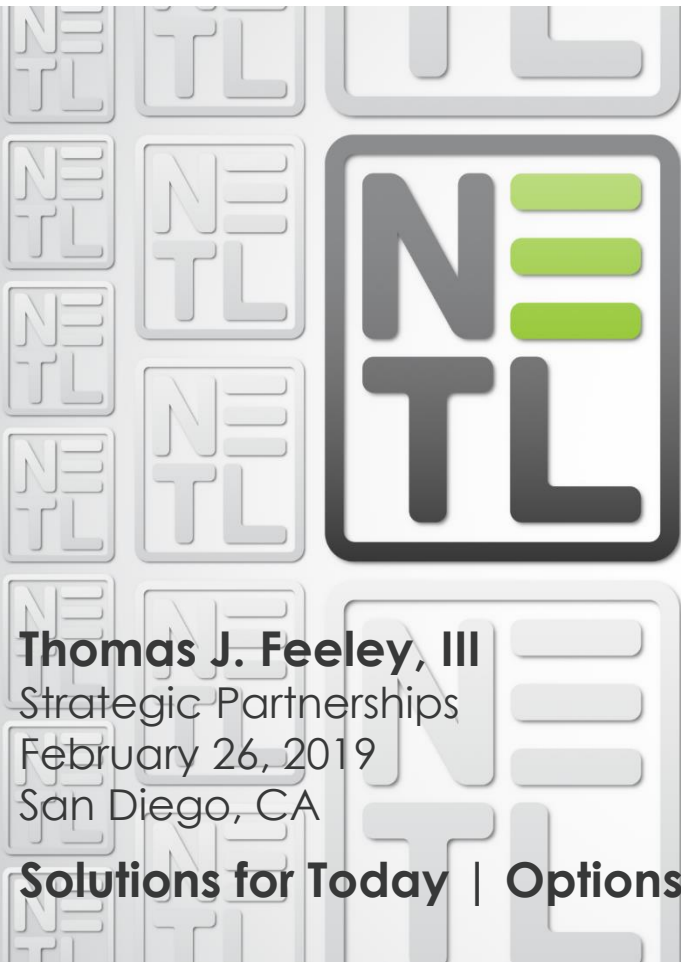


EUEC 2019

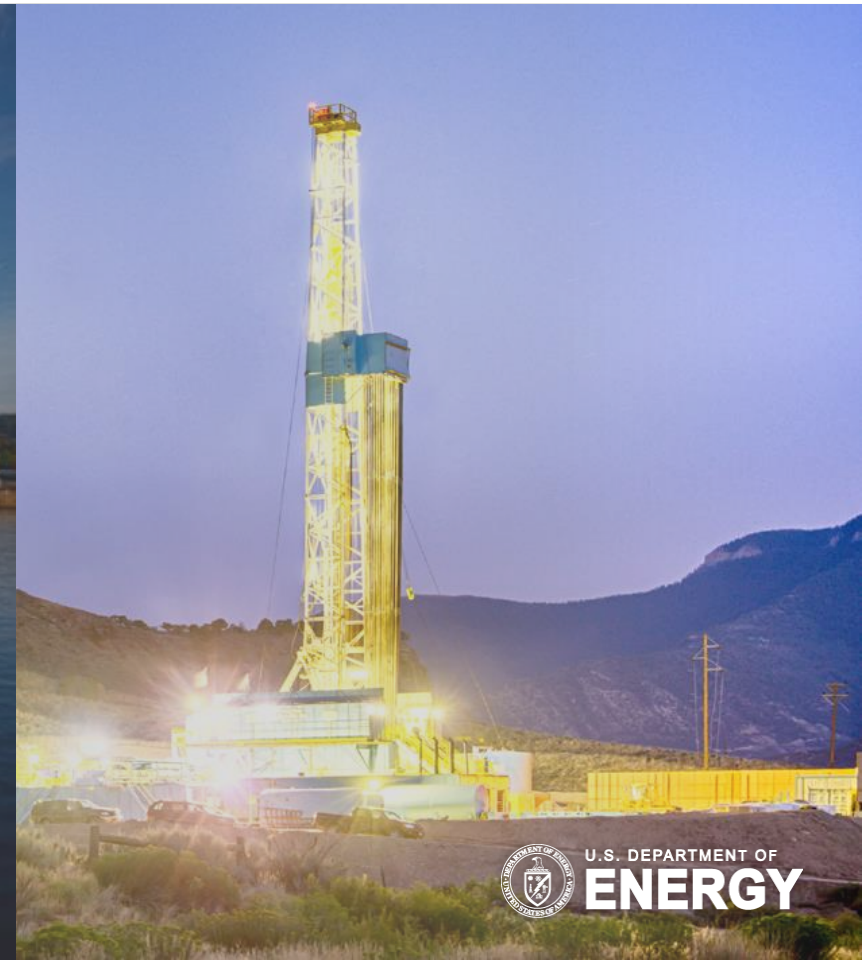


The Water-Energy Nexus: Partnering with the National Energy Technology Laboratory



