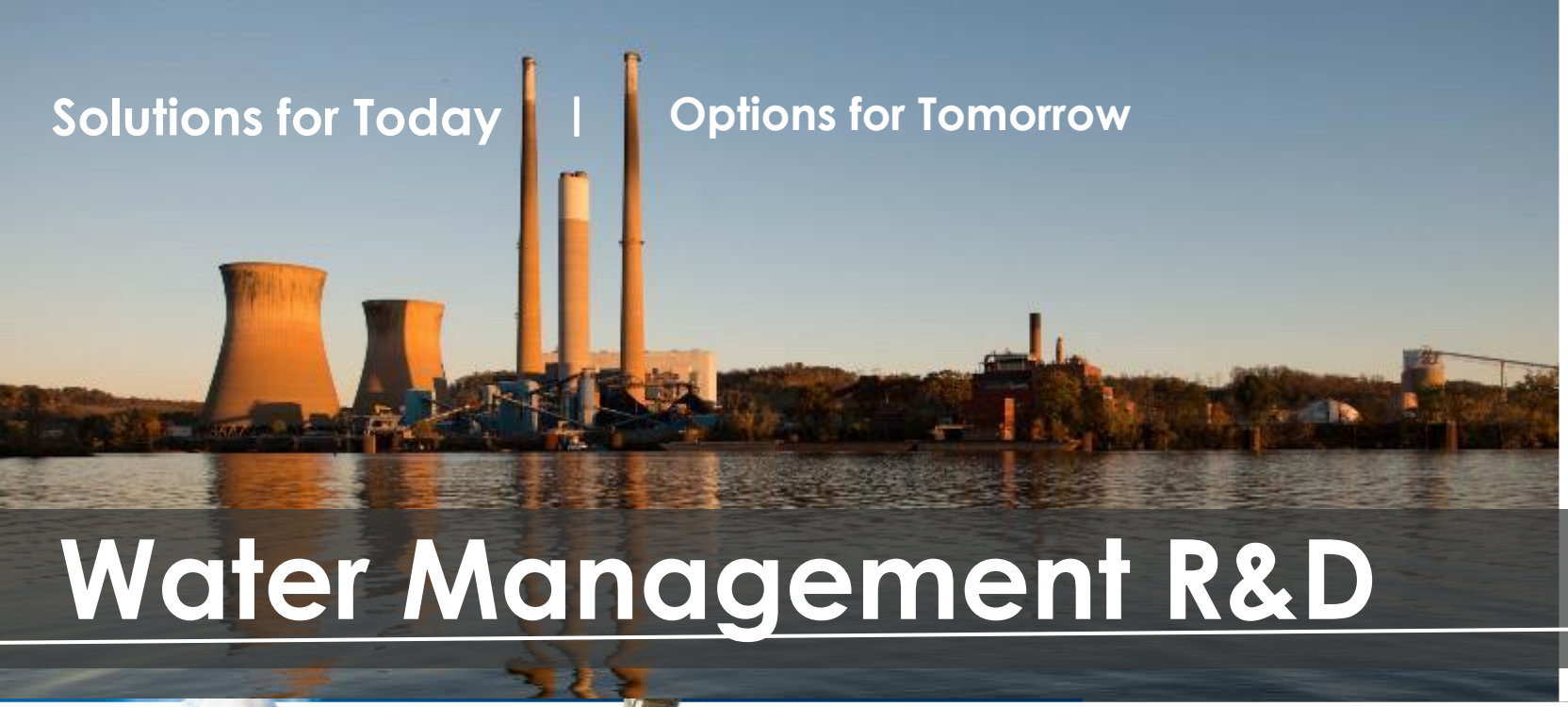


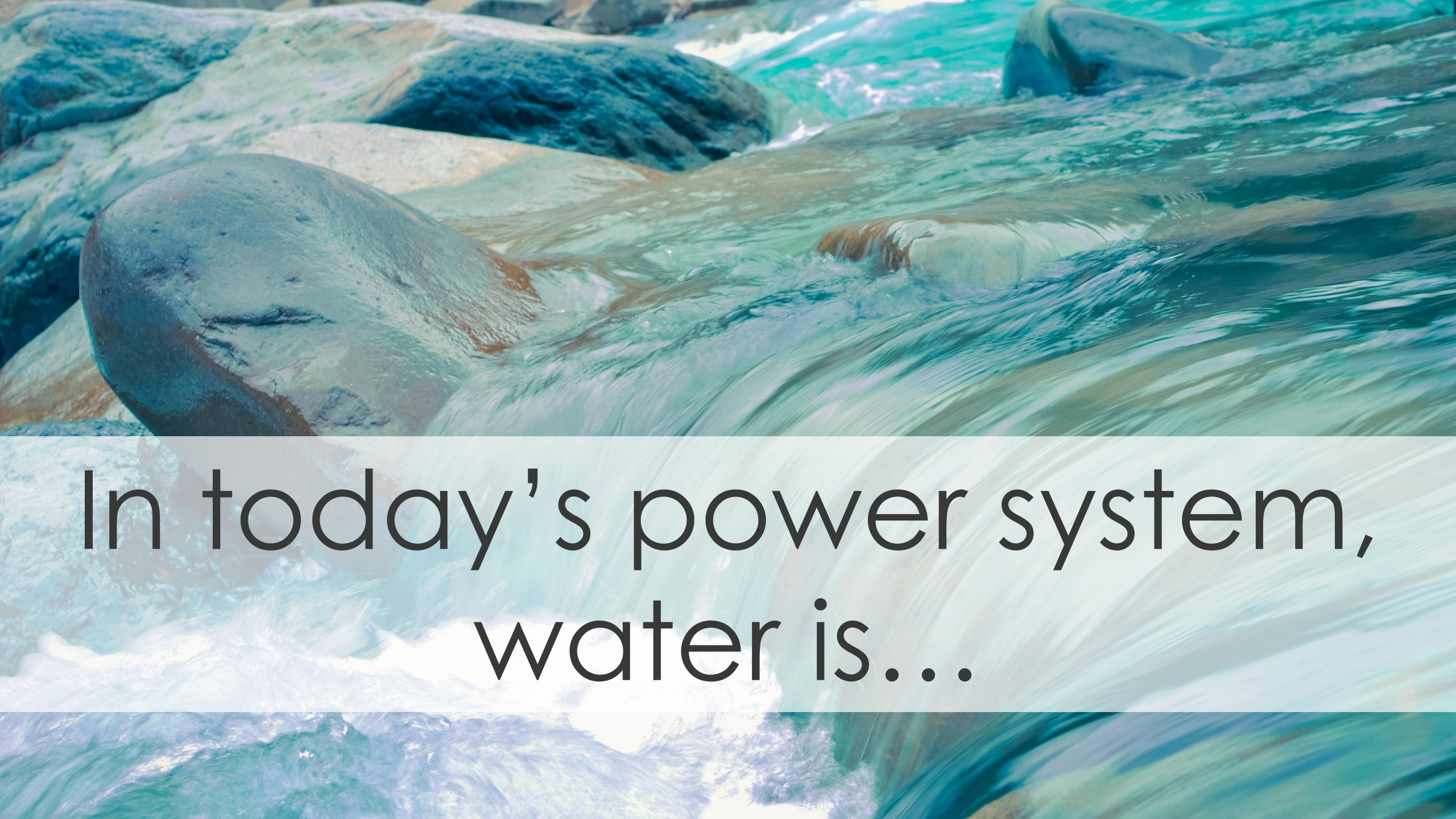
Solutions for Today | Options for Tomorrow

