

# **WATER-ENERGY NEXUS NEWS**

U.S. DEPARTMENT OF ENERGY | OFFICE OF FOSSIL ENERGY AND CARBON MANAGEMENT | NATIONAL ENERGY TECHNOLOGY LABORATORY



## **IN THIS ISSUE**

- 3** Project Highlights
- 7** In The News
- 8** Conferences and Events
- 9** Researcher Spotlight
- 10** Publications

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

# NETL's 25th Anniversary



NETL celebrated its 25th year as a Department of Energy (DOE) national laboratory in December 2024, reflecting on the lab's accomplishments and impactful discoveries since 1999—when the U.S. Secretary of Energy signed documents elevating the Federal Energy Technology Center to what is now NETL.

The anniversary event kicked off with remarks from the Under Secretary for Science and Innovation, the Assistant Secretary for the Office of Fossil Energy and Carbon Management (FECM) and NETL Director Marianne Walck before continuing with a panel discussion among former NETL directors; the live stream recording is available [here](#). The celebration also featured an extensive poster session across the technological spectrum, and lab tours highlighting NETL on-site experimental and analysis capabilities. Notable water-energy nexus accomplishments featured in the anniversary lookback include the following:

- The 2014 NETL and FECM collaboration to perform an initial study that assessed the potential recovery of rare earth elements from coal and coal byproducts, including acid mine drainage
- The development of award-winning technologies for dual purposes such as the Multi-functional Sorbent Technology (MUST)—first used in carbon capture applications, then patented to capture heavy metals from mine drainage and municipal water supplies
- The recent announcement from NETL researchers of a major discovery—produced water from oil and gas hydraulic fracturing processes in parts of Appalachia can be a source of lithium for rechargeable batteries to power electric vehicles

The 25th anniversary posters showcasing NETL's research and accomplishments relating to the water-energy nexus are as follows:

- [NETL's Water Database Key to Energy-Related Water Cleanup](#)
- [PARETO: Minimizing Produced Water Costs and Environmental Impact](#)
- [Informed Rare Earth Extraction from Mine Drainage Treatment Waste](#)

Additional details are available on the NETL website: <https://netl.doe.gov/25thanniversary>

# Highlights: Six Projects Selected to Support Regional-Scale Collaborations Focused on Securing Domestic Critical Minerals and Materials (CMM)

In January 2025, DOE/FECM announced a first round of project selections of \$45 million for Funding Opportunity Announcement (FOA) 3077: Regional Scale Collaboration to Facilitate a Domestic Critical Minerals Future: Carbon Ore, Rare Earth, and Critical Minerals (CORE-CM) Initiative. The funding opportunity expands the work of the **CORE-CM Initiative** basinal assessment and development of critical mineral (CM) supply chains from unconventional and secondary feedstocks—including fossil fuel energy and similar waste streams, such as coal waste and by-products, oil and gas produced waters, active mineral mines tailings and byproducts, and brines produced as part of carbon sequestration efforts.

NETL, under the purview of FECM, will manage the selected projects:

*Northwest Region CORE-CM Project* intends to work with three state geological surveys from Alaska, Oregon, and Washington to perform new data collection and analysis, geologic and mineral systems mapping, sample collection and characterization to better understand the geologic framework and distribution of underexplored mineral resource deposits in the Northwest.

*Upper Midwest & Illinois Basin Carbon Ore, Rare Earth, and Critical Mineral Initiative* plans to build understanding and the economic case for the development of CMM from coal and coal wastes in the Upper Midwest, with one main research area being a characterization campaign focused on understanding existing secondary (e.g., brine groundwaters and metalliferous shales) and unconventional (e.g., mine wastes and coal combustion residuals) sources of CMM.

*Developing a Regional Evaluation and Assessment of Critical Minerals* plans to catalyze economic growth and job creation by identifying resource potential in the Gulf Coast and Permian Basin areas—including from petroleum industry waste; produced water; coal, coal ash, and other coal-mine-related waste; and other nonfuel mine and processing wastes.

