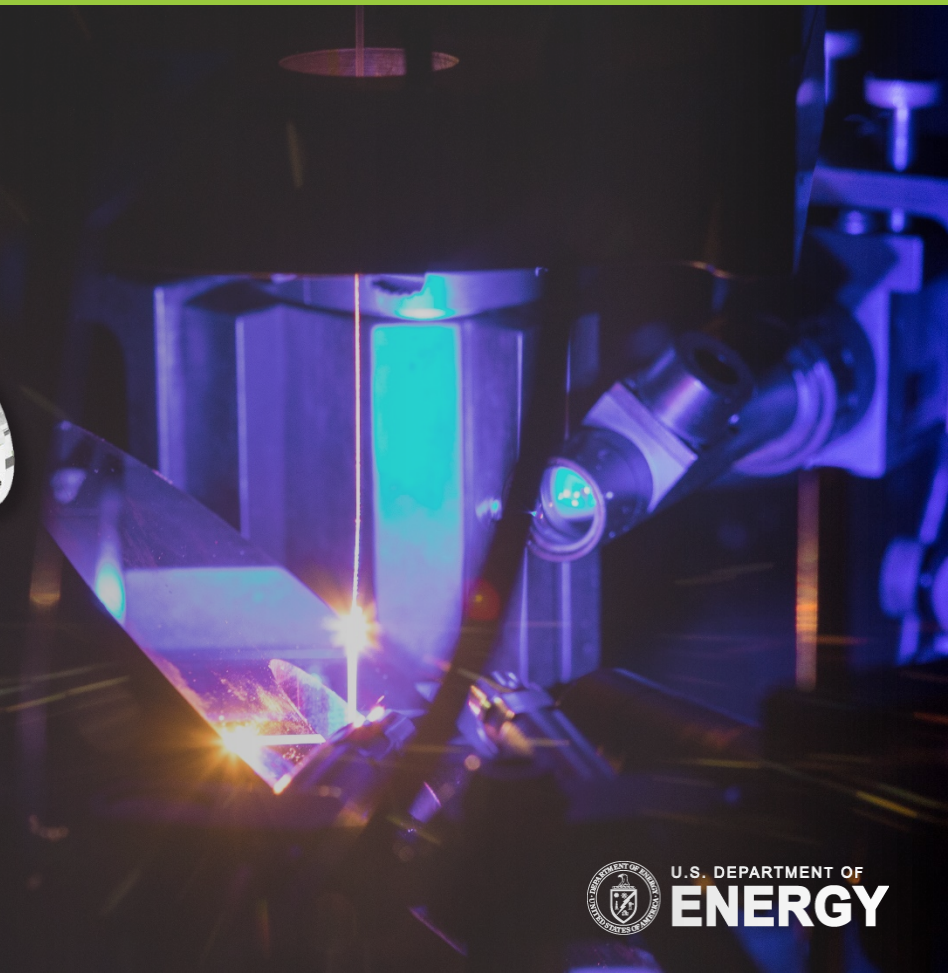
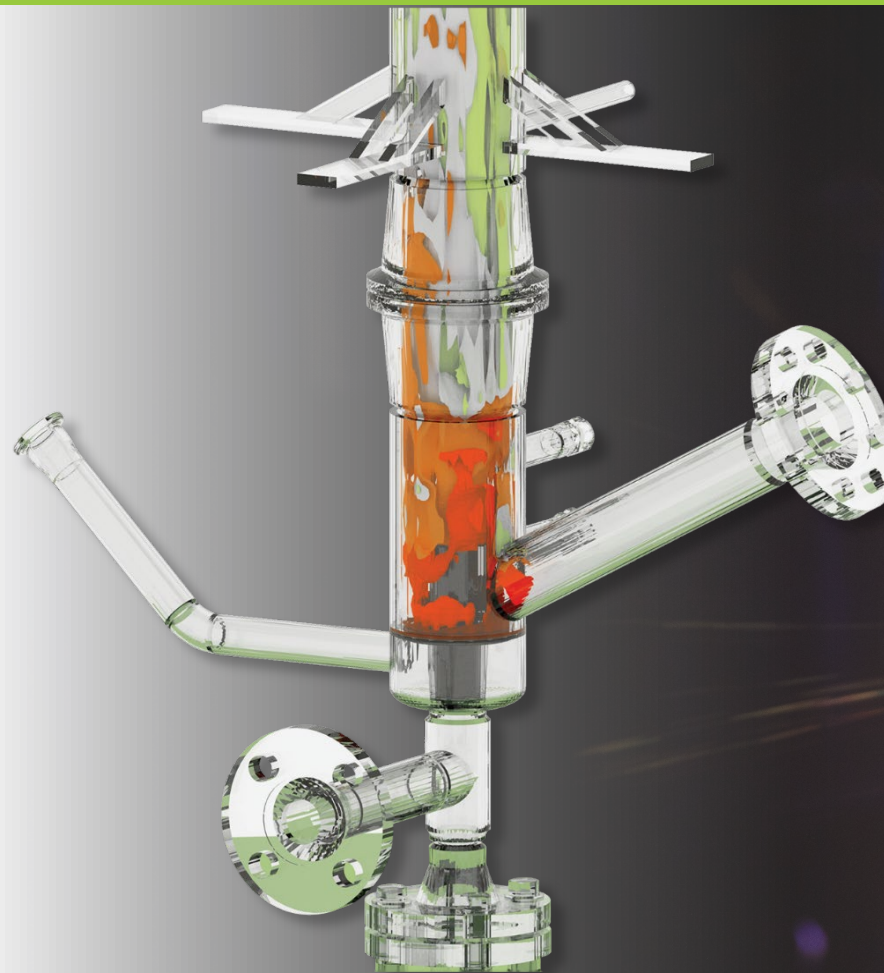


# How to Partner With NETL



Solutions for Today | Options for Tomorrow

Michael Knaggs & James Ferguson  
Strategic Partnerships



# Mission

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

# Vision

Be the Nation's renowned fossil-energy science and engineering resource, delivering world-class technology solutions today and tomorrow



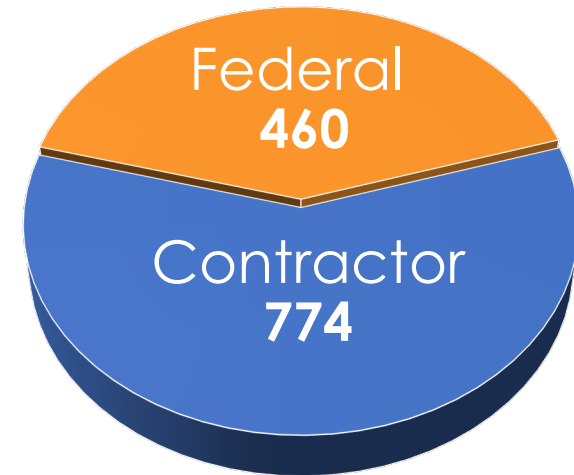
# NETL Snapshot

**NETL** is...

**900+** R&D projects/**50** states

**3** labs across U.S.

**\$1.03B** FY19 budget



**FTE WORKFORCE**

**NETL** possesses an array of authorities to manage & implement complex R&D programs

- Program planning, development, and execution
- Legal, Financial, Procurement and Head of Contracting Authority (HCA)
- Project Management Expertise

# NETL Infrastructure

Snapshot



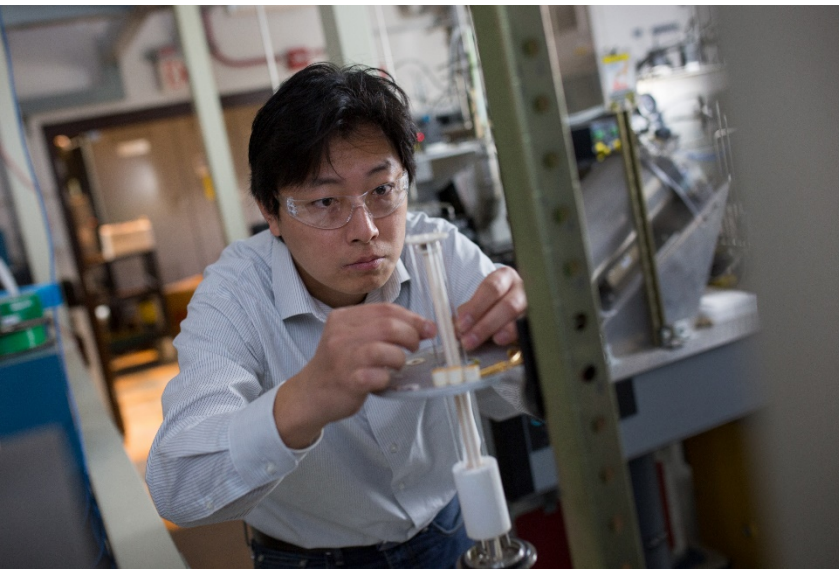
**165**  
laboratories

**1.1 million ft<sup>2</sup>**  
of building space

**237**  
acres of land

**112**  
buildings  
& structures

**\$550 million**  
replacement value





# NETL Budget

## FY 2019 Budget

\$1.03 Billion (10/1/2018 – 9/30/2019)

### Coal Program

Carbon Capture	\$101M
Carbon Storage	\$ 98M
Adv. Energy Systems	\$130M
Crosscutting Research	\$ 56M
NETL Coal R&D	\$ 36M
Rare Earth Elements	\$ 18M
STEP (sCO2 Electric Power)	\$ 22M
Transformational Coal Pilots	\$ 25M

### Oil & Gas Program

Natural Gas Technologies	\$ 51M
Unconventional FE Tech.	\$ 46M

### FE Program Support

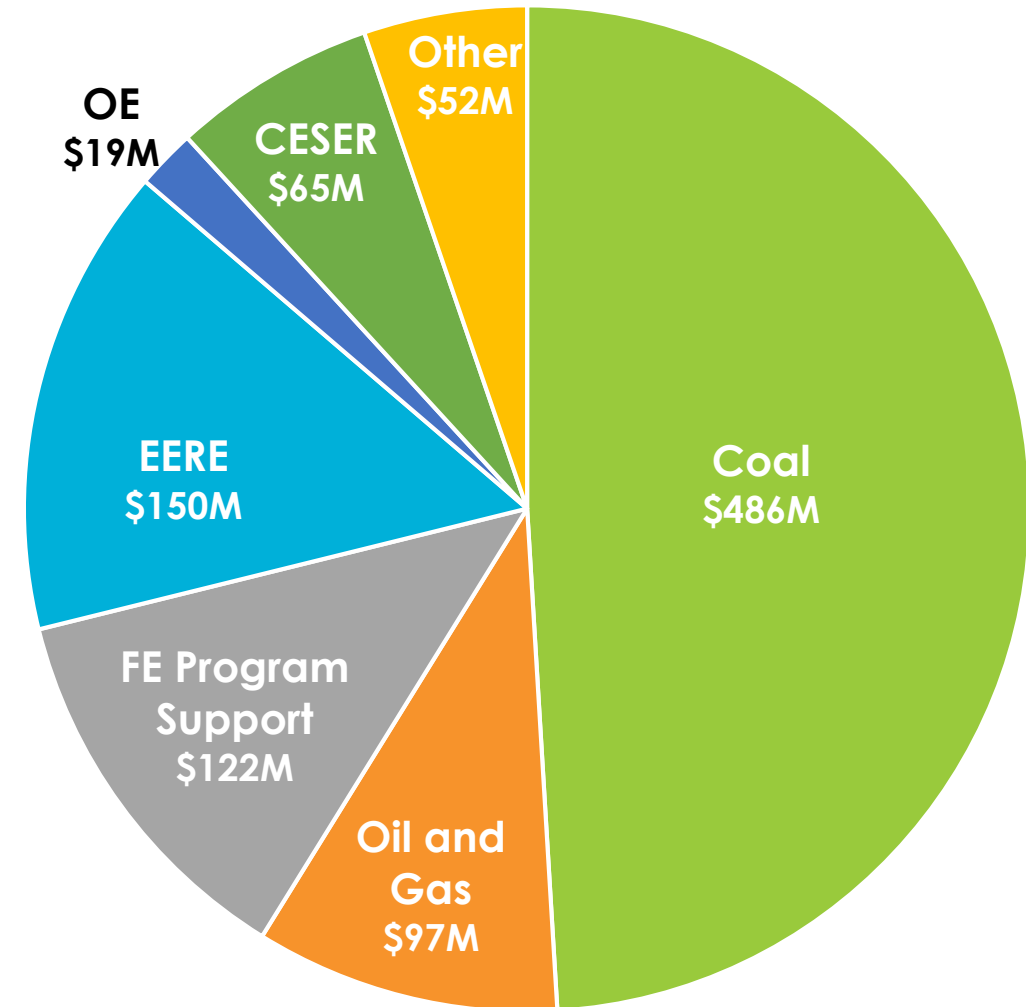
Program Direction	\$ 27M
NETL Research & Ops.	\$ 50M
NETL Infrastructure	\$ 45M

