SEMS: RESEARCH PROJECT DESCRIPTION

1. Project Background and Description

Hydrogen energy: quantifying leakage rates and the impact on the climate

Hydrogen has the potential to enable deep decarbonization of global energy systems towards our net-zero targets as it can be combusted with zero direct CO2 emissions or used in a fuel cells for many applications. For regions where we have an existing natural gas network we may even be able to utilize the existing infrastructure for hydrogen and reduce costs. However, leakage of hydrogen across its supply chain represents a risk. Firstly, the loss of product reduces efficiencies and increases costs, as well as potential safety hazards. Secondly, hydrogen is an indirect greenhouse gas (GHG) due to its reaction with hydroxyl radicals that increases the lifetime of other GHGs.

If we were to utilize existing gas grids (e.g. in the UK), how much hydrogen would we expect to lose to the atmosphere? And what would be the climate impact or broader environmental impact of this leak? This PhD project seeks to answer these questions via a combination of experimental leak testing, component modelling and environmental science modelling.

The project will involve assessing the potential for hydrogen to leak via both diffusion and fugitive emissions from seals, comparing rates to the existing leaks of methane. These leaks will then be modelled via well-known leak flow dynamic calculations. And finally the impact of hydrogen in the atmosphere will be assessed to determine the potential GHG footprint of hydrogen supply chains.

2. Project Scope

Three research project objectives

- *Determine the leak rates of hydrogen through existing natural gas infrastructure via experimental design*
- *Conduct modelling to predict hydrogen leakage through different components*
- *Determine the global warming impact of hydrogen leakage under different hydrogen production scenarios*

3. Desired Skills from the Student

Key skills needed for the PhD project

- *Practical lab experience*
- *Modelling of gas leak rates*
- *Understand the chemical interactions of hydrogen in the atmosphere*

4. Supervisory Team

Add supervisory team details

Primary: Dr Paul Balcombe, Division of Chemical Engineering and Renewable Energy, SEMS

Secondary: Dr Patrick Cullen, Division of Chemical Engineering and Renewable Energy, SEMS