*Assessment, Characterization, and Planning for Carbon Ore and Critical Minerals/Materials Resources Utilization in the Rocky Mountain Region* will evaluate CMM and carbon associated with coal-related materials, sedimentary-hosted minerals, waste-related materials and other potential value-added materials in the Rocky Mountain region, sharing resulting data through the DOE Energy Data Exchange database.

*Great Plains and Interior Highlands CORE-CM: Developing a Nexus of Carbon Ore & Critical Mineral Resources, Technology Innovation, and Communities of the Future* intends to address CORE-CM Initiative goals of catalyzing regional economic growth and resource security by developing domestic supply chains that use secondary and unconventional CM resources—assessing the Great Plains and Interior Highlands.

*Expand Appalachia CORE-CM* plans to lead a consortium of academic institutions, research laboratories, federal and state natural resource offices and consultancies to evaluate CMs for potential future extraction in the Appalachian Mountain region.

Further details on the selected projects are available [here](#).

## Highlights: WaterTAP Releases Version 1.2.0

The Water treatment Technoeconomic Assessment Platform (**WaterTAP**) is an open-source Python-based software tool for assessing the performance and economic viability of water treatment trains. This National Alliance for Water Innovation (NAWI) program is led by researchers at NETL in collaboration with other national labs including Lawrence Berkeley National Laboratory (LBNL), National Renewable Energy Laboratory (NREL) and Oak Ridge National Laboratory (ORNL). The tool includes modeling, simulation and optimization capabilities for membrane, evaporative, adsorption, chemical, electrochemical and biological processes.

The most recent releases in October and December 2024 included models for thermal vapor compression and crystallization, as well as refinements to existing models and capabilities. For more on WaterTAP, see <https://www.nawihub.org/knowledge/watertap/>.



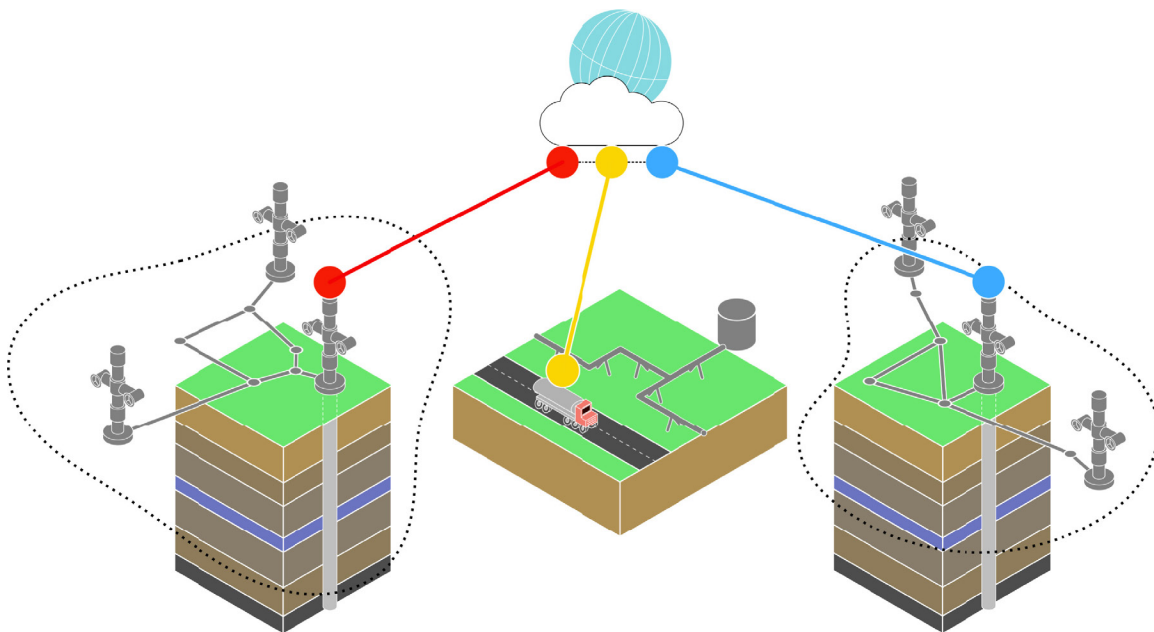
# Highlights: PARETO Team Creates Portal for Produced Water Exchange

