

DOE's Transformative Power Generation and Coal Beneficiation R&D Programs

2019 Annual Project Review Meeting

John Rockey - Technology Manager



April 9, 2019



- **Power Generation in the US and throughout the world**
 - Renewable Energy will continue to increase in market share
 - Coal will continue to be vital in providing low cost reliable for the future
- **We are committed to developing technologies**
 - Creating more nimble coal-fired generation facilities
 - Ensuring that coal-fired generation is the clean, efficient, and cost competitive

Coal Plants Challenged by Changing Power Markets

- Coal-fired power plants designed for baseload are not being deployed as originally intended or designed
 - Equipment and performance degradation is accelerated
- Changing market conditions require flexible power plants
- Cost and reliability must be improved



Transformative Power Generation

KEY TECHNOLOGIES

Improvements for Existing Coal Plants
(Near-Term – Implement in 3-10 years)

Coal FIRST – Coal Plant of the Future
(Mid-Term – Implement in 5-12 years)

Advanced Combustion
(Long-Term – Implement by 2030-2035)

RESEARCH FOCUS

- Efficiency Improvements
- Reliability Improvements
- Operational Flexibility

- Advancements in State-of-the-art Boilers

- Chemical Looping Combustion
- PFBC/Staged Oxy-Combustion
- Flameless Oxy-Combustion

■ Near-term Technologies

■ Transformational Technologies

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Focus for this Annual Project Review Meeting

■ Near-term Technologies

■ Transformational Technologies

Coal FIRST Technologies to Meet Opportunity

Flexible, Innovative, Resilient, Small, Transformative



GOAL: Develop the coal plant of the future to provide secure, stable, and reliable power.

R&D will underpin coal-fired power plants that are:

- capable of *flexible* operations to meet the needs of the grid;
- use *innovative* and cutting-edge components that improve efficiency and reduce emissions;
- provide *resilient* power to Americans;
- are *small* compared to today's conventional utility-scale coal plants;
- and will *transform* how coal plant technologies are designed and manufactured.

Improvements for Existing Coal Plants R&D



- **Efficiency Improvements**

- Improve heat rates under all conditions
- Improve heat rate during transient and low-load operation

