Data, AI and Ethics for Sustainable Energy Engineering

Module Descriptor

Module Code:	REN7DAE
Version:	V1.00
Status:	Final
Date:	05/11/2025

Data, AI and Ethics for Sustainable Energy Engineering

Summary Module Details

Module details

Module Title: Data, AI and Ethics for Sustainable Energy Engineering

Module Leader: Dr Mahmoud Dhimish

Module Mode: Supported online learning / residential short course

Semester: Autumn (UK) / residential short course

Level: 7

Credits: 20

Learning Hours: 200

Contact & Study Hours

Supported online learning study mode

Directed Study Time: 60 hrs (30%)

Self-directed Study Time: 70 hrs (35%)

Assessment Study Time: 70 hrs (35%)

Residential short course study mode

Pre-residential directed study time: 40 hours (20%)

Residential (face to face intensive teaching, assessment and workshops) time: 50 hours (25%)

Post-residential directed study time and assessment study time: 110 hours (55%)

Assessment Type

Coursework: 100%

Module Summary

This module explores the intersection of data science, artificial intelligence, and ethical frameworks in the context of sustainable energy engineering. Students will learn how data-driven methods and AI techniques (such as neural networks, optimisation, and intelligent control) can be applied to renewable energy systems, while also critically evaluating ethical and societal implications of digitalisation in the energy transition.

Learning is delivered through lectures, industry-informed case studies, and practical AI labs using real-world renewable energy datasets provided by academic and industrial partners. This ensures that students gain both the

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technical capability and ethical literacy required to deploy intelligent solutions responsibly within the global drive for net zero, with reference to the United Nations Sustainable Development Goals (UN SDGs) and Environmental, Social and Governance (ESG) principles.

Taken on which Programmes

MSc Renewable Energy and AI (C)
Residential Short Course Delivery Programme (E)

Core (C) or Elective (E)

Module Aims

This module aims to:

- Provide students with a foundational understanding of AI and data analytics techniques applied in renewable and sustainable energy systems.

- Develop critical awareness of ethical, social, and regulatory considerations in digital energy transitions.

- Enable students to apply AI and machine learning tools for energy modelling, forecasting, and optimisation.

- Equip students with interdisciplinary skills to balance innovation with responsible, ethical AI in engineering practice.

- Immerse students in hands-on application of AI tools through real-world datasets and practical implementation exercises.

Module Learning Outcomes

LO1.   Critically analyse and apply key AI and data science techniques relevant to sustainable energy systems.

LO2.   Use AI-based tools (e.g., ANN, ML algorithms) to model, forecast, or optimise renewable energy performance.

LO3.   Critically evaluate ethical challenges and regulatory issues associated with AI deployment in the energy sector.

LO4.   Integrate technical and ethical perspectives in the design of responsible intelligent energy solutions.

Indicative Module Content

Module topics

- Introduction to Data and AI in Energy: Data pipelines, big data in renewables, intelligent energy systems.

- Machine Learning for Energy: Regression, classification, clustering, neural networks (ANN, CNN), optimisation.

- AI Applications in Renewables: Fault detection, forecasting, predictive maintenance, energy yield modelling.

- Data Ethics and Governance: Data integrity, privacy, bias, fairness, transparency, accountability.

- Regulatory and Policy Context: AI standards, international frameworks, legal perspectives.

- Sustainability and Responsibility: Ethical AI in climate and energy applications.

- Practical Skills: Hands-on labs applying ML/AI methods to industry datasets (numerical and image-based), including scenario analysis and implementation tasks.

This content will be reviewed and updated regularly to reflect the legal, moral and financial changes in professional standards and practice, and the evolving body of knowledge regarding social science research.

Overview of Summative Assessment

Module learning outcomes	Assessment	Word count or equivalent	Weighting
LO1, LO2, LO4	**Assessment 1** Coursework	2,500	50%
LO1, LO2, LO3, LO4	**Assessment 2** Coursework	2,500	50%

Module Pass Mark (as a weighted average of all assessments): 50%

Key Module Learning Resources

Core Sources and Texts

The core reading resources within each module will be provided via the specific Virtual Learning Environment (VLE) module pages and within the e-Library. Additional reference material and supplementary resources to support your studies are available through the University e-Library.

Module tools

Students will have access to study materials, dedicated academic support, student forums, and learning activities via an online learning platform (VLE).

The module page on the VLE is broken down into structured study weeks to help students plan their time, with each week containing a mixture of reading, case studies, videos/recordings and interactive activities to go through. Online webinars/seminars led by the Module Leader can be attended in real time and provide opportunities to consolidate knowledge, ask questions, discuss topics and work through learning activities together. These sessions are recorded to support students who cannot attend and to enable students to recap the session and work through it at their own pace. Module forums on the VLE provide further opportunities to discuss topics with other students, complete collaborative work and get extra help from the module team.

Professional online resources

The e-Library provides access to trusted, quality online resources, selected by subject specialists, to support students' study. This includes journals, industry publications, magazines, academic books and a dissertation/work-based library. For a list of the key industry specific and education resources available please visit the VLE e-Library.

Other relevant resources

Access is also provided to further information sources that include the British Library and Open University UK catalogues, as well as providing a monthly current awareness service entitled, ***Knowledge Foundations*** - a compendium of news, research and resources relating to the educational sector and the Built Environment.

The module resource list is available on the module VLE page and is updated regularly to ensure materials are relevant and current.