The United States' electricity market is less like a crocheted blanket and more like a patchwork quilt. Instead of a single, uniform network of energy producers, distributors and users, the national grid encompasses several wholesale markets that serve different geographic regions. Each of these markets coordinates producers to guarantee an affordable, reliable energy supply. Algorithms typically guide these efforts to keep pace with demand.

With its Produced Water Exchange Portal, NETL is applying a similar approach to the management of produced water, a byproduct of oil and gas extraction. The portal makes it simpler for operators of oil and gas wells to share and trade the produced water their wells generate. Bringing operators together in this way creates opportunities to recycle produced water for well operations, alleviating the need to source surface water or to find open disposal wells. This water “recycling” has logistical, financial, and environmental benefits.

The portal is the result of a collaboration between NETL's Produced Water Application for Beneficial Reuse, Environmental Impact, and Treatment Optimization (**PARETO**) team and the Ground Water Protection Council. Because high concentrations of saline and contaminants typify produced water, it can threaten groundwater supplies and prove difficult for operators to manage. The PARETO initiative seeks to transform these challenges into opportunities for efficiency.

The portal uses market-clearing algorithms—like those that direct the electricity market—to match operators who need produced water with those who can supply or transport it. PARETO team member Philip Tominac describes the portal as a matchmaker of sorts. The software accounts for the distances between operators, the availability of pipelines that connect their operations, and the volume of produced water they can provide, transport or receive in a day. Additionally, operators can include water quality information (dissolved solids, salinity, etc.) to refine the matches they receive. While these factors influence a match, the primary driver is the bidding system, which uses willingness to pay to find compatible matches.



Source: NETL. New opportunities in produced water management:  
A market-based approach to produced water trading

## Highlights: PARETO Team Creates Portal for Produced Water Exchange (continued)

The portal's clearing algorithm has some advantages: it never sets market prices in breach of user bids. For example, if one operator is willing to pay \$0.65 per barrel to send its produced water away, the portal will not match that operator with another asking \$0.75 per barrel to receive it. Similarly, an operator that submits a bid of \$0.80 per barrel to receive produced water will not be matched with a supplier bidding just \$0.55 per barrel.

**The Produced Water Exchange**

A Free and Open "Matchmaking Portal" for Produced Water

As part of the U.S. Department of Energy's produced water optimization initiative, "Project PARETO", the National Energy Technology Laboratory along with the Ground Water Protection Council, has developed a novel produced water exchange portal prototype to demonstrate the utility of this technology to prospective stakeholders. This portal allows upstream and midstream organizations to declare when they have excess produced water or need water, and it identifies and proposes mutually beneficial "matches" that reduce the need for disposal and freshwater withdrawal. This portal is intended to facilitate water exchange practices that have already been adopted by the industry on an ad-hoc basis, improving the efficiency of operations, and reducing operational costs. [Powered by PARETO](#)

Login Register

U.S. DEPARTMENT OF ENERGY NATIONAL ENERGY TECHNOLOGY LABORATORY BERKELEY LAB GROUNDWATER PROTECTION COUNCIL

A recent study illustrates the portal's potential. The study—published in "[Geoenergy Science and Engineering](#)"—focused on historical operations data in Northeastern Pennsylvania. Its findings suggest that adopting systematic water sharing could increase the recycling rate of produced water (from 49.2% to 99%) while decreasing the cost of trucking and operations. In this way, the portal could help operators preserve the nation's natural resources while reducing operating costs.

