Simulation and Assessment

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Research Objective

The objectives for this project are to apply modeling techniques to a wide variety of issues associated with pre- and post-combustion CO_2 capture and oxy-combustion in order to accomplish the following:

- Assess the economic and operability potential of existing capture technologies in conjunction with removal of criteria pollutants
- Assess the technical feasibility and potential economic benefit and operability of novel carbon capture technologies
- Optimize the economics of different carbon capture technologies

Technical Approach

The approach aims to be inclusive of many projects and areas of interest with the understanding that, due to budget limitations, only a subset of the analyses will be completed. The levels of analysis will vary depending on the maturity of the technology and the availability of data from academic and industrial partners.

Active Research Tasks

- Initialize and augment a technical assessment of Huaneng's post-combustion, amine-based CO_2 capture technology
- Initialize models for existing pre-combustion capture technologies, chiefly physical sorbents, both as individual models and within the two reference plants (including water-gas shift and gas cleanup)
- Initialize models for existing post-combustion capture technologies, chiefly solvent-based, both as individual models and within the two reference plants
- Initialize and augment a dynamic model with immersive visualization capability for a generic IGCC system with a gas turbine and steam bottoming cycle
- Initialize steady-state and dynamic models for an oxy-fired PC plant

Potential Future Tasks

- Initialize models and modules for a subset of novel pre-combustion capture technologies, chiefly advanced membranes
- Initialize at least one advanced gasification technology module (either catalytic gasification or molten metal)
- Perform preliminary performance and cost analyses for IGCC systems based on the above models
- Initialize and augment a poly-generation plant, including coal and biomass co-firing, leveraged off the IGCC plant
- Perform preliminary performance and cost analyses for PC boiler systems based on the above models

Recent Progress

Base-case processes for an ammonia-based and a simple amine-based MEA carbon capture system has been simulated using the Aspen Plus platform (WVU). Currently, base-case steady-state simulations using the same flue gas as cited in Case 11 of the *Cost and Performance Baseline for Fossil Energy Plants Volume 1: Bituminous Coal and Natural Gas to Electricity*, rev. 2, November 2010 (DOE/NETL-2010/1397) have been simulated for the ammonia and MEA systems. Good agreement with the results of Case 12 for the MEA system has been obtained while the ammonia-based process is still being optimized.

Expected Outcomes

Application of advanced modeling and simulation tools will enable improvements in technology and systems integration that would not otherwise be possible. Such improvements will decrease the cost and improve the performance of CO_2 capture technologies.