

UK CCS workshop – CO₂ Transportation (*including networks and improving flexibility of networks/storage and capture plant operations and monitoring*)

Web meeting hosted by UKCCSRC

Date 3rd February 2022, 2 pm - 4 pm

Chaired by James Watt, WSP

Presenters: James Watt, WSP; Andrew Wood, Harbour Energy; Elian Pusceddu, Element Energy; Michelle Roaf, Air Products; Sam Bartlett, NPL; Simon Gant, HSE

Key UK research needs highlighted through workshop

Research needs identified in the January/February 2022 workshop:

- Non-cluster industries
 - How do networks/clusters enable remote emitters?
 - How to enable emitters that are outside of the clusters?
 - What is the true cost of CCS for small and/or remote emitters? How does this compare to alternative decarbonisation pathways for the same site?
 - Viable business models to decarbonise these sites
 - Impact of differing CO₂ specification on stranded emitters
- Network evolution
 - How is optimum transport at the cheapest cost achieved?
- What is the impact of composition/impurities?
 - Equations of state, changes on mixing and water content
 - Define the boundary limits acceptable for key impurities: outline the impacts on – material selection, corrosion allowance and operating conditions outside of these limits
 - Consider super critical (dense phase) gaseous and liquid transportation
- Injection of dense phase CO₂ into wells
 - Multi-phase flow in wellbore: modelling of multi-phase flow induced dynamic loads on wellbore architecture and impact of impurities on bubble point and phase behaviour
 - Hydrate formation and vapour freezing in wellbore: impact of impurities on temperature and phase behaviour, chemical reactions between impurities and potential for vapour freezing and water drop out conditions
- Repurposing legacy oil and gas pipelines for CO₂ transportation
 - Running ductile fracture and hoop stress design: improving the accuracy of existing theoretical models, field testing to improve modelling capabilities
 - Recommend standards and design margins for material selection and thickness
 - CO₂ phase behaviour in horizontal pipelines: impact of multi-phase flow on horizontal pipelines including slugging effects and axial loads
 - Assessment of supercritical pipelines in Europe: acceptability for supercritical onshore pipelines and process safety assessment for a range of pressures, temperatures and line sizes
- Shipping/CO₂ liquid transport
 - What are the conditions, logistics and impact on pipeline flow i.e. pressure issues
 - Full system evaluation of LCO₂ shipping pressure from 15bara to 7bara
 - European material code review and how it pertains to material selection for LCO₂ tanks: material codes review and testing to provide guidance on suitability for a complete design range of conditions

- System wide challenges
 - Effective metering of CO₂: understand limits of current metering technology to effectively measure CO₂ under a variety of phase conditions
 - Validation for modelling of dense phase CO₂ release: accurate modelling of dense phase and impure leak from an onshore pipeline
 - Impurity impact of CO₂ stream: understand impact of varying impurity levels on CO₂ phase behaviour and chemical reactions within stream
 - Integration of compression into capture plant
- Variability in CO₂ volumes/demand
 - What does this imply for the cost of CO₂ transport? What commercial arrangements need to be put in place to manage/mitigate the impact of this?
 - Shipping: How can fleets be optimised given varying uncertainties i.e. rough seas, peak demand short term peaks etc? What size of buffer storage reduces the full chain costs to mitigate the variability?
- Other
 - Public stakeholder engagement for CO₂ transport and engagement with current projects on public engagement knowledge
 - Online/offline technologies for monitoring of impurities
 - Setting holistic CO₂ specifications to address the whole CCUS chain

Research needs identified in the March 2021 workshop that were categorised as high priority in 2022:

- Whole system analysis
 - Connectivity from land to storage sites
- Repurposing of existing pipeline infrastructure
 - Including corrosion, equations of state, CO₂ composition and quality, leak detection, modelling and flow metering

Research needs identified in the March 2021 workshop that were categorised as medium priority in 2022:

- Flow metering
 - Measurement needs identified by NPL's Energy Transition report