

PhD Studentship Net2Zero

Dynamic Performance and AI-Driven Optimisation of Hybrid Energy Systems for Net Zero

Programme Length: 4 Years

Study Mode: Full-time

Location: Nottingham

Discipline: Engineering & Physical Sciences

Start Date: December 2026

Project Overview

This fully funded PhD project aims to develop and evaluate a novel hybrid energy system that integrates gas turbines, low-temperature carbon capture, biomass gasification, and advanced solar thermal technologies to enable carbon-negative fuel production and grid support.

The project addresses the urgent need to decarbonise energy systems while maintaining grid stability and supporting sustainable fuel production. The successful candidate will investigate how intelligent hybrid energy platforms can enhance system performance, maximise carbon utilisation, and contribute to the UK's net-zero ambitions.

Aim

The project aims to design and evaluate an integrated hybrid energy system capable of:

- Supporting flexible and resilient energy generation.
- Producing carbon-negative fuels.
- Enhancing grid stability under variable renewable energy penetration.
- Maximising carbon dioxide utilisation through advanced process integration.
- Demonstrating the technical, environmental, and economic feasibility of large-scale deployment.

Research Objectives

The successful candidate will:

- Develop thermodynamic models of integrated hybrid energy systems combining:
 - Gas turbines
 - Biomass gasification
 - Low-temperature carbon capture

- Advanced solar thermal technologies
 - Conduct transient simulations using UK climate and grid demand profiles.
 - Evaluate system performance under variable operating conditions.
 - Perform techno-economic assessments to determine commercial viability.
 - Undertake life cycle assessment (LCA) to quantify environmental benefits.
 - Develop AI-driven multi-objective optimisation frameworks to:
 - Coordinate energy flows across the hybrid system.
 - Improve operational efficiency.
 - Maximise carbon dioxide utilisation.
 - Support intelligent control strategies.
 - Investigate the transferability of the hybridisation framework to:
 - Industrial furnaces (e.g. steel and cement sectors)
 - Waste-to-energy plants
 - Other industrial energy systems
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Project Background

As global energy demand continues to increase, reducing carbon emissions while maintaining reliable energy supplies presents a significant challenge.

Gas turbine-based power generation remains a major contributor to electricity supply but also produces substantial carbon emissions. Existing hybrid energy system studies often focus on electricity-intensive Power-to-X approaches, whilst underutilising biomass conversion and advanced solar thermal technologies.

Emerging low-temperature carbon capture technologies, including electrochemically mediated amine regeneration, offer significant promise but remain largely unexplored within integrated hybrid systems.

This project seeks to address these challenges by developing intelligent, flexible, and economically viable hybrid energy systems capable of accelerating the transition towards net zero.

Supervisory Team

This CDT project will be supervised by:

- **Dr Ioanna Dimitriou**, University of Nottingham
 - **Dr Oliver Fisher**, University of Nottingham
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About the Net2Zero Centre for Doctoral Training

The EPSRC and BBSRC Centre for Doctoral Training in Negative Emission Technologies for Net Zero (Net2Zero CDT) is a partnership between:

- Aston University (Lead Institution)
- University of Nottingham
- Queen's University Belfast
- University of Warwick

Students benefit from:

- Access to world-class research facilities.
 - Collaboration with academia, industry, government, and policymakers.
 - International networking opportunities.
 - Training in engineering, communication, entrepreneurship, and business skills.
 - A three-month industrial, research, or policy placement.
 - Opportunities to contribute to transformative net-zero technologies.
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Candidate Profile

We are seeking highly motivated candidates who hold, or expect to obtain before commencing the project:

- A First Class or strong Upper Second-Class (2:1) Honours degree (or equivalent) in:
 - Chemical Engineering
 - Mechanical Engineering
 - Energy Engineering
 - Process Engineering
 - Or a closely related discipline

Essential Skills and Experience

Candidates should possess:

- Motivation, creativity, and resourcefulness.
- A mature approach to learning.
- A solid foundation in:
 - Thermodynamics
 - Process modelling

- Programming
 - Energy systems
- Experience in, or willingness to learn, modelling and simulation software such as:
 - MATLAB
 - Python
 - Engineering Equation Solver (EES)
 - Aspen Plus
 - TRNSYS
- Excellent written and verbal communication skills.

Desirable Attributes

Although not essential, experience in any of the following areas would be advantageous:

- Energy systems modelling
- Carbon capture technologies
- Biomass conversion processes
- Artificial intelligence and optimisation
- Techno-economic analysis
- Life cycle assessment

Funding Package

The studentship includes:

- UKRI tax-free stipend (£21,805 per annum for 2026/27)
- Full tuition fee support
- Research Training Support Grant (RTSG)

Equality, Diversity and Inclusion

The Net2Zero CDT is committed to equality, diversity, and inclusion and welcomes applications from candidates of all backgrounds.

We particularly encourage applications from groups currently underrepresented in higher education and research, including:

- People from Black, Asian, and minority ethnic backgrounds
- Disabled people

- LGBTQ+ people
 - Women
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Eligibility

This opportunity is open to Home Fee Status candidates only.

Applicants should ensure they meet the UK Government regulations relating to Home Fee Status eligibility before applying.

Academic Queries

For enquiries regarding the research project, supervision, technical aspects of the research, or the proposed work programme, please contact:

Dr Ioanna Dimitriou

University of Nottingham

Dr Oliver Fisher

University of Nottingham

Administrative Queries

For enquiries relating to eligibility, the application process, funding, or the Net2Zero CDT programme, please contact:

Net2Zero CDT Team

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