Thomas J. Feeley, III
Strategic Partnerships
February 26, 2019
San Diego, CA

Solutions for Today | Options for Tomorrow



Mission

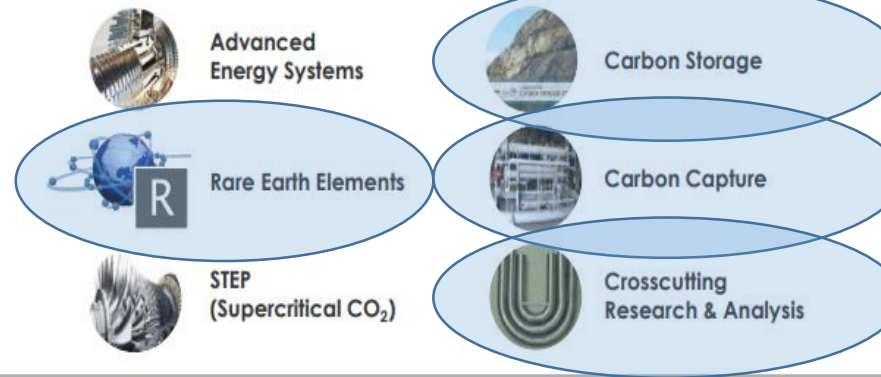
Discover, integrate, and mature technology solutions to enhance the Nation's energy foundation and protect the environment for future generations



INTEGRATED OIL & GAS PROGRAM



INTEGRATED COAL RESEARCH PROGRAM



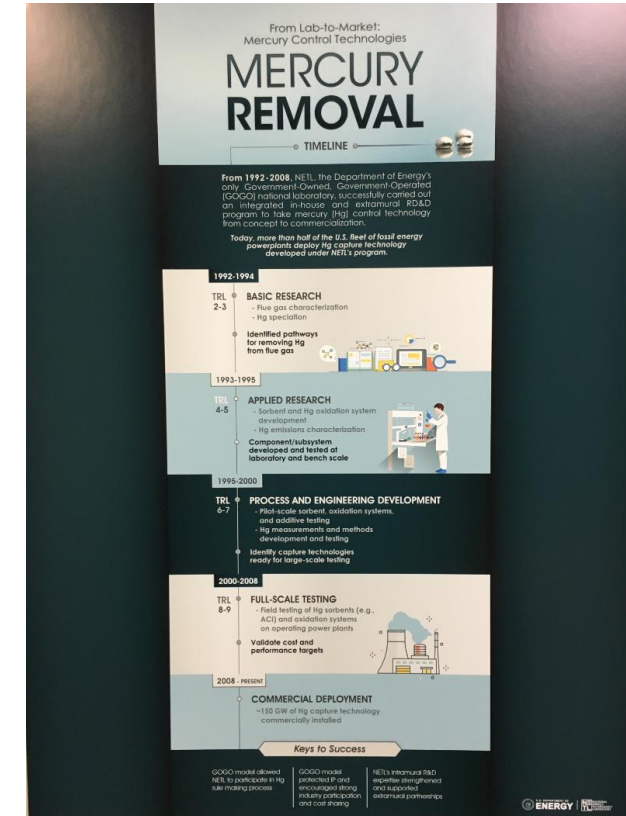
OFFICE OF ELECTRICITY DELIVERY & ENERGY RELIABILITY*



EERE VEHICLE TECHNOLOGIES PROGRAM*



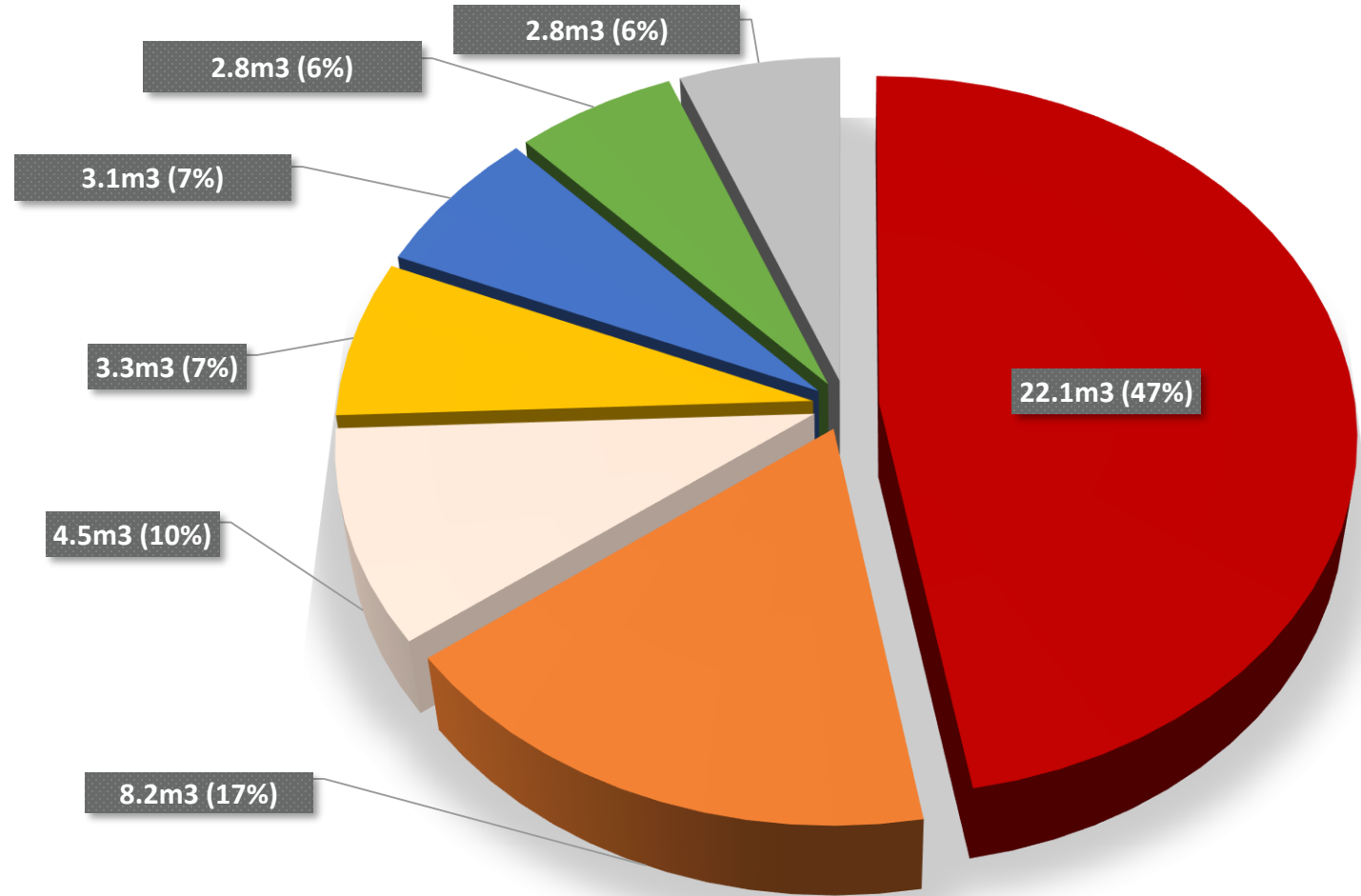
*NETL also conducts some intramural R&D efforts for this program office.



