

Solutions for Today

| Options for Tomorrow

Crosscutting Research

Annual Review Meeting

Pittsburgh, PA

April 9th, 2019



Briggs White

Crosscutting Technology Manager
National Energy Technology Laboratory

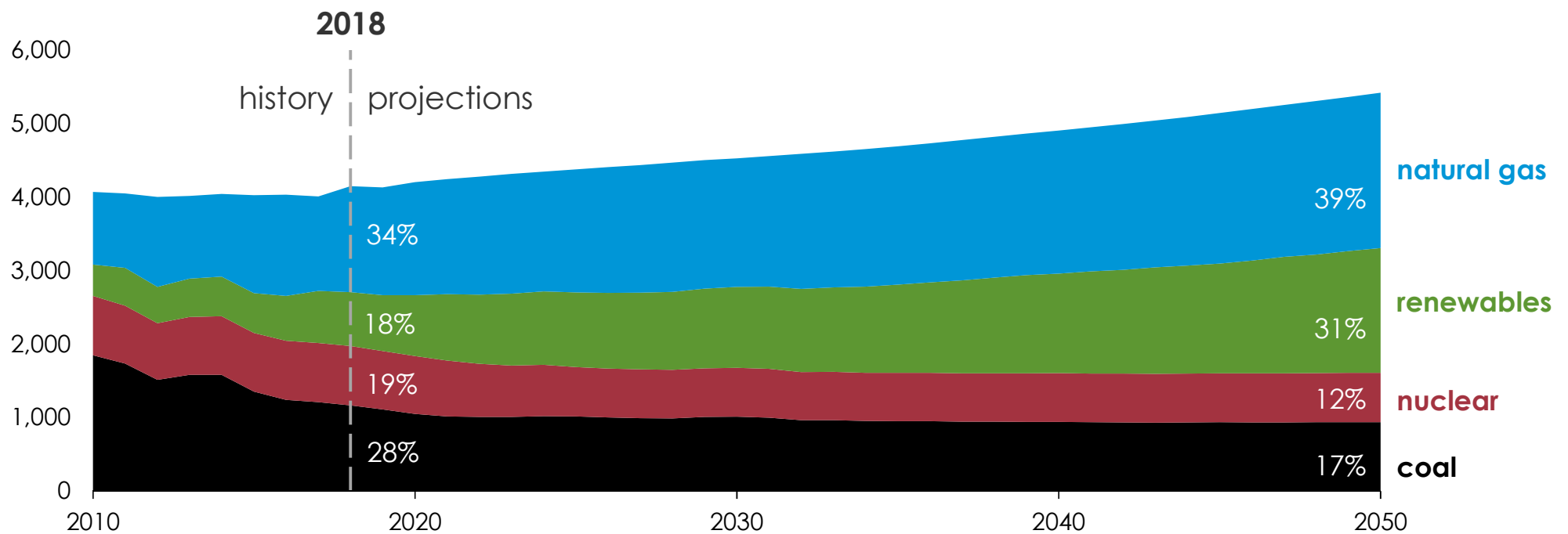


Align Technology Development with Program & Market
Coordinate Portfolio to Maximize Effectiveness



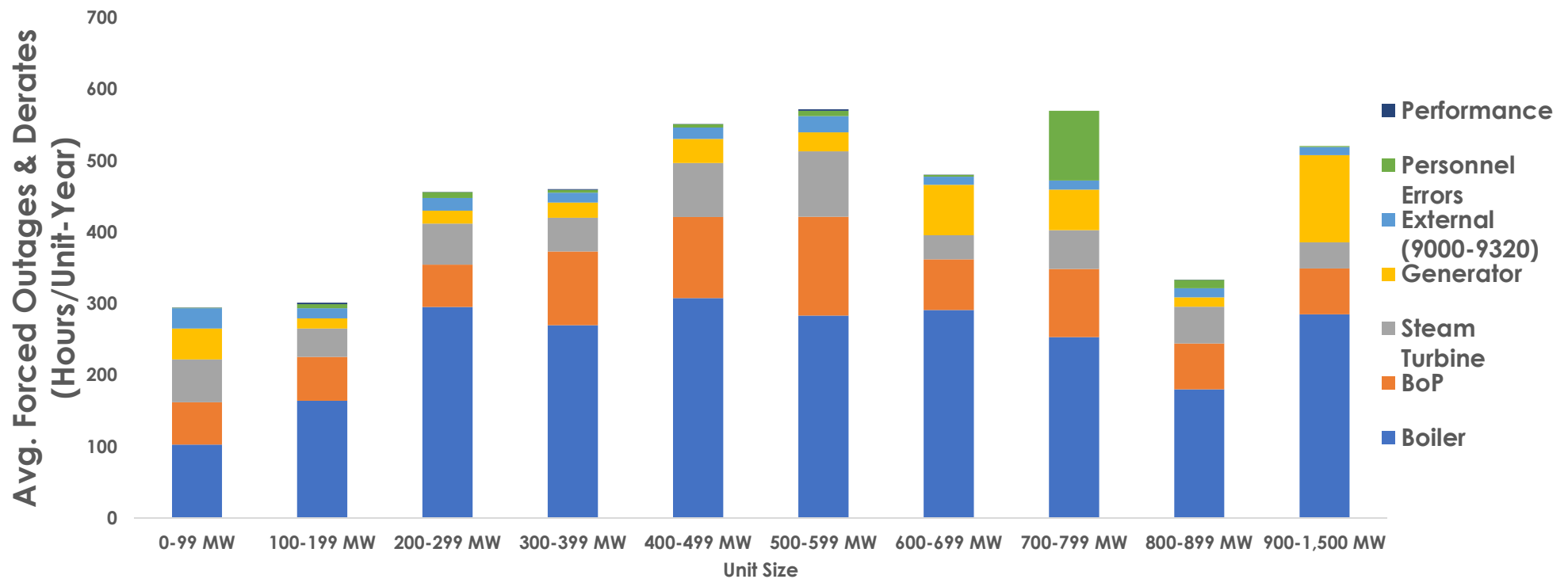
Electricity Outlook

Fossil Remains as Mix Evolves



Forced Outages & Derates

Coal-fired units (2013–2017)



Program Themes & Markets

Program Themes

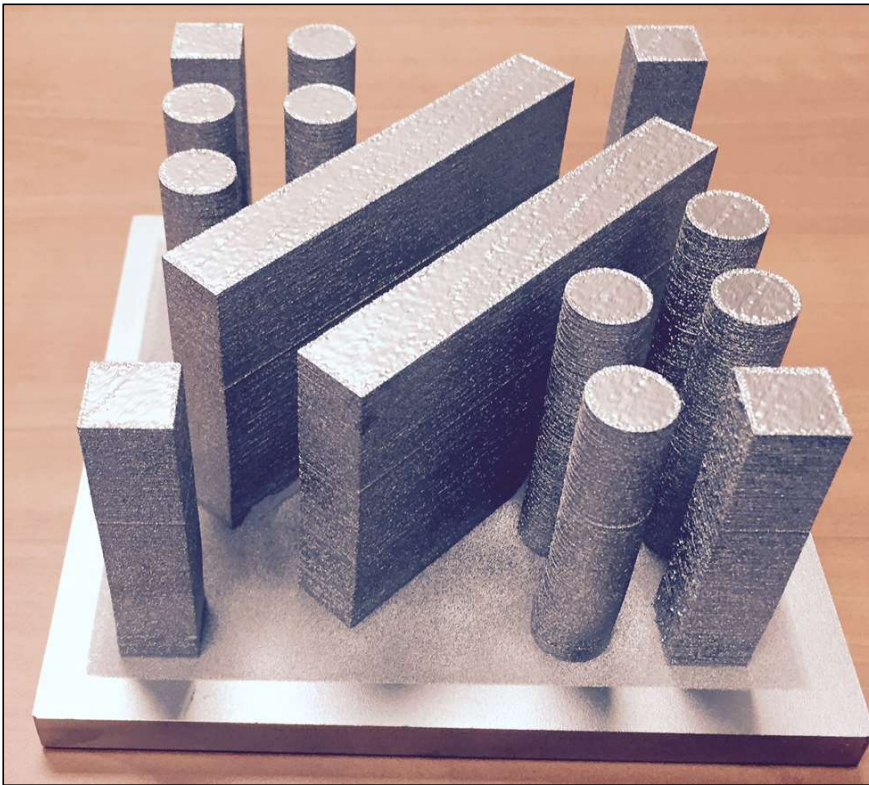
1. Cost of Electricity (COE)
2. Efficiency
3. O&M costs
4. Plant Revenue
 - Flexibility
 - Lower load
5. Reliability + Cybersecurity
6. Supply Chain
7. Water Consumption