As Project PARETO project advances, the team aims to conduct a pilot test of the portal with industry partners. This testing will provide valuable feedback that will help the team improve its design. Please contact [PARETO@netl.doe.gov](mailto:PARETO@netl.doe.gov) with questions about the pilot tests or interest in participating.

# In the News

## NETL Advances Landmark Research to Store Hydrogen in Subsurface

To understand hydrogen reactivity with shale caprock and begin to address impacts on long-term hydrogen storage, NETL researchers exposed shale samples (from the Western Gulf Basin in south Texas) to hydrogen, nitrogen and water under simulated subsurface storage conditions (50 °C and pressurized to 1,500 pounds per square inch absolute) for a duration of three to eight weeks. The researchers found that exposure of the shale to hydrogen gas alone did not result in any chemical alterations to the shale or any changes in the surface morphology. Exposure of shale to both hydrogen and water and nitrogen and water resulted in changes to the surface morphology as a result of gypsum dissolution and reprecipitation, indicating that hydrogen is not necessary to promote these changes.

## NETL-Supported Lower Cost Supercritical Carbon Dioxide Turbine Technology Successfully Demonstrated

An NETL-supported project, which could offer a path to lower-cost power generation, successfully demonstrated a supercritical turbine technology in a pilot plant that can produce enough power to supply electricity to approximately 4,000 homes—the largest scale demonstration of the technology ever accomplished. NETL Federal Project Manager Matthew Adams indicated that there are multiple reasons for the interest in supercritical CO<sub>2</sub> (sCO<sub>2</sub>) power cycle technology, saying, “sCO<sub>2</sub> power cycles offer the potential for more compact, higher efficiency power cycles compared to state-of-the-art steam power cycles, resulting in lower cost of electricity, reduced fuel and water usage and lower emissions.”

# Conferences and Events

Listed below are recent and upcoming conferences and events that align with the NETL's water-energy research efforts.

## WEF/AWWAA Utility Management Conference

**Description:** The Water Environment Federation (WEF) and American Water Works Association (AWWA) are again partnering to offer this gathering of utility executives and managers. Over the past three decades, members of AWWA and WEF have established The Utility Management Conference™ as one of the leading, most informative and prestigious management conferences.

**Date:** Feb. 11–14, 2025

**Location:** Dallas, Texas

**Website:** <https://www.wef.org/UtilityManagement>

## World Water-Tech Innovation Summit

**Description:** The World Water-Tech Innovation Summit is the premier networking event for water leaders, investors and innovators to share and showcase best practice in delivering climate-resilient, energy-efficient water systems. The event brings together progressive water enterprises, regulatory bodies, engineering firms, technology giants, investors and visionaries to address the decade's most pressing challenges.

**Date:** Feb. 25–26, 2025

**Location:** London, United Kingdom

**Website:** <https://worldwatertechinnovation.com/>

## The Permian Basin Water in Energy Conference

**Description:** The Permian Basin Water in Energy Conference (PBWIEC) facilitates collaboration and innovative strategy development for the improved use, recovery and recycling of water in the oil industry. The PBWIEC is a program of The University of Texas Permian Basin housed at the university's Shepperd Leadership Institute.

**Date:** Mar. 4–6, 2025

**Location:** Midland, Texas

**Website:** <https://waterinenergy.com/>

## 34th Annual International Conference on Soil, Water, Energy, and Air

**Description:** The 34th Annual Conference on Soil, Water, Energy, and Air offers attendees a diverse and dynamic technical program to address the evolving needs of the environmental field. This prestigious event has united environmental professionals for over three decades.

**Date:** Mar. 17–20, 2025

**Location:** San Diego, California

**Website:** <https://www.aehsfoundation.org/westcoast>

## 2025 NETL Resource Sustainability Project Review Meeting

**Description:** This review meeting will present the results from over 100 research projects across FECM technical program areas: Carbon Ore Processing, Critical Minerals and Materials, Environmentally Prudent Stewardship, Methane Hydrates, Methane Mitigation Technologies, Natural Gas Decarbonization & Hydrogen Technologies, and Water Management Technologies.

