Carbon Sequestration in the Southwestern United States: Using the 'String of Pearls' Model for Cost and Source-to-Sink Assessments

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Overview

This paper describes an Integrated Assessment analytical model used by the Southwest Regional Partnership on Carbon Sequestration (SWP) to assess up to hundreds of CO_2 source and geological sink sequestration projects in the Southwestern United States. The model was first developed as a central presentation tool, later into an integrated assessment source-to-sink matching tool (based on the 'String of Pearls' framework), and continues to evolve to give regional summaries for large-scale carbon sequestration potential cost and performance metrics. The model's development is part of the larger Southwest Regional Partnership on Carbon Sequestration consisting of over 20 organizations, including geological surveys, national labs, federal and state agencies, and is one of seven such partnerships organized by the National Energy Technology Laboratory.

Methods

The Integrated Assessment (IA) model development team at Sandia National Laboratories continues to expand and refine the model as the larger project continues to include additional source and sink data, technology assessments, and looks to employ increasingly standardized cost metrics. Additionally, the model is able to help decision makers (e.g., policy analysts and interested energy companies) determine where a CO_2 source (e.g., power plant) could be built given a set of planning constraints based on current power plant locations, sink availability, and existing pipeline infrastructure right-of-ways.

Results

The working results indicate that the cost of capturing carbon dioxide is by far the majority of a potential project's overall capital cost. For example, the capture, transportation and storage-associated cost breakdown of a plant in northern New Mexico may be 95%, 2% and 3% of the initial cost estimate, respectively. The IA also develops overarching results such as regional CO_2 sequestration totals, relative cost issues, and sink lifetimes across an initial fifty-year time horizon. The initial results indicate the region may support anywhere from several decades to over ten thousand years' worth of CO_2 sequestration potential capacity depending upon the assumptions regarding CO_2 source and sink resources. To sequester this much CO_2, however, may have substantial parasitic energy penalties ranging from 15 to 40% associated with capturing the CO_2 from, for example, power plants.

Conclusions

The IA team, as part of the larger SWP, continues to include additional and more refined capture cost data from a larger working group across all of the regional partnerships in an effort to develop a more 'seamless story' for carbon sequestration at a high level. These standardization efforts also allow for common technological progress to be included in the partnership's modeling efforts to address the cost and energy penalty issues. With the full 'String of Pearls' Integrated Assessment model, planners can assess the technologies, economics and address the other associated issues using an integrated, high-level view when deciding where to develop future carbon sequestration projects and understanding the overall potential carbon sequestration future in the U.S. Ultimately, however, many of the costs will be highly site-specific for power plant-scale carbon sequestration projects.

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