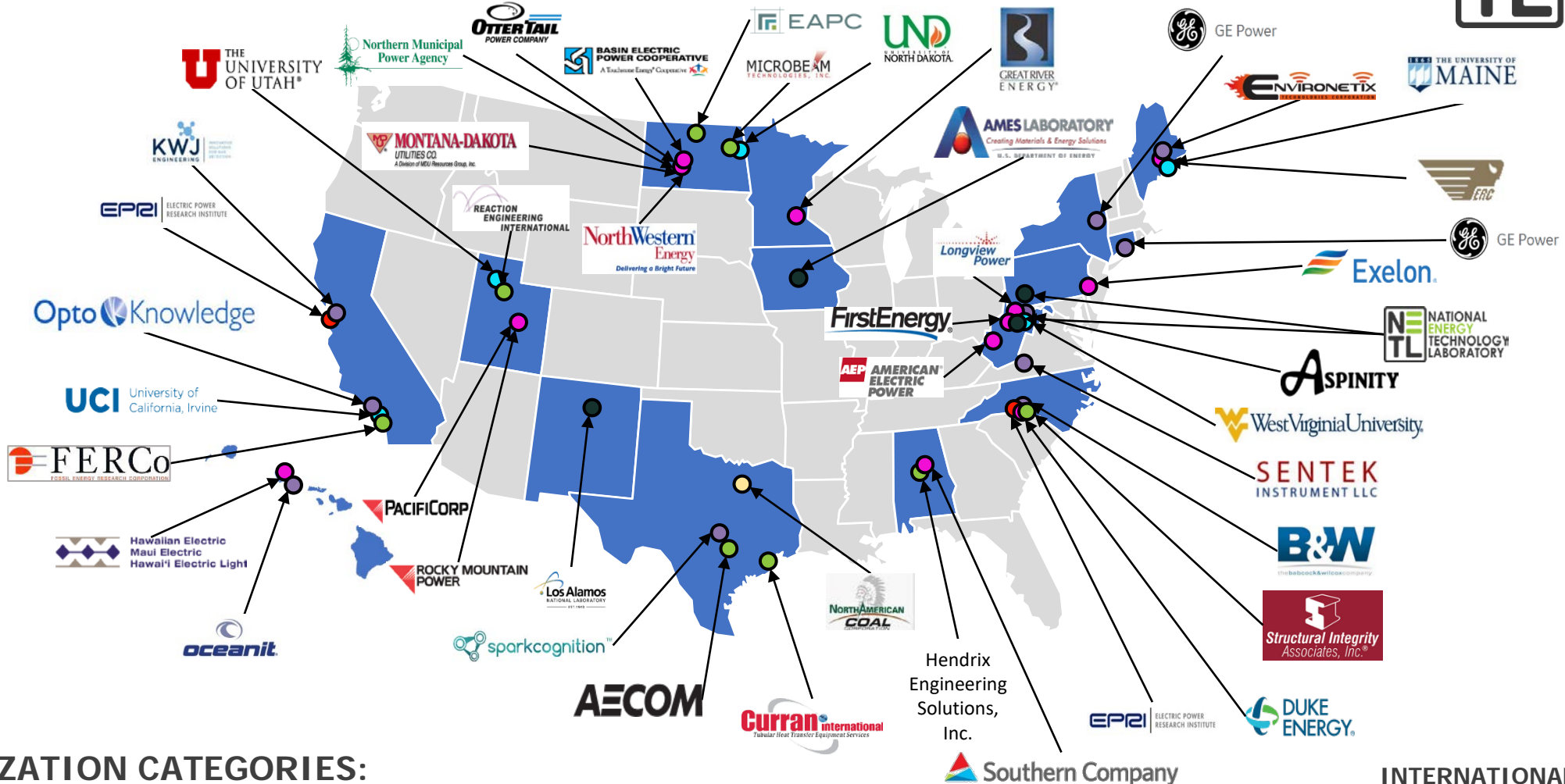
- **Reliability Improvements**

- Reduce forced outages
- Reduce maintenance cost through predictive monitoring

- **Operational Flexibility**

- Improve demand response
- Lower minimum load

Existing Plants Project Partners Map