Market Characteristics

1. Low Cost Technologies
2. Made for Flexible Operation
3. Clear Value Proposition
4. Aging/smaller Workforce
5. Low Effort Deployment
6. Heterogeneous Fleet

Technology Trends

Advanced Manufacturing



Repair Opportunities

Rapid Prototyping

New Possibilities

Automation & Robotics

Numerous Fossil Applications

Robotics and Automation

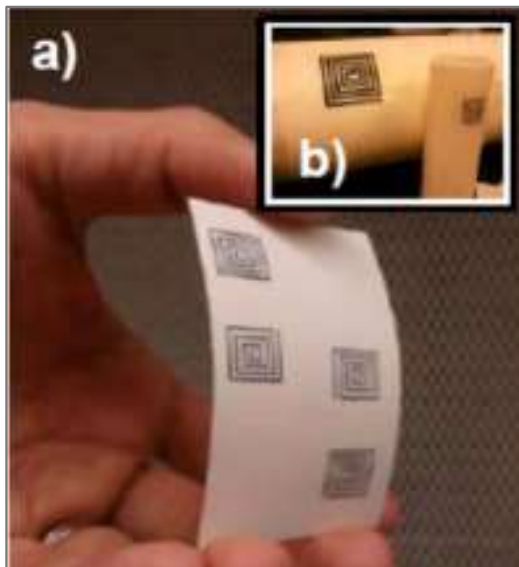
Accelerating Inspection & Insight



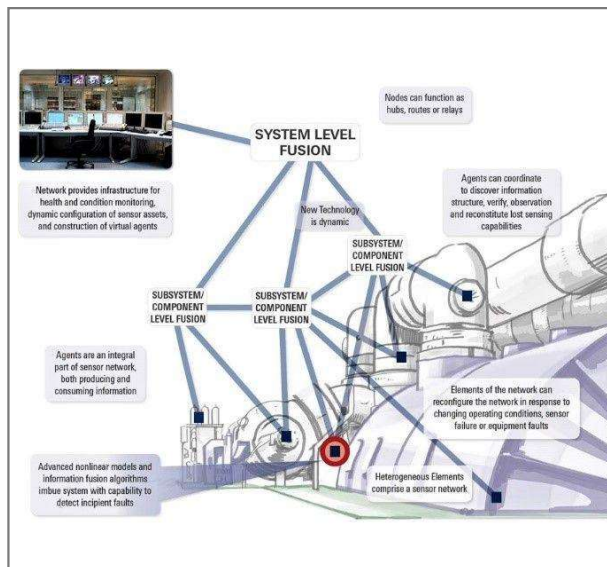
Pipe crawler allows for inspection without disassembly.

Robotics enable safer fossil energy exploration and improve efficiencies.





**Proliferation
Distributed Wireless
Sensors**



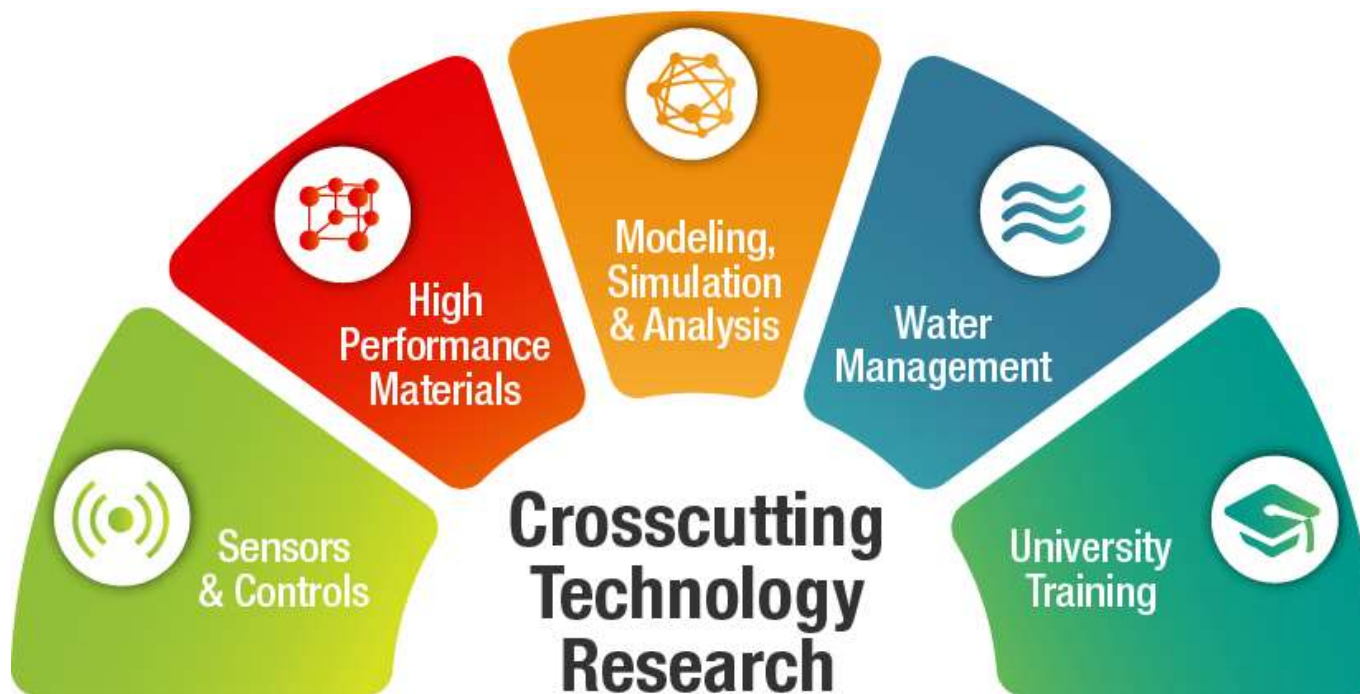
**Advanced Control
Predictive Maintenance**



