WATER MANAGEMENT TECHNOLOGIES

NETL's **Water Management Technologies Program** addresses both critical water-energy availability and critical water quality issues. Two water sources are of primary interest to the Program: produced waters associated with oil and natural gas production, and the aqueous effluents associated with coal combustion residuals (CCR) from fossil-based thermal electric power generation. Research focuses on the treatment and potential reuse of produced water associated with oil and natural gas development, particularly the production of unconventional resources, and the management of water impacted by flow through CCR associated with coal-based thermal electric power generation facilities.

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The production of natural gas and oil from the subsurface and the generation of electrical power from fossil fuels generate streams of wastewater containing components that are potentially harmful to the environment. Industry efforts to recycle these waste streams have been largely successful, but the scale of energy production in the U.S. is so great that significant volumes of these waste streams still require handling, transport, storage, and safe disposal. All of these activities can be problematic with respect to the environment, particularly the disposal of oilfield produced water and hydraulic fracturing flowback water via pumping into deep subsurface formations. Subsurface disposal primarily from oil and natural gas operations has induced seismic activity in certain regions, resulting in surface damage to communities and the environment. Reducing the volume of wastewater disposed of via deep well injection requires new technologies and processes to economically convert the waste streams into a useful product. Potential beneficial uses could include extracting useful minerals and elements when possible and producing reusable water when practical.

In addition, thermoelectric power generation accounts for more than 40 percent of freshwater withdrawals (143 billion gallons of water per day) and more than 3 percent of freshwater consumption (approximately four billion gallons per day) in the United States. As the cost associated with water consumption increases, so will the need for water treatment, recovery, and reuse.

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The Water Management Technologies Program addresses the competing needs for water consumption through research in three dynamic platforms:

INCREASING WATER TREATMENT EFFICIENCY AND BENEFICIAL USE POTENTIAL — There is an inextricable link between water and energy, and it is increasingly important to treat water effectively throughout the oil & gas and power generation sectors. This area aims to advance concepts for both new and existing treatment technologies to minimize water disposal and positively impact beneficial use.

TREATMENT OF ALTERNATIVE SOURCES OF WATER — Identifying and treating alternative sources of water associated with oil and natural gas development, such as brackish and effluent streams, offers opportunities for scientists to address energy-water system challenges. This area focuses on furthering technology to utilize alternative water resources that span multiple facets of research and development (R&D), including consideration of capital costs, operating costs, and system integration.

CHARACTERIZATION OF WATER RESOURCES — The complex relationship between energy and water is constantly developing. The characterization of water resources, either related to oil and natural production or CCR elements, is critical to optimizing the development of treatment technologies and beneficial use opportunities, including evaluating critical mineral content in a variety of influent streams.

This program leads a critical, National effort directed at the following: (1) removing all barriers to sustainable, efficient water treatment and beneficial use; (2) developing feasible technology solutions; and (3) enhancing our understanding of the relationship between energy and water resources.

WATER MANAGEMENT R&D PROVIDES INNOVATIVE TECHNOLOGIES FOR EFFICIENT ENERGY PRODUCTION IN THE FOLLOWING WAYS:

- Develops cost-effective technology solutions to efficiently treat a variety of water resources and accelerate beneficial use opportunities.
- Reduces water disposal through subsurface injection, which reduces potential for induced seismicity.
- Stretches water availability with new water treatment technologies that economically derive clean water from alternative sources.
- Employs data modeling and advanced analytics to examine existing water availability data on a regional basis.

Freshwater supplies in certain areas of the U.S. are under stress due to increased demand and climate change-induced drought. A number of these areas coincide with oil and natural gas production and coal-fired thermal power generation operations. In the not-too-distant future, there will likely be a combination of economic and regulatory drivers that will act to make the beneficial reuse of treated wastewater a viable, perhaps even necessary, option. Of further consideration, U.S. manufacturing enterprises are increasingly dependent on overseas suppliers for the minerals, metals, and elements necessary for the manufacturing of critical electronic components in modern consumer products and national defense.

NETL is a U.S. Department of Energy national laboratory that drives innovation and delivers technological solutions for an environmentally sustainable and prosperous energy future. Through its world-class scientists, engineers, and research facilities, NETL is ensuring affordable, abundant, and reliable energy that drives a robust economy and national security, while developing technologies to manage carbon across the full life cycle, enabling environmental sustainability for all Americans, advancing environmental justice, and revitalizing the economies of disadvantaged communities. Leveraging the power of workforce inclusivity and diversity, highly skilled innovators at NETL's research laboratories in Albany, Oregon; Morgantown, West Virginia; and Pittsburgh, Pennsylvania conduct a broad range of research activities that support DOE's mission to ensure America's security and prosperity by addressing its energy and environmental challenges through transformative science and technology solutions.

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