NETL led efforts to bring Hg control technology from concept to commercialization

World Fresh Water Resources (Trillion m³)

~2.5% of world's water is fresh, with ~70% tied up in ice caps



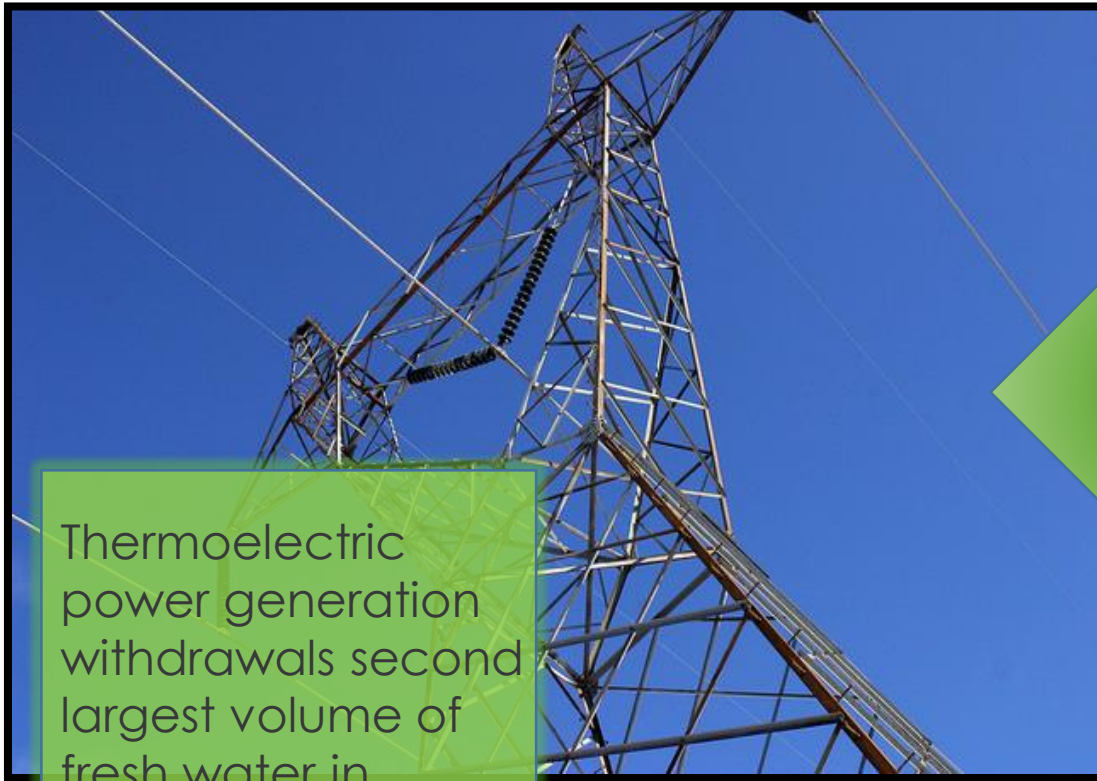
- China, 2.8 trillion m³
 - ~2,000 m³ per capita
- U.S., 3.1 trillion m³
 - ~7,750 m³ per capita

m³ = 264 gallons

Other Countries Brazil Russia Canada USA Indonesia China

Water and Energy - Inextricably Linked

Food is also a critical component of water nexus.



Thermoelectric power generation withdrawals second largest volume of fresh water in United States*.