**Fleet-wide Asset
Management Infrastructure**

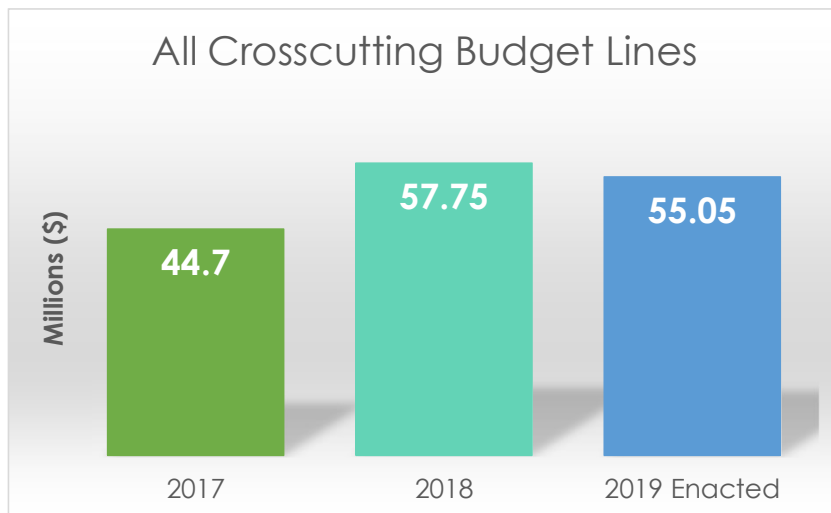
A Portfolio of Programs

Broad Applicability, Multiplier Impact



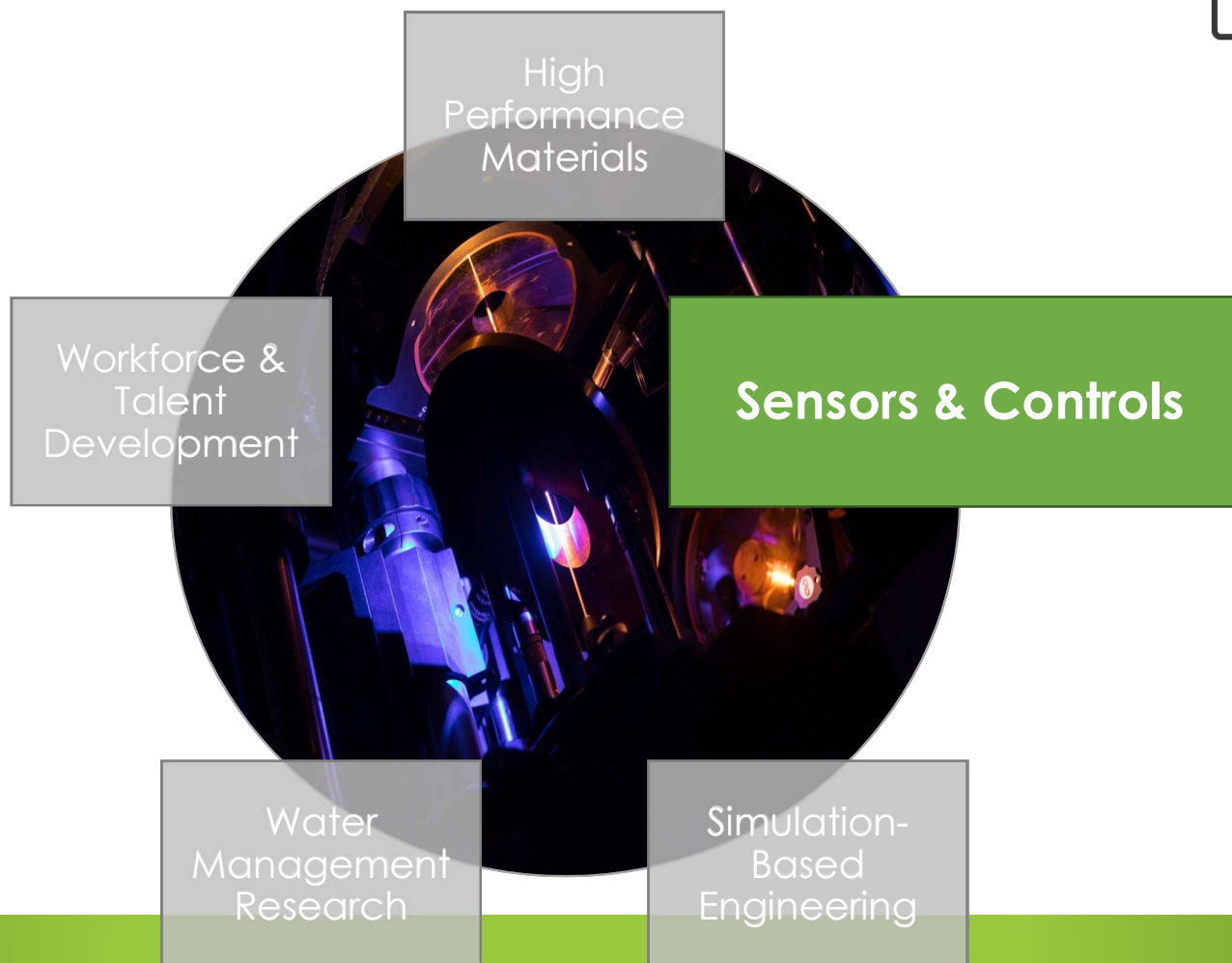
Budgets

- **Strong:** Sensors & Controls, Water Management, and University Training
- **Flat:** Materials
- **Decrease:** Modeling & Simulation



| Budget Lines | FY17 | FY18 | FY19 |
|----------------------|----------------|-----------------|---------------|
| Sensors & Controls | \$3.65M | \$7.5M | \$8M |
| Modeling | \$20.85M | \$20M | \$14M |
| Water Management R&D | \$9.8M | \$7M | \$8M |
| Materials | \$8M | \$20M | \$20M |
| HBCU | \$1M | \$1M | \$2.05M |
| UCR | \$1.4M | \$2.25M | \$3M |
| Total | \$44.7M | \$57.75M | 55.05M |