Water Management R&D

Annual Program Review Meeting

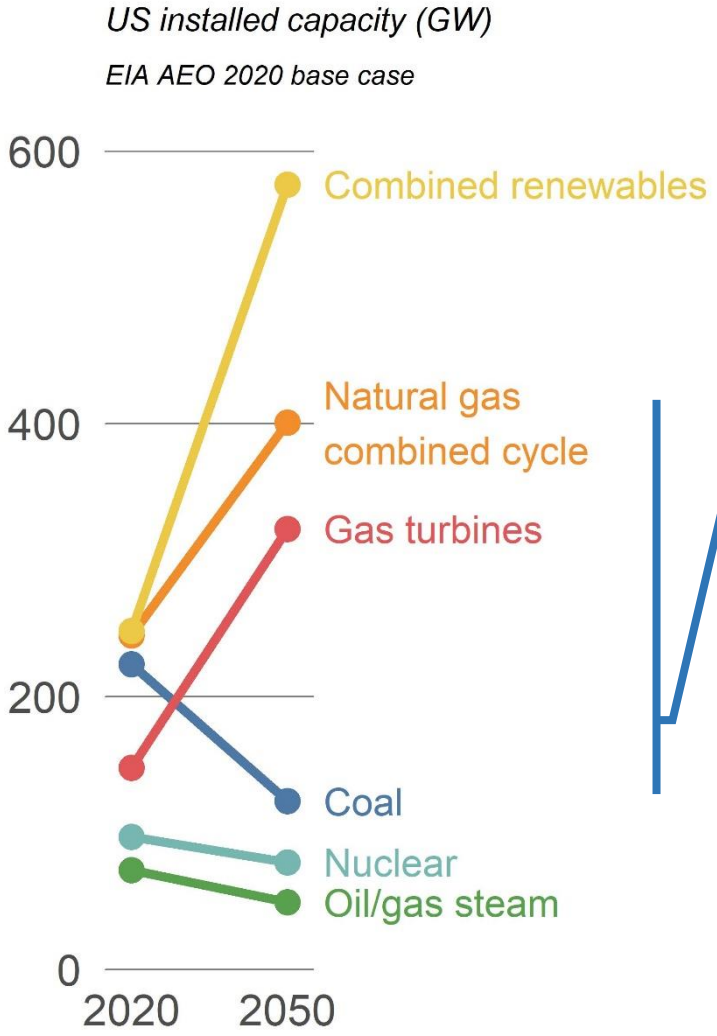
Briggs White | May 10, 2021

U.S. DEPARTMENT OF ENERGY



In today's power system, water is…

In competition with decarbonization



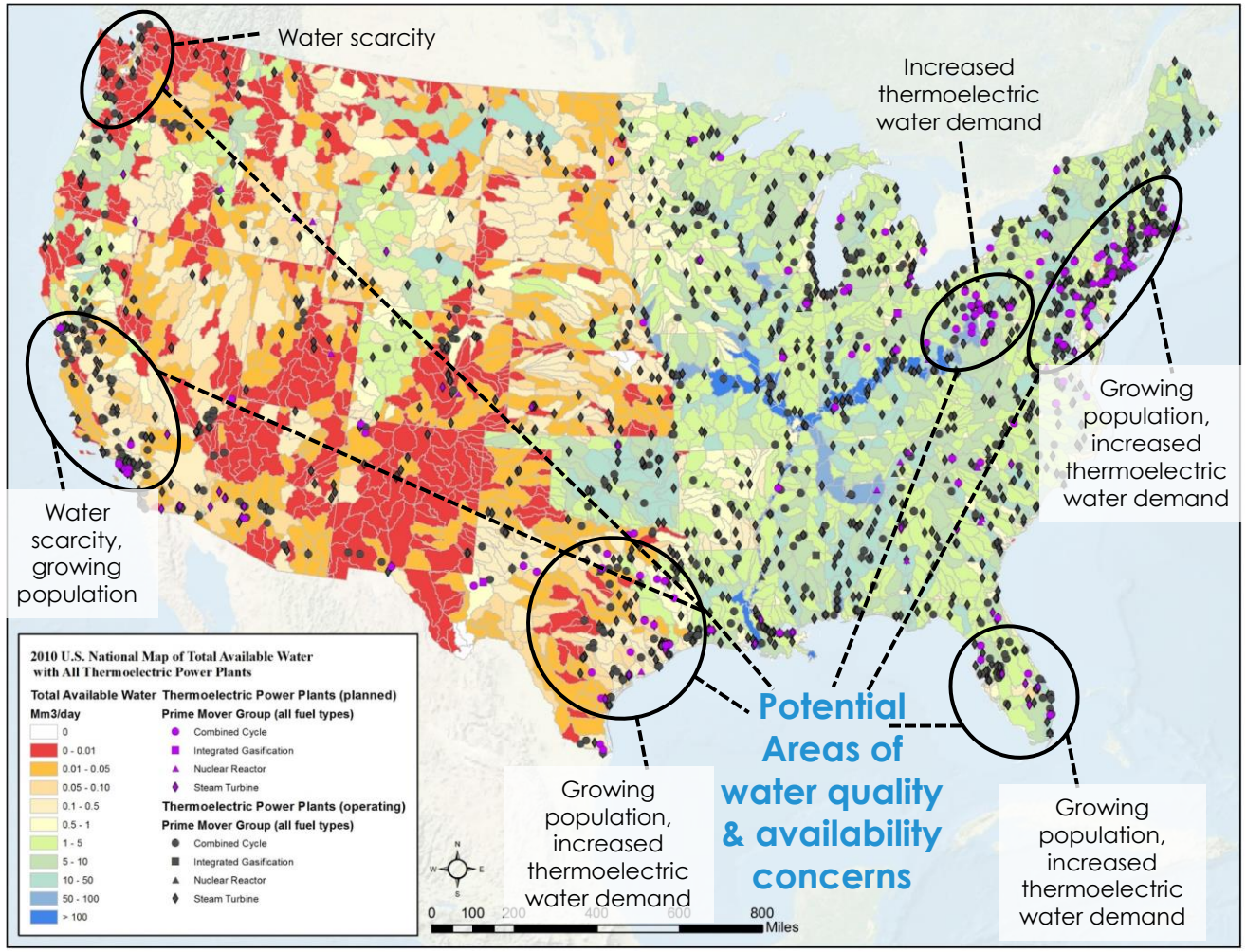
Adding CCS can increase water consumption by **50%**

