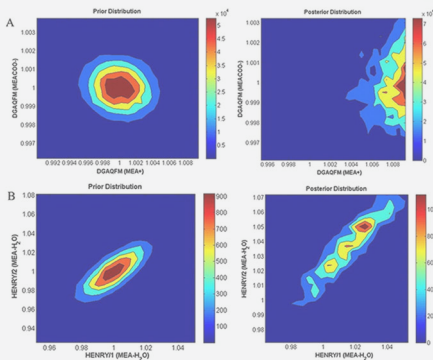
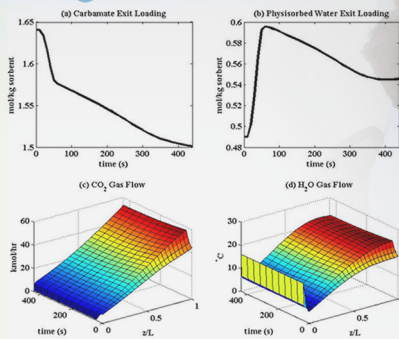


CARBON CAPTURE SIMULATION FOR INDUSTRY IMPACT (CCSI²)

CCSI²

Carbon Capture Simulation for Industry Impact



BACKGROUND

Near-term and large-scale reduction of carbon dioxide (CO₂) emissions from fossil-based electricity sources is critical for a zero carbon future. The Carbon Capture Simulation for Industry Impact (CCSI²) program is focused on developing a fundamental understanding of CO₂ capture technology, which will reduce carbon-based emissions. CCSI² collaborates with industrial, academic and government partners to disseminate a rigorously quantified understanding of CO₂ capture systems, manage risk and reduce the barriers to technology commercialization. The results are well-informed, accelerated technology transfer processes for timely implementation of technologies that benefit the world.

NETL

NATIONAL ENERGY TECHNOLOGY LABORATORY

PROJECT DESCRIPTION

CCSI² is led by the National Energy Technology Laboratory (NETL), partnering with Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Pacific Northwest National Laboratory, Oak Ridge National Laboratory, University of Toledo, University of Pittsburgh, University of Notre Dame, Carnegie Mellon University, University of Texas at Austin and West Virginia University.

CCSI² develops, validates, and applies advanced computational techniques for technology simulation, optimization, uncertainty quantification (UQ), and process control. Computational products are consolidated in the CCSI Toolset software for developing rigorous understanding of CO₂ capture technologies that enable efficient Research and Development (R&D). CCSI² develops a detailed multi-scale understanding of the most effective pathways to minimize the cost to capture CO₂. Between FY18 and FY22, CCSI² has directly supported more than ten projects in the Capture Program, with an investment of more than \$100M. Simultaneously, CCSI² has provided industry-wide benefit by applying a general Design of Experiments framework that optimizes large- and small-scale test programs, as well as highly accurate benchmark CO₂ solvent system modeling tools.

The primary goal of CCSI² is to provide a fundamental and interdependent understanding of CO₂ capture material, device, and system level performance leading to more informed R&D guidance on CO₂ capture technology development and reduced risks during commercialization. To achieve this goal, CCSI² will:

- Provide R&D support that reduces risk and increases rate of CO₂ capture technology commercialization
- Generate accurate understanding and quantified uncertainty in CO₂ capture system performance
- Continue to validate, apply and disseminate the CCSI Computational Toolset

PROJECT BENEFITS

CCSI² is focused on simultaneously accelerating and de-risking research and development of CO₂ capture technologies. Efforts in CCSI² reduce the timeline and cost to commercialize technologies capable of cost-effectively achieving deep CO₂ reduction from the fossil fuel power generation industry. Rooted in mathematical optimization frameworks, the computational methods employed by CCSI² ensure the best operation, configuration and minimized costs for low carbon fossil fuel generated electricity. While initiatives continue to improve fossil fuel processing in the short-term, NETL is working with our partners to achieve a responsible transition in the future to heavier reliance on renewable energy resources.

ACCOMPLISHMENTS/SUCCESSSES

CCSI² has developed a standard solvent-based CO₂ capture system modeling framework with fundamental, multi-hierarchical characterization that will be used by the international CO₂ capture industry to inform technology testing and development.

Leveraging this fundamental modeling approach, a general framework for optimal steady state design of experiments (DoE) has been applied to pilot scale testing to increase precision of CO₂ capture models to +/-3% in a matter of weeks as opposed to years in conventional approaches. This DoE uses principles of Artificial Intelligence (AI) to generate testing requirements for most efficient and informative experimental data generation. This approach simultaneously improves model uncertainty and maximizes impact of test programs at all scales and technology readiness levels.

CCSI² is performing multi-scale optimization of several CO₂ capture systems under development by the Fossil Energy Carbon Capture Program. Projects include: University of Texas at Austin—Advanced Solvent Configurations; Lawrence Livermore National Laboratory—Device Scale Advanced Manufacturing; Oak Ridge National Laboratory—Intensified Packed Column Design; Lawrence Berkeley National Laboratory—Metal Organic Frameworks (MOFs); Pacific Northwest National Laboratory—Low-Aqueous Solvents.

NETL is a U.S. Department of Energy national laboratory that drives innovation and delivers technological solutions for an environmentally sustainable and prosperous energy future. By leveraging its world-class talent and research facilities, NETL is ensuring affordable, abundant and reliable energy that drives a robust economy and national security, while developing technologies to manage carbon across the full life cycle, enabling environmental sustainability for all Americans.

Research Partners

Lawrence Berkeley National Laboratory | Lawrence Livermore National Laboratory | Los Alamos National Laboratory
Pacific Northwest National Laboratory | Oak Ridge National Laboratory | University of Kentucky | University of Texas at Austin | West Virginia University
University of Notre Dame | University of Pittsburgh | University of Toledo | Carnegie Mellon University

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