Key Technology Areas



Predictive Maintenance



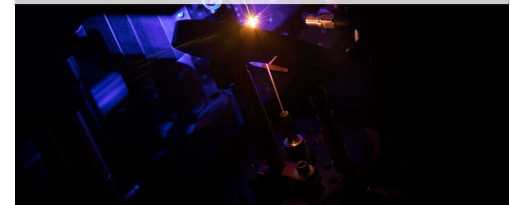
Cyber Security



Distributed Intelligent Controls



Automation for Ramping

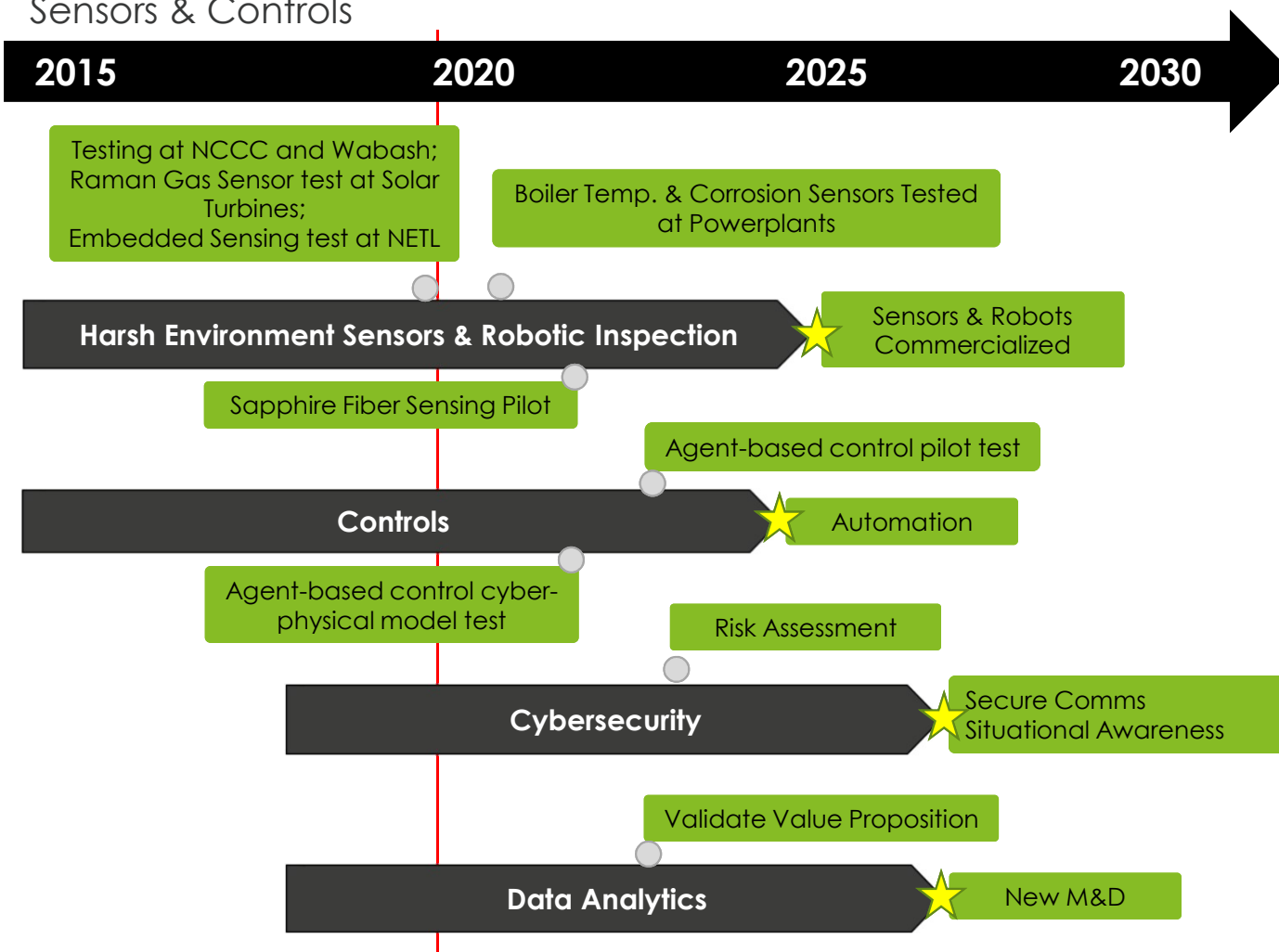


Mission: Test and mature novel sensor and control systems operable in **coal-fired power plants** capable of real-time measurements, improvements to the overall plant efficiencies, and more effective ramp rates.

Technology Development Schedule



Sensors & Controls



Enable Flexible Operation

Predict Component Failures

Assess Fossil Cyber Risks
Retire Risks with R&D

Key Technology Areas

High Performance Materials

Workforce &
Talent
Development

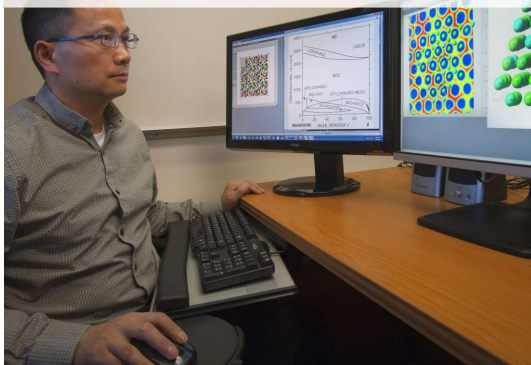
Sensors &
Controls

Water
Management
Research

Simulation-
Based
Engineering

Mission: Characterize, produce, certify cost-effective alloys and high performance materials suitable for extreme environments found in coal power generation to support existing and new plants.