### Non-Fossil Programs

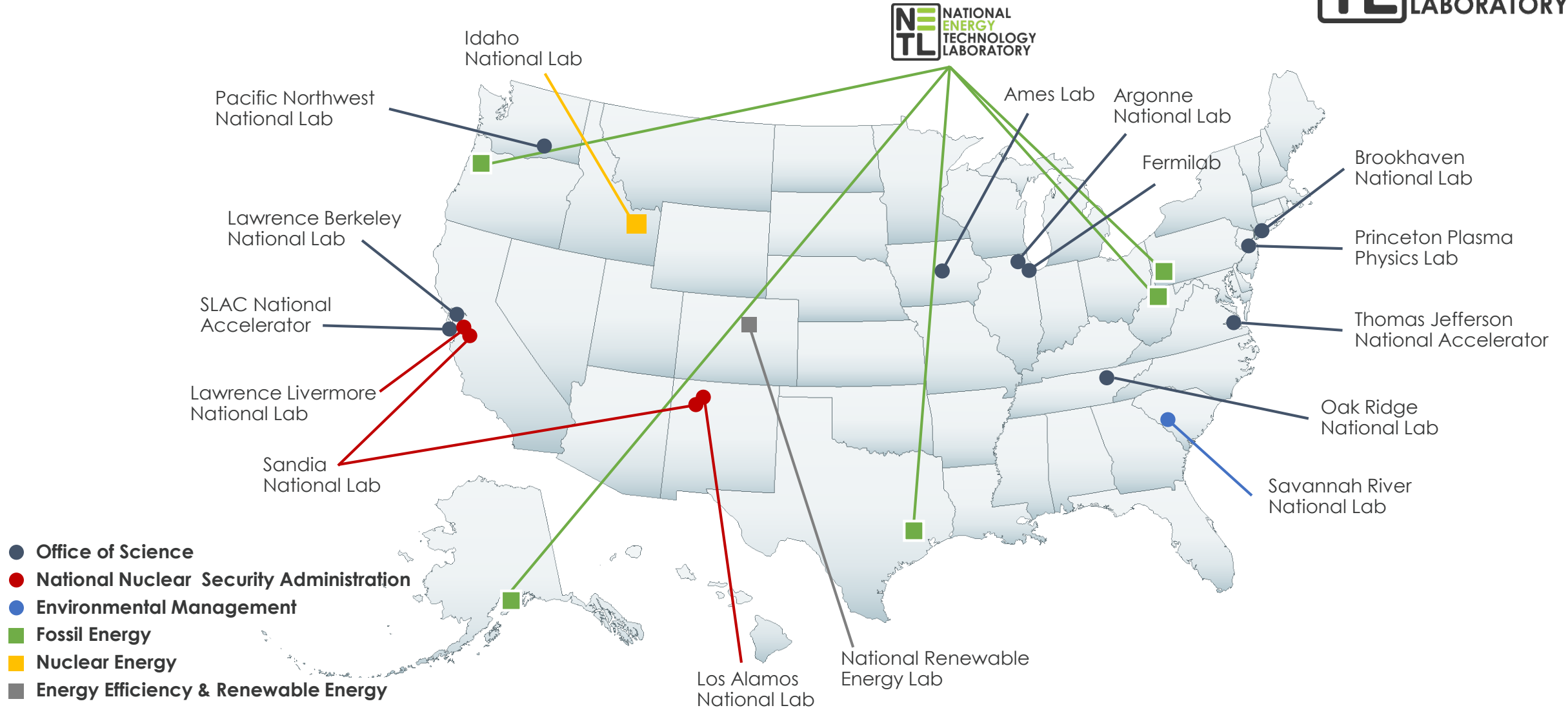
EERE (Efficiency & Renewables)	\$150M
Office of Electricity	\$ 19M
CESER (Cybersecurity)	\$ 65M

### Strategic Partnerships

Other	\$ 52M
-------	--------



# The DOE National Laboratory System





# NETL Key Research Areas by Site

Multiple Sites Operating as 1 Lab



OREGON

- Materials Performance
- Multi-environment Materials Characterization
- Alloy Development/Manufacture
- Geospatial Data Analysis



PENNSYLVANIA

- Process Systems Engineering
- Decision Science
- Functional Materials
- Environmental Sciences
- Energy Systems Optimization



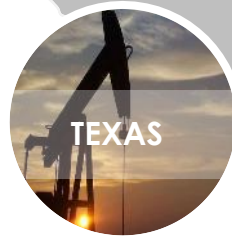
WEST VIRGINIA

- Energy Conversion Devices
- Simulation-Based Engineering
- *In-Situ* Materials Characterization
- Supercomputer Infrastructure
- Diagnostics, Sensors, and Controls



ALASKA

Oil and Gas Strategic Office



TEXAS

Oil and Gas Strategic Office

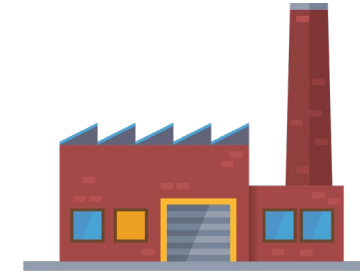
# Science & Technology Strategic Initiatives



**HIGH EFFICIENCY LOW EMISSION  
POWER GENERATION**



**FOSSIL ENERGY INTEGRATION,  
OPTIMIZATION, and RESILIENCY**



**MANUFACTURING HIGH-VALUE CARBON  
PRODUCTS from DOMESTIC COAL**

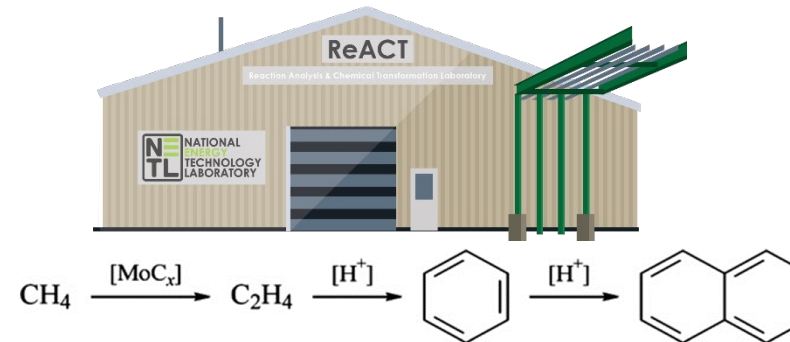
Graphene  
Inks/Fluids

Carbon  
Quantum Dots

Nanocomposite  
Plastics



**REAL-TIME DECISION SCIENCE for  
the SUBSURFACE**



**NATURAL GAS to VALUE-ADDED  
PRODUCTS**



# Partnering with NETL

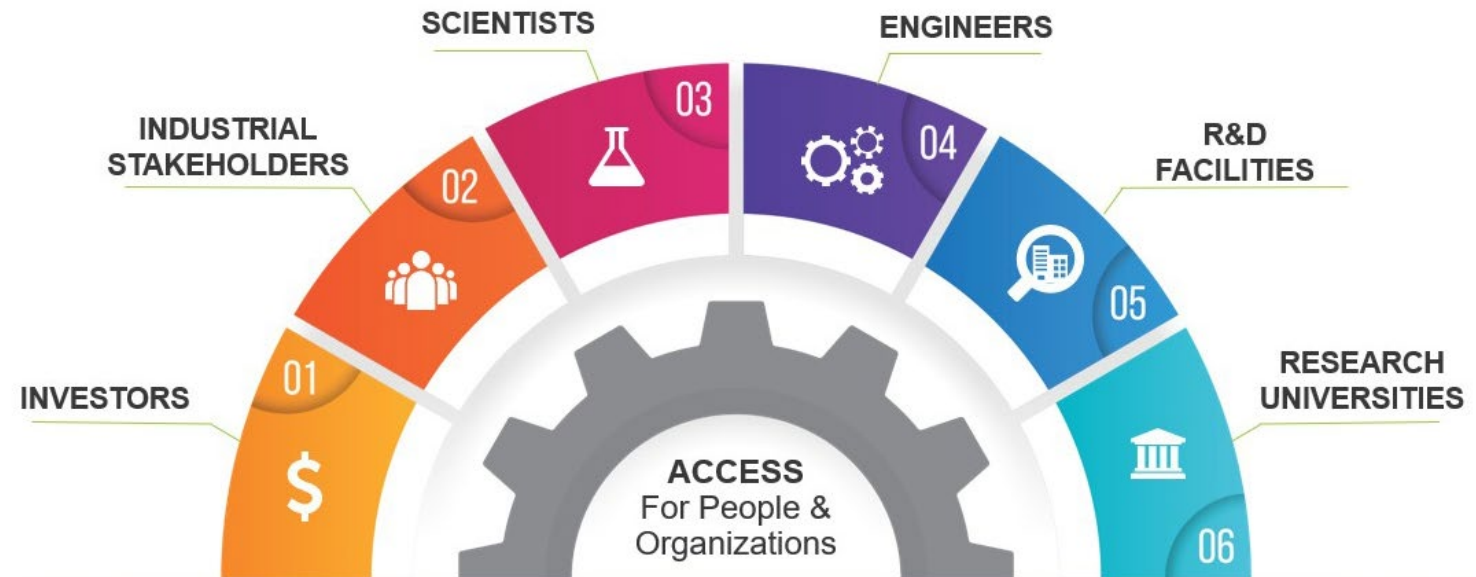
## People, Facilities, & Technologies



NETL supports technology commercialization by:

- Enabling technology breakthroughs
- Creating public-private partnerships
- Informing technology pathway & policy decisions
- Enhancing U.S. technology leadership & global competitiveness

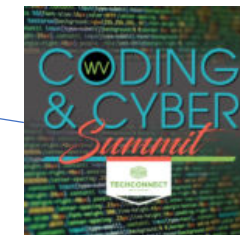
NETL is the nation's only national laboratory devoted to enabling & accelerating fossil energy technology discovery, development, & deployment.