+ a Global Trend Through 2050:

30% ↑ total water withdrawals

85% ↑ energy water usage

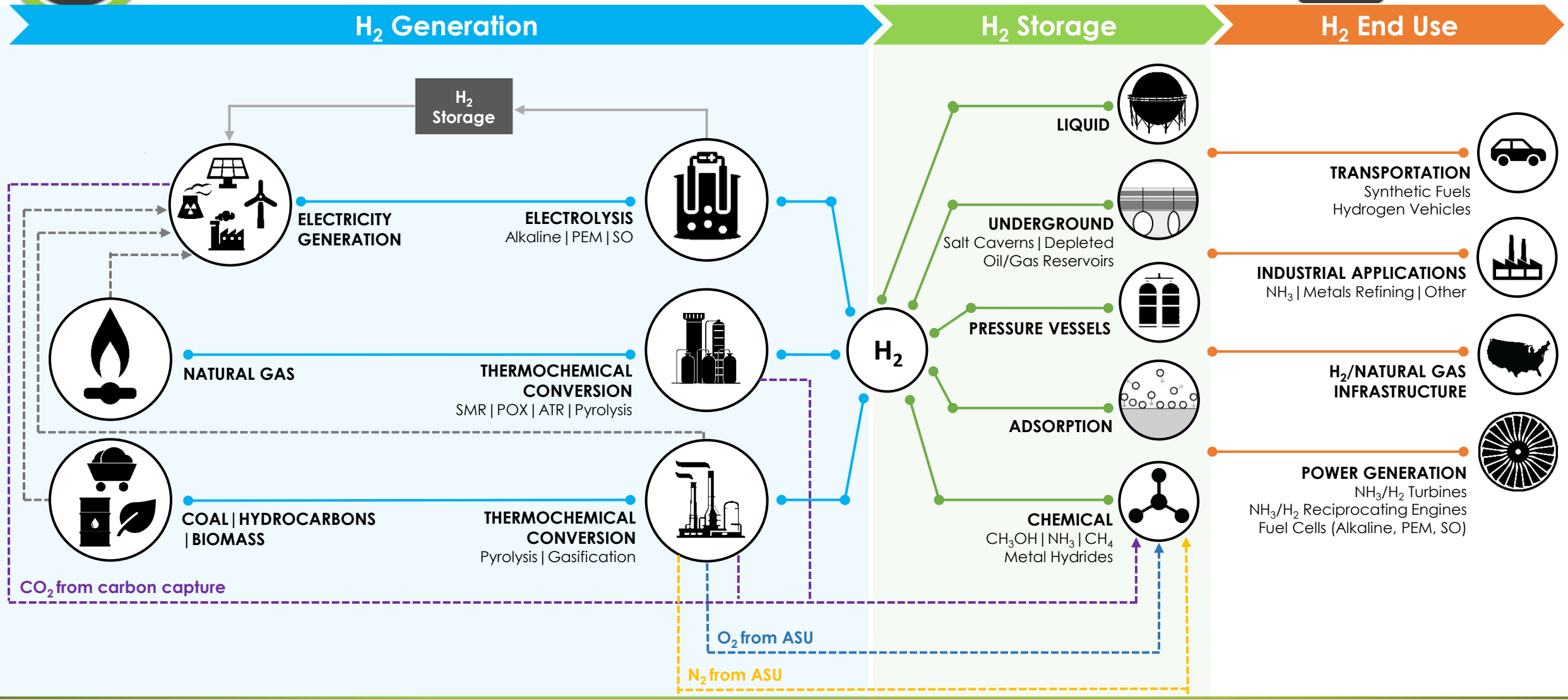
Highly regional in its challenges



- More effective water management needed to keep operating costs low as thermoelectric power grows
- Dry cooling technologies available for water-stressed regions