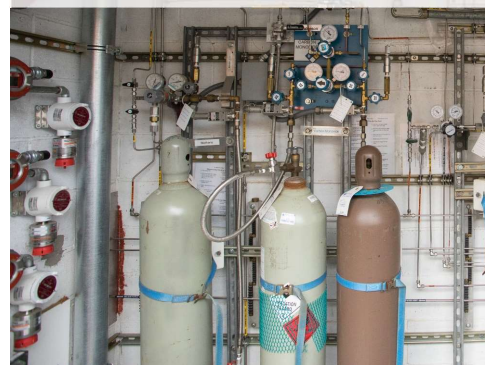
Computational Materials Design



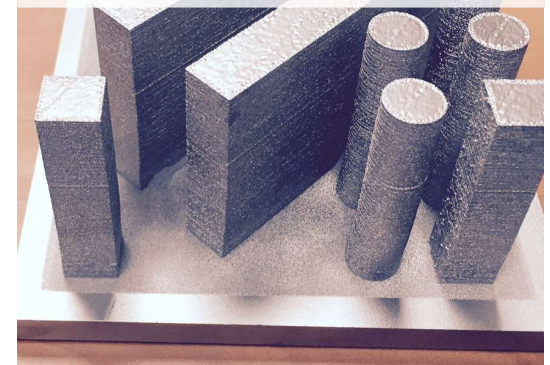
Advanced Structural Materials



Functional Materials for Process Performance



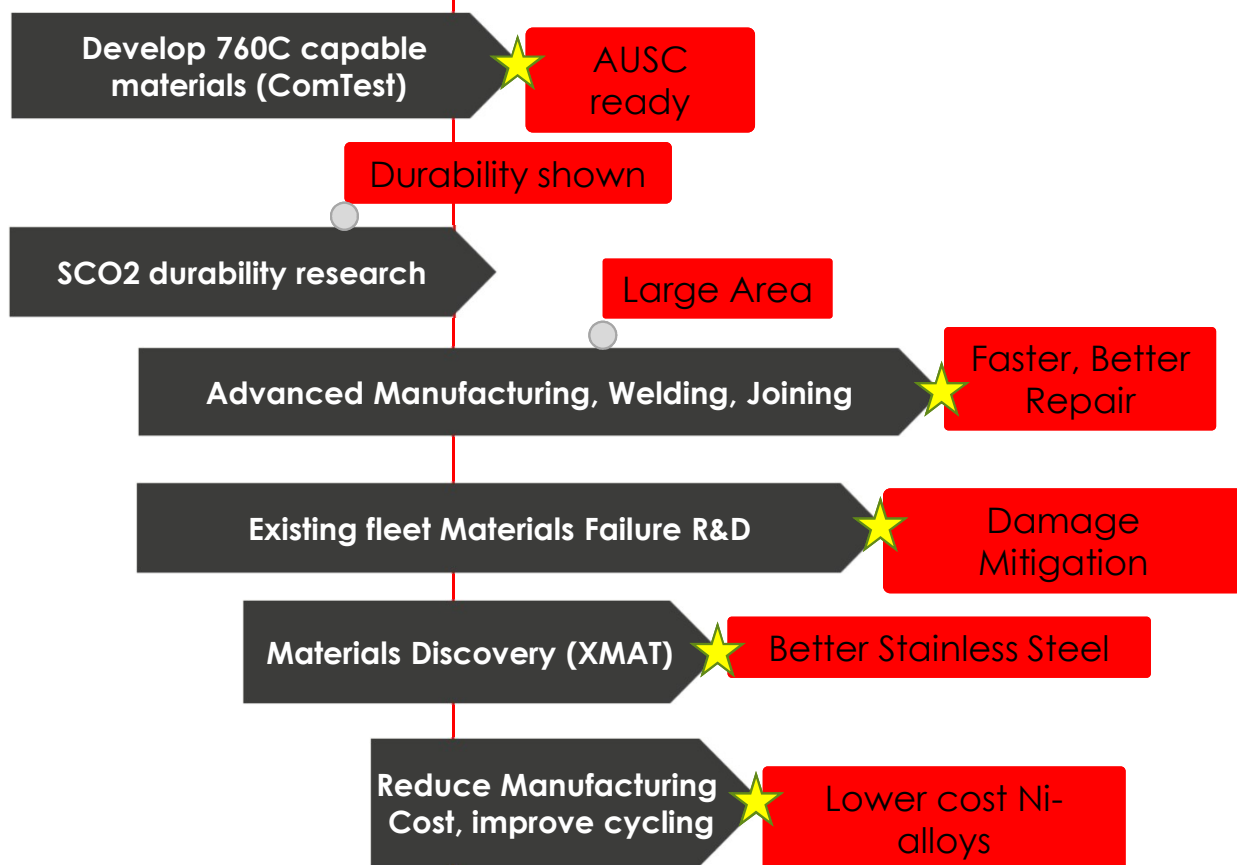
Advanced Manufacturing



Technology Development Schedule



High-Performance Materials



Enable AUSC Plants

Enable SCO2 Power Cycles

Address Existing Fleet Materials Issues

Reduce Alloy & Component Costs

ExtremEmat & ComTest Update

Projects Moving Forward

**Materials Discovery, Cost Reduction,
Service Life Prediction, Rapid Qualification**

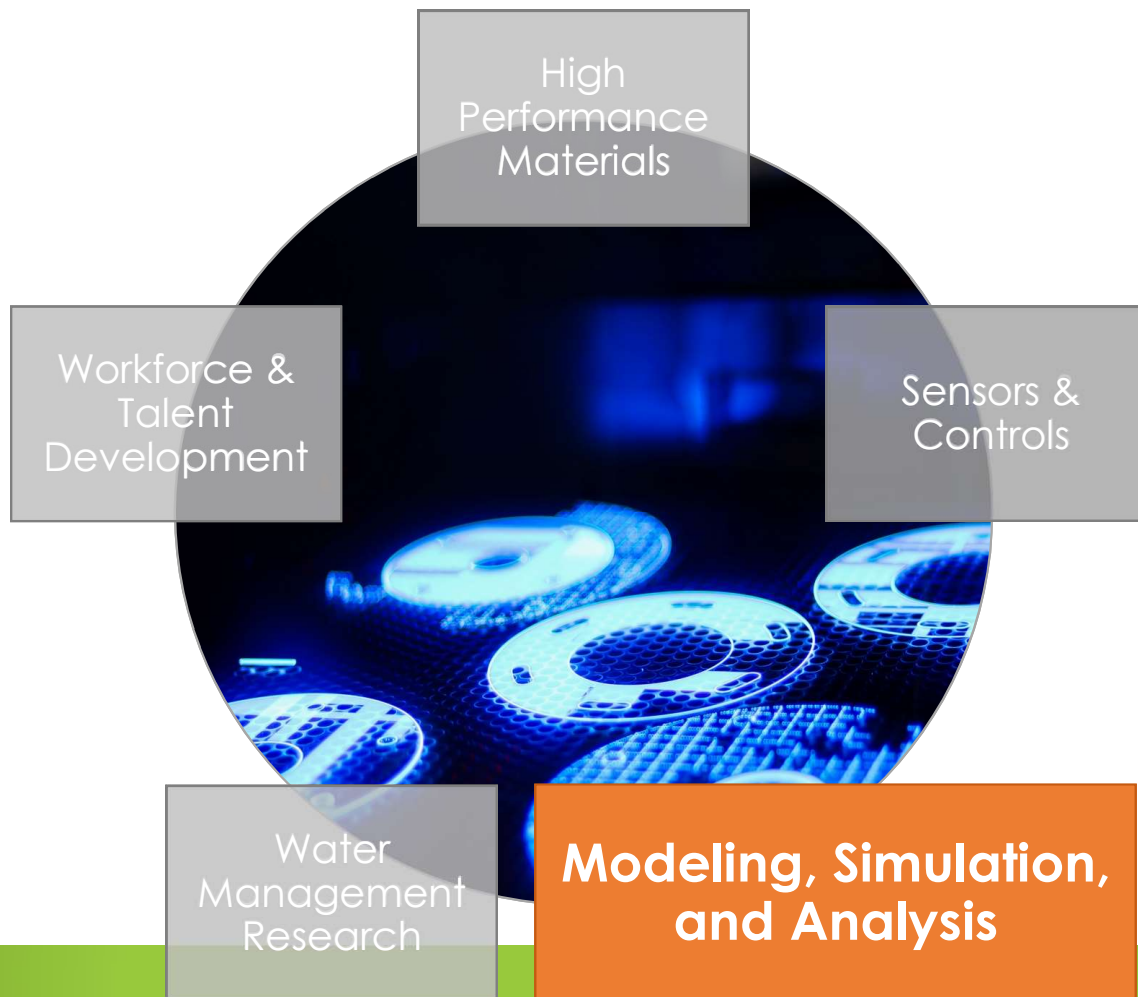
**ComTest Consortium Reading Materials for
AUSC**



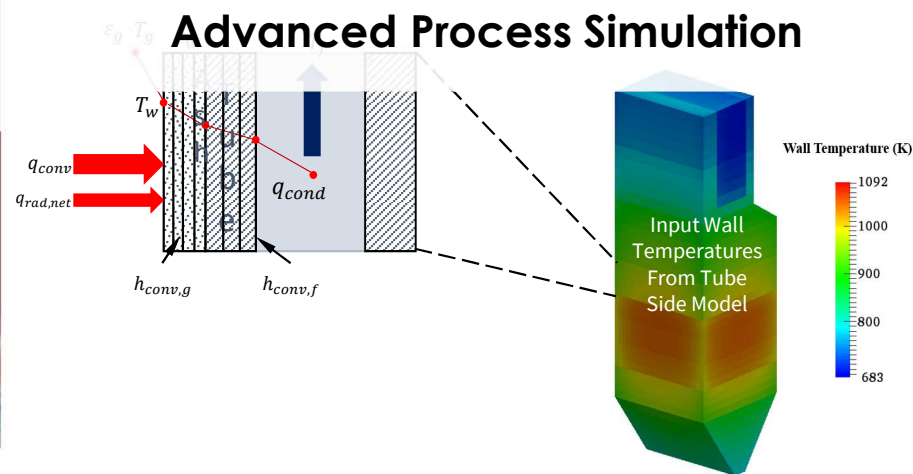
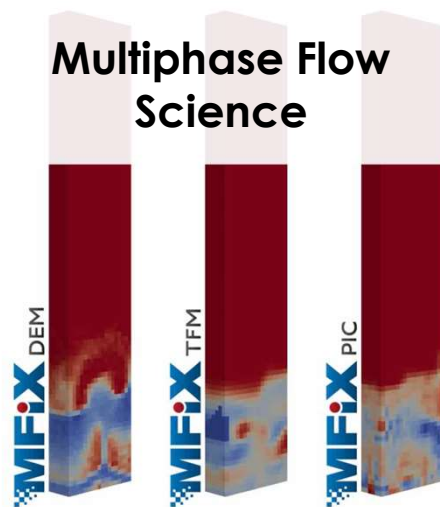
Machine Learning



