

PhD Studentships in MaREI's Circular Economy Energy and Environmental Systems Research Group

Closing Date for Applications: 24th January 2025

Research Centre: Energy, Climate and Marine Centre (MaREI)

School: School of Engineering and Architecture

College: College of Science, Engineering and Food Science

University: University College Cork, Ireland

Contract Type: Fixed Term Whole-Time

Job Type: Research

Salary: Tax-free stipend of €25,000 p.a. and tuition fees covered at the EU rate. Non-EU applicants may be required to pay additional non-EU fees

Duration and Start Date: 36-month duration, starting March 1st, 2025

Positions

- **3 x PhD Studentships** on Exploring Economic Viability and Market Development of Products from Anaerobic Digestion (EXPAND)

The MaREI Centre for energy, climate, and marine

The successful PhDs will be based in the MaREI Centre for energy, climate and marine headquartered in the Environmental Research Institute in University College Cork. MaREI is a key research centre within UCC's Environmental Research Institute (ERI), which is an internationally recognised Institute for environmental research dedicated to the understanding and protection of our natural environment and to developing innovative technologies, tools and services to facilitate a transformation to a zero carbon and resource efficient society. The MaREI Centre is a Research Ireland funded research centre headquartered in the ERI and includes 13 other Universities and Third Level Institutes from across Ireland, has 50 industrial partners and has accumulated research funding of over €60m. It combines the expertise of a wide range of research groups and industry partners, with the shared mission of solving the main scientific, technical and socio-economic challenges across the climate, energy and marine spaces. MaREI is also funded by SEAI, EI, EPA, ERDF, EU, HEA, Marine Institute, DCCA and IRC, as well as through contributions from our industry partners. Researchers in the MaREI Centre have over 30 years of experience in conducting fundamental and applied research supported by competitively won national and international funding, and commercial contracts with government agencies and industry. MaREI's strengths lie in the multi-disciplinary nature of its research teams, allowing it to combine insights across areas such as MRE Technologies, Materials & Structures, Observations & Operations, Coastal & Marine Systems, Bioenergy, Energy Policy & Modelling and Renewable Energy Management.

MaREI's Circular Economy Energy and Environmental Systems (CEEES) Research Group focus on renewable advanced fuel production in circular economy systems consists of approximately 20 researchers. The breadth of the work includes for analysis of systems from ocean (offshore wind and seaweed) to conversion (hydrogen, electro-fuels, gaseous and liquid biofuels) to end use (industry, transport fuel).

Detailed laboratory work includes for production of biohydrogen and biomethane from feedstocks such as agricultural residues, lignocellulosic crops, macro-algae (seaweed) and micro-algae. Research covers biological and thermochemical bioenergy pathways. The group investigates a range of innovative technologies at laboratory scale including for Power to Gas, demand driven biogas and novel biogas

upgrading technologies. Fundamental and applied aspects of biomass gasification, pyrolysis, and methanation are also investigated. Work includes for desktop analyses such as chemical kinetic modelling, process simulation, geographic specific bioresources, lifecycle analysis, sustainability analyses and techno-economic studies. The research facilitates the development of roadmaps, which describe how Ireland can initiate a green gas industry and contribute to mandatory renewable energy targets for renewable heat and transport fuels.

The CEEES research group is led by **Dr Archishman Bose** (Eli Lilly Lecturer at Process and Chemical Engineering), **Dr Richard O'Shea** (Lecturer in Sustainability in Enterprise), **Dr David Wall** (Senior Lecturer in Transportation) and **Prof Jerry D Murphy** (Director of the SFI MaREI Centre and Chair of Civil Engineering).