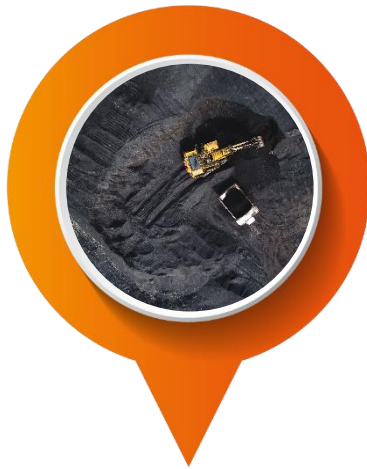
~80% of water cost is for energy to treat, process, and pump water

*Only small fraction of water used by powerplants is consumed.

Water Needed Throughout Fossil Resource Lifecycle

NETL Conducting Water-Related R&D Across Several Stages of Fossil Resource Development & Utilization

EXTRACTION



- Mining
- Drilling
- REE Recovery

PROCESSING



- Coal Cleaning
- Fuel Upgrading
- REE Recovery

TRANSPORT



- Barge
- Slurry

UTILIZATION



- Cooling
- Make-up Water

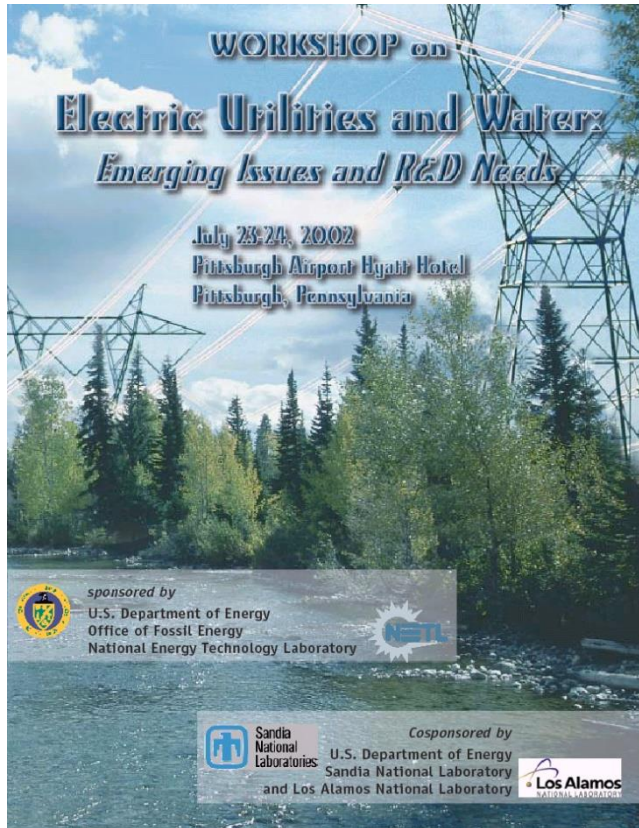
EMISSION CONTROL/BYPRODUCTS



- Wet Scrubbing
- CO₂ Capture/Storage
- Waste Disposal
- REE Recovery

NETL's Integrated Water-Energy R&D

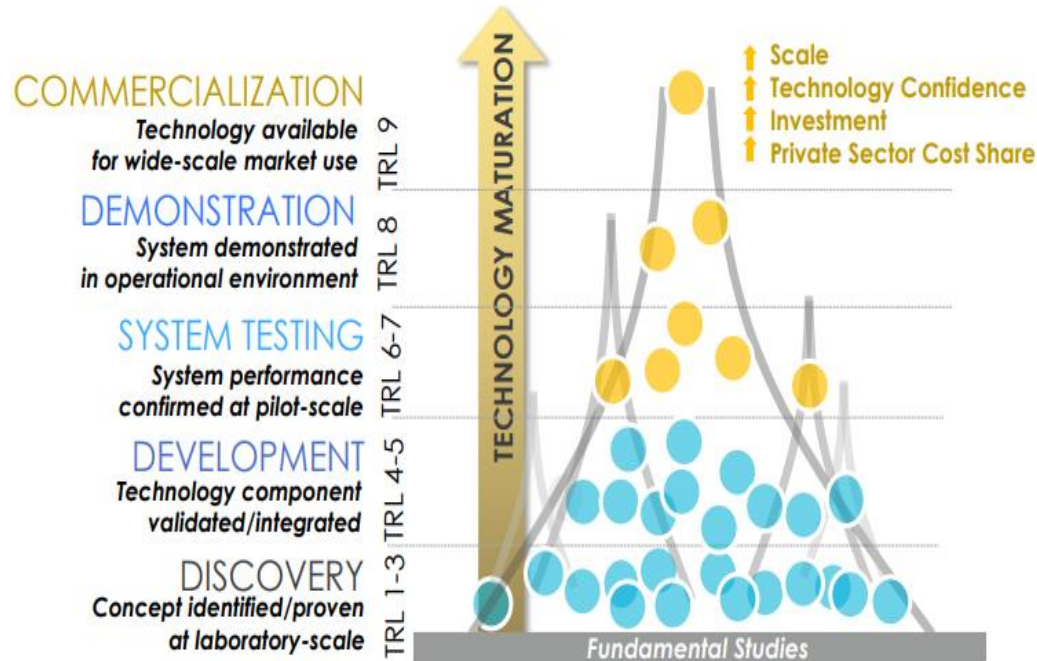
Program started in early 2000s as part of NETL's Innovations for Existing Plants Program



NETL's 1st Water-Energy Workshop

- In 2002, NETL sponsored its 1st workshop focused on emerging water issues and research needs associated with thermoelectric power generation
- Research focused initially on water availability and quality issues affecting the existing fleet of coal-fired power plants
- R&D expanded to include water issues encompassing NETL's carbon capture & storage, unconventional oil & gas development, rare earths, and related fossil energy programs

Water Research & Innovation at NETL



Water research conducted from discovery through demonstration.