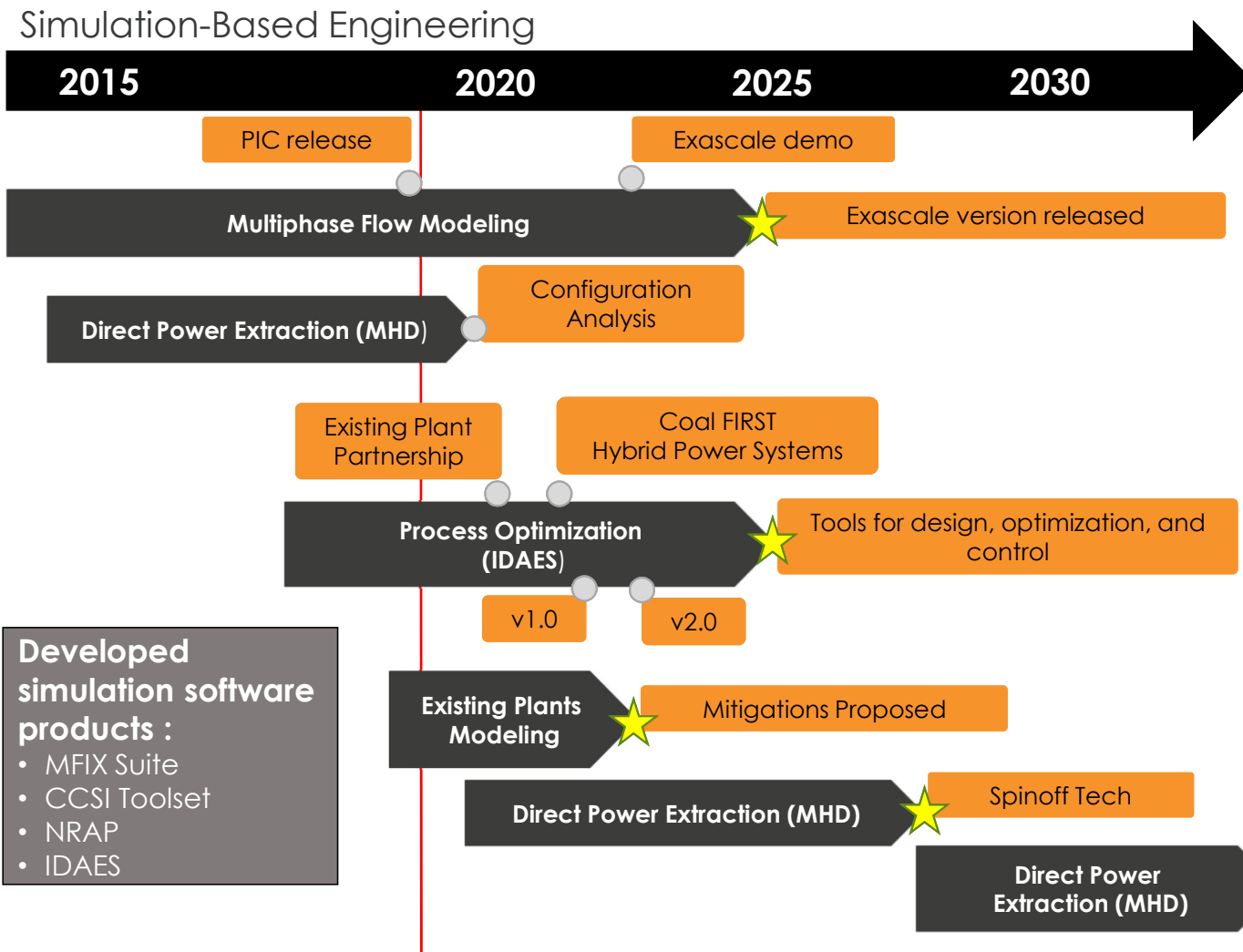
Key Technology Areas



Mission: Simulate coal fleet challenges to lift-up technology solutions, apply computational tools at multiple scales to accelerate development and deployment.



Technology Development Schedule

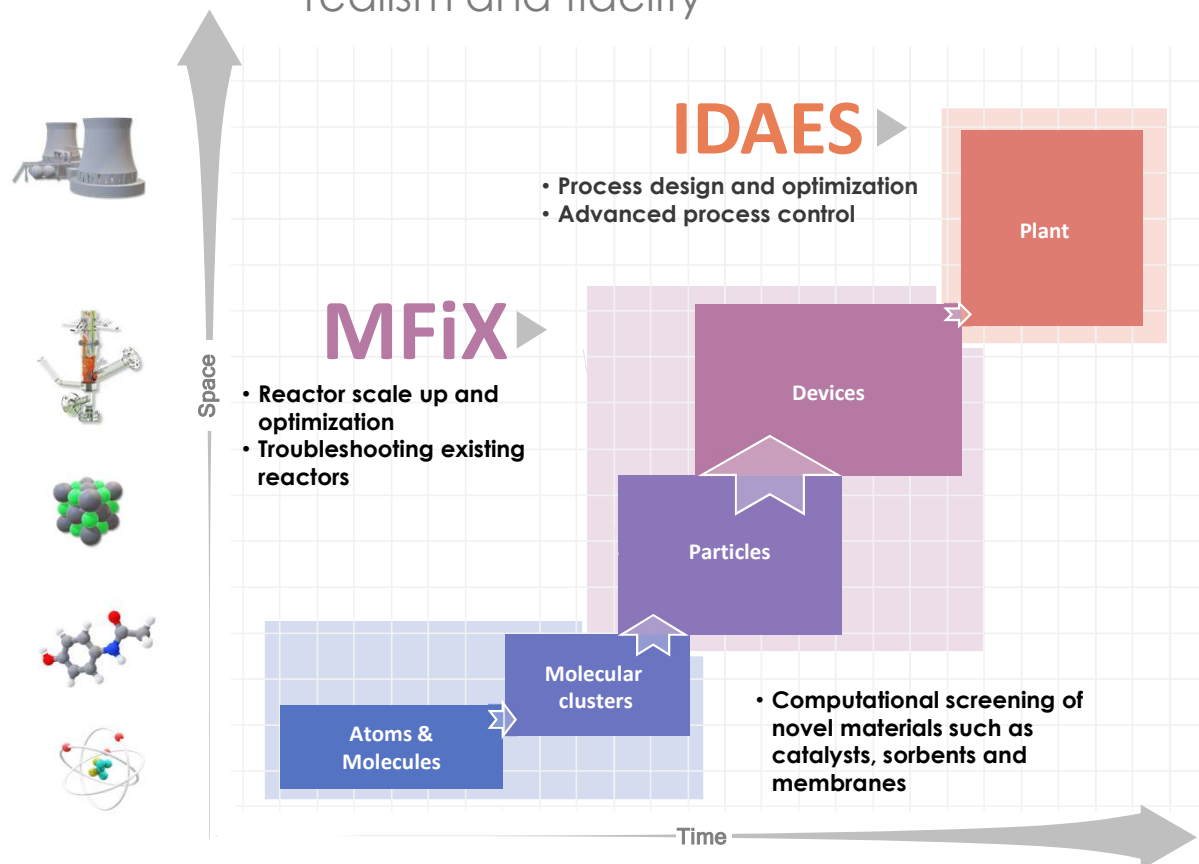


- Developed simulation software products :**
- MFIX Suite
 - CCSI Toolset
 - NRAP
 - IDAES

- Optimize Complex Devices, Processes, and Systems
- Solve Critical Fossil Challenges
- Accelerate Technology Development
- Advanced Direct Power Extraction Spin Off Technologies

NETL's Complementary Computational Tools

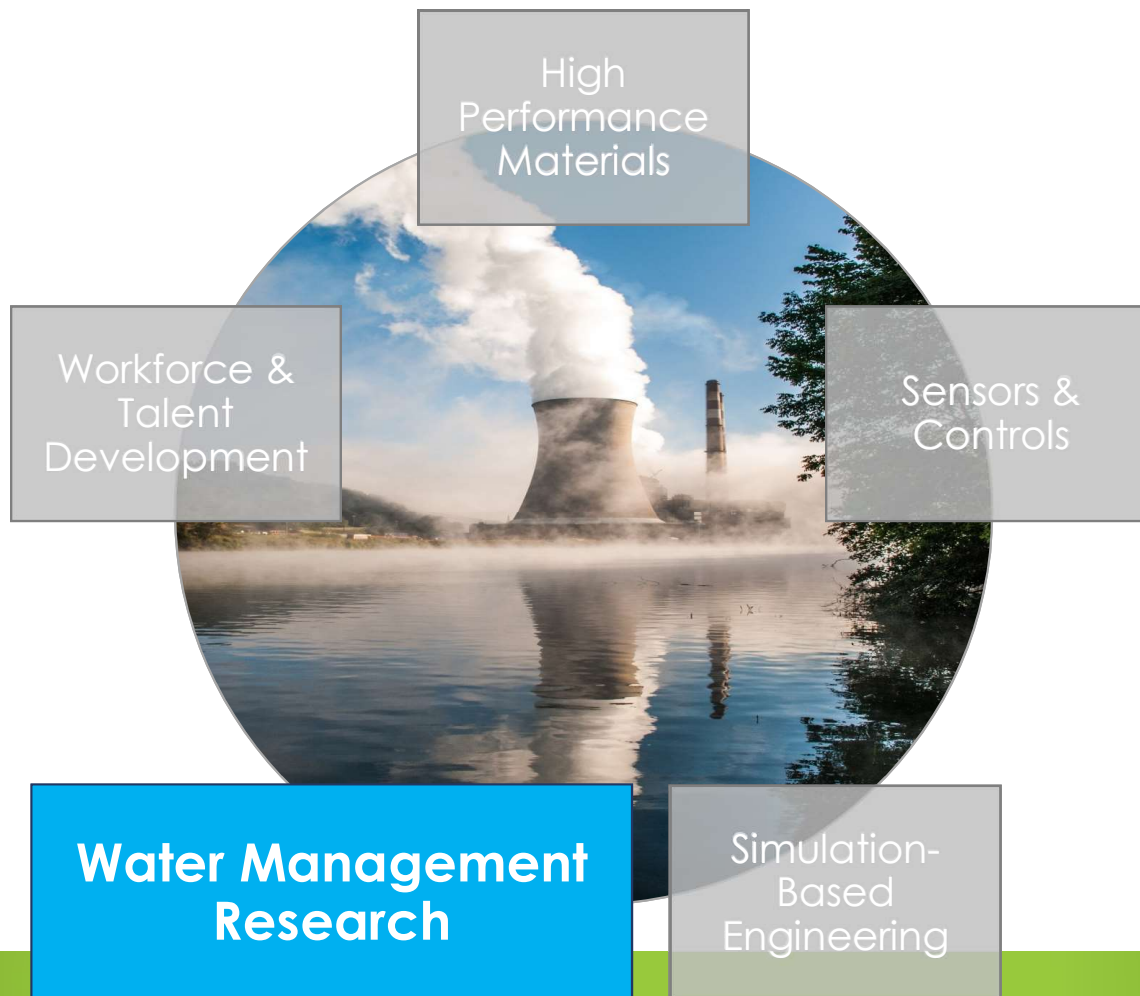
IDAES + MFIX: Working together to increase systems modeling realism and fidelity



