UNEARTHED

Offshore wind farms limit our ability to utilise the seabed beneath them

"Geoscience is vital for meeting Paris Agreement obligations"

John Underhill discusses the criticality of geoscience for low-carbon sustainable solutions

"**IT'S A REALLY** exciting time for the geosciences. Earth science has been instrumental in documenting climate change and is pivotal in finding solutions that address it. Put simply, it is no longer about diagnosis, but mitigation and cure. Geoscience is vital for meeting the obligations embedded in the Paris Agreement."

John Underhill, a Professor at Heriot-Watt University, UK, views geoscience and the people who study and practice it as absolutely crucial as we seek to introduce measures that enable us to decarbonise, move towards a low-carbon sustainable future and address the United Nations' Sustainable Development Goals.

"I have heard it said 'the time for geological studies has passed, it is simply an engineering issue and we should just get on and do it'. While engineering is undoubtedly a major part of the solution, the fact that carbon dioxide has quite different physical and chemical properties from long-chained, inert hydrocarbons because it is small, nimble and highly reactive in the presence of water (when

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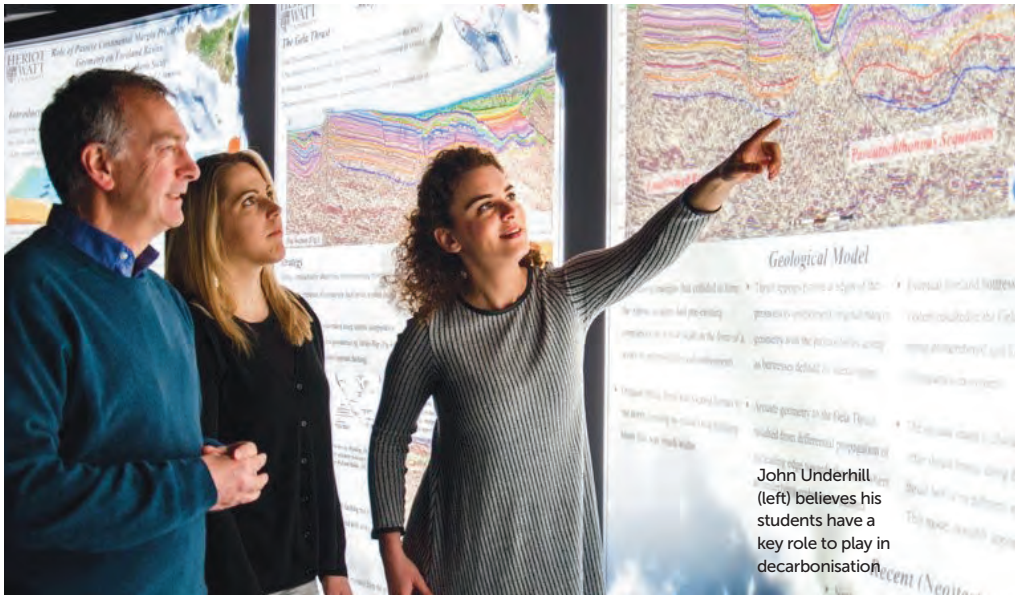
it forms carbonic acid) means we cannot simply assume that we can re-use depleted oil-and-gas fields for a new purpose. Frankly, if the wrong geological sites are selected for subsurface storage of carbon dioxide or hydrogen, credibility will be lost and a vital technology will not be deployed at scale.

"The drive for electric cars, wind turbines, solar panels and new technologies will also have major consequences for our science. Such technology demands not only a step change in the amount of electricity needed, but also the mining of metals, critical minerals and essential raw materials like lithium, cobalt, titanium and the rare-earth elements. It is incumbent upon us to ensure that the optimal locations are selected that minimise environmental impacts of extraction, do not exploit local communities and are sustainable in the long-term."



John Underhill (left) believes his students have a key role to play in decarbonisation

Holistic approach

John is particularly interested in the use of subsurface data to identify and critically evaluate safe sites for subsurface storage.

"I am committed to seeing the best and most appropriate use being made of the sea bed and subsurface geology as part of the net-zero agenda, ensuring the adverse environmental impacts are avoided.

"Despite the undoubtedly positive contribution of wind power to decarbonise the electricity system, wind farms have consequences that impact our ambition to do the same for other sectors and technologies. Since most offshore wind farms are fixed to the sea bed, it is much harder to visualise, characterise, monitor and, hence, utilise the subsurface that lies directly below them – an essential requirement if we are to locate and evaluate safe storage sites and monitor the CO_2 injection or hydrogen storage needed to decarbonise the UK's industrial hubs. The occurrence of wind farms will affect our ability to build blue hydrogen capacity because this relies on a spatial association between a producing gas field supplying the methane feedstock, carbon store and hydrogen export route to shore (and storage).

