and Understanding	SCQF Level 11. Understanding of sustainable energy and energy storage systems principles, methodologies and techniques. Developing leadership awareness on the environmental related issues.
	Practice the use-case utilisation of digital technologies in a predefined context and library resources.
Generic Cognitive skills	SCQF Level 11. Apply critical analysis, evaluation and synthesis to issues which are at the forefront of, or informed by, developments at the forefront of sustainable energy. Identify, conceptualise and define new and abstract problems and issues related to sustainable energy. Critically review, consolidate and extend knowledge, skills practices and thinking in sustainable energy. Understand complex issues regarding sustainable energy and storage systems and relate these issues to environmental protection.
Communication, ICT and Numeracy Skills	SCQF Level 11. Use of appropriate computer software for written and oral presentation. Discussion of appropriate use of ICT in support of research objectives (e.g. data collection and analysis of sustainable energy project).
Autonomy, Accountability and Working with others	SCQF Level 11. Responsibility of leading research topic (Continuous Assessment Energy Project) , ownership of sustainable energy project process including integrity of source usage (e.g. literature, ethical practice).

Pre-requisites:	Before undertaking this module the student should have undertaken the following:	
	Module Code:	**Module Title:**
	Other:	
Co-requisites	**Module Code:**	**Module Title:**

* Indicates that module descriptor is not published.

Learning and Teaching
Teaching in this module is research-led and students are learning about the latest research and development from the key academic staff and industry practitioners involved in renewable energy led by those academics (including resources). In addition, the module also benefits from research-based teaching since students as participants in research undertake inquiry based learning. The module will thus be taught by a combination of lectures, online and class-based group-work tutorials, practicals, guided independent study and through a flipped classroom with pre-recorded lectures but will also involve specialist experts in a variety of aspects of renewable energy and energy storage systems.

Learning Activities During completion of this module, the learning activities undertaken to achieve the module learning outcomes are stated below:	**Student Learning Hours** (Normally totalling 200 hours): (Note: Learning hours include both contact hours and hours spent on other learning activities)
Lecture/Core Content Delivery	24
Tutorial/Synchronous Support Activity	12
Independent Study	164
	200 Hours Total

****Indicative Resources: (eg. Core text, journals, internet access)** -

The following materials form essential underpinning for the module content and ultimately for the learning outcomes:

Da Rosa, Aldo Vieira.; Ordóñez, Juan Carlos. Fundamentals of renewable energy processes. London : Academic Press, 2022. 4th ed.

Michael Sterner, Ingo Stadler. Handbook of energy storage: demand, technologies, integration. Berlin : Springer (2019)

Guerrero-Lemus, Ricardo and Martínez-Duart, José Manuel (2012) Renewable Energies and CO2 Cost Analysis, Environmental Impacts and Technological Trends, Springer

Cossuta, Matteo; Foo, Dominic and Tan: Carbon emission pinch analysis (CEPA) for planning the decarbonization of the UK power sector, Sustainable Production and Consumption 25 (2021) 259-270

William D. Fletcher, Craig B. Smith. Reaching Net Zero [electronic: what it takes to solve the global climate crisis, Amsterdam, Netherlads ; Cambridge, MA : Elsevier, 2020

Beggs, Clive. Energy: management, supply and conservation, 2nd, Amsterdam; London : Elsevier Butterworth-Heinemann, 2009.

(**N.B. Although reading lists should include current publications, students are advised (particularly for material marked with an asterisk*) to wait until the start of session for confirmation of the most up-to-date material)

Engagement Requirements

In line with the Academic Engagement Procedure, Students are defined as academically engaged if they are regularly engaged with timetabled teaching sessions, course-related learning resources including those in the Library and on the relevant learning platform, and complete assessments and submit these on time. Please refer to the Academic Engagement Procedure at the following link: Academic engagement procedure

Supplemental Information

Programme Board	Engineering
Assessment Results (Pass/Fail)	No
Subject Panel	Engineering
Moderator	Mojtaba Mirzaeian
External Examiner	TBC
Accreditation Details	

Changes/Version Number	1

Assessment: (also refer to Assessment Outcomes Grids below)

Assessment Category 1: 100 % Continuous Assessment.
35% - Project on renewable energy and energy storage systems (includes report and MS Power Point presentation).
35% - assignment on Carbon Emission Pinch Analysis
30% - critical analysis of renewable energy policy of a given country or state.

(N.B. (i) **Assessment Outcomes Grids** for the module (one for each component) can be found below which clearly demonstrate how the learning outcomes of the module will be assessed.
(ii) An **indicative schedule** listing approximate times within the academic calendar when assessment is likely to feature will be provided within the Student Handbook.)

Assessment Outcome Grids (Footnote A.)

Component 1

Assessment Type (Footnote B.)	Learning Outcome (1)	Learning Outcome (2)	Learning Outcome (3)	Learning Outcome (4)	Weighting (%) of Assessment Element	Timetabled Contact Hours
Case study	✓	✓	✓	✓	30	0
Report of practical/ field/ clinical work	✓	✓	✓	✓	35	0
Presentation	✓	✓	✓	✓	35	0
			Combined Total For All Components		100%	0 hours

Footnotes

A. Referred to within Assessment Section above
B. Identified in the Learning Outcome Section above

Note(s):

1. More than one assessment method can be used to assess individual learning outcomes.
2. Schools are responsible for determining student contact hours. Please refer to University Policy on contact hours (extract contained within section 10 of the Module Descriptor guidance note).

This will normally be variable across Schools, dependent on Programmes &/or Professional requirements.

Equality and Diversity

Aligned with the University's commitment to equality and diversity, this module supports equality of opportunity for students from all backgrounds and learning needs. Using the VLE, material will presented electronically in formats that allow flexible access and manipulation of content. This module complies with University regulations and guidance on inclusive learning and teaching practice. Specialist assistive equipment, support provision and adjustment to assessment practice in accordance with the University's policies and regulations. More information on the University's EDI policies can be accessed at: https://www.uws.ac.uk/about-uws/uws-commitments/equality-diversity-inclusion/