# NETL and West Virginia Partnerships



WV Innovation and Entrepreneurship Day



● = Rare Earth Elements Sampling

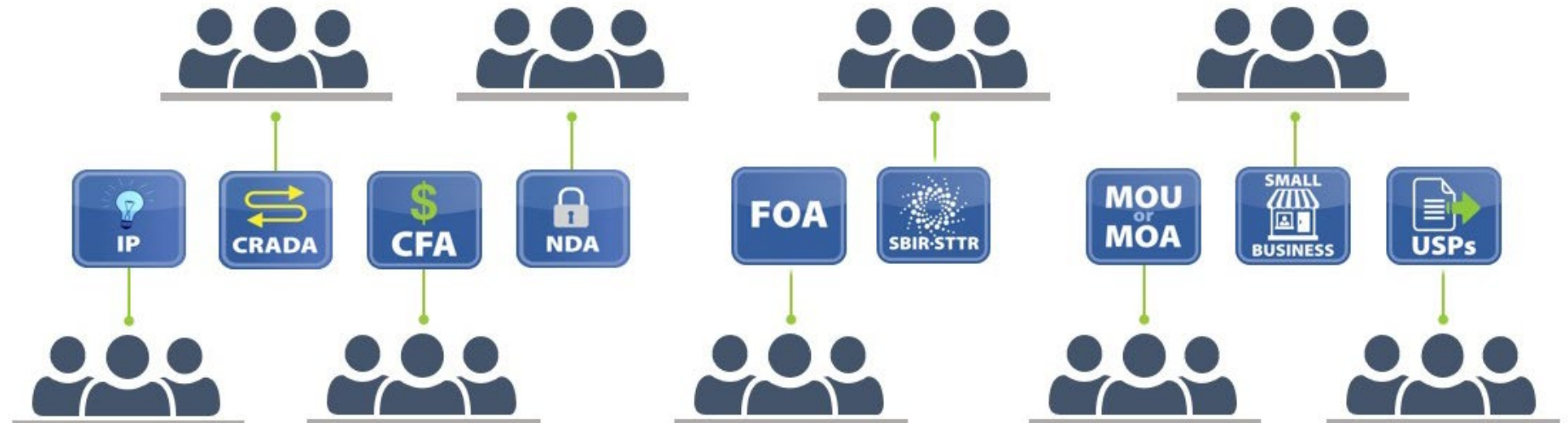


# Partnering with NETL

People, Facilities, & Technologies

## Mechanisms NETL uses to enable collaboration include:

- Non-Disclosure Agreements (NDAs)
- Cooperative Research and Development Agreements (CRADAs)
- Memorandum of Understanding/Agreement (MOU/MOA)
- Contributed Funds-in Agreement (CFA)
- Funding Opportunity Announcements (FOA) and Small Business Technology Transfer (SBIR/STTR)
- Licenses







# Toolbox



## Working with NETL

## How to Work With NETL

### Cooperative Research and Development Agreements (CRADA)

CRADAs allow for joint R&D performed by NETL and participant researchers. Background intellectual property (IP) protection is included for both parties and CRADA developed IP is addressed. CRADAs offer participants the right of first refusal to an exclusive license for jointly developed IP. Cost sharing between NETL and CRADA participant is essential. Small businesses are given preferential consideration.

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

### Contributed Funds-In Agreements (CFA)

Like CRADAs, CFAs are agreements between the federal government and private sector participants to work together on a mutually beneficial project. However, in a CFA, the private sector participant provides funds to NETL for a specific scope of work to be completed. At the end of the project, NETL reports research findings back to the participant.

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

### Memoranda of Understandings (MOU) or Memoranda of Agreements (MOA)

MOUs and MOAs are written agreements between NETL and other entities that state the scope of work for a specific project or state the terms of a partnering relationship. Parties to these agreements may include other federal agencies, local, state, international, or other government entities; the private sector; and educational institutions. Actual implementation of the understandings established by the MOU or MOA must be accomplished through a legally binding instrument such as an interagency agreement, contract or other appropriate agreement between the parties (as applicable).

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

### Non-Disclosure Agreements (NDA) & Non-Analysis Agreements (NAA)

NDAs are used when NETL and/or another party wish to exchange information that is either considered potentially patentable by NETL or proprietary by the other party. NETL is bound to information confidential by the Trade Secrets Acts (18 USC Sec. 1905). However, NETL will enter into an NDA that reiterates this protection. NDA may be unilateral or bi-lateral. NETL only executes its own NDAs.

NAA's protect NETL patented technology that is shared with another party for a pre-negotiated purpose, such as testing or further research. The other party agrees not to analyze the technology to determine composition, use the technology for commercial purposes, or transfer the technology to another party.

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



### Licenses

Licenses transfer NETL-owned intellectual property (IP) from the government to the private sector. NETL looks for licensing partners with a plan for technology development and marketing, with a high probability for technology commercialization and sharing IP benefits with the public.

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



### Small Business Innovation Research (SBIR) & Small Business Technology Transfer (STTR) Programs

SBIR and STTR are U.S. government programs in which federal agencies with funding for small businesses only. Small businesses that win awards in these programs keep the rights to any technology developed and are encouraged to commercialize the technology.

The SBIR and STTR programs have three distinct phases. Phase I explores the feasibility of innovative concepts with awards up to \$150,000 for about 9 months. Only Phase I award winners may compete for Phase II, the principal R&D effort, with awards up to \$1,000,000 over a two-year period. There is also a Phase III, in which non-federal capital is used by the small business to pursue commercial applications of the R&D. Federal agencies may award non-SBIR/STTR-funded, follow-on grants or contracts.

 [www.netl.doe.gov/node/3493](http://www.netl.doe.gov/node/3493)



### Funding Opportunity Announcements (FOA) & Financial Assistance Awards (FA)

A FOA is a notice of a federal grant funding opportunity. NETL uses FedConnect and/or Grants.gov and FedBizOpps to post solicitations FOAs and amendments related to the energy sector receive proposals and applications, and disseminate award information. Proposals accepted only as indicated in the solicitation document.

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

FAs support specific research activities conducted outside of NETL, resulting in cooperative agreements or grants. FAs may be unsolicited or the result of the competitive FOA process.

 <https://www.netl.doe.gov/node/5719>



### Unsolicited Proposals (USP)

A USP is an application for support of an idea, method, or approach is submitted by an individual, business, or organization, based solely on the proposer's initiative rather than in response to a DOE solicitation. Funding of unsolicited proposals is considered a noncompetitive action.

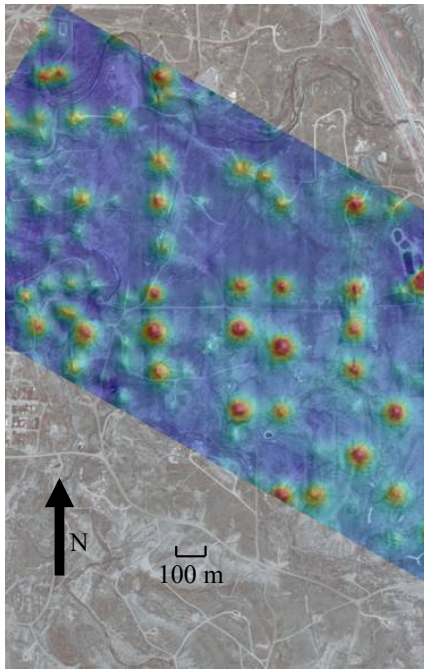
 [www.netl.doe.gov/business/unsolicited-proposals](http://www.netl.doe.gov/business/unsolicited-proposals)

Michael Knaggs

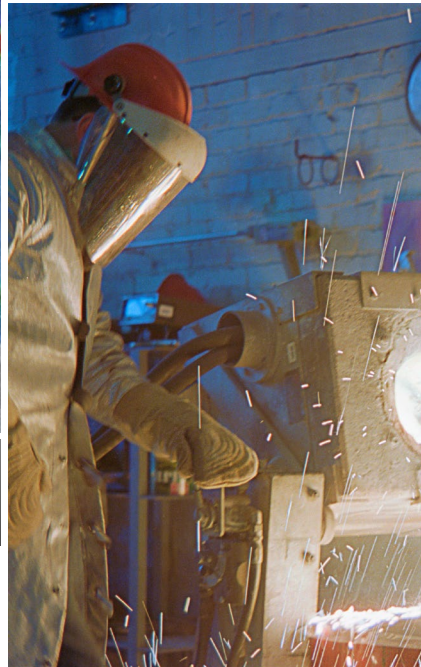
Associate Director of Strategic Partnerships  
Michael.Knaggs@netl.doe.gov



# NETL Research: Competencies & Capabilities



Geological & Environmental Systems



Materials Engineering & Manufacturing



Energy Conversion Engineering



Computational Science & Engineering

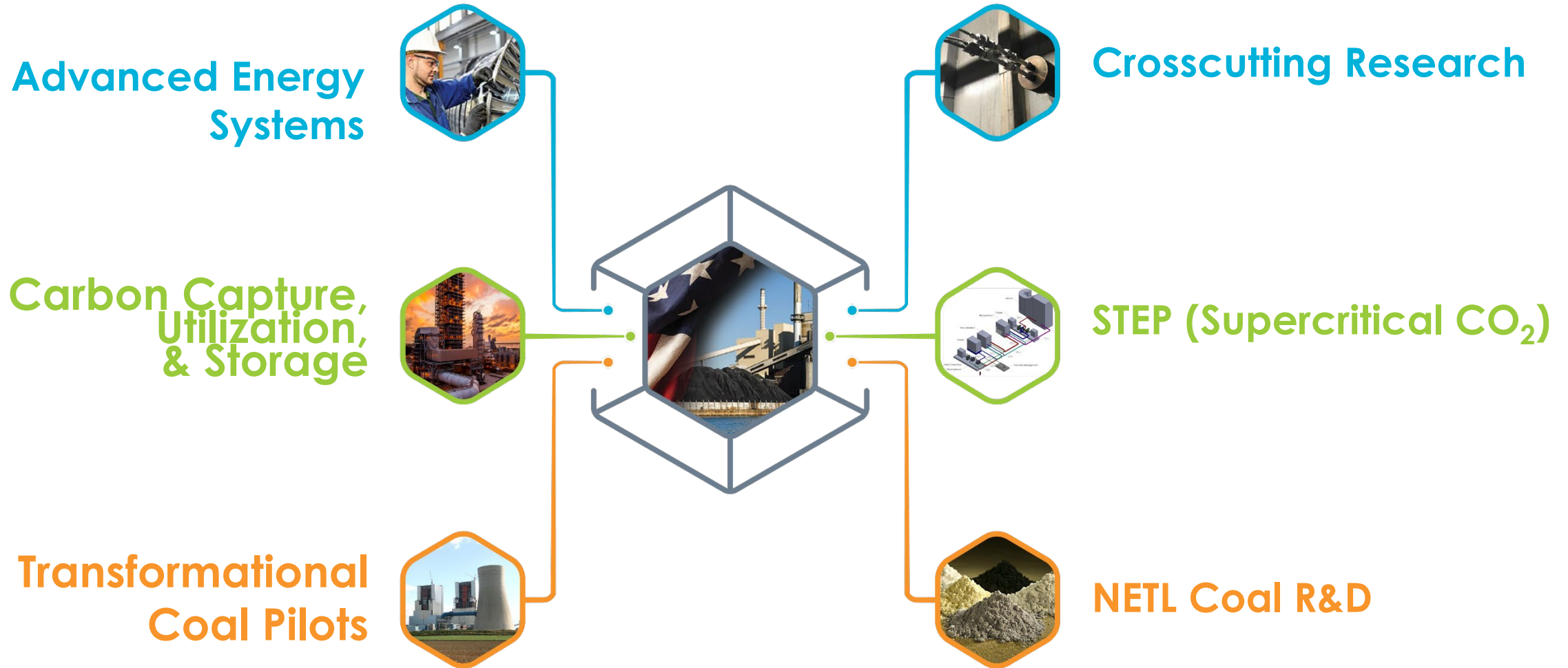


Systems Engineering & Analysis



Program Execution & Integration

# Coal Technology Thrusts



# Oil & Gas Technology Thrusts





# EERE, OE, and CESER Technology Thrusts



## Energy Efficiency & Renewable Energy (EERE)



Vehicles



Solid State Lighting



Geothermal

## Office of Electricity (OE)



Grid R&D



Energy Storage

## Cybersecurity, Energy Security, and Emergency Response (CESER)



Energy Security & Restoration



Cybersecurity

# Funding Opportunity Announcements

- **Funding Opportunity Announcements** (FOAs) are NETL notice of a competitive federal financial assistance funding opportunity.
- NETL uses **FedConnect.net**, **Grants.gov** and **FedBizOpps.gov** to post FOAs and amendments, to receive proposals and applications, and to disseminate award information.
- Proposals and applications are **only accepted electronically through FedConnect.net or Grants.gov** as indicated in the FOA document.

## Future Opportunities:

For a list of **NETL's open funding opportunities** please visit:

<http://www.netl.doe.gov/business/solicitations/index.html>

Interested parties may **register through this NETL Business page** to receive routine notification of new FOA opportunities.

# Non-Disclosure Agreements (NDAs)

- **Non-Disclosure Agreements (NDAs)** are sometimes referred to as confidentiality agreements, and are used when NETL and/or another party wish to exchange information that is either considered potentially patentable by NETL, or proprietary by the other party.
- NETL is bound to maintain information received in the course of business confidential by the **Trade Secrets Act** (18 USC Section 1905). **Therefore, an NDA is not required for Federal employees to receive proprietary information from other organizations.**
- **However, NETL will enter into an NDA that encompasses the Trade Secrets Act.**
- NDAs may be unilateral or bilateral, depending on the circumstances. NETL only executes its own NDAs.



