An Update on the National Energy Technology Laboratory’s Water-Energy Research and Related Activities

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NETL has long recognized the critical link between sustainable water and energy. Since 2002, NETL has been engaged in integrated, comprehensive RD&D to advance our understanding of fossil energy exploration, extraction, development, and use on freshwater availability and quality with the goal of improving the security and resiliency of our fossil-energy investments. Research on water is being carried out in a synergistic manner across the Laboratory’s programs in thermoelectric power generation, unconventional oil and gas development, carbon capture and storage, critical minerals and REE recovery, coal combustion residuals, university coal research, and systems modeling and analysis. Future activities may include the application of machine learning and artificial intelligence to critical water-energy challenges. Collectively, these projects support DOE’s Water Security Grand Challenge, a White House initiated, DOE-led effort to advance transformational technology and innovation to meet the global need for safe, secure, and affordable water.

You can explore specific areas of NETL’s water-energy research, learn more about our water program, and sign up for the Water-Energy Nexus Newsletter by visiting our new Water-Energy Nexus website at https://netl.doe.gov/water-energy-research.
In December 2020, NETL’s Crosscutting R&D Program announced that $3.3 million in Federal funding will be issued for cost-shared research and development projects under the DE-FOA-002399, Water Management for Thermal Power Generation. This effort will identify and treat alternative sources of water and will support the DOE’s Water Security Grand Challenge Goal 3: “Achieve near-zero water impact for new thermoelectric power plants, and significantly lower freshwater use intensity within the existing fleet.”

Water scarcity is a key consideration for managing current systems and planning for future investments. Efforts to decarbonize fossil fuel-based power plants may also contribute to water scarcity. Carbon capture and storage (CCS), fuel switching to biomass or hydrogen, and the integration of intermittent renewables onto the electricity grid will be accompanied by increases in water intensity. Treating water inside a power plant can give the asset a zero-liquid discharge (ZLD) footprint and provide the asset owner with flexibility when water is scarce.

The Funding Opportunity Announcement seeks to advance near-term solutions to reduce the impact of traditional and non-traditional water uses associated with coal, gas, and hydrogen-based power plants. These include plant-effluent streams and brines associated with CCS. Some of the plant effluents that might be treated consistent with the ZLD objective, as well as the environmental compliance include flue gas desulfurization wastewater, ash pond, and landfill leachate. Integrating treatment of non-traditional source waters such as brackish groundwater and water generated by municipal, mining, or agriculture operations with thermal power plants can provide additional synergies.

To learn more about NETL’s Crosscutting Water Research, visit https://netl.doe.gov/coal/water-management.
The objective of this two-year project is to develop a new membrane-based filtration system for removing organic compounds from produced water. The proposed membrane treatment process integrates the new filter with a series of well-established water treatment technologies to remove all suspended and dissolved solids, organic molecules, bacteria, and radioactive particles from the produced water generated in oil and natural gas production.

A New Membrane Based Treatment Process for Reclaiming and Reutilization of Produced Water – TDA Research, Inc.

This two-year effort is directed at the development of a novel membrane technology based on zwitterionic copolymers that can provide cost-effective pretreatment for produced water and maintain immunity to detrimental and irreversible membrane fouling.


This two-year effort is focused on developing and testing a new method for delivering a Fe$^{3+}$ coagulant and disinfectant for treating flowback and produced water (FPW) so that it can be reused for fracking and water-flooding at a cost savings of at least 50% compared to current practices. The treatment system will remove suspended solids, dispersed oil, H$_2$S, microorganisms, and scale-forming cations from FPW.

Non-Fouling, Low-Cost Electrolytic Coagulation & Disinfection for Treating Flowback and Produced Water for Reuse – University of Arizona

This two-year project will develop a working prototype of a two-part affinity-based membrane separation process for recovering hydrocarbons and separating organics from produced water. This research effort focuses on using nanostructured membranes that take advantage of interfacial chemistry principles to reduce fouling during water filtration and selectively permeate benzene, toluene, ethylbenzene, and xylenes and oil during resource recovery.
Conferences and Events

Listed below are of upcoming conferences and events that align with the Laboratory’s water-energy research efforts.

**AWWA Virtual Summit: Sustainable Water, PFAS, Waterborne Pathogens**
**Description:** Explore cutting-edge ideas related to the critical water sector topics of sustainable water, PFAS, and waterborne pathogens at the American Water Works Association (AWWA) Virtual Summit. Topics will include Water Resources Planning and Management, Treatment Challenges and Solutions, and Detection and Surveillance of SARs-CoV-2.
**Date:** February 10–11, 2021
**Locale:** Virtual
**Website:** [https://www.awwa.org/Events-Education/AWWA-Virtual-Summits/Sustainable-Water-PFAS-Waterborne-Pathogens](https://www.awwa.org/Events-Education/AWWA-Virtual-Summits/Sustainable-Water-PFAS-Waterborne-Pathogens)