In today's power system, water is…

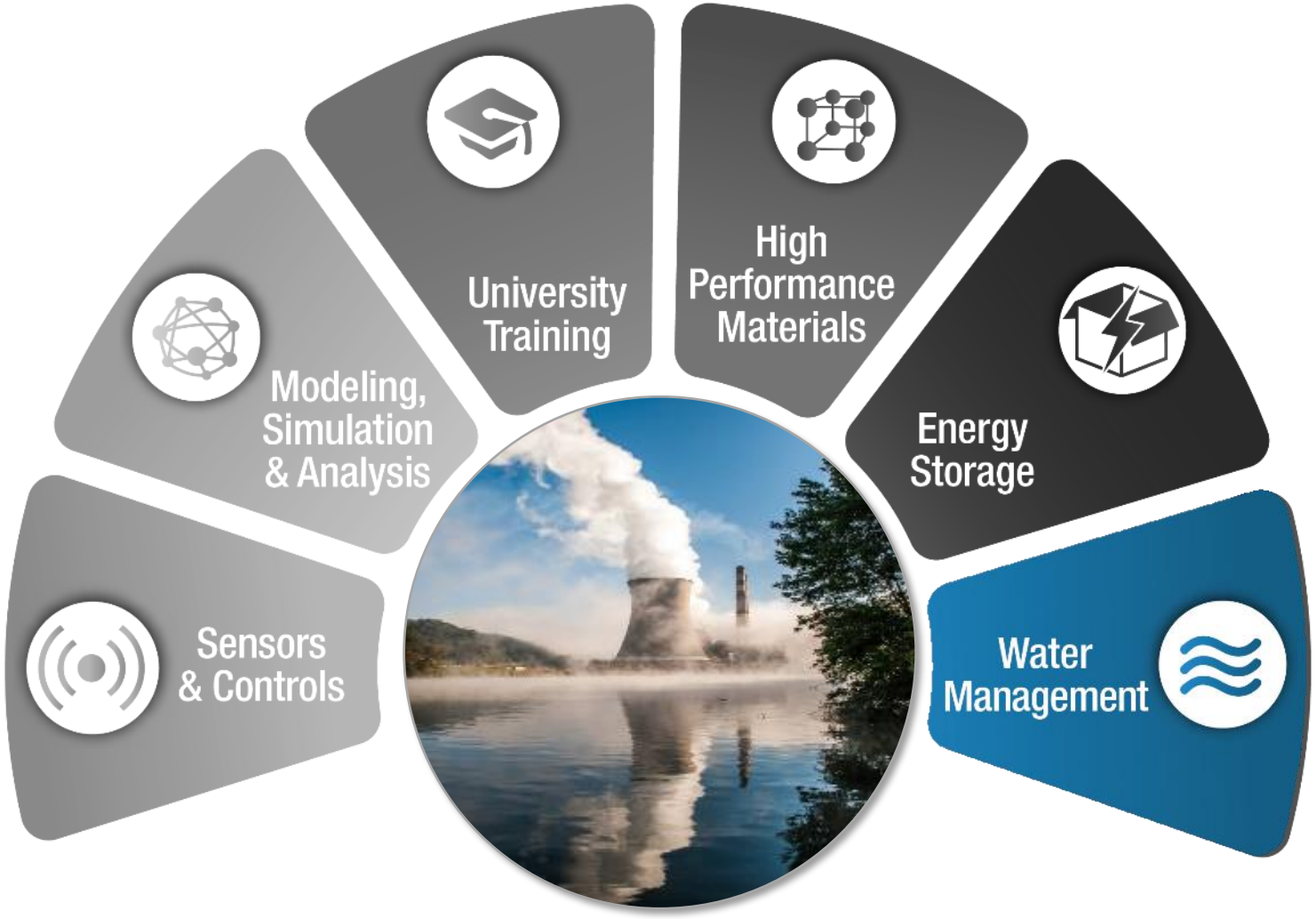
A platform for change



The NETL Crosscutting program is organized to…

The NETL crosscutting program is organized to…

Develop diverse solution



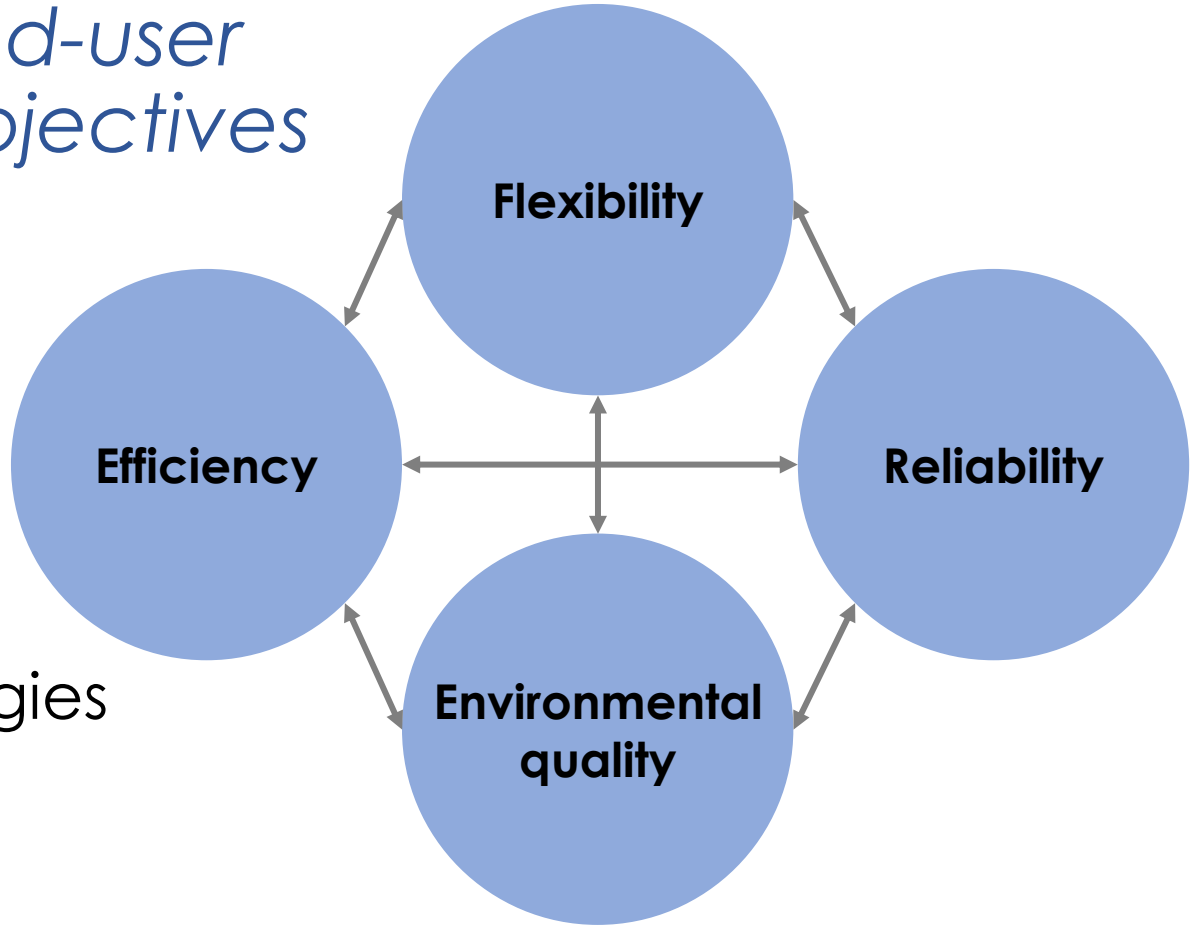
The NETL crosscutting program is organized to…

Meet disparate stakeholder needs

Mission

- Reduce freshwater use by advanced energy systems
- Minimize impacts of plant operations on water quality

End-user objectives



Outcomes

- Develop, scale, and deploy technologies
- Inform decision-makers
- Prioritize R&D for maximum impact
- Engage regional stakeholders

CROSSCUTTING TECHNOLOGY RESEARCH

The NETL crosscutting program is organized to…

Increase Flexibility and Decarbonize

NATIONAL ENERGY TECHNOLOGY LABORATORY

	Existing fleet	Next Gen.
SEGMENTS	Coal, Gas, O&G extraction, Carbon Storage	*Hydrogen*
NEEDS	Reliability, Efficiency, Flexibility, Decarbonization, Upkeep	Competitiveness
CHALLENGES	Management, Repair & Maintenance, Emissions, Water use, Cybersecurity, Workforce	RUL

SOLUTIONS

Water treatment

- Effluent
- Recycle
  - Charact.
  - Modeling
  - Physical
  - Chemical
  - Biological
  - Sensors