"Holistic, joined-up thinking is needed to ensure the best and most appropriate use is made of the sea bed and subsurface geology. A collective failure to understand the dependencies and impacts that result from blanket wind farm coverage may rule out some or all of the other promising technologies and the UK's pathway to net zero. A more judicious approach involving all the different regulatory bodies and various stakeholders is urgently required if the UK is to achieve the optimal outcome."

Global population growth and increasing energy demands mean that oil and gas will remain in the energy mix – as highlighted by the Committee for Climate Change, who see a continued role for oil and gas in 2050 and beyond.

"While it may not be universally accepted that oil and gas should continue to be explored for and produced in the UK, it should be remembered that the basin's indigenous supplies have a lower carbon footprint compared to the imports that would otherwise be needed to make up the shortfall. The reserves also provide the UK with energy security by reducing our reliance on other countries, and also mean we don't simply transfer our carbon burden to them." →

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John Underhill believes we must take an open-minded, data-driven approach to new solutions to meet energy needs

Skills shortage

To achieve our net-zero emissions targets requires a pipeline of talented people with the right skills to seek socially acceptable solutions. John believes that the association between geology and the extractive industries is too commonly made and feels it lessens the apparent attraction of Earth science to school children. He suggests we need a sustained effort to make geoscience a more visible, relevant and attractive subject, as well as more accessible to diverse communities.

"Our approach has shifted rapidly as universities seek to address an ongoing recruitment crisis. Many have or are re-designing their BSc and MSc courses; others have rebranded their department names. Likewise, the trends in research and available staff positions are changing to reflect net zero and the need to be relevant.

"Courses are populated with new content and there is an increasing awareness of the need to integrate topics like social license, public outreach, media communication and Government policy, as well as novel methods, such as virtual reality to augment fieldtrips through drone and laser technologies and artificial intelligence."

John is Academic Executive Director of the UK Centre for Doctoral Training (CDT), GeoNetZero, a programme that undertakes research and training in geoscience and the low-carbon energy transition. The GeoNetZero CDT initiative seeks to build the next generation of geoscientists – those who will deliver a sustainable future as we undergo the energy transition. This academic-industry partnership is going from strength to strength with 32 PhD students recruited and a further 16 set to join next year. Involving 12 UK universities and with continued support from the Natural Environment Research Council, the CDT was the only entity named in the postgraduate training section of the UK Government's North Sea Transition Deal, paving the way for further support for the programme.

Optimism and realism

John is hopeful about the UK's decarbonisation goals and the role geoscience can play in getting us there, but his optimism is allied with a realism.

"I remain concerned that hype, wish fulfilment, confirmation bias and false drivers are in the mix. To determine the best subsurface solutions, reliable geoscientific input is essential. We must take a data-led, evidence-based approach, and articulate our science in a way that can inform opinion and lead to the right choices being made.

"I am also worried about polarised opinions and feel there is a need for a more nuanced view to be appreciated. We must gather, table and analyse the data to find the best and most appropriate solutions, those that ensure low-carbon energy security, aid our pathway towards a decarbonised world and alleviate all forms of poverty (including fuel poverty) for a just and fair transition. To achieve this, we must be open minded, be willing to test our assumptions, identify and eradicate biases, and be willing to ask and tolerate testing questions that challenge long-held dogma and beliefs. It is essential that there is an independent, robust test of the technologies and their potential deployment. To undertake such a forensic analysis takes time and is dependent upon data being collected or made available.

"It may be ironic, but the very same data acquired in the pursuit of fossil fuels (such as seismic, well and core data) provide an excellent foundation for repurposing and evaluating the subsurface for decarbonisation. Fortunately, these data have recently become available through the National Data Repository (NDR). Access and use of these data will extend the life of the mature North Sea basin and its re-emergence as a site where carbon storage, geothermal, wind and hydrogen can provide new low-carbon energy sources, and as a repository to help us decarbonise industrial hubs.

"The re-purposing of UK basins will require skilled geoscientists. While the number of jobs may initially be limited, the need for talent will increase if we are to understand and characterise new decarbonisation opportunities. There is a dual opportunity for experienced individuals to up-skill or re-skill and for young professionals, early career researchers, students and school children to have a sense of optimism that there is a vital role for them in geoscience as we strive to meet net-zero targets."

JOHN UNDERHILL
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