**World Water Tech-Innovation Summit**
**Description:** By sharing best practices from around the globe and facilitating new connection and collaborations, the World Water Tech-Innovation Summit offers an invaluable platform to accelerate the transition to a digital future for the water and wastewater sectors.
**Date:** February 23–24, 2021
**Locale:** Virtual
**Website:** [https://worldwatertechinnovation.com](https://worldwatertechinnovation.com)

**AWWA Virtual Summit: Lead & Water Quality**
**Description:** Lead and Copper Rule requirements prompt continued action from the water sector to reduce lead exposure through drinking water. This AWWA Virtual Summit provides a holistic perspective on lead reduction actions and impacts through engaging presentation of the most relevant technical content and total water solutions.
**Date:** April 7–8, 2021
**Locale:** Virtual
**Website:** [https://www.awwa.org/Events-Education/AWWA-Virtual-Summits/Lead-Water-Quality-Summit](https://www.awwa.org/Events-Education/AWWA-Virtual-Summits/Lead-Water-Quality-Summit)

**2021 Virtual Joint AWRA & National Capital Annual Water Symposium**
**Description:** The 2021 Virtual Joint American Water Resources Association (AWRA) and National Capital Annual Water Symposium is a two-day conference engaging cross-disciplinary interactions; all focused around the next phase of water sustainability. Special sessions will focus on the idea of circular economies, managing for the unknown such as the COVID-19 pandemic, social hydrology, environmental justice, and innovations in water resource management.
**Date:** April 15–16, 2021
**Locale:** Virtual
**Website:** [https://www.awra.org/Members/Events_and_Education/Events/2021_Spring_NCR_Conference](https://www.awra.org/Members/Events_and_Education/Events/2021_Spring_NCR_Conference)
Nicholas Siefert, Ph.D. is a mechanical engineer on the Innovative Energy & Water Processes Team. He earned his doctorate in mechanical engineering from Carnegie Mellon University, master’s in applied physics from Air Force Institute of Technology, and bachelor’s in mechanical and aerospace engineering from Princeton University. His research interests include waste-to-energy, coal gasification with carbon capture, plasma physics, solid oxide fuel cells, and water treatment.

“I want to take waste streams and convert them into valuable products for other users, particularly in the water treatment areas, where eluent streams at power plants and produced water from oil and gas wells can be co-treated and converted into valuable products...”

Siefert serves as an advisory for the Power Committee within NAWI’s road mapping effort to determine the best ways to decrease the cost of water treatment. He also leads the in-house research at NETL in the area of water treatment at fossil power plants, which includes conducting experiment baseline testing for the FWP-1022428 Task 4 and developing novel processes for increasing the water recovery rate using reverse osmosis membranes.

Siefert has co-authored more than 35 scientific publications and holds four patents. His research includes a patent for Hydrophobic Carbon Capture Solvent (https://netl.doe.gov/node/5706), a patent for Allyl-Containing Ionic Liquid Solvents for CO₂ Capture (https://netl.doe.gov/node/386), FWP-1022428 Task 4 Concentrating Wastewater Effluent Streams (https://www.netl.doe.gov/node/9024), and Treating Effluent Streams at Coal Power Plants Using Membranes.
Recent Water-Related Publications and Presentations

Responding to the Water-Energy Nexus Challenge: NETL’s Comprehensive, Integrated R&D Program

Sustainable Water Use for Fossil Energy: NETL’s Research and Development Program (Infographic)

NetL’s Water-Energy RD&D Core Capabilities & Competencies

Below are several water-related journal articles authored or co-authored by NETL staff.

Regional and Seasonal Water Stress Analysis of United States Thermoelectricity

Uisung Lee, Argonne National Laboratory (ANL); Joseph Chou, NETL; Hui Xu, ANL; Derrick Carlson, NETL; Aranya Venkatesh, NETL; Erik Shuster, Timothy J. Skone, NETL, Michael Wang, ANL. (OCTOBER 2020)


Utilization of Produced Water Baseline as a Groundwater Monitoring Tool at a CO2-EOR Site in the Permian Basin, Texas, USA


Techno-Economic Analysis of Converting Oil & Gas Produced Water into Valuable Resources

Madison Wenzlick and Nicholas Siefert, NETL. (MAY 2020)

Contact Us

NETL is part of DOE’s national laboratory system. NETL is a government-owned, government-operated laboratory (GOGO) supporting DOE’s mission to advance the national, economic, and energy security of the United States.

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Program staff are also located in
Houston, Texas, and Anchorage, Alaska.

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Get Social with Us

There are several ways to join the conversation and connect with NETL’s Water-Energy Research Program:

Partnering with NETL

NETL’s partnership activities are central to DOE’s core mission. NETL utilizes a complete suite of contractual vehicles, as well as its inherent authority as a GOGO laboratory, to pursue technology development and eventual transfer of technology to the marketplace. NETL’s success in developing technology solutions that can be applied to the intersection of water and energy depends upon strong relationships with both public and private entities. From targeted competitive announcements to cooperative research and development agreements, NETL offers a variety of cost-shared funding and partnership arrangements to help move technology and intellectual property through the maturation cycle into the marketplace.

For more information on partnering with NETL in the water-energy space, contact:

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https://netl.doe.gov/water-energy-research