SEMS: RESEARCH PROJECT DESCRIPTION

1. Project Background and Description

Global low carbon hydrogen and ammonia supply chains: how to minimize emissions and costs

Whilst decarbonization of electricity has rapidly progressed in many regions, the decarbonization of heat and transport lags behind. Hydrogen offers a potential option for both heat and transport as it can be combusted with zero direct CO2 emissions or used in a fuel cells for many applications. However, low carbon hydrogen supply chains are immature and there is uncertainty about how they should be constructed. Furthermore the life cycle emissions and costs are uncertain and are likely to vary significantly across different regions. The selection of technologies and investment in infrastructure is a key challenge of the next decade and this project will shed light on which technologies and investment opportunities are most appropriate for different regions around the work, to minimize financial and environmental risk.

The project will involve process systems modelling and environmental assessments of different technology and infrastructure options for hydrogen production (e.g. electrolysis, natural gas reforming, biomass gasification), transport (compressed, liquefied, piped, conversion to ammonia), storage (large scale and small scale) and delivery (fuel station, industry plant). Every region in the world has different qualities in terms of resource availability, demand and infrastructure and this project will determine the best options for each region with high spatial resolution. Furthermore we will develop an innovative modelling approach which accounts for the uncertainties in immature technologies via a probabilistic life cycle approach.

2. Project Scope

Three research project objectives

- *Determine the lowest cost and emissions methods of hydrogen production, processing, transport and storage across different regions*
- *Develop a novel probabilistic techno-economic and environmental model of hydrogen supply chains*
- *Determine the key innovations in technology, infrastructure and policy to enable hydrogen in low carbon energy systems*

3. Desired Skills from the Student

Key skills needed for the PhD project

- *Experience in techno-economic and environmental assessments*
- *Knowledge of hydrogen and/or ammonia supply chains*
- *Knowledge of GIS software*
- *Systems modelling in Matlab/ Aspen Hysys/ R/ Python*

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