ORGANIZATION CATEGORIES:

- Service Provider (10)
- Coal Company (1)
- University (5)
- Utilities (16)
- Equipment Manufacturer (10)
- Research Institute (1)
- National Laboratory (3)

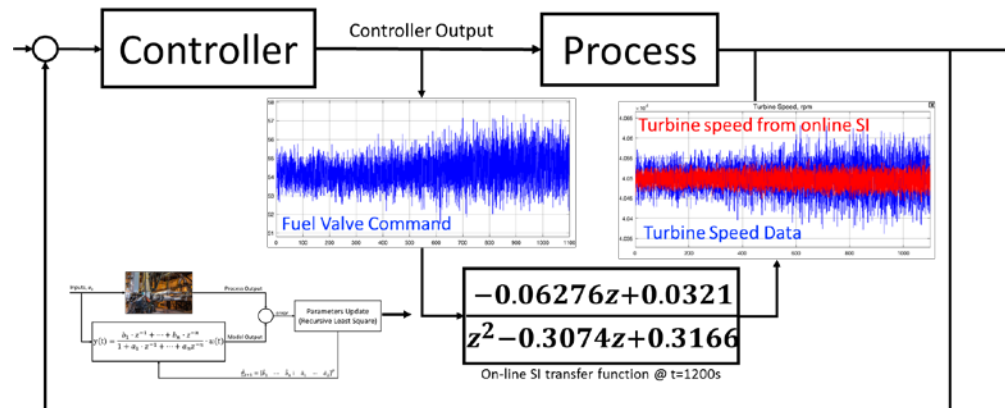
INTERNATIONAL PARTNERS:

