the ENERGY lab

R&D FACTS

Crosscutting Research

Industrial Carbon Management Initiative (ICMI)

Background

The ICMI project is part of a larger program called Carbon Capture Simulation and Storage Initiative (C2S2I). The C2S2I has a goal of expanding the DOE's focus on Carbon Capture Utilization and Storage (CCUS) for advanced coal power systems and other applications, including the use of petroleum coke as a feedstock for the industrial sector. The American Recovery and Re-Investment Act (ARRA)-funded work supports the President's stated goal of aggressively reducing our country's energy-related Greenhouse Gas emissions by 83 percent by 2050 from a 2005 baseline. Our nation will immediately see benefits that are directly attributable to projects resulting from the ARRA-funded work.

ICMI is developing carbon management strategies for industrial sources. Industrial sources are typically smaller sources of Carbon Dioxide (CO_2) than base-load power plants and may offer unique options for CO_2 capture, storage, or re-use. While the focus of the research is industrial applications, results are expected to benefit coal power generation, as well.

Research Thrusts

ICMI has three major research thrusts:

- Chemical Looping Technology Development – Chemical looping is a promising approach to generate heat in a combustion process while producing a concentrated CO_2 stream to facilitate carbon capture. Chemical looping research efforts can be categorized as: modeling tool development, experimental work, oxygen carriers research, sensor development, and evaluation of hydrogen production using chemical looping.
- Carbon Storage in Depleted Shale Formations – The potential for CO_2 storage in organic-rich shale formations that have been depleted of natural gas through primary production is being investigated. A secondary focus, enhanced gas production, will be addressed as well. Shale storage efforts can be categorized as empirical characterization of CO_2/shale interactions, simulation of CO_2 storage and enhanced gas recovery potential, and assessing the economic viability of this CO_2 management alternative.
- Photoactive Material (PAM) for Industrial Carbon Management – Catalytic and "photo-catalytic" materials will be studied to assess their potential for using energy from rejected heat or even visible light to convert CO_2 to useful chemicals. In specific industrial settings, this concept might exploit otherwise wasted heat

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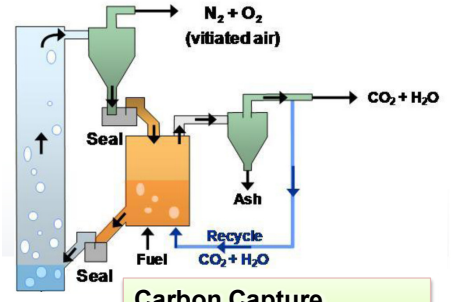
or sunlight to power the chemical reactions. The focus of the work will be characterizing the scientific behavior of new materials so specific industrial applications can be evaluated.

A small, exploratory research component is also included in the ICMI effort because of its potential applicability for integration with industrial processes using saline formations for CO_2:

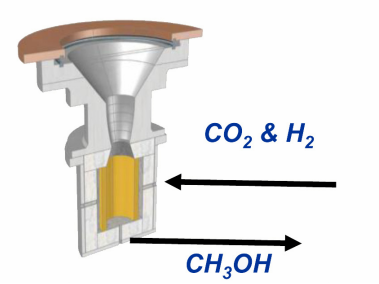
- Saline Water Treatment Using Clathrate Hydrates – Pumping saline water during CO_2 injection is one means by which the movement of CO_2 can be controlled and pressure relieved from the formation. Research is being conducted on the treatment of highly saline water using clathrate hydrates formed by injection of CO_2 into a reactor at temperatures and pressures conducive to hydrate formation. Findings will contribute to understanding tradeoffs between costs associated with saline formation extracted water management and potential benefits associated with formation pressure management.

Systems Analysis

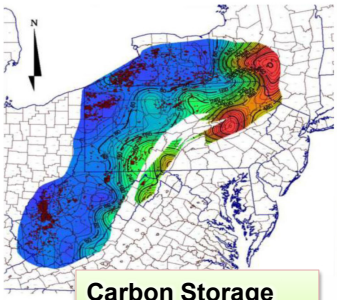
A critical element of ICMI is the development of CCUS technology that can be used in industrial applications with the eventual goal of application to larger coal-based systems. A combination of industrial market analysis, technology considerations, and techno-economic system models and analysis will be used to identify, assess, and down-select the most promising industrial applications that might use CL, CO_2 storage in spent shale, or re-use.



Carbon Capture
Chemical Looping Combustion

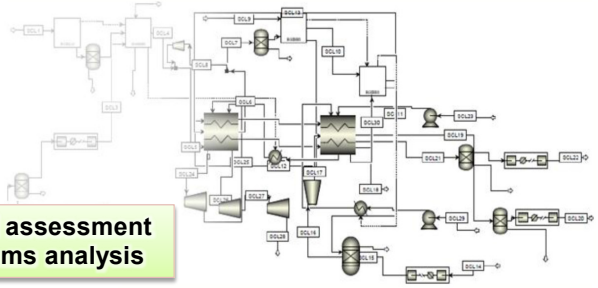


Carbon Utilization
Photocatalytic Conversion



Carbon Storage
Depleted Shale Fields

Research Thrusts



Industrial assessment and systems analysis