**Date:** Apr. 8–11, 2025 (*Postponed to the week of Sep. 22, 2025*)

**Location:** Pittsburgh, Pennsylvania

**Website:** <https://netl.doe.gov/events/25RS>



# Researcher Spotlight



**Adam Atia**  
Research Engineer  
[adam.atia@netl.doe.gov](mailto:adam.atia@netl.doe.gov)

Adam Atia is a site-support contractor supporting NETL's Process Systems Engineering Research team. He holds a Ph.D. and a Master's degree in Earth and Environmental Engineering from Columbia University. Concurrently, he was also National Science Foundation (NSF) Graduate Research Fellow for five years during which he conceptualized and led the winning desalination design for the DOE U.S.-Israel Integrated Energy and Desalination Design Challenge in partnership with ORNL.

Atia's research interests are centered around desalination and water reuse—particularly renewable-powered and demand-response membrane desalination. His work seeks to increase adaptability for the grid of the future, promote sustainable water treatment and reuse, and investigate potential solutions to the energy-water nexus under future scenarios.

In 2021, Atia joined NETL as an advanced process modeling and optimization engineer through KeyLogic. His current projects include several NAWI activities such as leading support of model development and analysis—most currently on a digital twin application with a desalination pilot evaluating actual versus prediction performance using the [WaterTAP](#) platform, for which he is the top contributor—and on flexible desalination modeling, working with partner water utilities to sustain water production via desalination of alternative water sources while also taking advantage of demand response incentives and time-of-use energy pricing to offset the cost of water production. Additionally, Atia leads support on a wastewater resource recovery modeling effort funded through the Industrial Efficiency and Decarbonization Office. He also supports another NAWI activity related to the valorization of brackish groundwater brine.



*Atia participating in a joint WaterTAP/membrane desalination workshop at University of Arizona.*

Recent publications Atia has co-authored include journal articles, [Optimizing Desalination Operations for Energy Flexibility](#), [Nonlinear Programming Optimization of a Single-Stack Electrodialysis Desalination System for Cost Efficiency](#), [Modeling Framework for Cost Optimization of Process-Scale Desalination Systems with Mineral Scaling and Precipitation](#), [Cost Optimization of Low-salt-Rejection Reverse Osmosis](#), and conference papers on [Cost-optimal Selection of pH Control for Mineral Scaling Prevention in High Recovery Reverse Osmosis Desalination](#) and [IDAES-PSE Software Tools for Optimizing Energy Systems and Market Interactions](#).

# Publications and Presentations

Below are several water-related publications and presentations authored or co-authored by NETL staff.

## Cost Optimization of a One-stack Electrodialysis Desalination System

Xiangyu Bi, LBNL; Austin Ladshaw, ORNL; Timothy Bartholomew, NETL; Adam Atia, NETL support contractor; Srikanth Allu, ORNL; Alexander Dudchenko, NETL. (JANUARY 2025)

► <https://doi.org/10.1016/j.desal.2024.118512>

## Application of Ion Sieve Sorbent Prepared from Mineral Stream Associated with Critical Minerals in Direct Lithium Extraction

Chin-Min Cheng, NETL support contractor; Mengling Stuckman, NETL; Christina Lopano, NETL; Maximilian Barczok, NETL support contractor; Wei Xiong, NETL support contractor; Bret Howard, NETL; Colleen Hoffman, NETL support contractor; Nicholas Siefert, NETL; Justin Mackey, NETL support contractor; George Guthrie, NETL; Fan Shi, NETL. (DECEMBER 2024)

► <https://netl.doe.gov/energy-analysis/details?id=c0bf2b60-67c5-4273-b1ff-ee211e02c2fa>

## Optimizing the Design and Operation of Water Networks: Two Decomposition Approaches

Yijiang Li, Georgia Institute of Technology (Georgia Tech); Santanu Dey, Georgia Tech; Nikolaos V. Sahinidis, Georgia Tech; Naresh Susarla, NETL support contractor; Miguel Zamarripa, NETL support contractor; Markus Drouven, NETL. (JANUARY 2025)

► <https://doi.org/10.1016/j.compchemeng.2024.108897>

## Posters & Presentations

### WaterTAP Overview and Updates

Timothy Bartholomew, NETL. (DECEMBER 2024).