# SBIR-STTR Program

Stimulate High-Tech Entrepreneurial Innovation



## SBIR – Small Business Innovation Research STTR – Small Business Technology Transfer

### Program Characteristics:

- Limited Competition
- Intellectual Property (IP) and data rights specific to SBIR-STTR
- Potential for progressive funding through phases

**Contacts:** **Maria Reidpath**  
**NETL SBIR/STTR Coordinator**  
**304-285-4140**  
**[maria.reidpath@netl.doe.gov](mailto:maria.reidpath@netl.doe.gov)**

Douglas Archer  
FE SBIR/STTR Portfolio Manager  
301-903-9443  
[douglas.archer@hq.doe.gov](mailto:douglas.archer@hq.doe.gov)

### One Idea – Three Phases:

- **Phase I:** Proof of Concept / Feasibility
- **Phase II:** Prototype of Innovative Concept
  - Phase IIA: Continue R&D within scope
  - Phase IIB: Continue R&D beyond scope towards commercialization
- **Phase III:** Pursuit of commercial application (non-SBIR-STTR funding is used, i.e. private or other governmental funding)

### More Information:

- Mailing list go to <http://science.energy.gov/sbir/> notifications release of topics, FOAs, webinars, other updates
- Announcement of Topic and FOA Release at <http://science.energy.gov/sbir/funding-opportunities/>

# NETL Available Technologies for R&D and Licensing



- NETL has a number of technologies and inventions available for further research & development and/or licensing
- To search the NETL inventions database, please visit:  
[netl.doe.gov/business/tech-transfer/available-technologies](https://netl.doe.gov/business/tech-transfer/available-technologies)
- For more information, and for inquiries, please e-mail:  
[techtransfer@netl.doe.gov](mailto:techtransfer@netl.doe.gov)

## What Can I Do Next?



# Partnering with NETL



## What You Can Do Next:

- Request an **introductory meeting and a lab tour**
  - **NETL will organize a meeting with management and researchers, and will provide a customized lab tour aligned to your technical interests.**

## What You Can Do Next:

- Attend **peer reviews, workshops, conferences, technical forum, etc.**
  - NETL holds periodic technical events which open to the public or by invitation.

## What You Can Do Next:

- Apply for **competitive, cost-shared funding opportunities**

### Future Opportunities:

For a list of NETL's open funding opportunities please visit:

<http://www.netl.doe.gov/business/solicitations/index.html>

Interested parties may register through this NETL Business page to receive routine notification of new FOA opportunities.

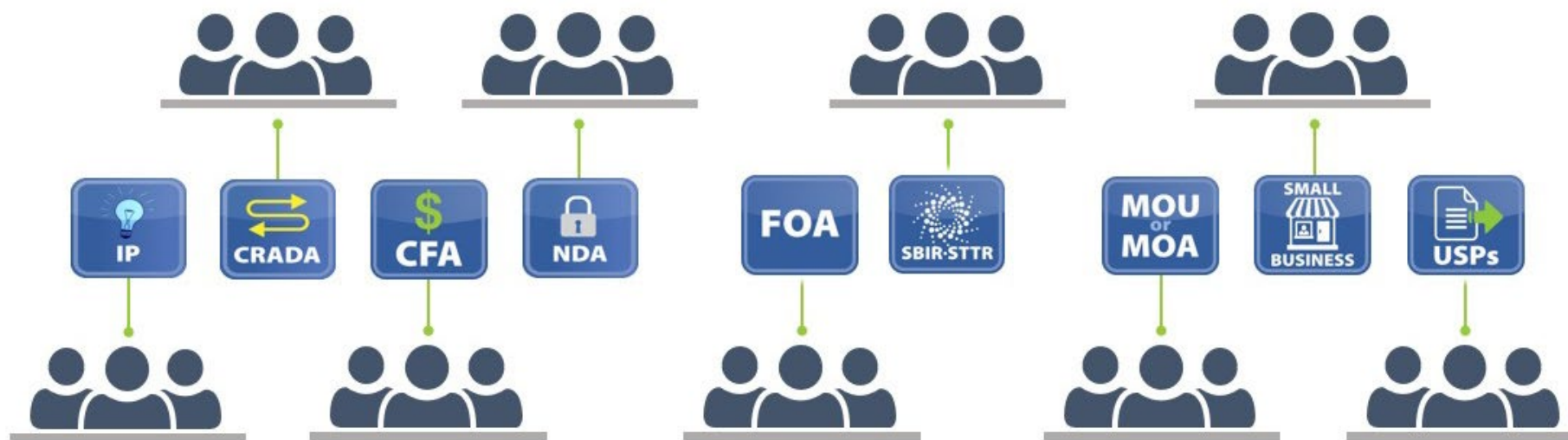


# Partnering with NETL

## Summary

NETL actively seeks partners to:

- Collaborate on **research & development**, and **technology innovation** through agreements (CRADAs, CFAs, etc.)



## What You Can Do Next:

- Assist on **education & outreach activities**, including **K-12 STEM education** and the **Science Bowl**
  - **NETL visits numerous K-12 schools throughout the year, and conducts the West Virginia Science Bowl early each calendar year (usually January – April).**
  - **Volunteers and sponsors are welcome and needed!**

# Contact Information



***For More Information, Contact James Ferguson***

***James.Ferguson@netl.doe.gov***

***(412) 386-6043***

***www.netl.doe.gov***





# THANK YOU FOR ATTENDING!

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VISIT US AT: [www.NETL.DOE.gov](http://www.NETL.DOE.gov)

 @NETL\_DOE

 @NETL\_DOE

 @NationalEnergyTechnologyLaboratory



U.S. DEPARTMENT OF  
**ENERGY**

# Back-up Slides

# Fossil Energy Priorities



## **Develop the Coal Plants of the Future**

Advancing small-scale modular coal plants of the future, which are highly efficient and flexible, with near-zero emissions



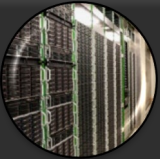
## **Modernize the Existing Coal Fleet**

Improving the performance, reliability, and efficiency of the existing coal-fired fleet



## **Reduce the Cost of Carbon Capture, Utilization, and Storage (CCUS)**

Reducing the cost and risk of CCUS to enable wider commercial deployment



## **Advance Big Data**

Optimizing recovery of oil and gas resources with real-time analysis and machine learning



## **Energy-Water Nexus**

Improving our efficient use of scarce water resources



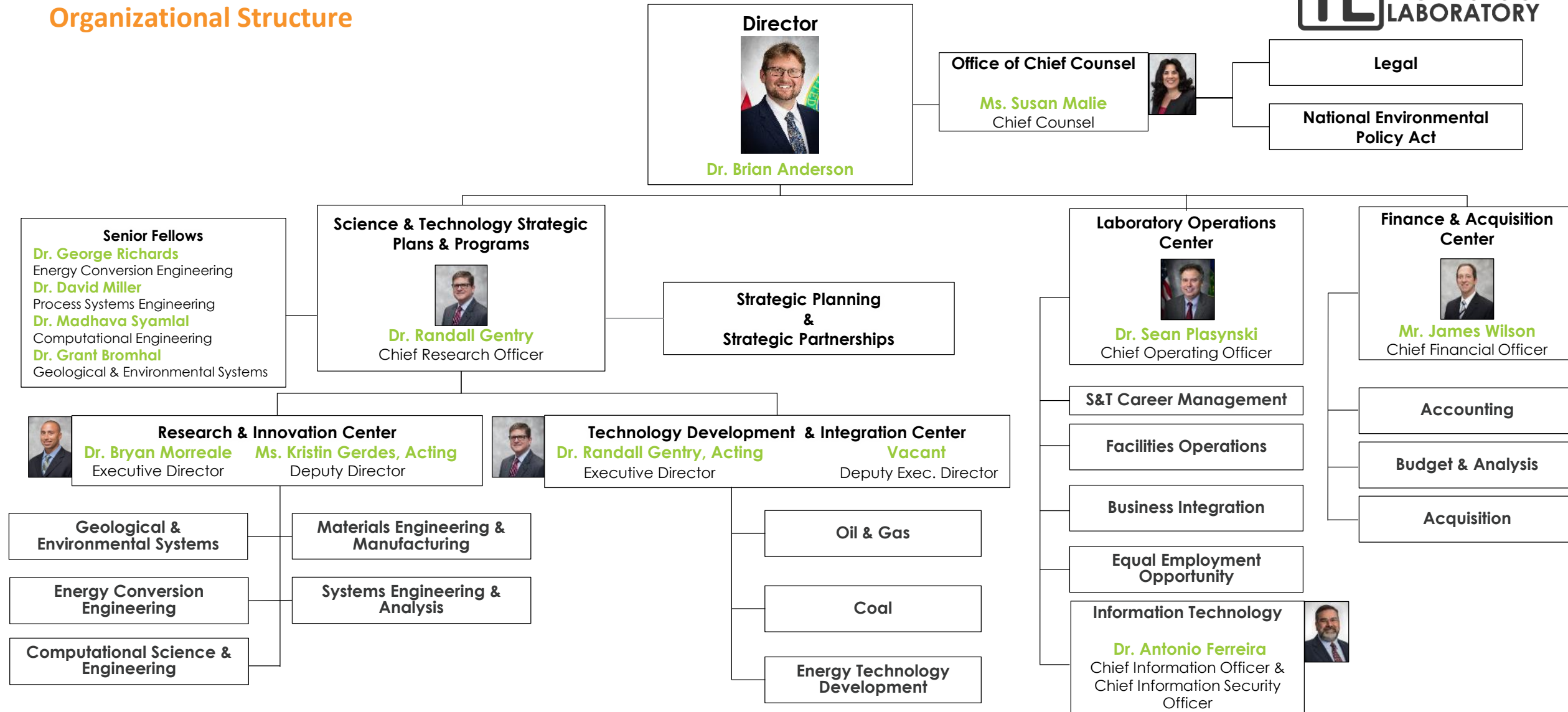
## **Strategic Petroleum Reserve**

Maintaining drawdown readiness while completing Life Extension 2, carrying out mandated crude oil sales, and investigating new ways to monetize the asset

# National Energy Technology Laboratory

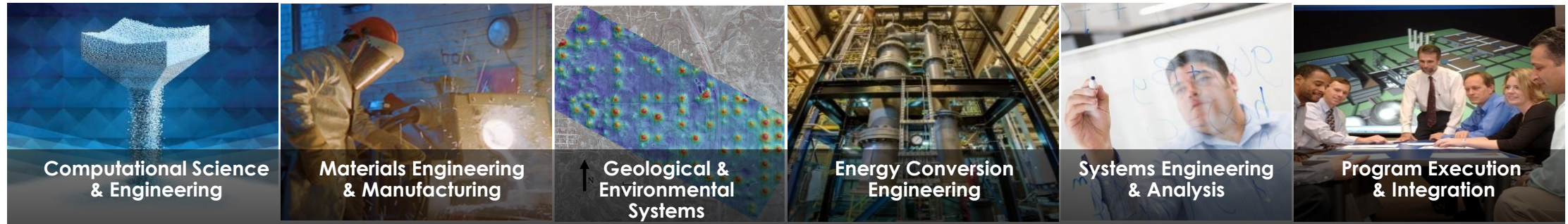


## Organizational Structure



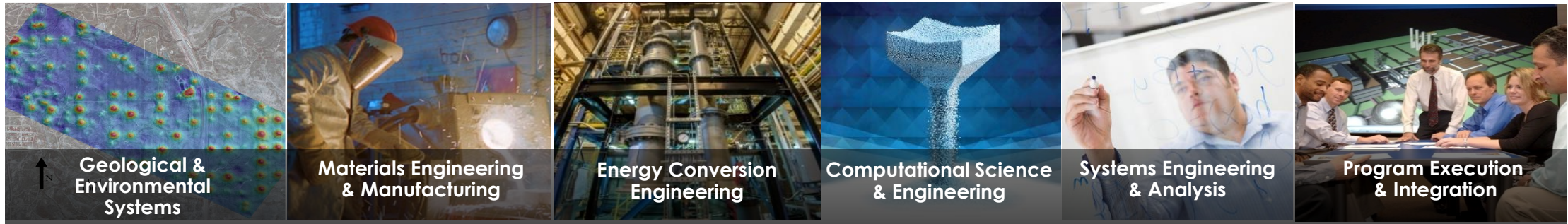


# Core Competencies & Technology Thrusts



<p><b>COAL</b></p>	Carbon Storage 	Carbon Capture 	Sensors & Controls 	Advanced Materials 	Advanced Computing 	Advanced Energy Systems 	Water Management 	Rare Earth Elements 
<p><b>OIL &amp; GAS</b></p>	Enhanced Resource Production 	Environmentally Prudent Development 	Methane Hydrates 	Offshore 	Natural Gas Infrastructure 	Unconventional 		
<p><b>Support to Other DOE Offices</b></p>	<b>Energy Efficiency &amp; Renewable Energy (EERE)</b> Vehicles     Solid State Lighting     Geothermal			<b>Office of Electricity (OE)</b> Microgrid     Energy Storage		<b>Cybersecurity, Energy Security, and Emergency Response (CESER)</b> Energy Security & Restoration     Cybersecurity		

