Module Specification

Zero Carbon Buildings

Version: 2027-28, v1.0, 19 Mar 2025

Contents

Part 1: Information

Module title: Zero Carbon Buildings

Module code: UBLL7N-30-3

Level: Level 6

For implementation from: 2027-28

UWE credit rating: 30

ECTS credit rating: 15

College: College of Arts, Technology and Environment

School: CATE School of Architecture and Environment

Partner institutions: None

Field: Architecture and the Built Environment

Module type: Module

Pre-requisites: None

Excluded combinations: Energy Transformations 2026-27, Sustainability and Energy Simulations 2026-27

Co-requisites: None

Continuing professional development: Yes

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: This module covers three key areas of zero carbon building design. It explores the embodied carbon of materials, emphasising life cycle assessment (LCA) techniques to reduce construction industry carbon footprints through material selection, reuse, and recycling. Students will also study dynamic energy simulation, using computational fluid dynamics (CFD) and thermal modelling to optimise building energy performance, including benchmarking and CO2 emissions. Finally, the

module covers energy technologies, including combustion principles, biofuels, boiler system design, on-site electricity generation, storage solutions, and solar energy systems, equipping students with the knowledge to design and specify sustainable, energy-efficient buildings.

Features: Not applicable

Educational aims: This module aims to develop students' ability to analyse energy technologies, create zero carbon design strategies, and evaluate environmental benefits, optimising building fabric and systems through dynamic simulations while contributing to sustainable development goals.

Outline syllabus: This module three main areas of zero carbon building design and specification.

Embodied carbon of materials - emphasising the importance of reducing the carbon footprint in the construction industry. Students will explore the concept of embodied carbon and learn methods for calculating and assessing it using life cycle assessment (LCA) techniques. The module will also highlight sustainable materials and strategies to minimise embodied carbon.

Dynamic energy simulation of fabric operational performance - focusing on the use of computational fluid dynamics (CFD) and thermal simulation techniques. Students will investigate the dynamic behaviour of materials and the role of thermal mass in buildings, alongside space heating, heat transfer, and heat exchange mechanisms.

Energy Technology - providing a comprehensive understanding of various energy systems used in buildings. Students will explore the principles of combustion, the design and operation of boiler systems, flue gas analysis, on-site electricity generation and storage, and solar energy systems.

In this module the following competencies are met and assessed to passing standard appropriate to this level of study:

The principles of climate change and biodiversity as relevant to design and construction.

The principles of building physics and environmental design.

Propose design solutions that achieve or exceed relevant performance standards and requirements.

Use appropriate digital systems for creating, modelling, processing, presenting, and sharing design, building and project information.

Locate, evaluate and apply relevant legislation, regulations, standards, codes of practice and policies related to the development of the built environment.

Understand how modelling and post occupancy evaluation inform design

Work constructively with and within a broader team, exercising leadership, effective communication and personal responsibility.

Part 3: Teaching and learning methods

Teaching and learning methods: Teaching Strategy for the Module

The subject is taught through a structured and diverse set of activities designed to enhance student understanding and engagement. The strategy includes the following components:

1. Introductory Lectures - A comprehensive set of lectures provides a foundational overview of the subject, establishing key concepts and objectives. These session serves as a starting point for deeper exploration through subsequent activities.

2. Interactive Tutorial - Tutorials are designed to foster engagement by encouraging questions, discussions, and problem-solving. These sessions allow students to clarify concepts and apply their knowledge in a collaborative setting.

3. Computer based tutorials - regular taught sessions use engineering software in Technology Enhanced Learning rooms, combining individual tasks and group work to analyse system parameters, interpret data, and present meaningful outputs in a collaborative environment.

4. Online Learning Resources - A rich suite of online learning materials supports students in their independent study. These resources include multimedia content, readings, interactive tools, and self-assessment opportunities, enabling students to learn at their own pace and in the manner that suits their individual preferences.

