

Project title: Climate change impacts on future hydrogen demand and availability

Ref: OP2443

Keywords: Weather, Climate change, Hydrogen, Energy Systems

One Planet Research Theme:

Climate & Climate Change | Earth System Processes | Anthropocene | Environmental Informatics

Lead Supervisor:

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Key Research Gaps and Questions:

1. How will hydrogen demand in future energy systems depend on weather and climate?
2. Will weather phenomena will affect hydrogen production in future energy systems?
3. How and where should future hydrogen infrastructure be built to synergise with the natural and weather-driven resources.

Project Description:

Hydrogen is expected to play a key role in achieving Net-Zero: future energy scenarios for the UK predict as much as 83 GW of hydrogen production – more than the current electricity demand of the entire country – by 2050. However, producing hydrogen – even green hydrogen, which is powered by renewable electricity – requires substantial infrastructure and natural resources. The availability of these resources is uncertain in a future climate: will renewable energy be abundant enough to power GW scale electrolyzers? And will enough water be available? Will bioresource availability be a factor? The demand for hydrogen is also uncertain and will also depend on future weather patterns. Will cold, still winters require a storable fuel source? Will some heating and transport demand be met using hydrogen, and how will this vary with temperature? Hydrogen production and demand could be influenced by weather and climate patterns, making the future uncertain.

This project will map the how future hydrogen production and demand are driven by the weather and climate. The student will combine meteorological analysis with future energy system modelling and optimisation to determine how and where hydrogen infrastructure should be built to maximise access to natural resources, embed environmental sustainability into its economic model, and help enable a shift to a circular, resource-efficient economy in which surplus renewable energy can be converted to storable fuels.

This project will build on previous work, including research on future climate and energy systems (CLEARHEADS SuperGen Flexible fund project) and an ongoing project on hydrogen integration for Accelerated Energy Transition (HI-ACT). The proposed supervisory team has a strong track record from working on this project and a history of successful collaboration.

Prerequisites:

Qualification: Good first degree in relevant field of science or engineering

Knowledge, Skills and Experience: Experience in mathematical modelling and data analysis, awareness of energy network structure and regulation, experience with energy system or meteorological data sets.

For more information, please contact David Greenwood (David.greenwood@ncl.uk)