# NETL Research: Capabilities and Technologies



- Subsurface Research, Analysis and Characterization
- Data Analytics / Machine Learning / Decision Science
- Next Generation Materials for Harsh Environments
  - Advanced Alloys, Superalloys, High-Entropy Alloys, etc.
- Advanced Manufacturing
  - additive manufacturing/3D printing, smart manufacturing, modular chemical process intensification
- CO<sub>2</sub> Capture with Membranes, Solvents and Sorbents
- Advanced Sensors and Controls for Harsh Environments
- Emissions Mitigation / Environmental Impacts
- Catalysts to Convert CO<sub>2</sub> into High-Value Products
- Coal to High-Value Products / Rare Earth Elements

- High Pressure Combustion / Advanced Cooling Technology
- Thermal Science and Heat Transfer
- Solid Oxide Fuel Cells and Hybrid Energy Systems
- Reaction Activation and Chemical Transformation
- Computational Materials Engineering & Molecular Science
- Multi-Scale Modeling, Simulation & Optimization
- Process Systems Engineering and Analysis
- Grid Modeling and Analysis / Grid Modernization
- Institute for the Design of Advanced Energy Systems
- Multiphase Computational Fluid Dynamics Modeling
- Customized Analyses, Assessments and Studies

# Technology Development Pathway

An Active Portfolio from Concept to Market Readiness

## COMMERCIALIZATION

Technology available  
for wide-scale market use

TRL 9

## DEMONSTRATION

System demonstrated  
in operational environment

TRL 8

## SYSTEM TESTING

System performance  
confirmed at pilot-scale

TRL 6-7

## DEVELOPMENT

Technology component  
validated/integrated

TRL 4-5

## DISCOVERY

Concept identified/proven at  
laboratory-scale

TRL 1-3

TECHNOLOGY MATURATION

- ↑ Scale
- ↑ Technology Confidence
- ↑ Investment
- ↑ Private Sector Cost Share

Fundamental Studies



Tools

## KNOWLEDGE-BASED DECISION MAKING

- **Systems Engineering and Integration**
  - Engineering analysis
  - Pre-FEED/FEED studies
  - NEPA
- **Decision Science and Analysis**
  - Screening studies
  - Techno-economic analysis
  - Technology Readiness Assessments



# Coal Technology Thrusts

## Advanced Energy Systems

Developing & deploying advanced, more efficient, & robust coal-based power technologies to optimize the use of our abundant domestic fossil energy resources & leverage existing infrastructure.



## Carbon Capture, Utilization, & Storage

Advancing technologies & techniques to effectively capture, safely store, & economically utilize CO<sub>2</sub> derived from power generation & other industrial processes.



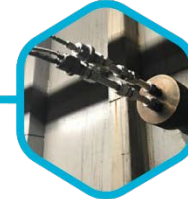
## Transformational Coal Pilots

Developing pilot-scale transformational coal technologies aimed at enabling step-change improvements in coal-powered systems accelerating their readiness for the marketplace.



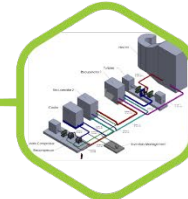
## Crosscutting Research

Accelerating science & engineering-based solutions across multiple operational platforms to optimize plant performance, reduce O&M costs & water consumption, & develop the next-generation of structural & functional materials.



## STEP (Supercritical CO<sub>2</sub>)

Developing & modeling sCO<sub>2</sub> power cycles with the potential to achieve efficiencies greater than 50%, with broad applicability to fossil, nuclear, waste-heat, & concentrated solar energy power systems



## NETL Coal R&D

Developing novel extraction, processing, & manufacturing technologies to produce a cost-competitive domestic supply of rare earth elements from U.S. coal & coal by-products to sustain our Nation's robust economy.





# Oil & Gas Technology Thrusts

## Onshore Unconventional

Developing technologies to maximize resource recovery and reduce operational impacts in unconventional oil & gas plays.



## Gas Hydrates

Characterizing gas hydrate resources and developing ways to tap their massive energy potential.



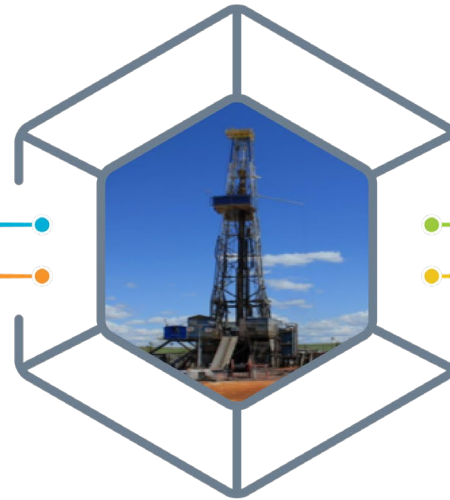
## Offshore

Minimizing the environmental impacts of deepwater and ultra-deepwater oil & gas production.



## Natural Gas Infrastructure

Developing technologies and practices to assess and mitigate methane emissions from natural gas transmission, distribution, and storage facilities.



# High Efficiency Low Emissions Power Generation

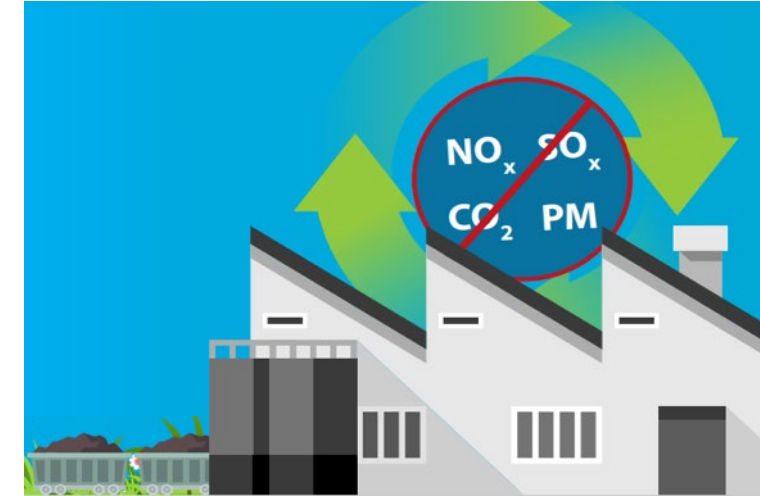
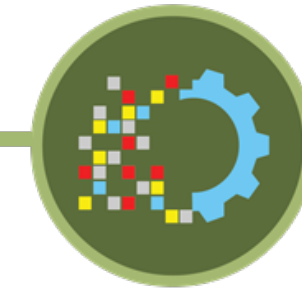
**F**lexible

**I**nnovative

**R**esilient

**S**mall

**T**ransformative



## NETL Focus Areas

- **Reduce** time required to design, construct, and commission new coal-based power systems
- **Minimize** water consumption and criteria emissions
- **Be carbon-capture ready** to reduce CO<sub>2</sub> emissions
- **Integrate** with energy storage, coal upgrading, or other opportunities for enhanced value stream realization
- **Enhance** demand responsiveness, including rapid start-up and high efficiency operation through wide range

# Fossil Energy Integration, Optimization, and Resiliency

## High-Efficiency, Cost-Effective, Fast Deployment



**HISTORICAL FOSSIL FUEL POWER PLANTS**

- Large; high capital costs
- Relatively slow deployment
- Inflexible (incapable of energy storage)
- Primarily focused on simple arrangements



**NEXT-GENERATION FOSSIL FUEL POWER PLANTS**

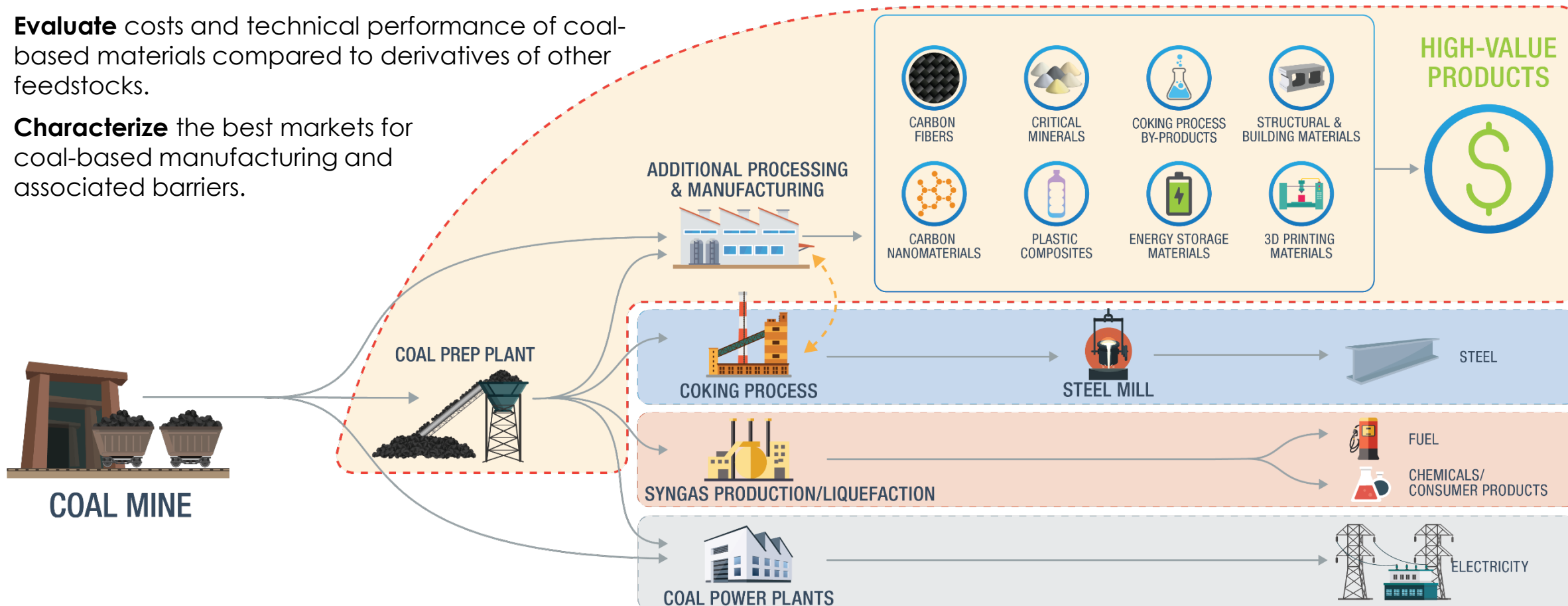
- Smaller; lower capital costs
- Faster deployment
- Higher flexibility with high efficiency at multiple loads
- Accommodating ongoing transitions from simple arrangement to complex energy systems

# Manufacturing High-Value Carbon Products from Domestic Coal

Develop and utilize carbon materials to maximize the value of domestic coal

## NETL Focus Areas

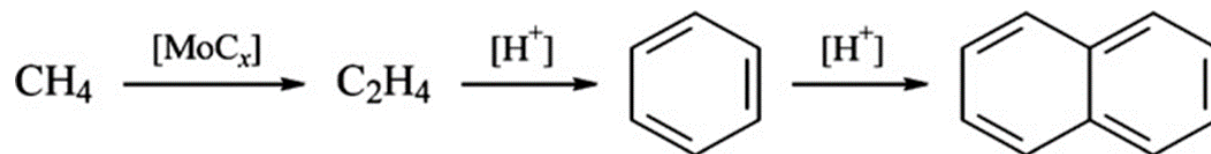
- **Identify** new manufacturing processes for converting coal into high-value products beyond traditional energy markets.
- **Evaluate** costs and technical performance of coal-based materials compared to derivatives of other feedstocks.
- **Characterize** the best markets for coal-based manufacturing and associated barriers.





