the ENERGY lab

PROJECT FACTS

Existing Plants, Emissions & Capture

Study of the Use of Saline Formations for Combined Thermoelectric Power Plant Water Needs and Carbon Sequestration at a Regional-Scale

Background

Thermoelectric power plants are dependent on an adequate supply of water for the generation of electrical energy. As power plants can impact U.S. water resources, it is critically important to protect these supplies while ensuring that the energy needs of the nation continue to be met. The Department of Energy National Energy Technology Laboratory (DOE NETL) Existing Plants, Emissions & Capture (EPEC) Water-Energy Interface is responding to this challenge through the development and application of advanced technologies that focus on non-traditional sources of water, innovative water reuse and recovery, advanced cooling, and advanced water treatment and detection to reduce the amount of freshwater needed by thermoelectric power plants and minimize potential water quality impacts.

Carbon dioxide (CO_2) emissions from fossil-fueled thermoelectric power plants may be controlled in the future as a method to mitigate global warming. One innovative approach to minimize freshwater resources for use in thermoelectric power plants is to take advantage of the possible need for CO_2 sequestration. This synergistic approach could, depending on site specific conditions, use underground saline formations as both a storage site for captured CO_2 and as a water source to support the operation of power plants. One strategy under development for permanent storage of captured CO_2 is injection into deep saline geologic formations, and an option may exist to remove some quantity of saline water in order to relieve pressure created within the formation by the injected CO_2. The water produced from the formation may have a beneficial use as an alternative water source for the power plant, provided that it can be economically treated before it is utilized.

Project Description

NETL and Sandia National Laboratories (SNL) are investigating the feasibility of coupling geologic CO_2 storage and extracted water use for existing and expanding thermoelectric power plants. SNL will utilize its geochemistry and desalination technical expertise to determine the treatment methods needed and the costs required to beneficially use the extracted water in power plants. The data collected will be used to conduct a systems-level evaluation of the regional challenges and opportunities to optimize power plant processes such as CO_2 sequestration and waste heat recovery to improve water resource utilization while reducing system costs. The efforts will include water geochemistry research, cost analysis of the extracted water treatment needs, and systems analysis of regional benefits and opportunities.

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PERFORMANCE PERIOD

Start Date	End Date
07/15/2007	09/30/2012

COST

Total Project Value
$3,450,000

DOE/Non-DOE Share
$3,450,000 / $0

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U.S. DEPARTMENT OF ENERGY

Goals

The primary goal of this project is to develop a national-scale model to assist in the assessment and understanding of the site specific advantages and disadvantages of developing an integrated system where CO_2 is captured from a power plant and injected for permanent geologic storage while also extracting storage formation water to be used (after treatment) as non-traditional cooling water makeup at that same power plant.

Objectives

The project objectives support the development of the CO_2 sequestration and produced water utilization model through a series of activities including (1) conducting a systems-level evaluation of the regional challenges and opportunities using water quality, treatment methods, and cost data; (2) assessing the scale of CO_2 storage potential within select formations; (3) determining how power plants might improve their ability to use these water supplies; (4) determining the system costs associated with using and treating these waters, including those associated with CO_2 storage; (5) expanding the integrated assessment model—the Water Energy and Carbon Sequestration Model (WECS)—into a national-scale model that draws from existing saline formation databases such as NatCarb (developed through NETL funding), power plant databases such as eGRID (developed by the EPA), and geochemical and geomechanical studies of CO_2 storage effects and migration rates (developed by the NETL/SNL) to determine optimal locations for this integrated storage and water extraction process; (6) finalizing development of the model product (WECS II) to include the full NatCarb database, a custom power plant module, representative water treatment system, and a CO_2 sequestration module for site-specific analyses; and (7) refining the WECS II interface, securing protection for the model, and developing a model distribution strategy.

Planned Activities

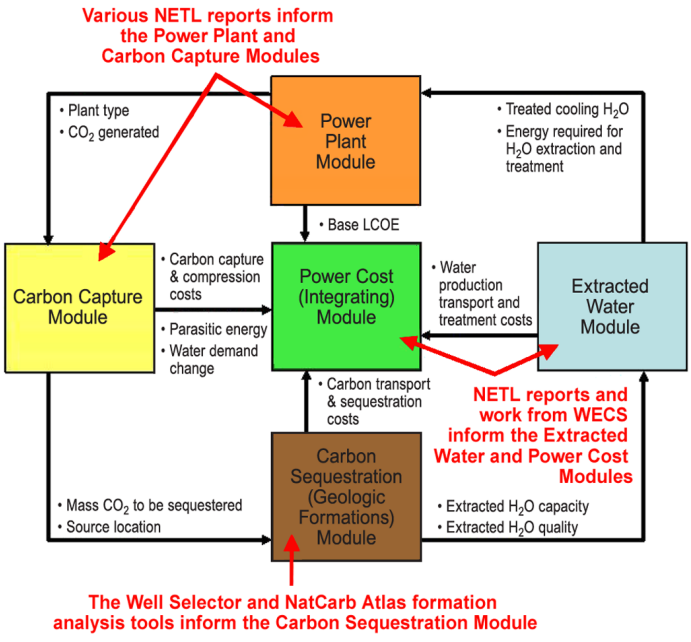
- Perform geochemical and water quality studies, and identify water treatment needs.
- Outline the methodology and subsequent framework developed to characterize power plant waste heat options and opportunities as they relate to energy and water treatment technologies.
- Develop the geomechanical highlights for the generic geo-assessment-oriented criteria needed to examine saline formations.
- Evaluate the potential to scale up the characterization of power plants, CO_2 sequestration, and extracting and treating saline waters.
- Complete an expanded scale and scope for the data assessment for saline formations.
- Determine custom options for the characterization of power plants, CO_2 sequestration, and extracting and treating saline waters.
- Finalize the WECS II model interface, model protection method, and model distribution strategy.
- Prepare and deliver a complete WECS manual with documentation.

Accomplishments

- The geochemical and water quality studies were completed.
- Water treatment needs were identified.
- Geomechanical and modeling update was accomplished.
- Framework methodology was developed.
- Additional geomechanical and other modeling (and analytical) results/progress were accomplished.
- Methodology and subsequent framework were developed to characterize power plant waste heat options and opportunities as they relate to energy and water treatment technologies.

Benefits

The planning tool developed by this project will enable stakeholders to make informed decisions about, and acquire greater insight into, an innovative synergy that has the opportunity to add value to fossil fueled thermoelectric power plants as a result of possible future CO_2 geologic sequestration in saline formations. The utilization of economically treated produced waters by these power plants will reduce the burden on the nation's freshwater supplies while enabling the plants to continue to deliver the energy that the nation requires.



Modular structure of the WECS II model, indicating how the different modules are informed and how they interact