- Rhytics – South Korea
- Corrosion Management Ltd. - UK

On-Line System Identification

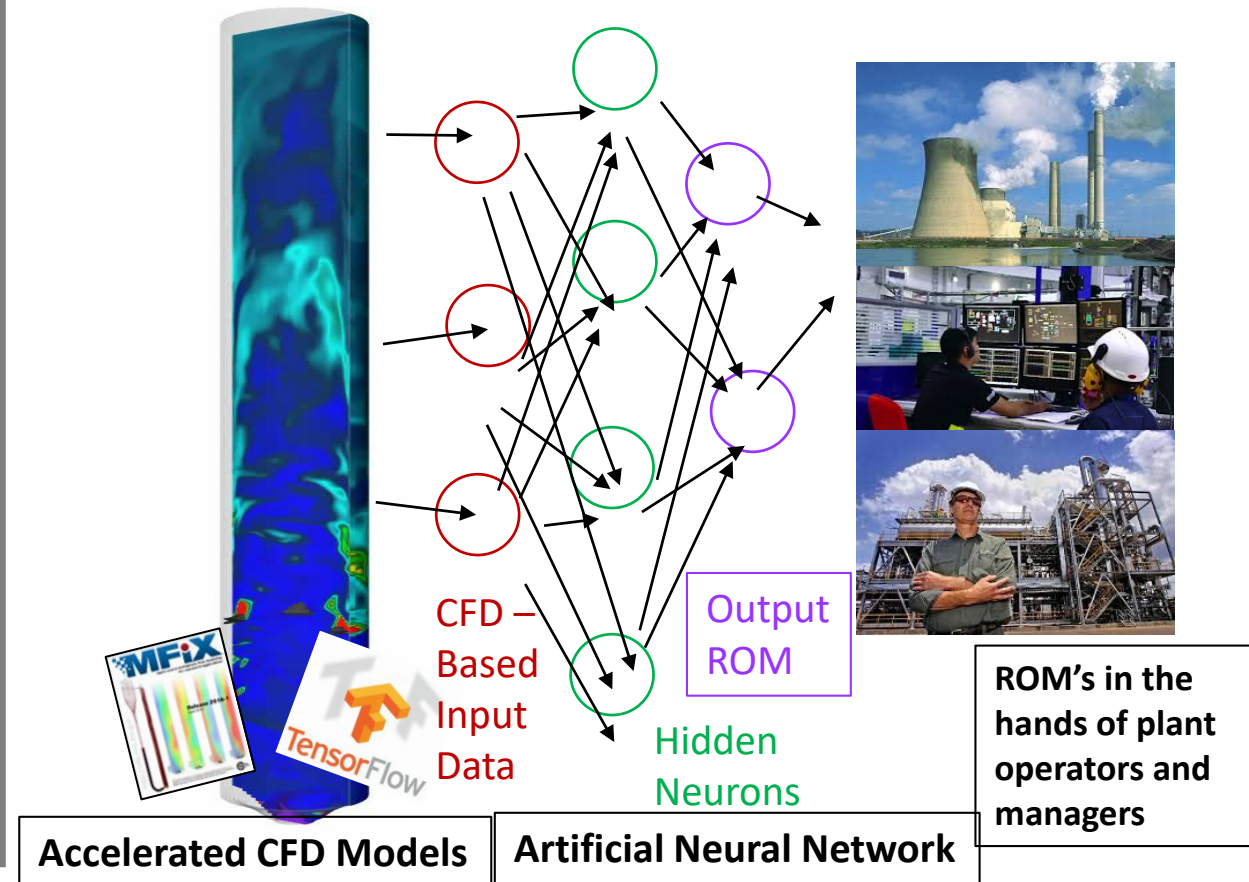
Application: Data Analytics for Coal-fired Plants for Continuous Controller Characterization

