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The marginalisation of cross-cutting issues in CCUS Mission Innovation PRDs

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Session 2B: RD&D priorities for CO2 Storage and cross-cutting aspects of CCUS

Edinburgh
28 November, 2018

Mission Innovation's Mission

- Mission Innovation (MI) is a global initiative designed to accelerate the pace of innovation and make clean energy widely affordable. Led by the public sector, it aims to mobilise both public and private sector efforts. MI also provides a platform to support collaborations among members and facilitate engagement with business, industry and investors, so as to attract more private funding into innovative clean energy research.
  - Mission Innovation Action Plan, p. 1

Crosscutting Issues as afterthought in PRD process

- "Three panels were formed, corresponding to the core topics of Capture, Utilization, and Storage. A fourth panel, Crosscutting, assessed research directions common to the three core topics."
- "These PRDs include opportunities for understanding and improving materials, chemical processes, and other scientific and technical areas required to develop the next-generation technologies needed for efficient, cost- effective management of carbon emissions"
- "These PRDs will yield the design of new materials, novel chemical and physical processes, and new sensors and characterization and computational tools that will make CCUS processes more efficient, reliable, and cost-effective."
- "The workshop participants acknowledged that the challenges of CCUS are daunting, but they were confident that research addressing the identified PRDs holds enormous promise for reaching the goal of stabilizing global CO2 levels."

CO2 'Crosscutting' Priority Research Directions

- PRD CC-1: Integrating Experiment, Simulation, and Machine Learning across Multiple Length Scales to Guide Materials Discovery and Process Development
  - E.g, Designing Molecules via Computational Screening and Synthesis
  - Develop novel experimental methods using in situ/operando sensing
  - Develop "big data" analytics and machine learning methods to analyze/mine data from experiments and simulations
  - Develop and use AI methods for materials discovery
- PRD CC-2: Coupling Basic Science and Engineering for Intensified Carbon Capture, Purification, Transport, Utilization, and Storage Processes
  - Development of a new molecular-based thermodynamic approach for the reliable description of fluid throughout the fluid phase diagram
  - Explicit treatment of allowed reactions within this new framework to describe potential cascades of reactions within the CO2 mixtures in the transport and storage value chain
  - Efficient coupling of this framework with a computational fluid dynamics framework
  - Curation of a database of high-quality experimental data against which to test and refine the modeling approaches developed

Genuine Systems & Policy Subjects within Cross-Cutting PRDs

- PRD CC-3: Incorporating Social Aspects into Decision-Making
- PRD CC-4: Developing Tools to Integrate Life Cycle Technoeconomic, Environmental, and Social Considerations to Guide Technology Portfolio Optimization

PRD CC-3 Incorporating Social Aspects into Decision-Making

Scientific challenges

Brief overview of the underlying science challenge: The causes and consequences of social aspects are poorly incorporated into considerations throughout the CCUS value chain, deployment projections, and tensions between societal drivers and technological drivers.

- Stakeholder participation can act as a central aspect for integrating technology, society, and environment.

Summary of research direction

What fundamental research is needed to address the challenge?

- Understanding mechanisms for social mobilizations and tipping points.
- How to incorporate or integrate these dynamics in quantitative and qualitative models and their outputs.

Why can this research be done now? (e.g. are there recently developed capabilities?) numerous relevant examples across spectrum of topics, increased understanding of behavioral decision-making, cascades, social networks, refined understanding of social dynamics an risk for CCUS.

Potential scientific impact

What impact will this research have on the CCUS scientific field? Create environment in which CCUS as a whole advances up the TRL levels.

What impact will it have on the general scientific community?

Understand and de-risk how social factors influence various innovation, infrastructure, technology development and diffusion dynamics.

Potential impact on CCUS technology

How will this impact CCUS-relevant technologies? Provides mechanisms to address risk communications, facilitate lab and field deployment, begetting experience and going down the learning curve to higher TRL levels.

Concluding Thoughts

- There is a tension between the approach taken to CCUS PRDs and the stated purpose of Mission Innovation
- Getting the MI process to consider systems and policy issues was always going to be an uphill battle since the agenda had already been defined by those advocating a narrow focus on capture, 'utilisation' and storage as silos.
- Of the 30 PRDs in total, only two PRDs can be considered as offering a wider systems & policy perspective on the research needed into CCUS integration and deployment pathways. Nevertheless, both those PRDS offer many opportunities for collaboration and advancing knowledge on taking CCUS forward

Thanks!

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