NETL has established a robust portfolio of both intramural (in-house) and extramural water-related research projects and initiatives across the following areas:

- **Advanced cooling technology**
 - Wet, dry, and hybrid cooling
- **Non-traditional water recovery & use**
 - Recovery and reuse of mine water, produced/flowback water, powerplant wastewater
- **Water treatment and detection technology**
 - Desalination, advanced sensors, novel sorbents
- **Decision science and modeling**
 - Modeling, analysis, and decision-making tools

Recent Energy-Water Legislation

Energy and Water Research Integration Act of 2019

H.R. Bill 34, introduced in 116th Congress, tasks DOE with creating strategic plan that integrates water considerations in energy research, development, and demonstration programs and projects by —

- Advancing energy efficiency technologies that meet objectives of:
 - 1) Minimizing freshwater withdrawal and consumption
 - 2) Increasing water use efficiency
 - 3) Utilizing nontraditional water sources with efforts to improve quality of water from those sources



NETL's Water-Energy Research



NETL and its partners have developed a number of advanced tools and technologies applicable to the recovery, treatment, and reuse of water for fossil energy production and power generation.

\$100 MILLION+

NETL's active water-energy research portfolio

32

Active projects in water-energy research

INDUSTRY PARTNERSHIPS



ACADEMIA PARTNERSHIPS



NATIONAL LAB PARTNERSHIPS



Current Water-Energy Project Examples

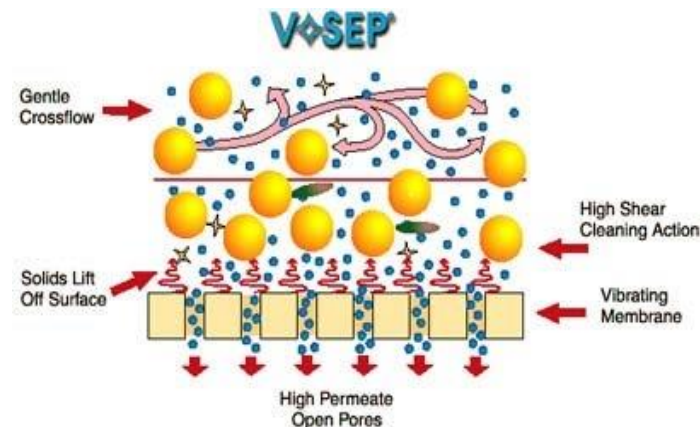
Development and Field Testing Novel Natural Gas Surface Process Equipment for Replacement of Water as Primary Hydraulic Fracturing Fluid

Southwest Research Institute to develop, validate, and demonstrate affordable non-water-based and non CO₂-based stimulation technologies, which can be used instead of, or in tandem with, water-based hydraulic fracturing fluids to reduce water usage and the volume of flowback fluids.



Treatment of Produced Water from Carbon Sequestration Sites for Water Reuse, Mineral Recovery, and Carbon Utilization

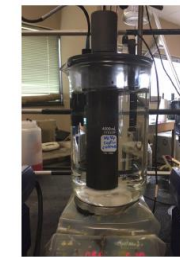
Southern Research Institute developed technology to treat produced waters with large total dissolved liquids that could not normally be treated using traditional membrane processes in an environmentally sustainable manner.



Intensified Flue Gas Desulfurization (FGD) Water Treatment for Reuse, Solidification, and Discharge

In flue gas, toxic species with higher oxidation states are substantially formed in FGD wastewater. University of **Kentucky and Duke Energy** will examine the effectiveness of electrocoagulation with air-based flotation for removing regulated species from FGD.

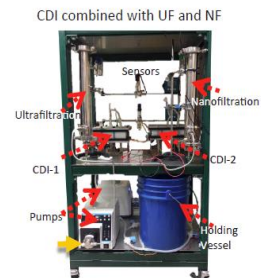
UKy-CAER Separation Modules



Iron-based
Electrocoagulation



In-house developed
zeolite membrane



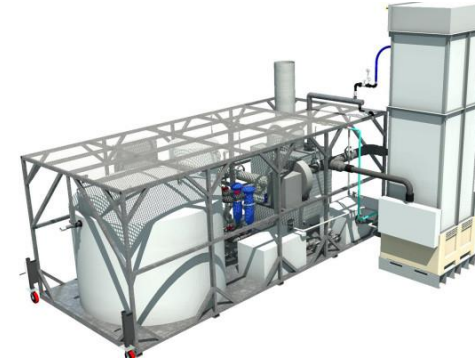
Continuous operation
using CDI, UF, and NF

