School of Computing, Engineering, and the Built Environment
Edinburgh Napier University

PHD STUDENT PROJECT

Funding and application details

Funding status: Self-funded students only

Application instructions:
Detailed instructions are available at https://www.napier.ac.uk/research-and-innovation/research-degrees/how-to-apply

Prospective candidates are encouraged to contact the Director of Studies (see details below) to discuss the project and their suitability for it.

Project details

Supervisory Team:

- DIRECTOR OF STUDY: Zuansi Cai (Email: Z.Cai@napier.ac.uk)
- 2ND SUPERVISOR:

Subject Group: Engineering & mathematics

Research Areas: Engineering

Project Title: Modelling of microbial induced hydrogen loss for underground hydrogen storage

Project description:

Hydrogen is identified to play a key role in the UK's goal of achieving net zero emissions by 2050. To meet this target, the UK needs hydrogen storage capacity of at least 15 TWh (~ 450k tonnes) meet short-term and seasonal supply and demand variability. Currently, the UK only has one hydrogen storage facility in Teesside, with a capacity of ~30 GWh (0.9k tonnes of hydrogen) in salt caverns.

Underground hydrogen storage in depleted oil/gas reservoirs has been considered to provide grid-scale hydrogen storage capacity to support the UK's energy transition for net zero emissions. Hydrogen, however, is one of the most important

electron donors for many subsurface microbial processes, including methanogenesis, sulfate reduction, and acetogenesis. These processes could induce hydrogen loss in the storage facilities and compromise quality of the extracted gas.

This project aims to develop numerical capability to assess microbial induced hydrogen loss for underground hydrogen storage. The developed numerical capability will be based on our in-house model (GPSFLOW) and validated against reported data. Further numerical assessments will be conducted based on UK ongoing and potential gas storage facilities. The outcome from the project will provide evidence-based decision-making for the future role of underground hydrogen storage for the UK's energy transition.

References:

[1] Cai, Z., Zhang, K., & Guo, C. (2022). Development of a Novel Simulator for Modelling Underground Hydrogen and Gas Mixture Storage. International Journal of Hydrogen Energy, 47(14), 8929-8942. https://doi.org/10.1016/j.ijhydene.2021.12.224

Candidate characteristics

Education:

A second class honour degree or equivalent qualification in Engineering, or Computing

Subject knowledge:

- Mathematics
- Multiphase flow

Essential attributes:

- Competent in C++ programming
- Knowledge of Geology and thermodynamic
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes: