PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Sequestration

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CARBON CAPTURE AND WATER EMISSIONS TREATMENT SYSTEM (CCWESTRS) AT FOSSIL-FUELED ELECTRIC GENERATING PLANTS

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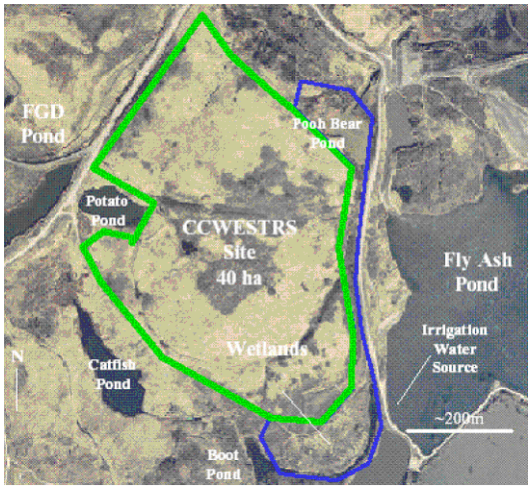
Background

A 40-hecatre reclaimed surface mine area at the 2,558-megawatt Tennessee Valley Authority (TVA)-owned Paradise Fossil Plant near Drakesboro, Kentucky, is serving as the demonstration site where gypsum by-products from the plant's wet scrubber have been used to amend the soils. Wastewater from the flue gas desulfurization process, water, and the coal fly ash pond process water have been be used to irrigate the trees and herbaceous cover. The plants will in turn capture and store carbon dioxide while reducing pollutant loadings to the local watershed. The "Carbon Capture and Water Emissions Treatment System" (CCWESTRS) was constructed at the Paradise Fossil Plant on existing, poorly reclaimed coal mined land by establishing plantings of vegetative species. Sequestration occurs through carbon uptake by trees, with biomass recovery for the forest products industry, and in the soil, which currently has low carbon levels. An average of 1.5 to 3 tons of carbon per acre/year is estimated to be sequestered in the CCWESTRS over a 20-year period. The TVA has installed a system to drip irrigate coal fly ash pond process water over the entire site. Tree growth and response, along with other relevant observations have been performed over the course of the project through 2005 to determine effectiveness of the integrated technologies to sequester carbon and accomplish other project benefits.

The project initially started using FGD Process water to irrigate the 40 hectare site with limited success. High boron content (~58 mg/L) of the FGD water caused high mortality rates in the planted trees. Therefore the system was redesigned to use coal fly ash pond process water which had lower boron concentration of ~7mg.L. Boron has been shown to hinder growth and survival of trees and other plants at concentrations above2-4 mg/l. Therefore this settling pond water was diluted to below 4 mg/L.



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Primary Project Goal

To demonstrate a "whole plant" approach using by-products from a coal-fired power plant to sequester carbon in an easily quantifiable and verifiable form.

Objectives

- Provide economically competitive and environmentally safe options to off-set projected growth in U.S. baseline emissions of greenhouse gases after 2010
- Achieve the long-term goal of $10/ton of avoided net costs for carbon sequestration
- Provide half of the required reductions in global greenhouse gases by 2025

Accomplishments

- Identified species of hardwoods (sycamore and sweetgum) that are resistant to boron toxicity at concentration in irrigation water less than 7 mg/L, which could increase sequestration rates.
- Demonstrated sequestration on reclaimed mine lands using FGD materials in varying depths, different tree species, and process water containing various levels of boron with survival rate greater than 80%.
- Measured the impacts of different FGD mulch and irrigation rates on concentrations and effects of boron in biomass and the soil profile
- Developed best management practices for sequestration on reclaimed mined lands using FGD material as a mulch to improve soil quality and coal fired power plant process water as an irrigation source to increase carbon sequestration rates.

Benefits

- Developing a potentially widely applicable passive technology for water treatment for criteria pollutant release reductions
- Using power plant by-products to improve coal mine land reclamation and carbon sequestration
- Developing wildlife habitat and green-space
- Generating Total Maximum Daily Load (TMDL) credits for water and air-borne nitrogen
- Developing additional forest lands that will be available for timber harvesting

Flue Gas Desulfurization wastewater pond