# Natural Gas to Value-Added Products

## Rapid Advancement in Process Intensification Deployment (RAPID) Manufacturing Institute Project

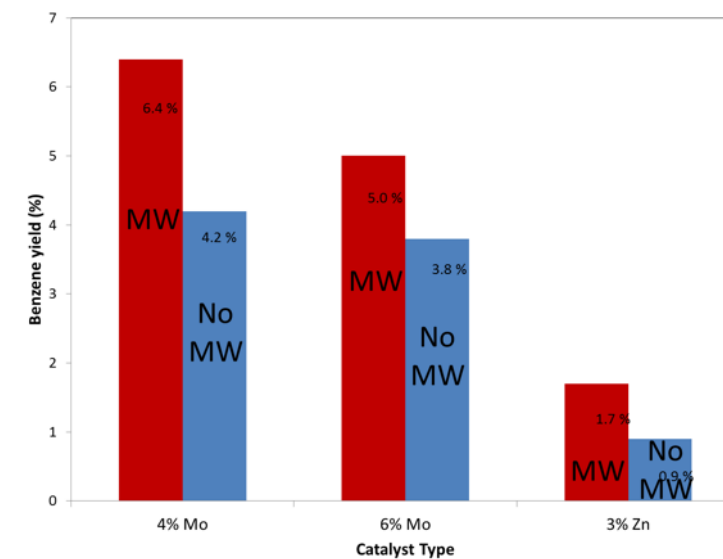


Microwave-assisted Catalysis for Process Intensified Modular  
Production of Value-Added Chemicals from Natural Gas

**Funding Agency:** DOE Advanced Manufacturing Office (AMO) thru AIChE's RAPID Institute

**Partners:** NETL, WVU, University of Pittsburgh, and Shell

**Duration:** 2018-2021 (4 Year)



## Reaction Analysis and Chemical Transformation (ReACT) facility features

Fuel flexible – gaseous hydrocarbon fuels, coal, liquid hydrocarbon fuels, biomass, coal and biomass mixtures, and syngas

Equipped with advanced diagnostics – high-speed imaging, thermal imaging and online gas analysis

Wide range of temperature and pressure (1000°C/600 psi)

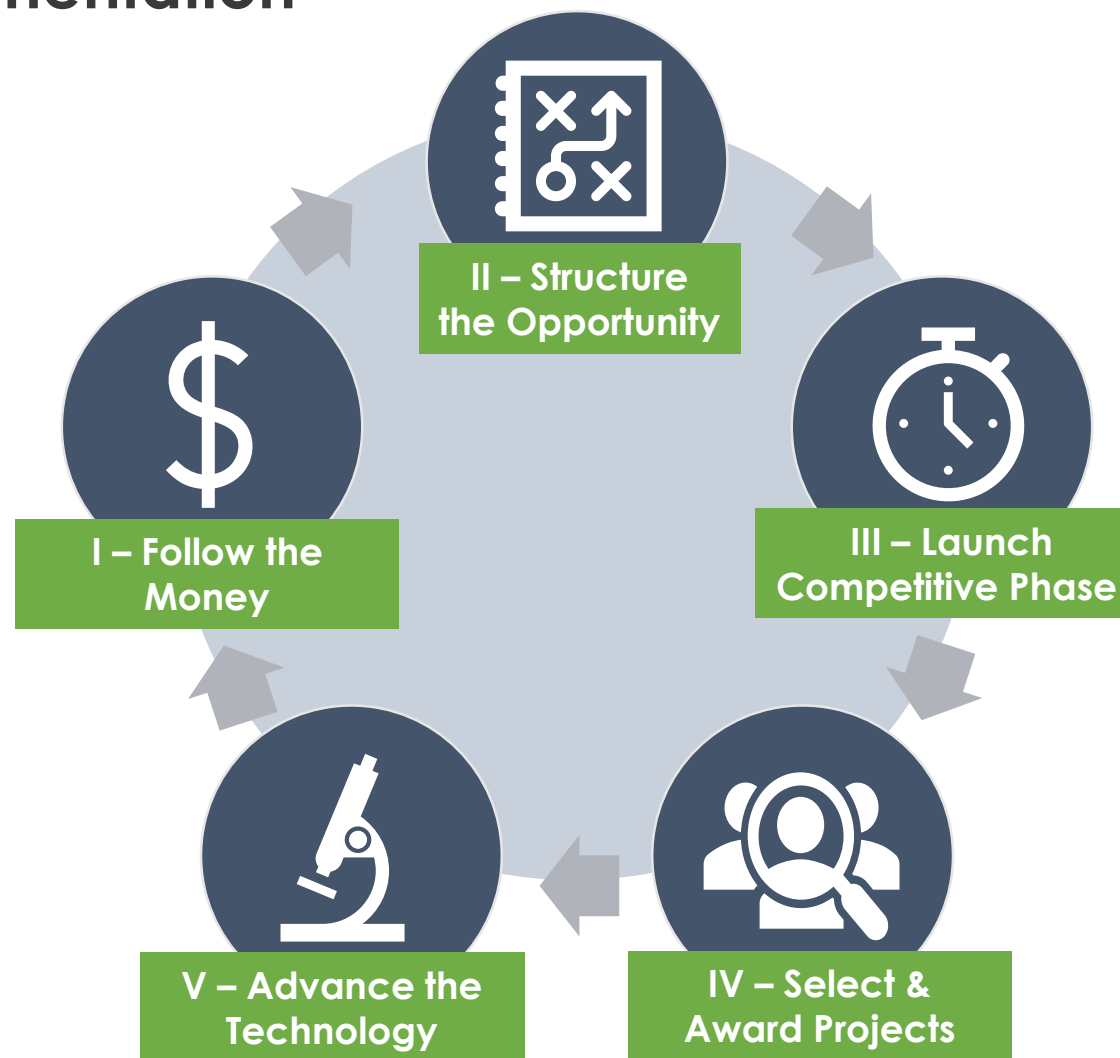
Fully automated 24/7 unattended operations

- Increase power cycle efficiency
- More power generation for less fuel
- Fewer emissions
- Optimize chemical reactor designs for specific chemical transformations



# NETL's Annual FOA Process Flow

## Planning and Implementation

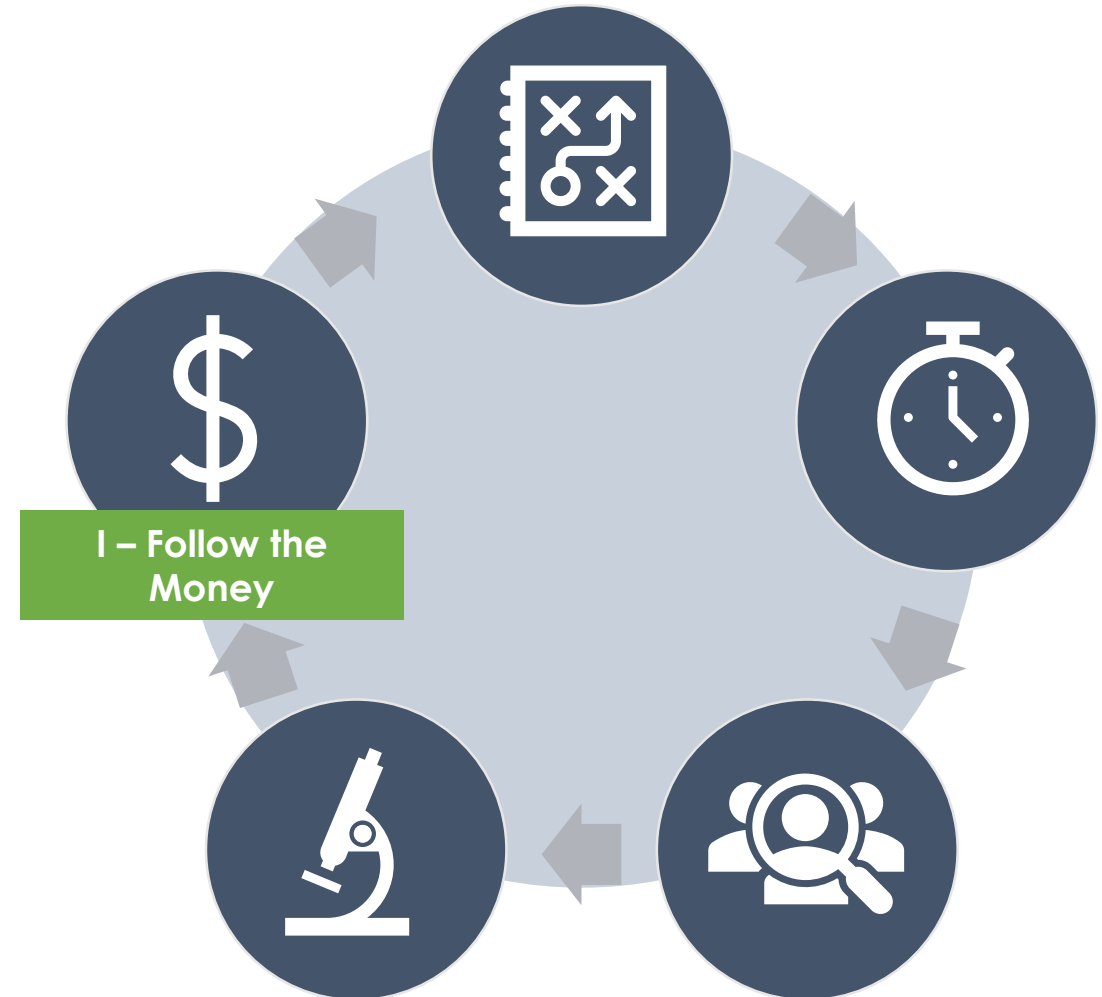


# NETL's Annual FOA Process Flow

## Planning and Implementation

### Phase I

- President's Congressional Request Budget
- House Committee Mark
- Senate Committee Mark
- Annual FY Appropriation



# NETL's Annual FOA Process Flow

## Planning and Implementation

### Phase II

- **Generate Annual Spend Plan for all Technology Areas**
- **Complete Acquisition Planning Process**
- **Identify Portfolio of FOAs to be Initiated**
- **Schedule FOA Critical Path Milestones**