Cooling tower

- Dry cooling
- Novel
- Plume abatement

Condensers

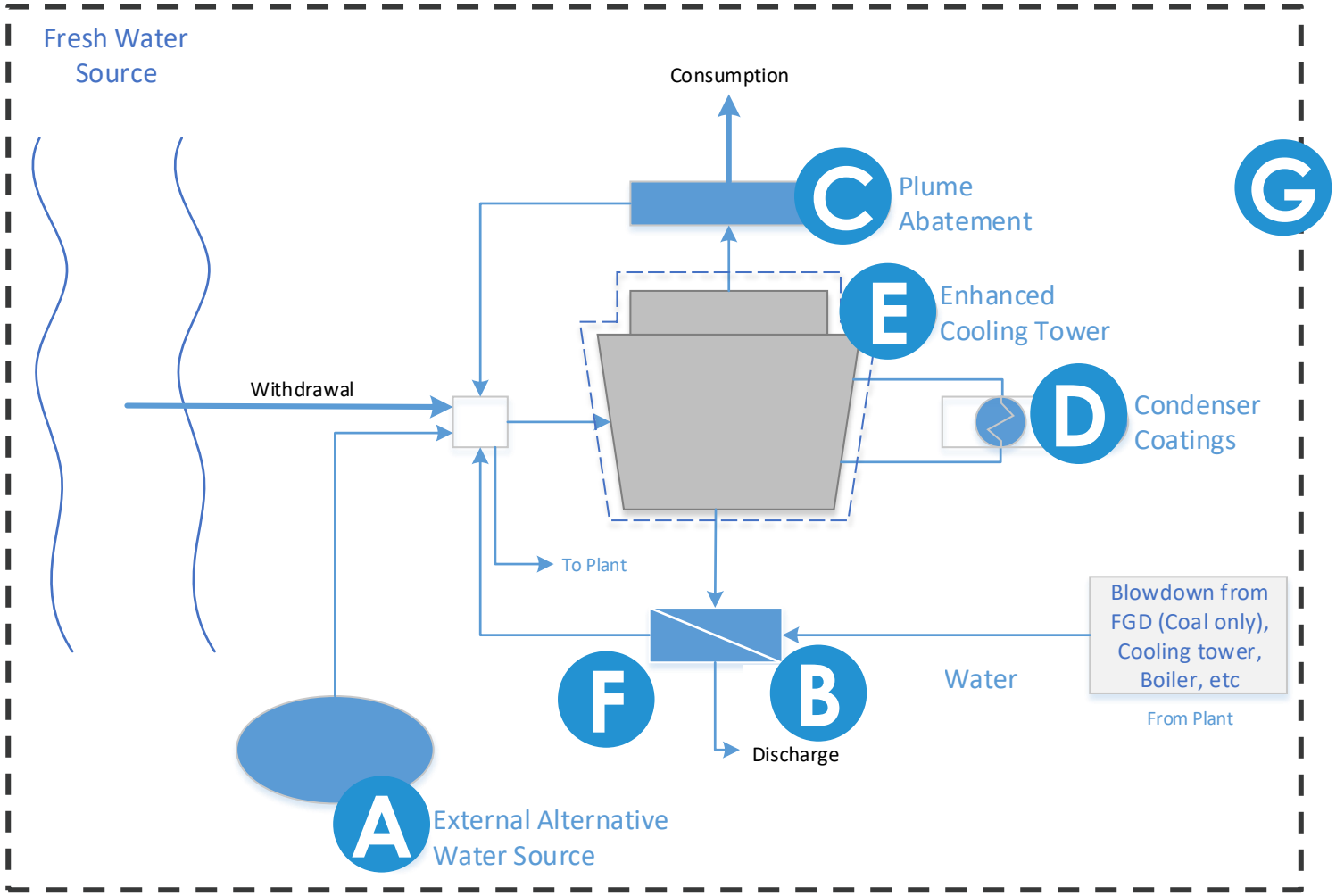
- Steam-side
- Water-side
  - Physical
  - Chemical

Systems analysis

- Policy
- Technology
- Scenario

The NETL crosscutting program is organized to…

Address broad challenges



A External sources

B Internal sources

C Plume abatement

D Condenser modifications

E Enhanced cooling towers

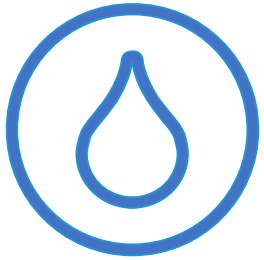
F Wastewater treatment

G Systems Analysis

The NETL crosscutting program is organized to…

Respond to regulations and the market

Regulatory Drivers on Quantity & Quality



Clean Water Act 816(b)

