Proposed Studentship - *Funded*

Subsurface reservoirs for chemical storage of electricity

Fully funded, 4-year PhD opportunity

Supervisor(s): Prof. Dave Waltham, Dr. Anirban Basu (Department of Earth Sciences, Royal Holloway University of London) & Dr. Stefanie Kuenzel (Department of Electrical Engineering, Royal Holloway University of London)

Picture credit: @craigdoesdesign

Project Description:

In Flow-batteries, chemical energy is stored in fluids (electrolytes) external to the battery. This is a cheap and efficient form of electricity storage but, to be useful for large-scale applications, electrolyte tanks need to be enormous. This project investigates whether we can use salt caverns, deep aquifers or exhausted hydrocarbon fields for electrolyte storage. This idea is novel and the technical, environmental and economic problems have never been investigated. Power-system and geochemical aspects are the subject of an EPSRC major grant proposal under development.

The PhD pilot project, proposed here, concentrates on reservoir geology/geophysics and will:

1. Use established reservoir modelling techniques to quantify the storage volumes and likely electrolyte inflow and outflow rates of caverns, aquifers and depleted reservoirs.
2. Review a few UK continental shelf (UKCS) locations to assess suitability in terms of reservoir properties, proximity to current or future offshore windfarms and environmental safety.

Detailed Workplan:
1. Literature review covering: i. Alternate proposals for subsurface storage of energy (compressed air, power to gas etc.); ii. Reservoir modelling as applied to hydrocarbon fields; iii. Hydrocarbon trapping mechanisms and reservoir compartmentalization; iv. Electrical aspects (flow batteries, grid requirements, wind-farm intermittency etc.)
2. Physical properties of reservoirs and seals. How will these influence electrolyte storage and retrieval? This will involve reservoir modelling using standard industry techniques but with densities and viscosities appropriate to electrolytes.
3. Evaluation of a small number of possible UKCS storage locations. The objective is to use a few examples to develop the techniques and criteria needed to assess potential reservoirs.
4. Putting it all together. A single location will be chosen and an outline plan developed which estimates the capacity, power and cost of that installation. These results will be compared to those of alternative

subsurface energy storage methods as well as to more conventional solutions such as batteries or pumped-water-storage. An initial environmental impact assessment will also be made.
5. Writing up.

Benefits:

This proposal is part of the multi-University, industry-funded Doctoral Training Centre in "Geoscience and the Low Carbon Energy Transition - GeoNetZero". The successful applicant will therefore be on a PhD programme with exceptional benefits including:

- Fees and maintenance fully funded for 4 years.
- Additional £20k of research support funding (e.g. for conference attendance).
- 20 weeks of mandatory vocational training and industry links to enhance employability.
- Industry links.

Eligibility:

UK nationals are eligible for a full award. For EU nationals starting a degree in 2021/22, the UK Government has confirmed that you will not be eligible to pay the same fees as UK students. This means you will be classified as an international student. At Royal Holloway, we wish to support those students affected by this change in status through this transition. For eligible EU students starting their course with us in September 2021, we will award an automatic fee reduction which brings your fee into line with the fee paid by UK students. This will apply for the duration of your course.

Closing date for applications 1st February 2021
Shortlisted applicants will be interviewed on 24th February 2021

Applications should be made via the Royal Holloway Direct website:
https://www.royalholloway.ac.uk/studying-here/applying/research-degrees/how-to-apply/

Please contact the lead supervisor directly for further details

D.Waltham@rhul.ac.uk