NETL's Water-Energy Successes

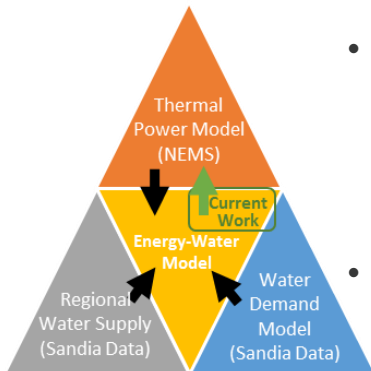
NETL-Sponsored Projects



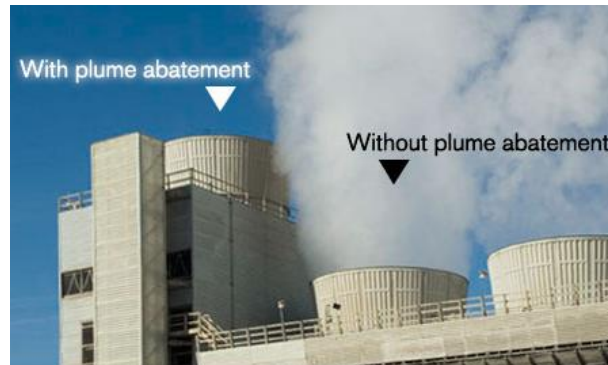
- **HydroFlex** provides power companies with new option for treatment of coal ash slurries and effluents from CCR containment ponds.
- Significantly reduces sulfates and other contaminants left behind by lime pretreatment while also reducing calcium concentrations and overall hardness of lime-treated water



- **AltelaRain®** is a patented modular water distillation/decontamination system that treats highly challenging fluids.
- AltelaRain® has been effectively treating complex waste fluids for the past decade.



- NETL developed novel **National Energy-Water Model prototype** for EIA's National Energy Modeling System (NEMS)
- Model allows for forecasting water needs for power generation under various demand and supply scenarios



- The **SPX ClearSky Plume-Abatement System** a novel approach to the reduction of cooling tower plumes
- Technology achieved nearly 20% water recovery during field testing at San Yuan Generating Station
- SPX Cooling Technologies has more than 80 plume-abatement installations worldwide,

The TOOLBOX

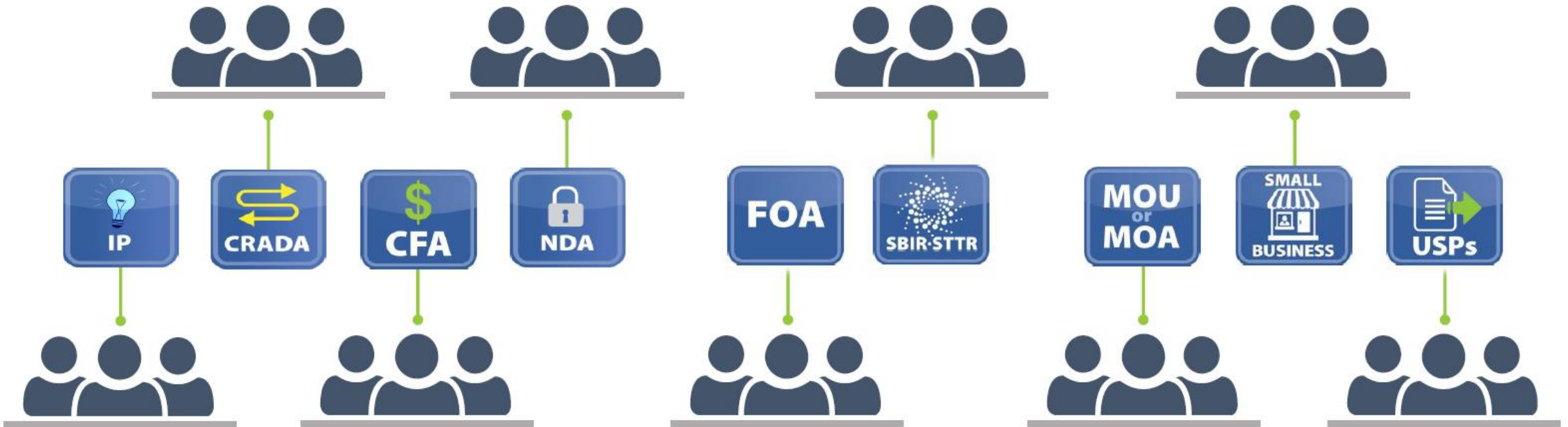
How to Work with NETL



IP – Intellectual Property
CRADA – Cooperative Research & Development Agreement
CFA – Contributed Funds Agreement
NDA – Non-Disclosure Agreement



FOA – Financial Opportunity Announcement
MOU/MOA – Memorandum of Understanding/Agreement
USP – Unsolicited Proposals



NETL Business Page



<https://www.netl.doe.gov/business/solicitations>



About ▾ Research ▾ Programs ▾ Business ▾ Education ▾ Library ▾ News and Events ▾

Solicitations and Funding Opportunities

NETL uses [Fedconnect](#), [EERE Exchange](#), [Grants.gov](#), and [FedBizOpps](#) to post solicitations and funding opportunity announcements and amendments, receive proposals and applications, and disseminate award information. Entities wishing to participate in these solicitations will need to register at these websites. Proposals will be accepted only through FedConnect or Grants.Gov as indicated in the solicitation document.

[Accessing Solicitations/Funding Opportunity Announcements in FedConnect](#)

NETL solicitations and funding opportunities are listed below by program area, in descending order of posting date.