Research Project information:

Exploring Economic Viability and Market Development of Products from Anaerobic Digestion (EXPAND)

The anaerobic digestion (AD) industry in Ireland is nascent. The Climate Action Plan (CAP) has set a target of 5.7 TWh of biomethane to be delivered by 2030. To meet this target, up to 200 AD plants will be built nationally. The industry will be based on the digestion of agricultural biomass, primarily grass and slurry feedstocks. It is now recognised that the value of AD goes far beyond the energy in biomethane; such systems are now considered a multi-product platform that encompasses the wider bioeconomy. For example, AD generates a nutrient-rich biofertiliser in the form of digestate which can offset the requirement for synthetic chemical fertiliser. Scrutiny on digestate management and nutrient application will become an important feature in future AD system development. AD also generates a source of biogenic CO₂ which can have various applications such as in the food and beverage sector or can be sequestered for climate mitigation. However, significant research is required to advance the economic viability and market development of these by-products to give a clearer picture of future AD deployment in Ireland. The EXPAND project aims to advance the knowledge of such by-product utilisation and their role in the wider bioeconomy by 1) determining technically feasible AD value chains and the market demand of AD products; 2) exploring innovative pathways for digestate valorisation; 3) assessing optimal utilisation or valorisation of biogenic CO₂ from AD; and 4) assessing the economic viability and market development of a business ecosystem for by-products of AD in Ireland.

The Positions

Three PhD studentships are being advertised. The positions are 36 month fully-funded PhD (tax-free stipend of €25,000 per year and tuition fees covered at the EU rate; Non-EU applicants may be required to pay additional non-EU fees) which will be based at the School of Engineering and Architecture in University College Cork in MaREI.

PhD 1: Optimal pathways for valorisation of digestate derived from agricultural feedstocks. The work will include for the production of pyrochar and hydrochar from digestate as a soil amendment and a biobased fertiliser at laboratory scale; investigating the nutrient adsorption capacity of biochar; conducting pot trials to assess grass growth yields and undertaking a techno-economic and lifecycle assessment of existing/novel digestate management practices. This PhD will be supervised by Dr David Wall and Dr Archishman Bose.

PhD 2: Optimal pathways for biogenic CO₂ conversion to biochemicals or biofuels – specifically through bioelectrochemical systems (BES) such as microbial electrolysis cell (MEC) and microbial electrosynthesis (MES). The key responsibilities include: conduct experimental and theoretical studies on CO₂ valorisation in BES systems; develop and test electrode materials, catalysts, and configurations for MEC and MES reactors; perform data analysis and modelling to optimise system performance. This PhD will be supervised by Professor Jerry Murphy and Dr Xue Ning.

PhD 3: Assessing the economic viability and market potential of anaerobic digestion by-products. The project will include: the analysis of the cost-effectiveness and financial viability of AD by-products; the identification of potential markets and opportunities for commercialization; the development of stakeholder engagement strategies and the related evaluation of the potential contribution that AD by-products can provide in sustainable practices, such as sustainable consumption and circular economy. This PhD will be supervised by Dr Bernadette Power and Professor Valeria Andreoni.

Criteria (for all positions)

- First-class honours degree (or equivalent) in civil, environmental, energy, mechanical, and/or chemical engineering; candidates from other disciplines such as mathematics, social science and business may also be considered if it can be shown is relevant to the topic (such as PhD3)
- Capability of working within a project team to achieve results.
- Good communication, organisation, and interpersonal skills.
- Applicants whose first language is not English must show evidence of English proficiency (e.g. IELTS minimum 6.5, individual sections 6.0), please check the requirements at: <https://www.ucc.ie/en/study/comparison/english/postgraduate/>

To Apply:

Please email **(1) your C.V.** and **(2) a one-page perspective** on “*valorising digestate and CO₂ through a circular bioeconomy approach*” to Dr David Wall (david.wall@ucc.ie)

Please use the following in your email subject line when submitting your application to indicate your preferred PhD vacancy: e.g., “**PhD1_APPLICANT NAME**” or “**PhD2_APPLICANT NAME**” or “**PhD3_APPLICANT NAME**”

Please note candidates should select their most preferred PhD vacancy (1, 2 or 3) and submit only one application.

For informal inquiries applicants can email: david.wall@ucc.ie