COMPUTATIONAL TOOLS WORKING TOGETHER

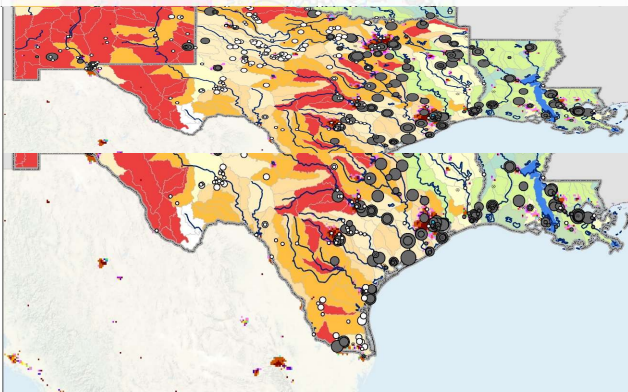
- **IDAES** - framework for design, optimization, and control of steady state and dynamic processes.
- **MFIX** - suite of multiphase flow simulation software for designing devices such as combustors.

Key Technology Areas

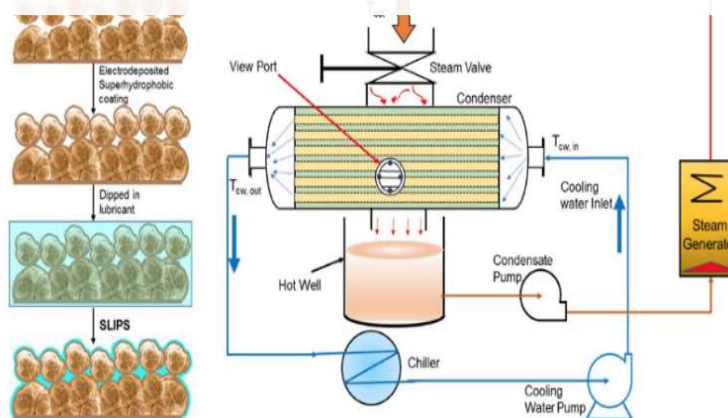


Mission: Provide leadership, raise awareness, and offer cost-effective technical solutions to potential national issues in water quality and availability.