Fossil Energy

Posted Date ▾	Solicitation/Funding Opportunity Announcement Number	Title	Closing Date	DOE Contact
2019-01-18	Request for Information	Versatile modular gasification technology for competitive markets	2019-02-08	Amanda Lopez
2019-01-11	DE-FOA-0002058	Notice of Intent to Issue Funding Opportunity Announcement No. DE-FOA-0002058	2019-02-28	Nicholas Anderson
2018-12-21	DE-FOA-0001993	University Turbine Systems Research (UTSR)	2019-03-04	Chuck Tomasiak
2018-12-21	DE-FOA-0001990	Advanced Technologies for Recovery of Unconventional Oil and Gas Resources	2019-02-25	Maureen Davison
2018-12-21	DE-FOA-0001989	Improving Efficiency, Reliability, and Flexibility of Existing Coal-Based Power Plants	2019-02-28	Jodi Collins

NETL uses Fedconnect, Grants.gov, and FedBizOpps to post funding announcements.

Recent Funding Opportunities

Energy-Water Desalination Hub

Establish an Energy Innovation Hub in Energy-Water Desalination to accelerate transformational advances in science and engineering focused on reducing the energy and cost requirements of desalination to provide clean and safe water

2/7/19 – Concept Papers Due

5/7/19 – Full Applications Due



University Training and Research for Fossil Energy Applications

Advanced technologies to treat cooling tower blowdown water resulting in: 1) a stream that is reusable as plant makeup water (for the cooling tower or other process water needs) and 2) concentrated salts/brine.

2/25/19 – Applications Due



Crosscutting Research for Coal-Fueled Power Plants

Develop technologies to enhance performance and economics of existing and future coal fleet including advanced cooling technologies.

12/4/18 – Notice of Intent Issued

FOA Issued 1st Q of 2019



Water Security Grand Challenge

Announced by White House 10/25/2018, and Led by DOE

Coordinated suite of prizes, competitions, early-stage R&D funding opportunities, critical partnerships, and other programs by 2030 in order to:

- *Launch desalination technologies that deliver cost-competitive clean water*
- *Transform energy sector's produced water from waste to resource*
- *Achieve near-zero water impact for new thermoelectric power plants, and significantly lower freshwater use intensity within the existing fleet*
- Double resource recovery from municipal wastewater
- Develop small, modular energy-water systems for urban, rural, tribal, national security, and disaster response settings.



<https://www.energy.gov/eere/water-security-grand-challenge>

Chevron Partnership to Address Water Issues



FE and Chevron Technology Ventures (CTV) Tackle Produced Water

- Part of a Cooperative Agreement with DOE's Office of Fossil Energy; DOE to provide subject matter expertise
- CTV seeking technologies that can significantly decrease produced water management costs while reducing or eliminating waste streams.
- Supports DOE's Water Security Grand Challenge
- FE and CTV will continue to share technical expertise and related information, keep each other apprised of related efforts, and seek out other potential collaboration opportunities over time.



On February 14, 2019, Chevron and DOE announced three \$25K awards to:

- Mangrove Water Technologies
- Crystal Clearwater Resources
- Techverse, Inc.