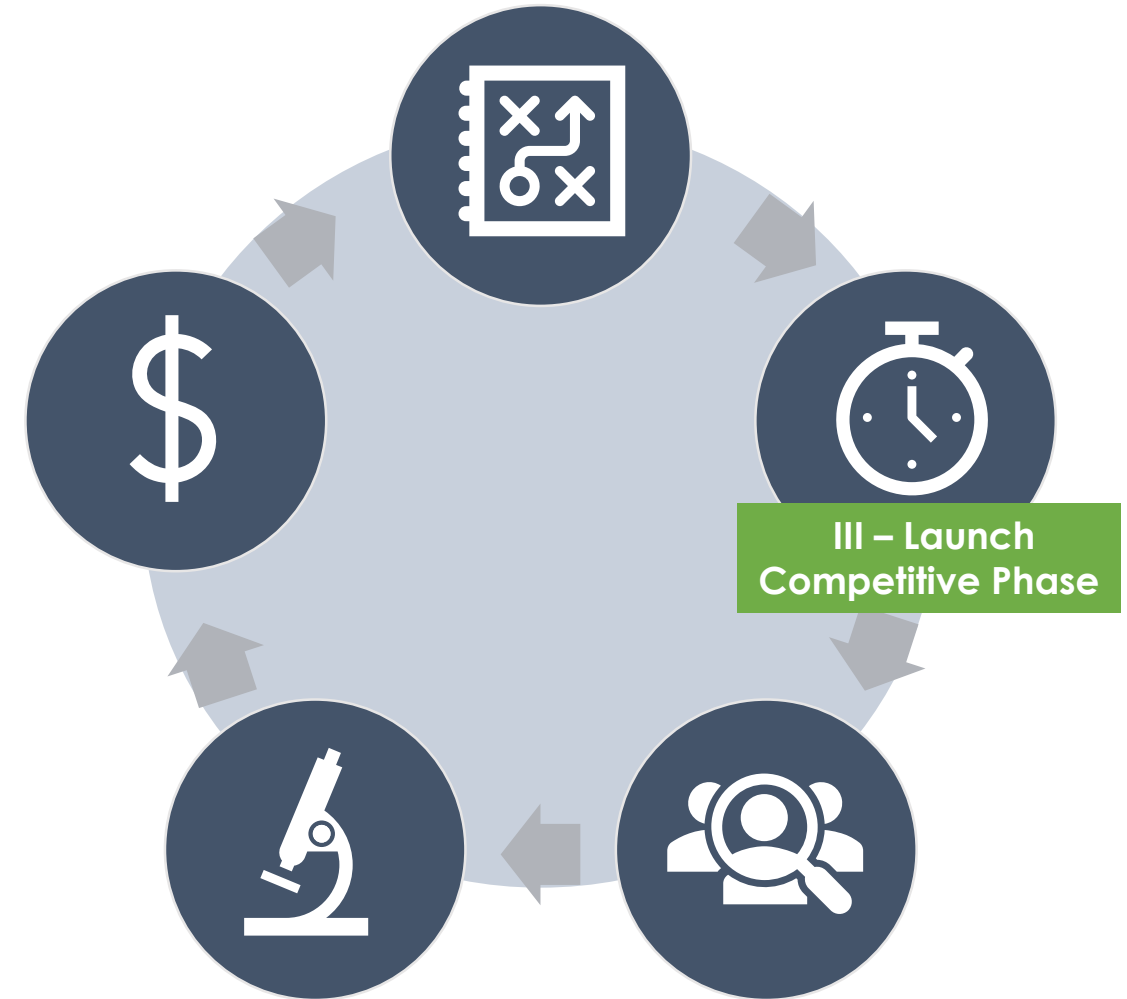


# NETL's Annual FOA Process Flow

## Planning and Implementation

### Phase III

- Develop Requirements Document
- Generate Procurement Strategy
- Craft Evaluation Criteria, Scoring Plan, Program Policy Factors, and Selection Criteria
- Select Merit Review Chair and Source Selection Official
- Staff Scoring Panels with Subject Matter Experts
- Publish & Issue FOA (and amendments if needed)

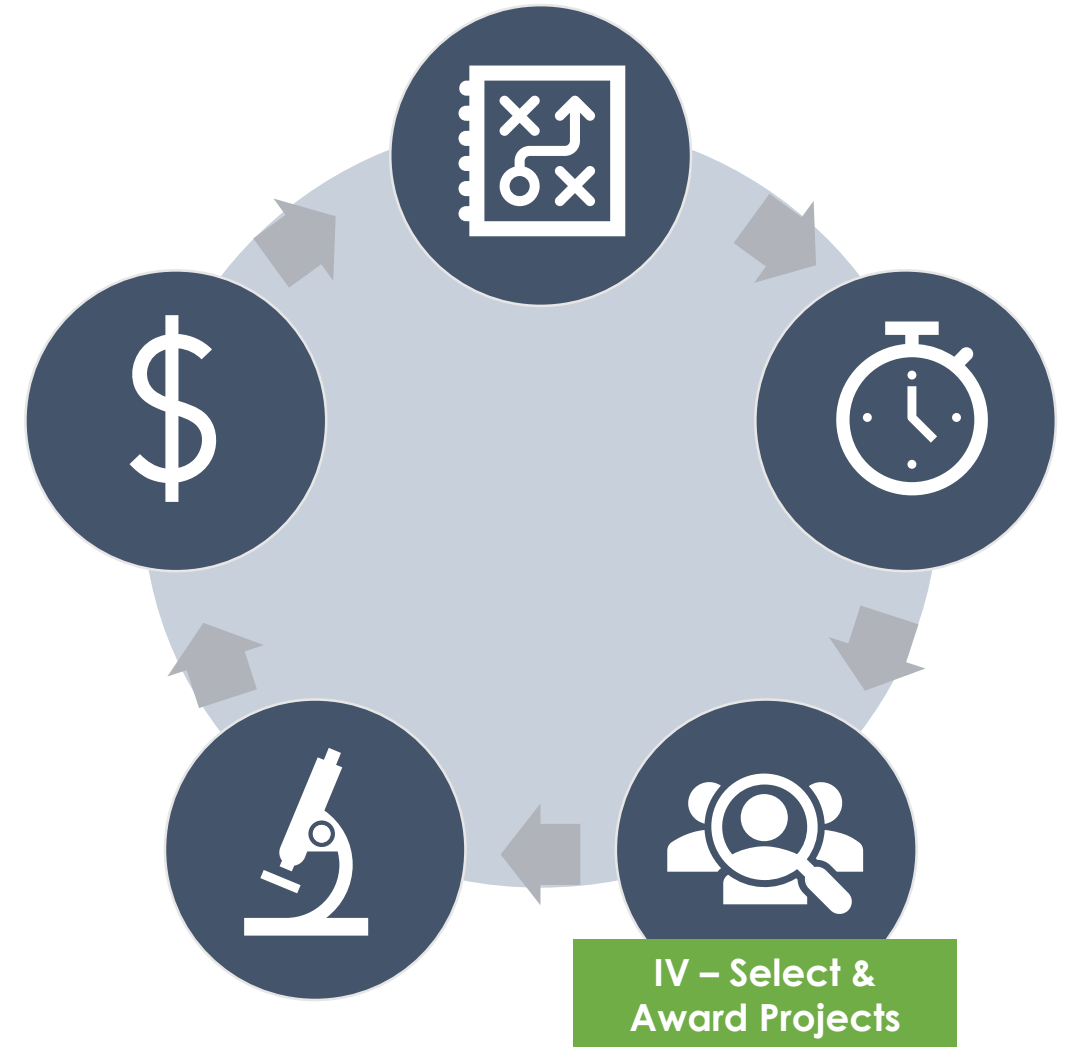


# NETL's Annual FOA Process Flow

## Planning and Implementation

### Phase IV

- Complete Initial Screening, Qualify Applications
- Develop Consensus Strengths and Weaknesses, Score Applications
- Prepare Senior Technical Briefing
- Select and Announce Winners
- Initiate Negotiations and Make Award

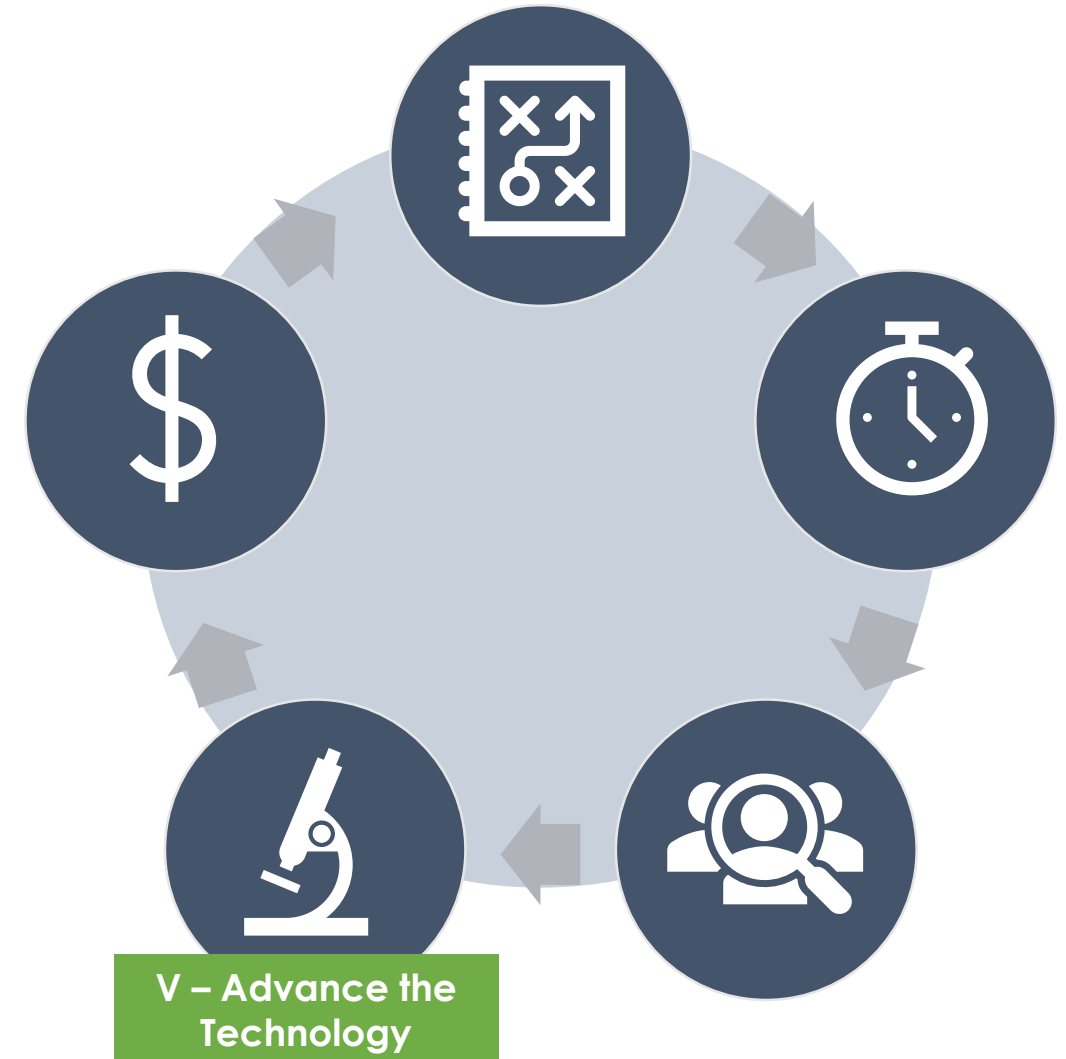


# NETL's Annual FOA Process Flow

## Planning and Implementation

### Phase V

- **Evaluate Performance and Measure Progress**
  - Technology Maturation Planning
  - Technology Readiness Assessments
  - Independent Program/Project Peer Reviews
- **Inform Future R&D Needs**



# Cooperative Research and Development Agreements

(CRADAs)



*In May 2019, NETL formally launched a 10-year, \$100 million CRADA with ExxonMobil and the National Renewable Energy Laboratory (NREL) to explore cooperative research and development endeavors to advance groundbreaking low-emissions energy technologies toward commercial scale.*

**Cooperative Research and Development Agreements (CRADAs)** allow for joint research and development performed by NETL and other participants. Background intellectual property (IP) protection is included for the parties and CRADA-developed IP is addressed. A CRADA offers participants the option for an exclusive license in a particular field of use for IP developed by NETL.

Cost sharing between NETL and the CRADA participant is essential.



# Memorandum of Understanding

- **Memorandums of Understanding (MOUs) OR Memorandums of Agreement (MOAs)** are written agreements between NETL and other entities that outline collaboration between the parties.
- **An MOU or MOA is not considered a binding contract.** It cannot be used to obligate or commit funds or be used as the basis for the transfer of funds between the parties.
- Actual implementation of the understandings established by the MOU or MOA must be accomplished through a legally binding agreement, such as an Interagency Agreement, CRADA, or other appropriate agreement between the parties.