Effluent Limitation Guidelines

Performance Drivers

Waterside fouling and scaling

+ Steam-side corrosion

+ Steam-side air in-leakage

Higher fuel costs,

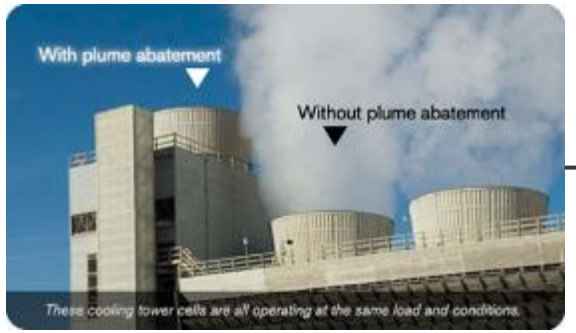
Expensive maintenance,

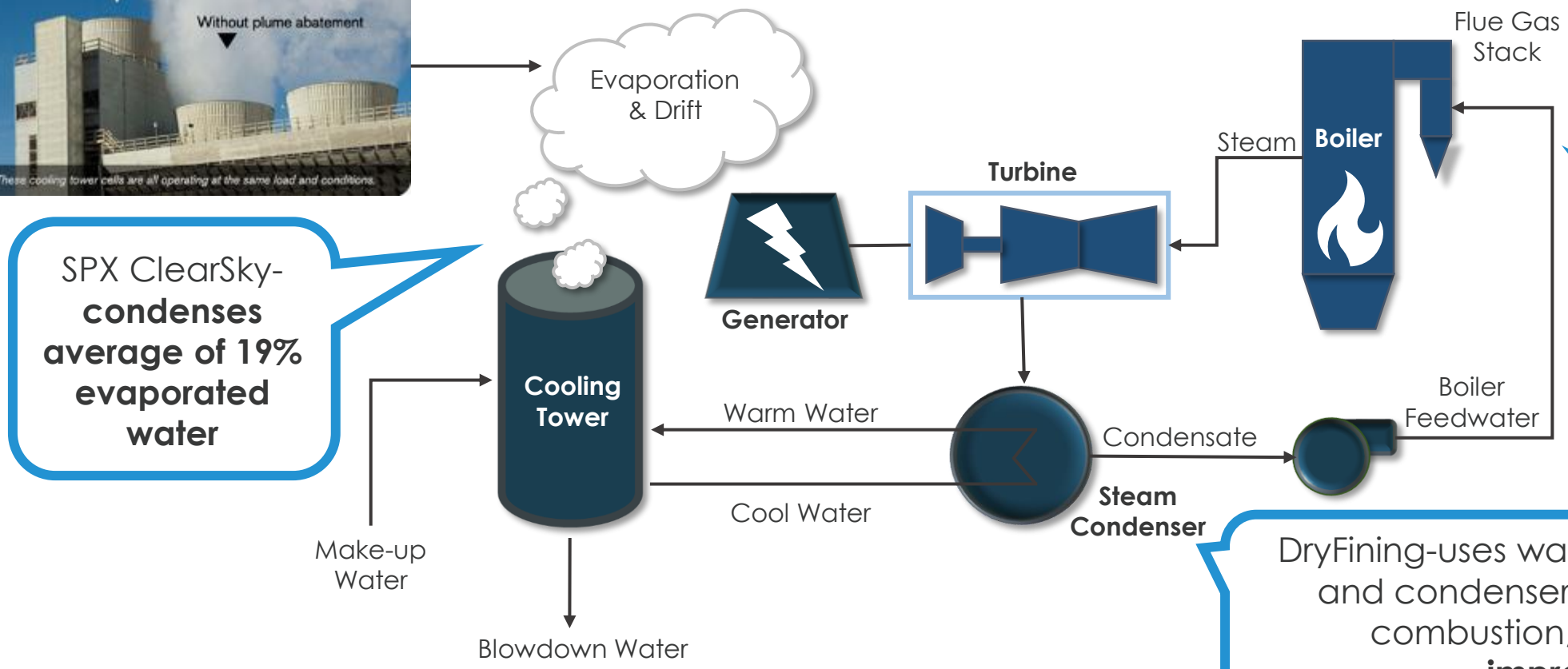
Plant shut downs

Our program impacts stakeholders with…

Our program impacts stakeholders with…

Commercial Successes





SPX ClearSky- **condenses average of 19% evaporated water**

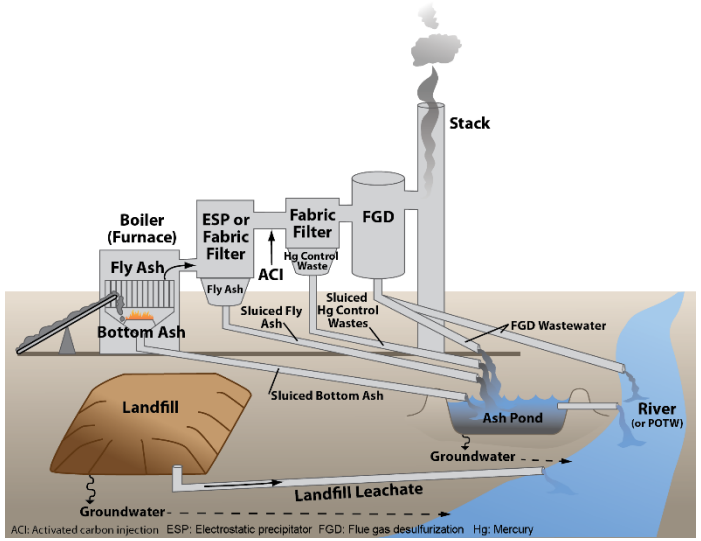
Spiritwood, Great River Energy, North Dakota, Combined Heat and Power for bio-refinery, **60% efficiency.**

DryFining-uses waste heat from flue gas and condenser to dry coal prior to combustion, **5.8% efficiency improvement**.

Our program impacts stakeholders with…

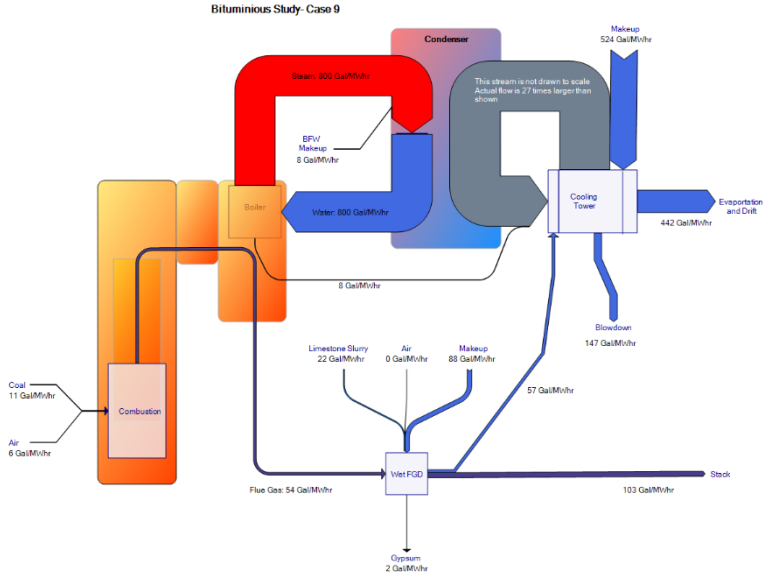
Operationally meaningful outcomes

Emissions Control



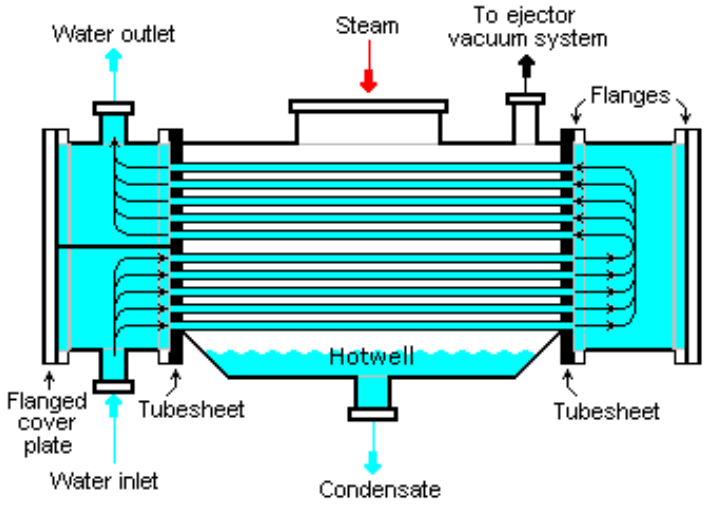
Technological preparedness with a focus on cost and flexibility.

Water Use Optimization



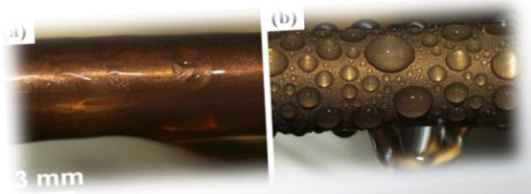
A heightened focus on sustainability requires improved management of withdrawals.