NETL Strategic Partnerships Contacts



Thomas J. Feeley, III

Water-Energy Nexus

412-386-6134

Thomas.Feeley@netl.doe.gov

Mike Nowak

Work-for-Others

412-386-6020

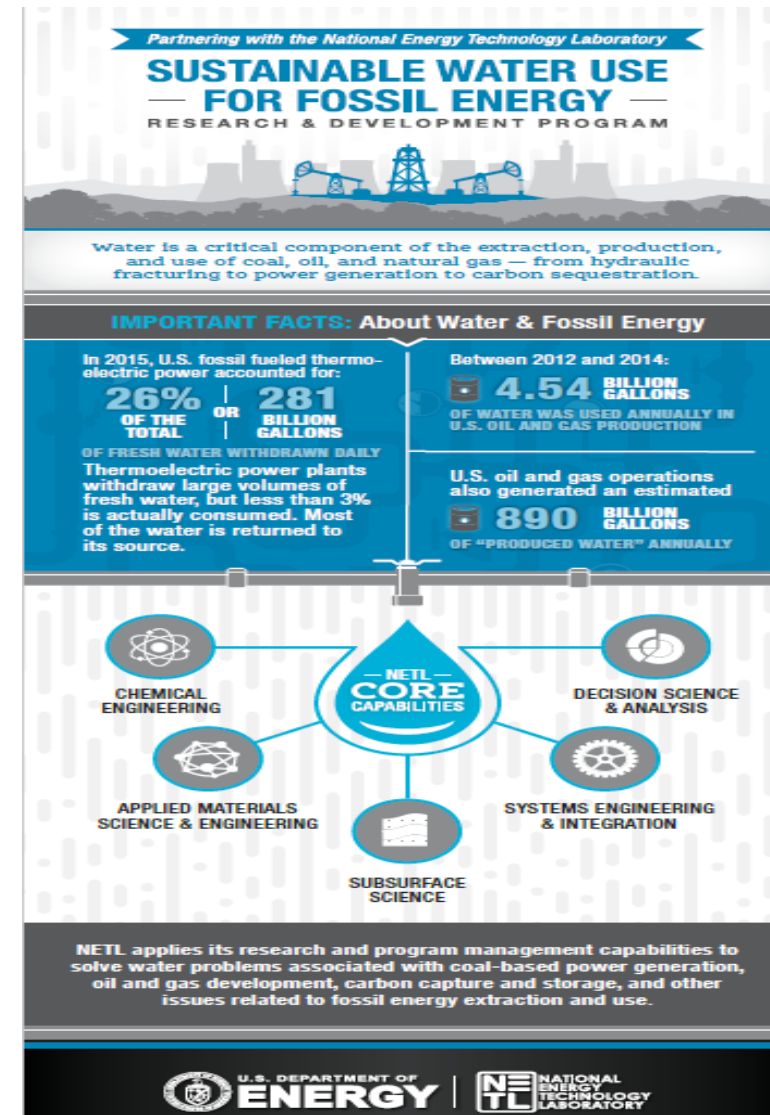
Michael.Nowak@netl.doe.gov

Jessica Lamp

Tech Transfer/Licenses/Agreements

412-386-7417

Jessica.Lamp@netl.doe.gov



QUESTIONS?

Get Social With Us At: www.NETL.DOE.gov



@NETL_DOE

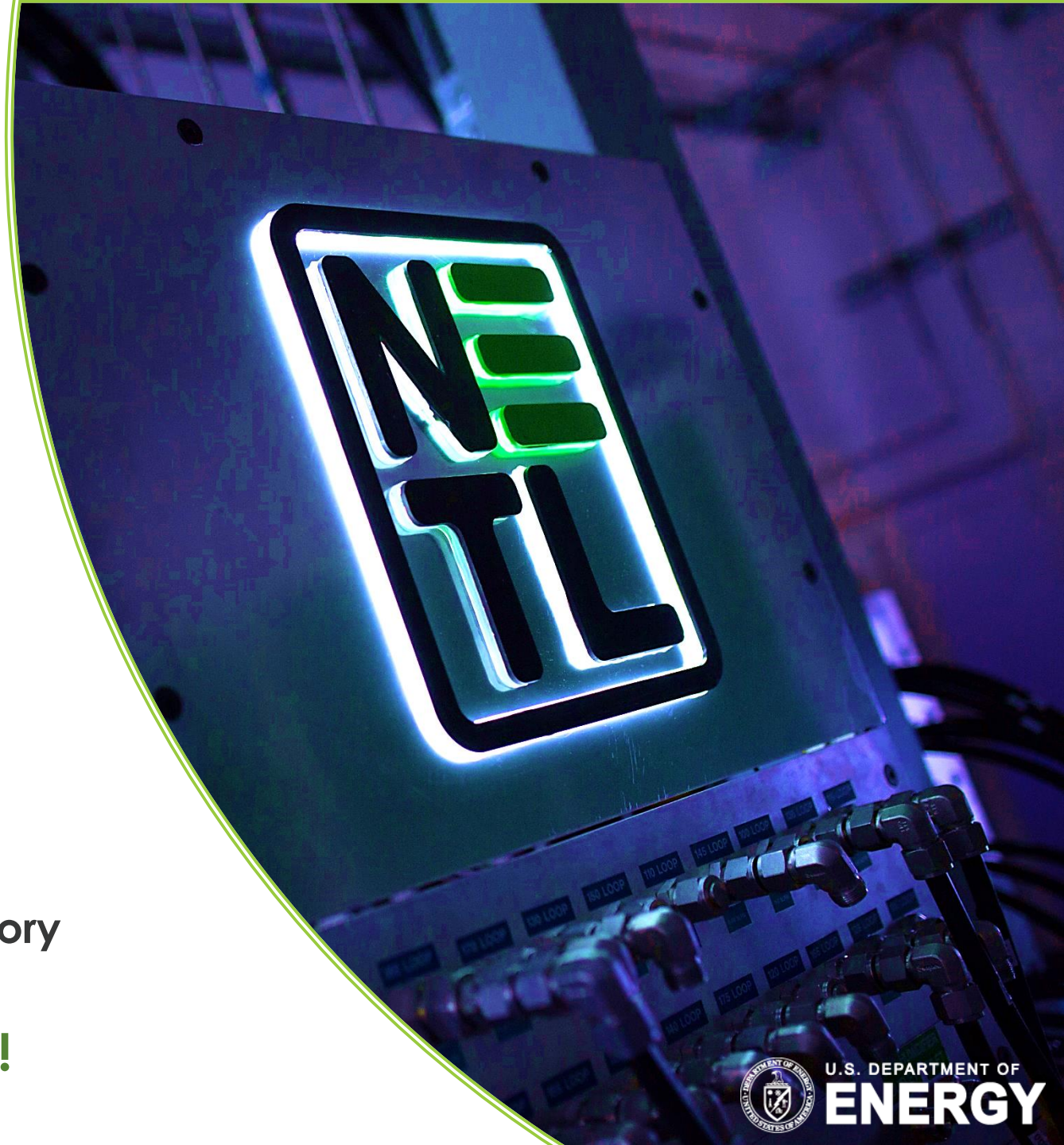


@NETL_DOE



@NationalEnergyTechnologyLaboratory

Visit the NETL exhibit booth, #577!



U.S. DEPARTMENT OF
ENERGY