

EBNet POC2023 Summary Sheet – Funded Projects

POC202311

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Simultaneous Bioremediation of Nutrient Pollution and Carbon Fixation Through a Novel, Integrated Anammox and Acetogens-Based Bio-Electrochemical System

Proposal Summary

The carbon and nitrogen cycles are two of the Earth's most important biogeochemical cycles due to their integral roles on the Earth's living systems. Although both cycles are seriously damaged by harmful anthropogenic activities, the later cycle received less attention from the scientific community in terms of its proper management and recovery from the damages caused. Improper management of the nitrogen cycle is also associated with the accumulation of fixed nitrogen compounds, i.e., nutrients in the environment, causing severe environmental pollution problems, including eutrophication, acid rain, red tides, and rapid destruction of the ozone layer. This project, thus, aims to develop a novel bio-electrochemical system for simultaneous management of both nitrogen and carbon cycles by removing excess nutrients and CO₂ from the environment. In particular, the project envisions to employ both microbial anaerobic ammonium oxidation (anammox) and carbon dioxide (CO₂) reduction by acetogens in an integrated, one pot bio-electrochemical system by supplying renewable electricity. The electroactive microorganisms in the integrated system will oxidise nutrients into inert nitrogen gas and reduce CO₂ into high-value organic acids; thereby, contributing to the bioremediation of both nutrient and carbon pollutions simultaneously. Such an integrated, novel, one pot proof-of-concept bio-electrochemical system-based reactor can not only help manage the nitrogen and carbon cycles, but also provide a cost-effective and attractive solution to current energy-intensive wastewater treatment processes and help decarbonise the UK's chemical industry sector.