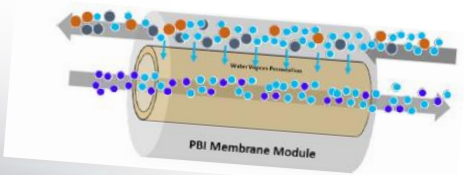
Performance Optimization



Improving total plant efficiency and optimizing in real time to flexible operations

Benefits to the environment

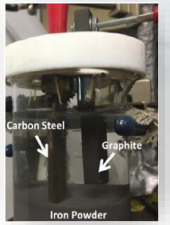




Combined Technologies Could Reduce Thermoelectric Water

Withdrawal by 603 BGY (1,653 MGD)

Consumption by 154 BGY (423 MGD)

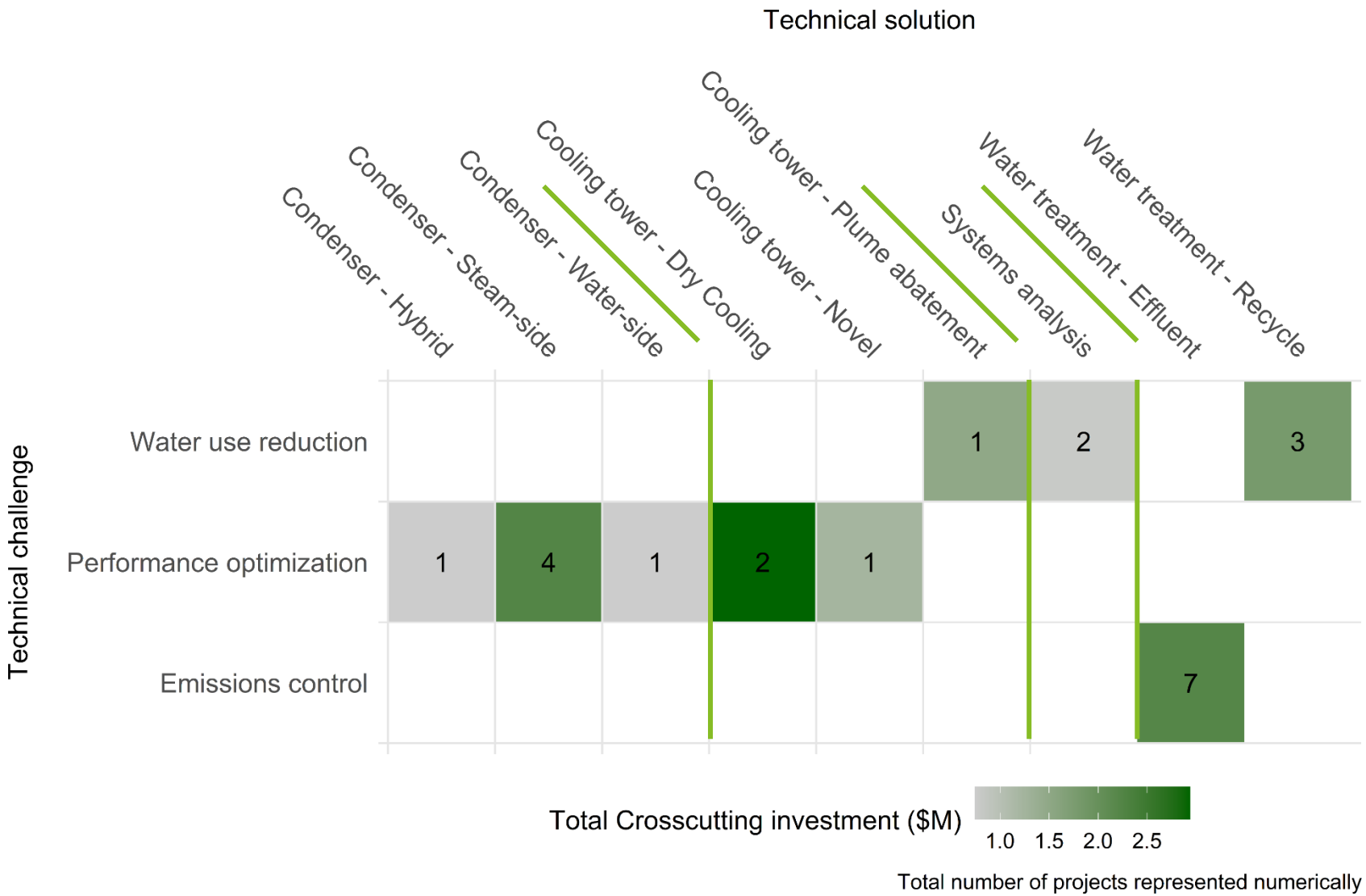


Based on a 50% market penetration and implementing 5 technologies

The current portfolio is…

The current portfolio is…

Balanced across challenges/solutions



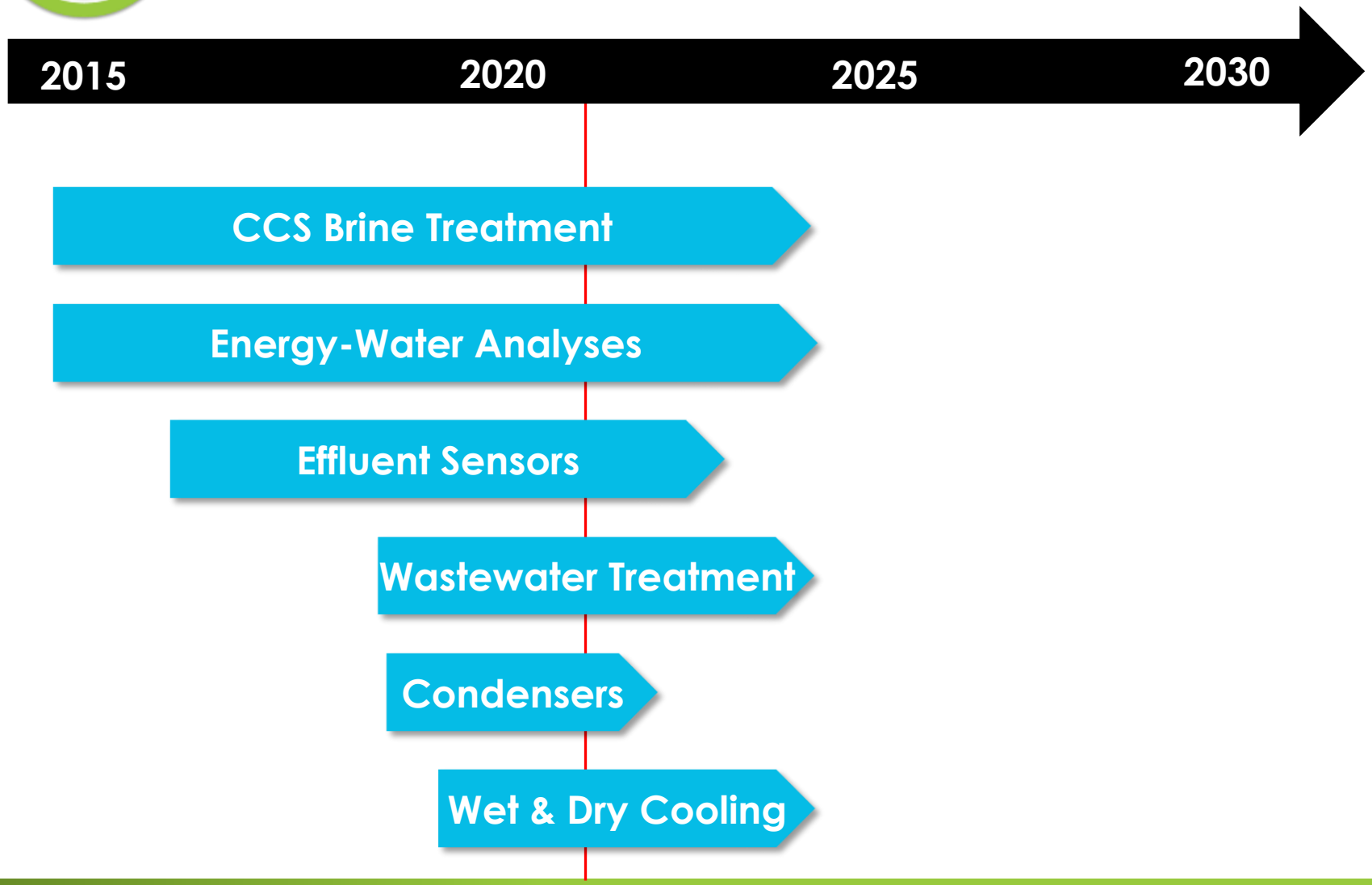
Σ

22 projects

$17.5M invested

The current portfolio is…

Driving towards near term impacts



- Minimize water use and effluent generation
- Enable flexible operation with reduced O&M
- Facilitate hydrogen, biomass, and CCS
- Increase plant efficiency

The current portfolio is…

Redefining the possible

INTERPHASE MATERIALS

Application of Heat Transfer Enhancement (HTE) System for Improved Efficiency of Power Plant Condensers

- **Demonstrated success from testing at full-scale** across HVAC chillers, industrial heat exchangers, engine cooling, and a power plant condenser
- Test data revealed the reduced heat rate can save an **~$190k in fuel costs and 12,800 less tons CO2 produced**

WestVirginiaUniversity

Produced Water and Waste Heat-Aided Blowdown Water Treatment: Using Chemical and Energy Synergisms for Value Creation

- Introducing Produced Water to Blowdown Water, without any chemical addition, and resulted in **100% Ba removal** at ratio BD:PW = 10:1
- An activated carbon filtration **unit showed >90% total organic carbon removal**