- approach to optimize control
- improve efficiency and economics
- improve control during load following
- detect equipment deterioration

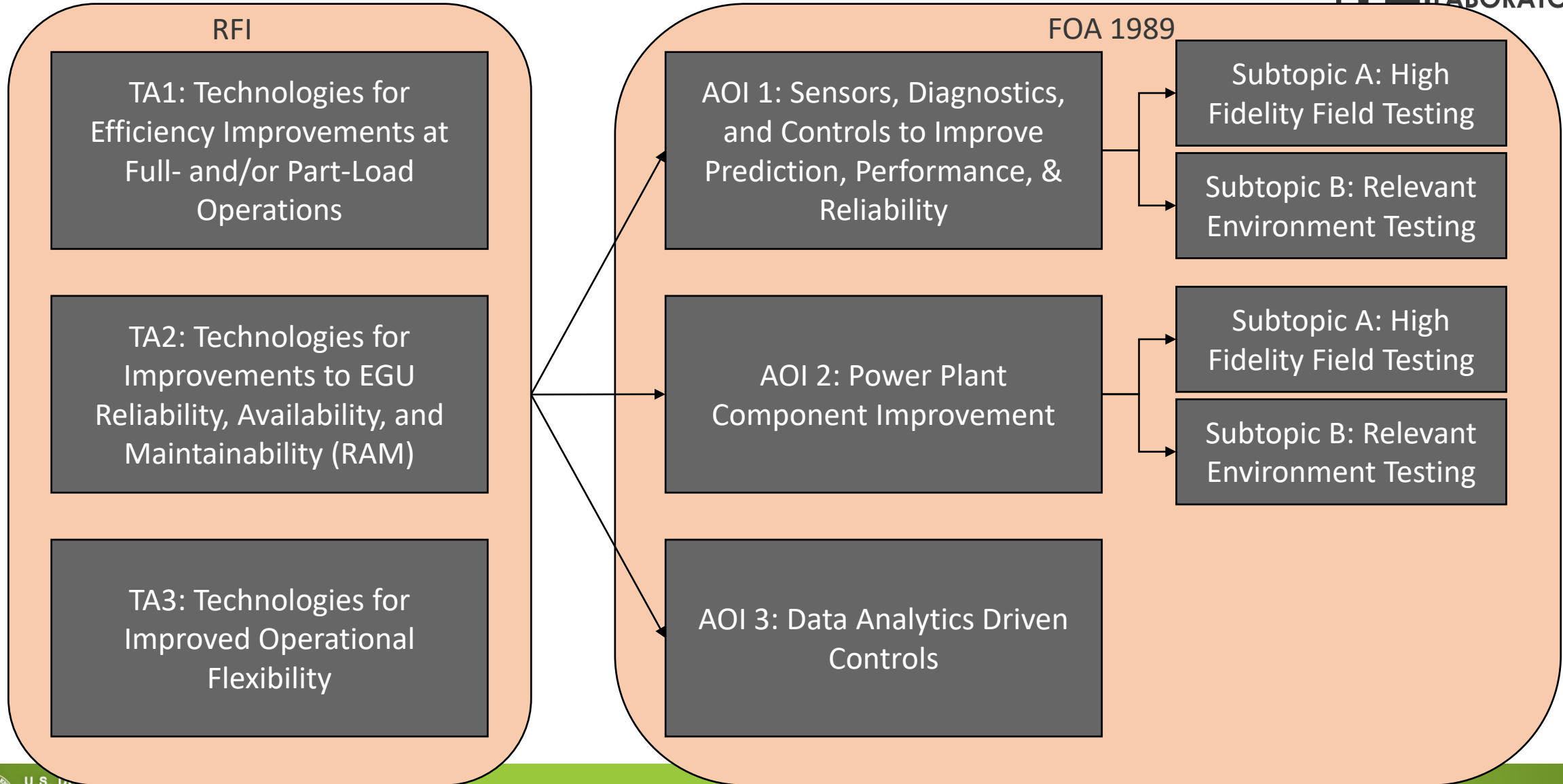


Boiler Modeling

Application: Reduced Order Model Development based on Validated CFD Data



Stakeholder Outreach – Existing Plants



Funding Opportunity Announcement Issued in FY 2019



FOA 1989: Transformative Power Generation and Cross-cutting Sensors and Controls: Improving Efficiency, Reliability, and Flexibility of Existing Coal Power Plants

- Total Funding: \$38M; DOE Funding: \$34M (Transformative Power Gen), \$4M (Cross-cutting)
- 12-20 project awards expected
- Closed February 28, 2019

Takeaways – Transformative Power

- Coal-fired plants must be more flexible, reliable, and efficient
- Program focuses on existing and new plants
- Lab and field testing of impactful technologies underway
- All projects have industry involvement

Stakeholder involvement essential for transition of technologies to industry



Transformative Power Generation Contacts



<https://www.netl.doe.gov/node/6101>



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DOE's Coal Beneficiation R&D Program



John Rockey – Technology Manager

April 9, 2019



Solutions for Today | Options for Tomorrow



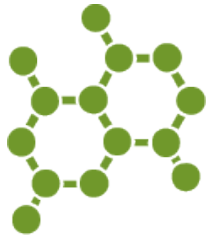
Why Coal Beneficiation?

- Annual coal consumption has gone from about 1.2 billion tons to 700 million and could fall to 400 million by 2030
- New coal-fired power plant builds in the U.S. are unlikely over the next 10 years
- Coal has exciting opportunities to expand use in both traditional markets and in new applications



Coal Beneficiation R&D Areas

COAL BENEFICIATION HAS THREE PRIMARY R&D AREAS:



COAL TO CARBON PRODUCTS



FEEDSTOCK UPGRADING

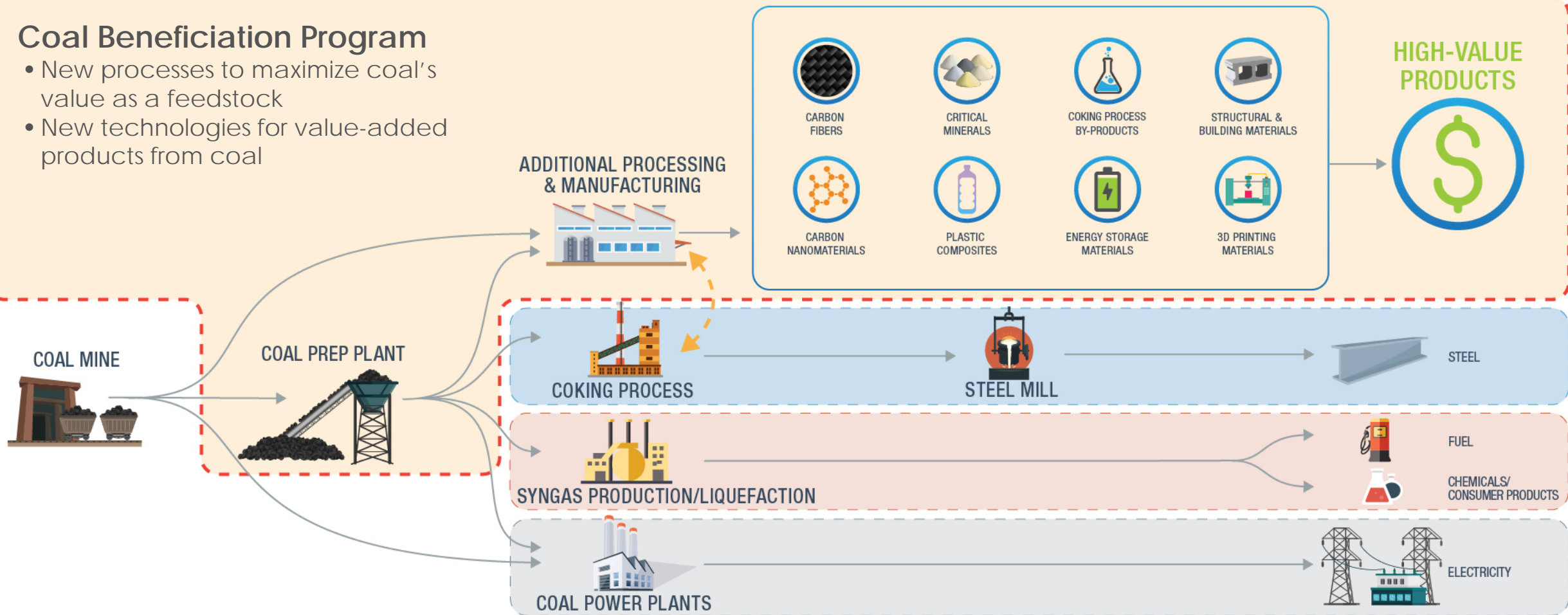


COAL PROPERTIES DATABASE

Expanding the Coal Value Chain

Coal Beneficiation Program

- New processes to maximize coal's value as a feedstock
- New technologies for value-added products from coal



Coal Beneficiation Projects

NETL RIC PROJECTS

Coal-Based Carbon Materials Manufacturing
 National Energy Technology Laboratory Research and Innovation Center – Pittsburgh, PA, Morgantown WV, Albany, OR
TOTAL: \$1,150,000 • DOE SHARE: \$1,150,000

Converting Coal into Carbon Nanomaterials and Composites
 Ramaco Carbon – Sheridan, WY
Public-private partnership

Transforming Coal into High-Value Products
 Russell County Industrial Development Authority and Virginia Carbonite – Russell Co, VA
Public-private partnership

Technical Economic Analysis of the U.S. Value-Added Coal Product Industry
 Oak Ridge National Laboratory – Oak Ridge, TN
TOTAL: \$300,000 • DOE SHARE: \$300,000

The Novel Charfuel® Coal Refining Process 18 TPD Pilot Plant Project for Co-Producing an Upgraded Coal Product and Commercially Valuable Co-Products
 CarbonFuels, LLC – Denver, CO
TOTAL: \$3,180,519 • DOE SHARE: \$2,000,000

U.S. Coal to Conductive Inks
 Minus 100, LLC – Clarks Summit, PA
TOTAL: \$224,813 • DOE SHARE: \$224,813

