Energy Expertise
// Carbon Capture and Geological Storage

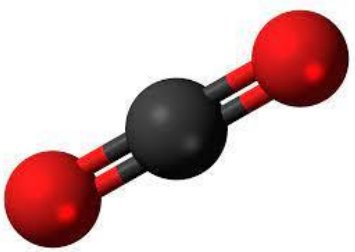
Main expertise areas

- Assessment of storage site capacity and integrity
- Reservoir simulation of potential storage sites
- Injectivity of CO_2 in saline aquifers
- Monitoring of stored CO_2
- CO_2 plume geothermal – utilising CO_2 in geothermal systems
- Biomass power generation and trigeneration with CCS
- Hydrogen production with integrated CO_2
- CO_2 adsorption capture
- Geological storage of hydrogen

Background

Carbon Capture and Storage (CCS) is a technology that involves capturing CO_2 produced during power generation or other industrial processes then permanently storing it in underground rock formations. The deployment of CCS is one of the 'Key Commitments' in the UK Net Zero Strategy. CCS is a critical part of the net zero transition as it provides a decarbonisation option for carbon intensive industries where there are no other alternative solutions, as well as offering a potential carbon negative power generation option when used with biofuels.

As well as a permanent storage solution for captured CO_2, geological storage can also be used to temporarily store other fluids such as hydrogen, compressed air, and syngas in formations such as salt caverns.



DEI experts in Earth Sciences, Engineering, Chemistry, Maths, as well as social scientists focusing on energy transitions and carbon markets are working on multiple elements of CCS and geological storage to support the net zero transition.

Researchers:

Jon Gluyas, Ørsted/Ikon Chair in Geoenergy, Carbon, Capture and Storage, geoscientist with expertise in storage site capacity, injectivity, integrity and monitoring for CCS and geological storage of hydrogen and other fluids

Gavin Bridge, Professor in Economic Geography whose expertise includes geographies of energy transition and governance, and global production networks for old and new carbon economies

Janie Ling-Chin, Assistant Professor in Engineering, researcher in post combustion capture, carbon adsorption technology, utilisation of captured CO_2

Simon Mathias, Professor in Environmental Engineering, expert in mathematical models of movement of fluids in porous media

Julien Mouli-Castillo, Postdoctoral Research Associate in Earth Sciences, with expertise in CO_2 and Hydrogen geological storage

Tony Roskilly, Chair in Energy Systems, research expert of industrial decarbonisation and novel energy systems incorporating carbon capture

Andrew Smallbone, Associate Professor and Director of EPSRC Network+ on the Decarbonisation of Heating and Cooling, expert in CCS for industrial decarbonisation

Jeroen Van Hunen, Professor in Earth Sciences, expert fluid dynamics applied to the Earth, research interests in CO_2 geological storage

Yaodong Wang, Associate Professor in Engineering, research interests in novel biofuel energy systems including integration with CCS

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ENERGY, SCIENCE AND SOCIETY

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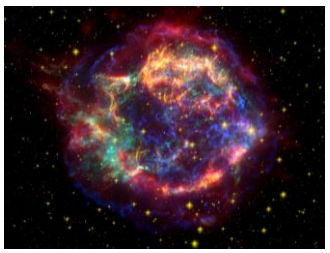
Examples of research projects

- DEI participated in the **UK Storage Appraisal Project (UKSAP)**, a £4M project led by ETI which produced the first UK storage appraisal database. DEI's role in this project involved storage unit mapping and site risk analysis
- DEI led the **Carbon Storage Monitoring using Muon Tomography** £1.2M project, which developed and tested a method of monitoring stored CO_2 in an interdisciplinary study involving geologists, particle physicists and engineers
- EPSRC funded **CCS from Industrial clusters and their Supply chains**, led by Dr Andy Smallbone, project evaluated multiple potential ICCS clusters planned worldwide and assessed impact on products and consumers, especially focussing on the Teesside Industrial Cluster
- ESRC funded **Fraying ties? Networks, territory and transformation in the UK oil sector** project led by Professor Gavin Bridge investigating the ongoing transformation of the UK's strategic position within global networks and the changing role of five kinds of 'asset' in the UK (natural resources, access to capital, product markets, expertise and diplomatic capacity)
- DEI are collaborating in the EPSRC funded **Performance and Injectivity of CO_2 in Hyper-Saline Aquifers** project developing fundamental knowledge and predictive models to establish know-how of injectivity loss under different rock heterogeneity, thermodynamic and hydrodynamic conditions



DEI Spin Out Companies CCS Activity:

Geoptic – Company formed by Durham, St Mary's and Sheffield Universities providing geotechnical muon services grown out of DEI led Muon Tomography project which developed muon detectors that can operate in deep, hostile environments found deep below the Earth's surface.

Geoenergy Durham – spin out company providing bespoke consultancy services to the geoenergy sector, and currently one of a group of three companies that have been appointed by the Department of Business, Energy and Climate Change (BEIS) to provide engineering and technical advice on progressing CCUS in the UK.

Examples of recent publications

- Fuel cell integrated carbon negative power generation from biomass, Roy, D., et al, Applied Energy (2023), Volume 331, https://doi.org/10.1016/j.apenergy.2022.120449
- Mapping hydrogen storage capacities of UK offshore hydrocarbon fields and exploring potential synergies with offshore wind, Peecock, A., et al, Geological Society London (2023), Volume 528, https://doi.org/10.1144/SP528-2022-40
- Petrographic and diagenetic investigation of the distal Triassic 'Budleighensis' fluvial system in the Solway and Carlisle Basins for potential CO_2 storage, Marsh, J.R et al, Petroleum Geoscience (2022), 28 (3) https://doi.org/10.1144/petgeo2021-065
- Analytical Solution for Predicting Salt Precipitation During CO_2 Injection Into Saline Aquifers in Presence of Capillary Pressure, Norouzi, A.M. et al, Water Resources Research (2022), 58 (6), https://doi.org/10.1029/2022WR032612
- A low-carbon future for the North Sea Basin, Quirk, D.G. et al, Geological Society, London, Special Publications (2022), 494, https://doi.org/10.1144/SP494-2020-236
- Muography, a Key Technology for Monitoring Carbon Geostorage, Thompson, L.F. et al, Geophysical Monograph Series (2022), https://doi.org/10.1002/9781119722748.ch14
- Comparative analysis on temperature swing adsorption cycle for carbon capture by using internal heat/mass recovery, Applied Thermal Engineering (2020), 169, https://doi.org/10.1016/j.applthermaleng.2020.114973