This multi-faceted teaching strategy ensures a well-rounded learning experience, combining theoretical understanding, practical application, and independent exploration to meet diverse learning needs.

Module Learning outcomes: On successful completion of this module students will achieve the following learning outcomes.

MO1 Critically analyse various energy transformation technologies commonly used in buildings, including boilers (hot water and steam), power generators, and storage systems, and evaluate factors that influence system efficiency.

MO2 Develop and propose an effective zero carbon design strategy for a case study building, incorporating considerations such as embodied carbon of materials, fabric optimisation through dynamic computer simulation, and appropriate energy technologies.

MO3 As part of a group, formulate a critical argument supporting a zero carbon strategy for a case study building, comparing its strengths and weaknesses against hydrocarbon-dependent alternatives and highlighting its contribution to broader sustainable development goals.

Hours to be allocated: 300

Contact hours:

Independent study/self-guided study = 228 hours

Face-to-face learning = 72 hours

Reading list: The reading list for this module can be accessed at readinglists.uwe.ac.uk via the following link https://rl.talis.com/3/uwe/lists/5AAA290B-1C6D-6A57-5F2D-27291881ADE8.html?lang=en-GB&login=1

Part 4: Assessment

Assessment strategy: Assessment Strategy
The assessment strategy for this module is designed to evaluate students' ability to apply zero carbon design strategies, energy technologies, and dynamic simulations to real-world building projects. The approach emphasises critical thinking, technical competence, and practical application, helping students refine their design and analytical skills.

First Attempt Assessment
Task 1 – Portfolio: Zero Carbon Design and Energy Systems
Students will submit a comprehensive portfolio, developing a zero carbon strategy for a case study building. This portfolio will focus on calculating and simulating energy systems, addressing embodied carbon, and optimising building fabric. Students will evaluate the strengths and weaknesses of their proposed strategy and provide supporting analysis, including dynamic simulations of building performance and selection of appropriate energy technologies.

Task 2 – Group Set Exercise: Zero Carbon Strategy Argument
As part of a group, students will complete a set exercise where they present a critical argument for their chosen zero carbon strategy, comparing it with traditional hydrocarbon-dependent alternatives and discussing its alignment with sustainable development goals. The exercise will assess their ability to make evidence-based recommendations for a complex issue. Peer feedback will be used to ensure a fair distribution of the awarded mark.
Preparation for this assessment will include enhanced support as part of the scaffolding for inclusive assessment, helping students to gain confidence with group work. Alternative assessment types for students with approved reasonable adjustments may be considered, but shall retain an element demonstrating group

work.

Second Attempt Assessment

Task 1 – Portfolio

Students will revise their initial portfolio potentially for a different case study, to a similar expectation of the first attempt.

Task 2 – Set Exercise

A revised set exercise will provide an opportunity for students to rework their argument, potentially based on a different building scenario.

Feedback Strategy

Formative feedback will be given on the initial portfolio draft. prior to the first attempt opportunity. Detailed written feedback of submitted work will guide improvements in technical writing, design strategies, and argumentation, supporting students' academic development.

Assessment tasks:

Portfolio (First Sit)
Description: Engineering Portfolio (3,000 words)
Weighting: 75 %
Final assessment: No
Group work: No
Learning outcomes tested: MO1, MO2

Set Exercise (First Sit)
Description: Recorded Presentation (10 minutes)
Weighting: 25 %
Final assessment: Yes
Group work: Yes
Learning outcomes tested: MO3

Portfolio (Resit)
Description: Engineering Portfolio (3,000 words)

Weighting: 75 %

Final assessment: No

Group work: No

Learning outcomes tested: MO1, MO2

Set Exercise (Resit)

Description: Recorded Presentation (10 minutes)

Weighting: 25 %

Final assessment: Yes

Group work: Yes

Learning outcomes tested: MO3

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Architecture and Environmental Engineering [Frenchay] BEng (Hons) 2025-26