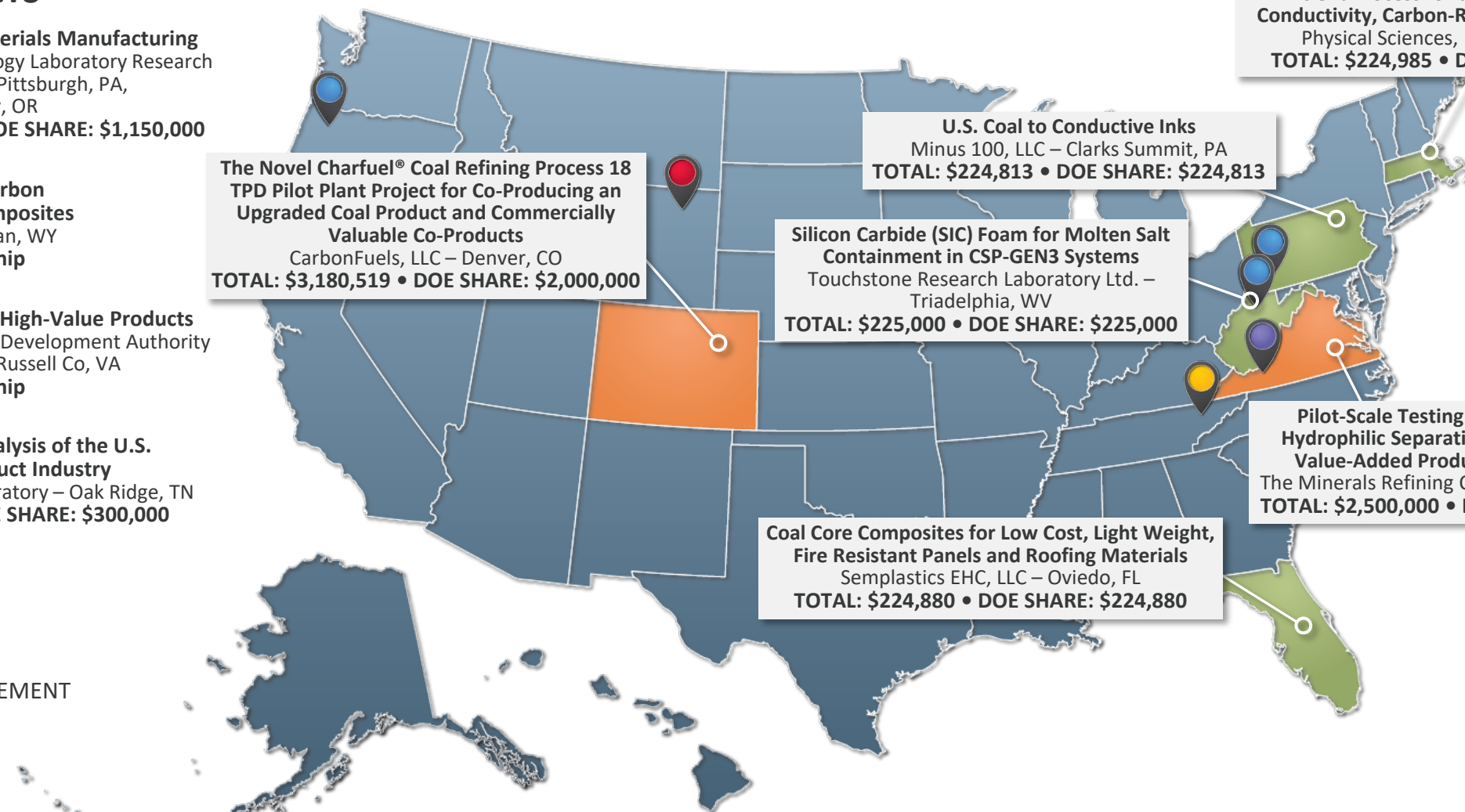
Silicon Carbide (SiC) Foam for Molten Salt Containment in CSP-GEN3 Systems
 Touchstone Research Laboratory Ltd. – Triadelphia, WV
TOTAL: \$225,000 • DOE SHARE: \$225,000

Coal Core Composites for Low Cost, Light Weight, Fire Resistant Panels and Roofing Materials
 Semplastics EHC, LLC – Oviedo, FL
TOTAL: \$224,880 • DOE SHARE: \$224,880

Efficient Process for the Production of High Conductivity, Carbon-Rich Materials from Coal
 Physical Sciences, Inc. – Andover, MA
TOTAL: \$224,985 • DOE SHARE: \$224,985

Pilot-Scale Testing of the Hydrophobic-Hydrophilic Separation Process to Produce Value-Added Products from Waste Coal
 The Minerals Refining Company – Richmond, VA
TOTAL: \$2,500,000 • DOE SHARE: \$2,000,000

COOPERATIVE AGREEMENT
 SBIR GRANT



Takeaways – Coal Beneficiation

- Exciting opportunities exist to expand the coal value chain
- New program - less than a year old
- Lab scale through pilot scale projects getting underway
- All projects have industry involvement

Stakeholder involvement essential for transition of technologies to industry



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https://www.netl.doe.gov/Coal_Beneficiation

