PROJECT facts

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

Innovations for Existing Plants

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WETLAND WATER COOLING PARTNERSHIP: THE USE OF RESTORED WETLANDS TO ENHANCE THERMOELECTRIC POWER PLANT COOLING AND MITIGATE THE DEMAND ON SURFACE WATER USE

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Background

Thermoelectric power plants require a significant volume of water to operate, accounting for 39 percent of freshwater (136 billion gallons per day) withdrawn in the United States in 2000, according to a U.S. Geological Survey study. This significant use of water ranks second only to the agricultural sector that uses an estimated 40 percent of the U.S. freshwater supply for irrigation purposes. While the majority of the water is returned to the source (freshwater withdrawal), a significant volume is consumed in the power production process and not returned to the source (freshwater consumption), due to evaporation. The operation of existing thermoelectric power plants and the permitting of new plants are challenged by competing demands from other water-use sectors, stricter permitting requirements, and growing populations in water-constrained regions. Furthermore, a recent U.S. Department of Energy (DOE) analysis predicts an increased consumption of freshwater by thermoelectric power stations over the next 20 years due to greater use of closed-loop cooling systems which consume far more water than open-loop systems, due to evaporation losses. The DOE Office of Fossil Energy Existing Plants Program is conducting research to develop innovative technologies to reuse power plant cooling water and associated waste heat and to investigate methods to recover water from coal and power plant flue gas.

Description

Wetland restoration involves returning the biological, physical, and chemical functions of a degraded wetland to its original state. In this project, researchers will investigate the benefits, costs, and limitations of using restored wetlands

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for power plant water reuse and as tertiary treatment of wastewater treatment plant effluent prior to use in a power plant, thus mitigating the demand on current surface water systems. The project will examine how restored wetlands can enhance the performance, efficiency, and operation of conventional systems given current Federal, state, and local water permits and regulations.

Primary Project Goal

The primary goal of this project is to use restored wetlands to help alleviate the increasing stress on surface and ground water resources from thermoelectric power plant cooling requirements. The project aims to develop implementable water conservation and cooling strategies using restored wetlands. It also aims to provide the benefits of reduced water usage with added economic and ecological values at thermoelectric power plant sites, including enhancing carbon dioxide (CO_2) sequestration in the corresponding wetlands; improving net heat rates (thus increasing mWh of generation) from existing power generation units; avoiding limitations when low surface water flows or excessive heat limit the ability of the unit to operate within permitted levels (occurs during the hottest days when demand for electricity is greatest); and providing a suite of biological and physical mechanisms to help treat wastewater effluents, such as mercury and sulfur dioxide.

Objectives

The overall objective of the project is to strategically explore and develop implementable water conservation and water cooling strategies using restored wetlands. These strategies will simultaneously provide biological carbon management strategies, action plans, and programs that integrate the known science methodologies with regional policy; market, economic, and business models; education and outreach; and social programs. The project will enable power producers to explore and implement the process of cooling restored wetlands to conserve water, to beneficially reuse cooling waters for conservation and climate change mitigation purposes, and to improve wetland conservation initiatives throughout the United States.

Benefits

The benefits of using an alternative, natural system to complement the cooling, water treatment, and sequestration of CO_2 will be significant and extensive for the power generation industry for the following reasons:

- Restored natural wetland systems provide a net environmental gain in terms of wildlife habitat, water quality, and other enhanced ecosystem functions.
- The technology has the potential to increase operating efficiencies for power generating companies.
- The technology lessens the tremendous demand on surface water, while enhancing the habitat and ecological benefits.
- The new technology creates a win-win situation by linking power production to regional habitat restoration and conservation initiatives.

Planned Activities

The planned activities for this project include:

- Produce an assessment of water cooling needs with a catalogue of various strategies that are operational where ponds, lakes, or wetlands are currently being used for cooling water and mitigating anthropogenic fossil fuel CO_2 emissions and other greenhouse gases (GHGs) associated with reuse and cooling of heated waters from power plant operations.
- Develop a literature review on the use of restored wetlands for water cooling and heat management needs by various industries, including power producers.
- Complete a conceptual design, technical evaluation, and modeling of specific cooling strategies that employ wetlands.
- Construct a pilot-scale (5-acre) restored wetland at a host utility.
- Evaluate a range of issues, such as environmental efficacy, regulations, and public policies related to widespread adoption of wetland cooling practices.
- Create action plans to promote and guide region-wide implementation of conservation and wetland-based water cooling strategies with the incremental benefit of GHG mitigation practices.

PERIOD OF PERFORMANCE

10/01/08 to 09/30/11

COST

Total Project Value
$1,148,050

DOE/Non-DOE Share
$914,472 / $233,578

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Photo of a temperate wetland