

PhD Studentship Net2zero Development and Demonstration of a Laboratory-Scale Next Generation Multifunctional Reactor for Biochar Production and Bioenergy with Carbon Capture and Storage (BECCS) Technology

Programme Length: 4 Years

Study Mode: Full-time

Location: Nottingham

Discipline: Engineering & Physical Sciences

Start Date: October 2026

Project Overview

This fully funded PhD project aims to develop and demonstrate a laboratory-scale multifunctional reactor capable of operating both as a biochar/bio-syngas generator and as a Bioenergy with Carbon Capture and Storage (BECCS) reactor.

The project sits at the forefront of net-zero research, combining reactor engineering, biochar production, biomass utilisation, and carbon capture technologies. Working closely with academic researchers and industrial partners, the successful candidate will contribute to the development of innovative low-carbon technologies that support greenhouse gas removal and sustainable energy generation.

Aim

The project aims to develop and demonstrate a laboratory-scale reactor that can function as both:

- A biochar and bio-syngas generation system.
- A Bioenergy with Carbon Capture and Storage (BECCS) reactor.

Research Objectives

The successful candidate will:

- Collaborate with a commercial laboratory furnace manufacturer to conceptually design a laboratory-scale electrically heated furnace capable of housing the multifunctional reactor.
- Design and work alongside University engineering technicians to manufacture at least two reactor configurations (fluidised-bed and fixed-bed) that can be integrated within the furnace system for biochar production and BECCS evaluation using calcium-based and other solid sorbents.
- Carry out biochar production experiments using a range of biomass feedstocks and characterise the resulting biochar materials using advanced analytical techniques available at the University of Nottingham, including:
 - BET surface area analysis

- Scanning Electron Microscopy (SEM)
- X-ray Diffraction (XRD)
- Thermogravimetric Analysis (TGA)
- Conduct CO₂ capture experiments using the multifunctional reactor testing system with:
 - Calcium-based sorbents at elevated temperatures.
 - Alternative solid sorbents, including biochar-derived sorbents, at lower temperatures.

The research programme will initially utilise simulated CO₂-containing gas streams before progressing to experiments using real CO₂-containing flue gases.

Supervisory Team

This CDT project will be supervised by:

- Prof. Hao Liu, University of Nottingham
- Dr Yaoyao Zheng, University of Nottingham
- Nate Macmillan, AEL CCS

About the Net2Zero Centre for Doctoral Training

The Net2Zero Centre for Doctoral Training brings together Aston University, the University of Nottingham, Queen's University Belfast, and the University of Warwick to develop the next generation of leaders in negative emission technologies and net-zero solutions.

Students benefit from:

- Access to cutting-edge 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.

Candidate Profile

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

- A First Class or strong Upper Second-Class (2:1) Honours degree and/or a Master's degree (or equivalent) in:
 - Chemical Engineering
 - Mechanical Engineering
 - Materials Science
 - Chemistry
 - A closely related discipline

Desirable Experience

Although not essential, previous design or operational experience with fluidised-bed reactors would be advantageous.

Full training in the design, operation, and application of fluidised-bed reactor systems will be provided throughout the PhD, making this an excellent opportunity for candidates wishing to develop expertise in advanced reactor technologies, bioenergy systems, biochar production, and carbon capture.

Funding Package

The studentship includes:

- Tax-free UKRI 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 from all backgrounds. We particularly encourage applications from groups currently underrepresented in higher education and research.

Eligibility

This opportunity is open to Home Fee Status candidates only.

Academic Queries

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

Prof. Hao Liu

University of Nottingham

Professor Hao LIU (BEng, MEng, PhD, CEng, MEI)

liu.hao@nottingham.ac.uk

Chair in Energy Engineering

Co-Director of EPSRC/BBSRC Centre for Doctoral Training in Negative Emission Technologies for Net Zero: Net²Zero

Dr Yaoyao Zheng

member of:

LCERT research group ([Link](#)).

Editor board member of Carbon Capture Science and Technology ([CCST](#)) journal

UKCCSRC

Combustion Institute (British Section)

Yaoyao.Zheng@nottingham.ac.uk

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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