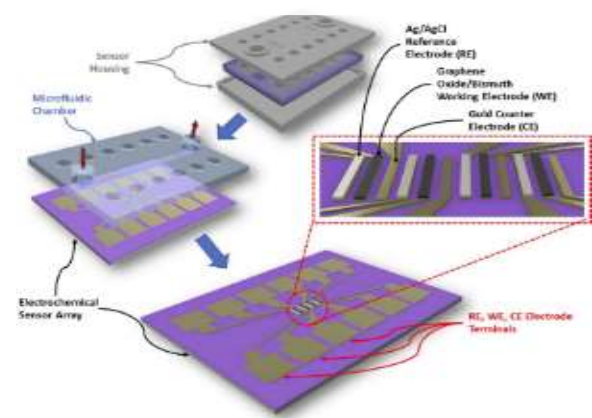
Energy Water Analysis



Water Efficiency and Reuse

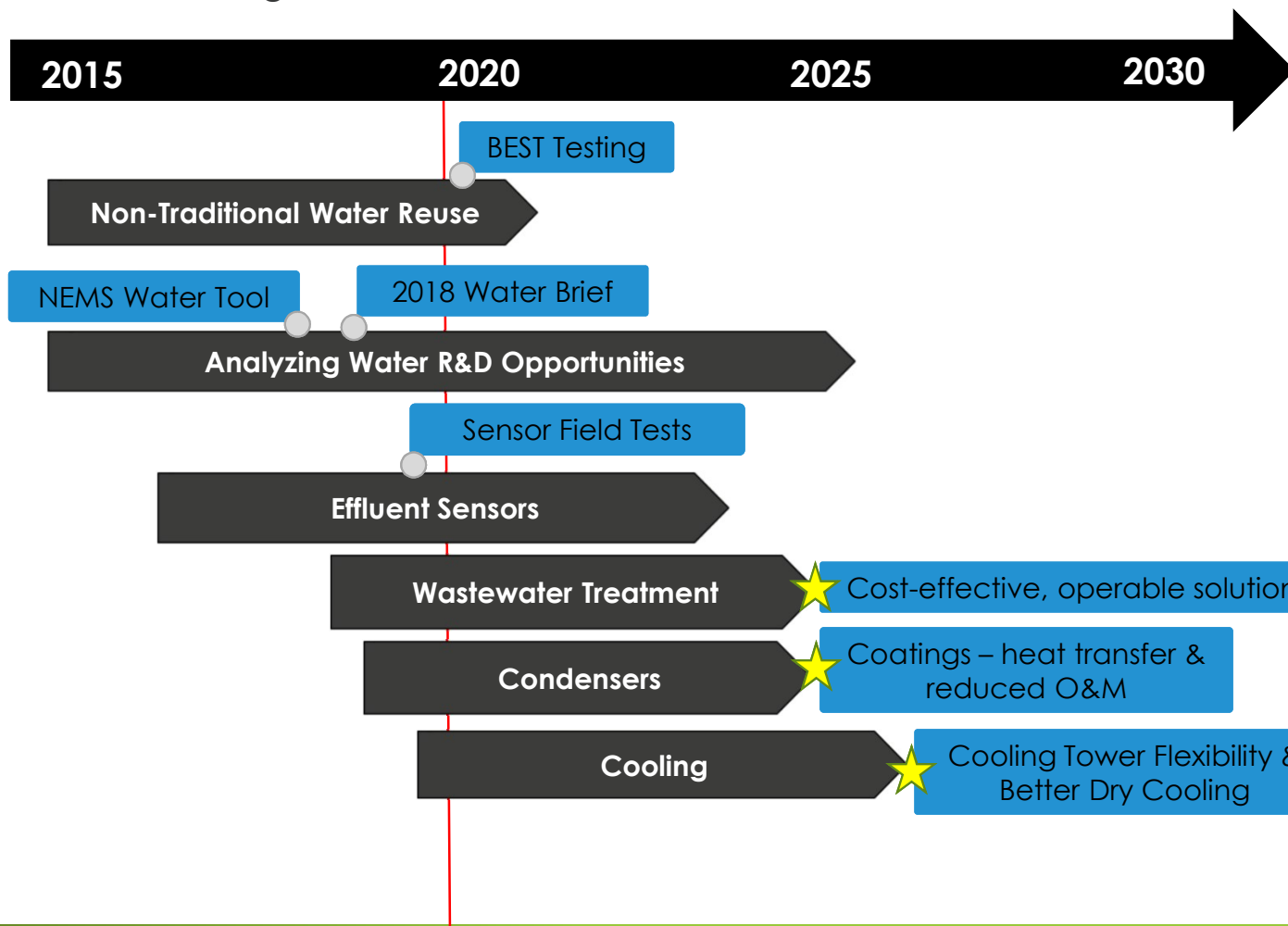


Flexibility & Cost



Technology Development Schedule

Water Management



Minimize water use and effluent generation

Enable flexible operation with reduced O&M

Advance water treatment technologies

Increase plant efficiency

Key Technology Areas

University Training & Research

High
Performance
Materials

Sensors &
Controls

Water
Resources

Simulation-
Based
Engineering



University Training and Research

Workforce & Talent Development



\$25M and 130 grants
3,000 student researchers
Fossil Energy research
STEM training addresses workforce gap

\$400,000 per award
No cost share requirement

Since Program Inception

UCR Program Results:

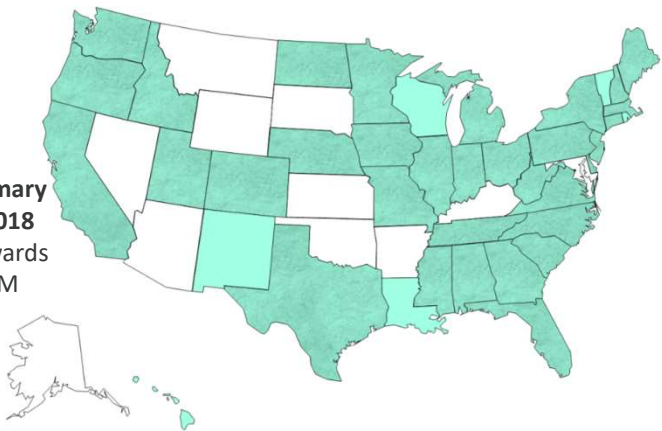
- 1000+ Technical Papers
- 10+ Technical Awards
- 7 Patents Issued to Date

HBCU Program Results:

- 500+ Technical Papers
- 5+ Technical Awards
- 2 Patents Issued to Date

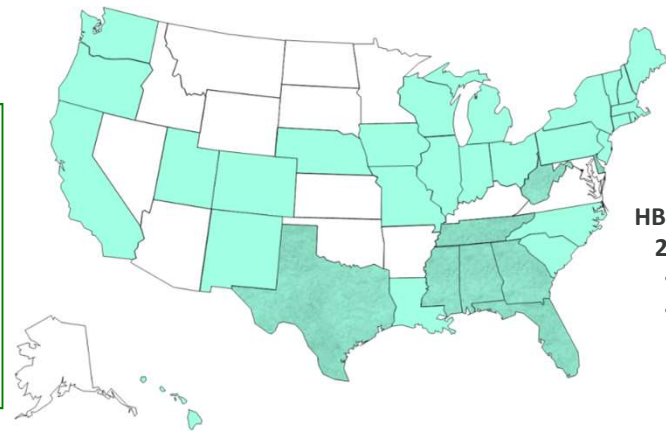
UCR Summary 2010 – 2018

- 50 Awards
- \$16.7M



HBCU Summary 2010 – 2018

- 27 Awards
- \$5.9M





Call to Action

Researchers



Create

- FOAs
- Opportunities at NETL

Deploy

- Put work in context
- Assess value proposition
- Work with end-users

Share

- Coordinate with other researchers
- Tell us about your successes
- How can we help?



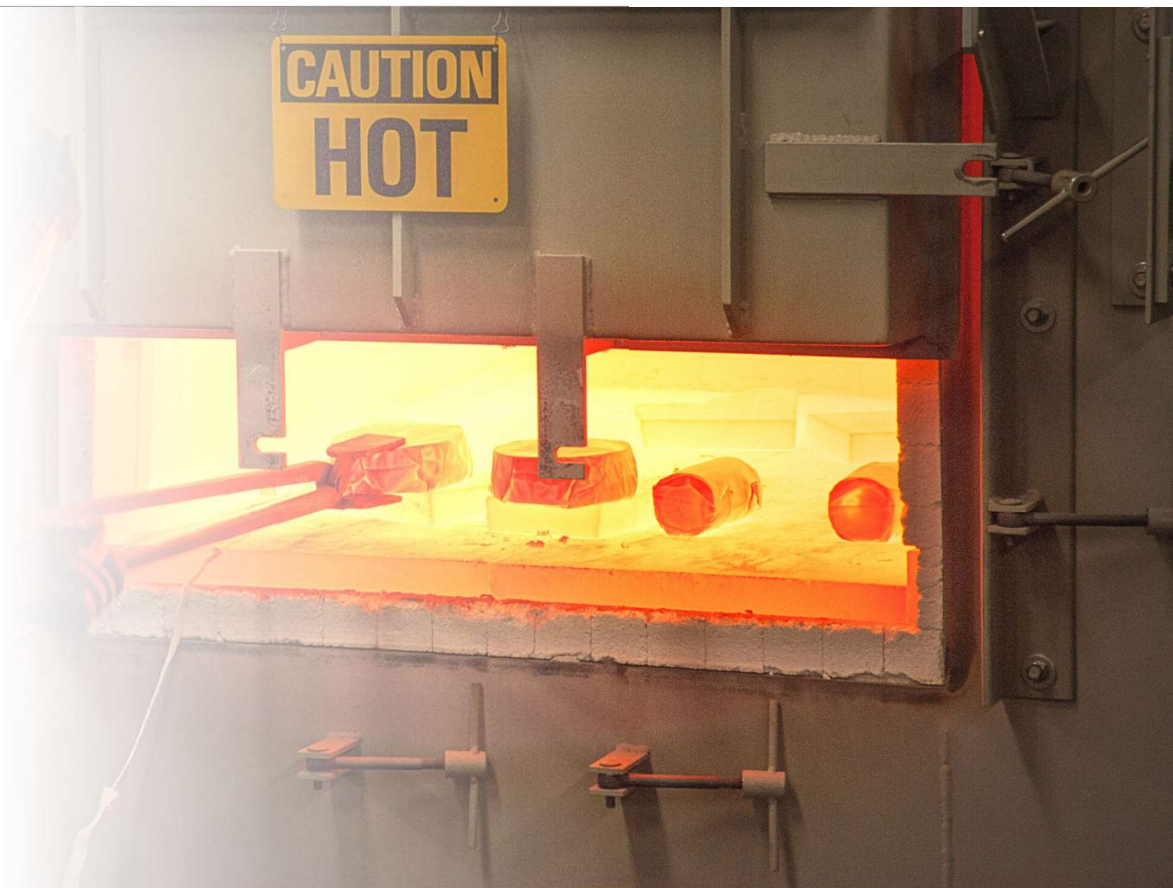


Call to Action

Industry



- FOAs
- HPC4Materials
- Industrial Advisory Boards
- Partner with researchers
- RFIs/Workshops
- Attend facilitated discussions
- Attend poster session
- Survey



Program Alignment and Market Deployment Critical Portfolio Coordination

- How can we help?


Contributing Toward

- Existing Coal Fleet
- Enabling New Power Cycles
- Domestic Materials Supply Chain

Thank You to Partners

Crosscutting Research Contacts

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




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