InfiniteCooling

Water Recovery from Cooling Tower Plumes

- **Designed and produced a hot wire sensor** capable of measuring the liquid water content of a plume
- Set and ran simulations of a full-scale plume were in Solidworks Flow Simulator.
- **Completed a redesign and build of the lab cooling tower,** with a new heater solving the rust issue seen in the first iteration.

MONTROSE ENVIRONMENTAL

Flue-Gas Desulfurization Effluent Management Using Innovative Low-Energy Biosorption Treatment System to Remove Key Contaminants

- Down-selected to adsorption media that demonstrates **90% selenium removal**
- Completed testing protocol for demo scale set-up
- Procured and **installed biosorption treatment system at Plant Bowen**

We move forward, together, as…

A complete innovation ecosystem

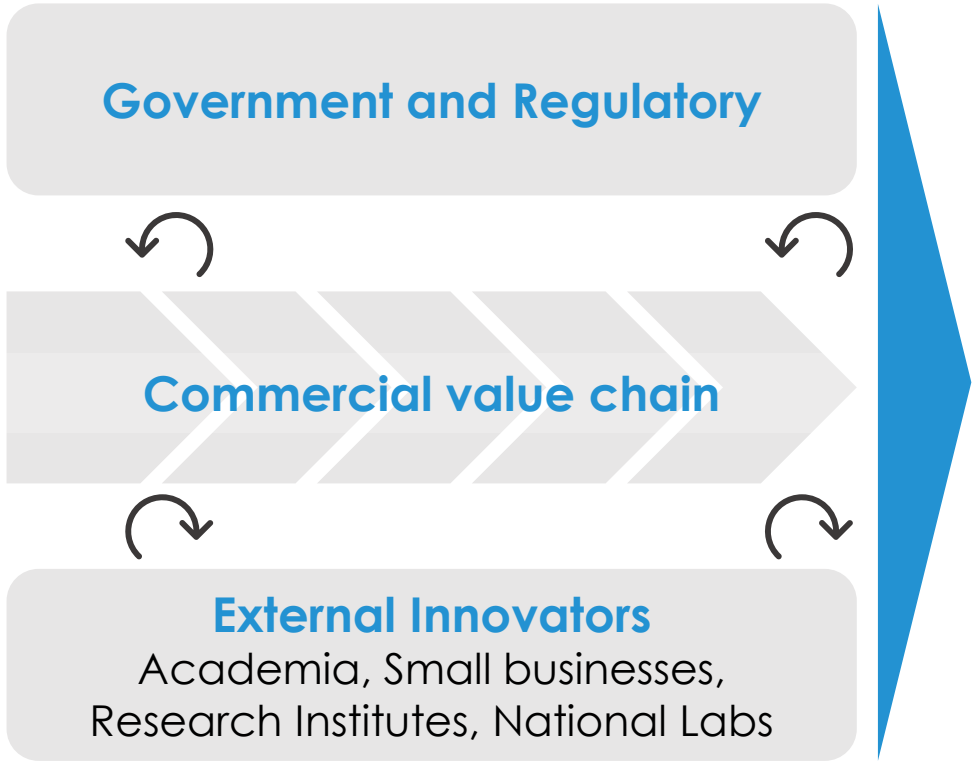
Roles in the Ecosystem

- Objectives & aspirations
- Systems-level planning
- Policy & impact analysis

- Problem definition
- Product specifications
- Scale-up

- Transformational tech
- Workforce development
- Vision for the future

S T A K E H O L D E R S



Collaboration Opportunities

- **Many ways to partner:**
  - Directly with lab
  - Through funded competitions
- **Engage with RFIs, Workshops**
- **Build on our efforts**
  - USEA thought leadership
  - AWARE and IECM tools
  - Sandia Database
  - NETL RIC MVR baseline data
  - BEST testing infrastructure at EERC
  - NETL RIC Bias sorbent

Water Management Program Contacts

https://www.netl.doe.gov/research/coal/crosscutting

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