► [https://youtu.be/2X2qRQK\\_cvE](https://youtu.be/2X2qRQK_cvE)

### Portable Fiber Optic Sensor for Rare Earth Elements and Other Critical Metals Using Photoluminescence Methods

Scott Crawford, NETL; John Baltrus, NETL; Ki-Joong Kim, NETL; Ward Burgess, NETL support contractor; Ariana Adkisson, Mickey Leland Energy Fellowship; Nathan Diemler, NETL support contractor. (NOVEMBER 2024)

► <https://netl.doe.gov/energy-analysis/details?id=298b020d-cfa6-43f7-aed9-191f80b98200>

### Treatment and Mineral Recovery from Combustion Residual Leachate and Produced Water

Chad Able, NETL support contractor; Tommy Schmitt, NETL support contractor; Alison Fritz, NETL; Nicholas Siefert, NETL. (OCTOBER 2024)

► <https://netl.doe.gov/energy-analysis/details?id=68933f21-1f3d-49a3-b489-a5e626898d35>

### Evaluating Property Model Accuracy for Cost Optimization of Desalination Technologies

Savannah Sakhai, West Virginia University (WVU); Timothy Bartholomew, NETL; Fernando Lima, WVU. (OCTOBER 2024)

► <https://netl.doe.gov/energy-analysis/details?id=ef0dd863-23e6-4b9d-9f92-8d8a1388460f>

### Characterizing Radium Distributions, Source Attribution and Impacts from Marcellus Produced Water

Justin Mackey, NETL support contractor; Bonnie McDevitt, U.S. Geological Survey; Anna Wendt, NETL; Daniel Bain, University of Pittsburgh. (SEPTEMBER 2024)

► <https://netl.doe.gov/energy-analysis/details?id=5f26e92d-e92f-4a63-990e-af2ec5c439c8>

### PARETO Training Workshop: Optimized Decision-Making for Produced Water Networks

Travis Arnold, NETL support contractor; Elmira Shamlou, NETL support contractor; Philip Tominac, NETL support contractor; Miguel Zamarripa, NETL support contractor; Markus Drouven, NETL; Sangbum Lee, NETL. (SEPTEMBER 2024)

► <https://netl.doe.gov/energy-analysis/details?id=37f0097f-d823-4780-a69d-dafb00acd730>

# 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:

**Thomas J. Feeley, III**

Research Partnerships & Tech Transfer

[Thomas.Feeley@netl.doe.gov](mailto:Thomas.Feeley@netl.doe.gov)

412-386-6134

## Contact Us

To subscribe to the Water-Energy Nexus Newsletter, please click [here](#).

The National Energy Technology Laboratory, part of the U.S. Department of Energy national laboratory system, is owned and operated by the DOE. NETL supports the DOE mission to advance the energy security of the United States.

1450 Queen Avenue SW  
**Albany, OR** 97321-2198  
541-967-5892

3610 Collins Ferry Road  
P.O. Box 880  
**Morgantown, WV** 26507-0880  
304-285-4764

626 Cochran Mill Road  
P.O. Box 10940  
**Pittsburgh, PA** 15236-0940  
412-386-4687

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

**CUSTOMER SERVICE:** 1-800-553-7681

[www.netl.doe.gov](http://www.netl.doe.gov)

## Get Social with Us

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



U.S. DEPARTMENT  
of ENERGY



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

### Disclaimer

This project was funded by the United States Department of Energy, National Energy Technology Laboratory, in part, through a site support contract. Neither the United States Government nor any agency thereof, nor any of their employees, nor the support contractor, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.