## Recent MOUs with NETL: City of Pittsburgh MOU & ORNL



# 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**

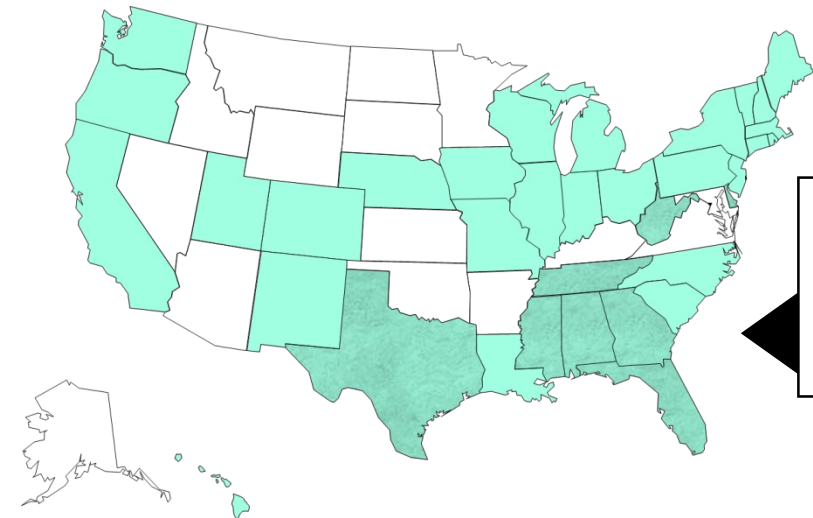
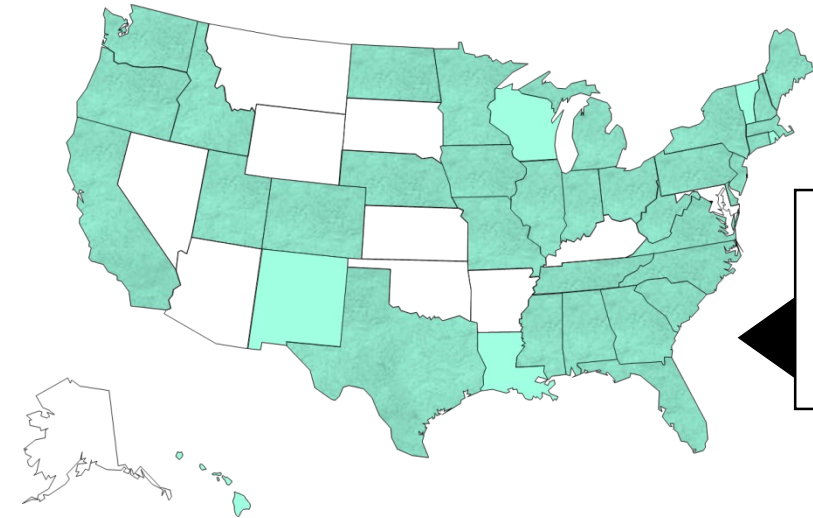
### *Since Program Inception*

#### 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



# University Training and Research



## University Coal Research

Started in 1979, UCR is designed to increase the competitiveness of universities in fossil energy research committed to improving the scientific understanding and environmental acceptability of coal while training new generations of research scientists and engineers.

- Students are expected to present project progress at annual review meetings.
- An estimated 2,500 students have received degrees while conducting research under the program.

## Historically Black Colleges & Universities

Started in 1984, the program is designed to raise the level of competitiveness of Historically Black Colleges and Universities/Other Minority Institutions in fossil energy research and tap an under-utilized resource by increasing opportunities in the areas of science, engineering, and technical management.

- Each grant typically involves 3-5 students throughout the duration of the project.
- Students are expected to present project progress at annual review meetings.

An essential element in the success of the university training is direct student participation to promote the influx of fresh ideas and ensures continued training of future scientists and engineers toward the opportunities in energy career fields.

# NETL's Unsolicited Proposal Process



## **NETL receives Unsolicited Proposals for all of DOE:**

- Application for support of an idea, method, or approach
- Submitted by an individual, business, or organization
- Based solely on the proposer's initiative rather than in response to a DOE solicitation
- Considered a non-competitive action

## **DOE may accept an Unsolicited Proposal if it:**

- Demonstrates a unique and innovative concept or a unique capability
- Offers a concept or service not otherwise available to the Federal government
- Does not resemble a recent or current competitive solicitation

DOE Unsolicited Proposal Process: [www.netl.doe.gov/business/unsolicited-proposals](http://www.netl.doe.gov/business/unsolicited-proposals)



# Connect with NETL



## Strategic Partnerships

Mike Knaggs

[Michael.Knaggs@netl.doe.gov](mailto:Michael.Knaggs@netl.doe.gov)

(304) 285-4926

## CRADAs and CFAs (Agreements)

Jessica Lamp

[Jessica.Lamp@netl.doe.gov](mailto:Jessica.Lamp@netl.doe.gov)

(412) 386-7417

## SBIR/STTR

Maria Reidpath

[Maria.Reidpath@netl.doe.gov](mailto:Maria.Reidpath@netl.doe.gov)

(304) 285-4140

## Unsolicited Proposals

John Augustine

[John.Augustine@netl.doe.gov](mailto:John.Augustine@netl.doe.gov)

(412) 386-4524

## Small Business Proposals

Jennifer Scharrer

[Jennifer.Scharrer@netl.doe.gov](mailto:Jennifer.Scharrer@netl.doe.gov)

(412) 386-7416

## Funding Opportunity Announcements (FOAs)

Sean Plasynski

[Sean.Plasynski@netl.doe.gov](mailto:Sean.Plasynski@netl.doe.gov)

(412) 386-4867

# Highlighted Available Technologies: Solid Oxide Fuel Cells

## Integration of Thermal Energy Storage into Solid Oxide Fuel Cell Systems

Hybrid-fuel systems that incorporate renewable energy with fossil fuels require the ability for system flexibility. NETL's thermal energy storage technology can be integrated to allow "load follow" to extract and convert thermal energy to electricity without a separate energy storage device.

## High-Temperature Sensors for Monitoring and Control of Solid Oxide Fuel Cells

This real-time active sensor optimizes the overall performance and lifetime of the fuel cell, improving efficiencies, operational monitoring, and control while lowering emissions. These sensors can be employed in gasification, gas turbines, boilers, nuclear power generation, aviation, and industrial energy efficiency.

## Single Step Electrode Infiltration Process

This low-cost method eliminates the multiple heat treatment steps required by existing electrode infiltration processes, enhancing fuel cell performance, durability, and lifespan. It also reduces the amount of catalyst material required, and can be used in a wide range of processes where coating of a porous microstructure is needed.

# Highlighted Available Technologies: Sensors and Controls

## Cyber-Physical System Model for Monitoring and Control

This cyber-physical model (CPM) monitors power plant and chemical manufacturing operations to interpret discrepancies in real time. It evaluates the process state for instabilities, addressing vulnerability and improving integrity.

## Sensors for Corrosion Monitoring in Harsh Environments

These advanced sensor platforms are capable of wireless and distributed early corrosion detection. This technology will allow for embedded, real-time, remote corrosion sensing capabilities in extreme subsurface environments and other harsh environments (boilers, turbines, etc.)

## Embedded Gas and Temperature Sensors for Extreme Environments

This portfolio of advanced optical sensor materials offers a range of technologies that improve process monitoring in harsh environments and extreme temperatures. These materials reduce fabrication complexity, operate across a broad spectrum of wavelengths, and incorporate remote monitoring capabilities.

## Laser-Induced Breakdown Spectroscopy (LIBS) Probe for Simplified Light Collection and Laser Operation

This LIBS probe eliminates the need for two mirrors, reducing complexity and cost of the laser head and maximizing the quality of light returned for analysis. This invention improves analysis of advanced materials and geologic systems, and can be used in medical and chemistry applications.

# Highlighted Available Technologies: **Membranes and Sorbents**

## Oxygen Separation Using Magnetic Membranes

These mechanical membranes separate oxygen from air at ambient temperatures, improving on current separation methods and allowing for the efficient separation of highly purified oxygen. This invention is useful for applications where high-purity oxygen is required, including in metal, chemical, glass, cement and paper production.

## Constant Pressure High Throughput Membrane Permeation Testing System

This cost-effective, modularly designed system enables the simultaneous evaluation of a near-infinite number of membranes with a single instrument. Its ability to mimic a diverse range of gas separation conditions allows for the rapid, efficient testing of candidate membranes.

## Stable Immobilized Amine Sorbents for the De-Coloration of Waste Waters

This recyclable innovation uses low-cost, porous silica particles that bind to contaminants, removing organic-based colorants and pollutants from different water sources, including dyes from textile, food processing, and coffee bean wastewater streams.

## Novel Sorbents for Radioactive Contaminant Removal From Wastewater

These low-cost, scalable and robust amine-based sorbents have been shown to effectively remove radioactive isotopes from liquids. They exhibit several advantages over existing technologies, including recyclability, low raw material costs, and a faster, simpler preparation procedure.



# Highlighted Available Technologies: **Structural Materials**

## High-Performance Corrosion-Resistant High-Entropy Alloys

NETL's new alloy composition offers excellent corrosion resistance. It can be applied as a coating, is more effective and lower cost than existing commercial solutions, and improves resistance to pitting caused in harsh environments such as sea water.

## Chromia Refractory Brick

This new refractory brick material has improved performance in high-temperature, high-pressure environments, proving more advantageous than existing refractory materials. Developed for gasifier applications, these liners extend the service life of equipment, resulting in lower replacement costs and down time.

## Optical Sensing Materials Comprising Metal Oxide Nanowires

These nanowire materials serve as the active layer in harsh environment and high-temperature chemical sensing applications. Several advantages over the existing state-of-the-art includes increased sensitivity and chemical selectivity in process monitoring and optical sensing applications.

## Tunable Nanocomposite Alloys for Magnetic Field Sensing

Nanocomposite materials with soft magnetic properties (i.e., easily magnetized or demagnetized) offer improved thermal stability and mechanical properties for advanced electronic and power systems that operate under high temperatures, frequencies, and power levels.

## Highlighted Available Technologies: Coal & CO<sub>2</sub> for High-Value Products

### A Cost-Effective Process for Making Graphene from Domestic Coal for use in Commercial Products

This process produces high-quality graphene from domestic coal for use in a wide range of consumer products, including paints, coatings, textiles, batteries, structural composites, and sorbents. The technology also produces rare-earth elements and distilled crude oil liquid and has been proven with different types of coal.

### Producing Hydrogen from Coal Via Catalytic/Chemical Looping Processes

NETL has developed catalyst materials for novel gasification processes that produce hydrogen-rich syngas. The catalyst also acts as an oxygen donor, foregoing the need for expensive cryogenic air separation. This makes the proposed process more efficient and potentially lower in cost. The material developed is resistant to physical or chemical degradation.

### Pelletized Basic Amine Sorbents Using Fly Ash and Polymer Binders

This method generates sorbents from low-cost materials, such as fly ash, that are effective at capturing carbon dioxide from flue gas. These sorbents demonstrate high mechanical strength, high capture capacity, and long-term stability, and can be used for packed bed, moving bed, and other reactor configurations.

# Highlighted Available Technologies: **Modeling and Optimization**

## Cyber-Physical System Model for Monitoring and Control

This technology has the ability to monitor and control multistage, networked plants, can interpret discrepancies in real time, and can assess the process state for instabilities. It addresses vulnerabilities related to cyberattacks, sabotage, and fault detection, and increases the accuracy of numerical approaches.

## Novel Algorithm Enables Manufacture of Continuous Single-Crystal Fibers of Infinite Length

This method enables the use of multiple feedstock pedestals to grow single-crystal optical fibers to potentially infinite lengths, far surpassing those of existing commercial fibers. This technology offers advantages over existing technologies, producing a superior product while allowing the growth process to be interrupted as many times as necessary.

## Computational and Simulation-Based Tools for Drilling Optimization

This invention, an apparatus and method for collecting real-time measurements, provides in-time recommendations for drilling parameters to optimize the rate of penetrations while reducing the energy expended. The technology is expected to increase drilling efficiency, resulting in reduced drilling time and cost.

# Lab Partnering Service (LPS)

Suite of DOE-wide Resource Tools

Website: [labpartnering.org](https://labpartnering.org)

Access to portfolio opportunities through:

- **Expert Search**

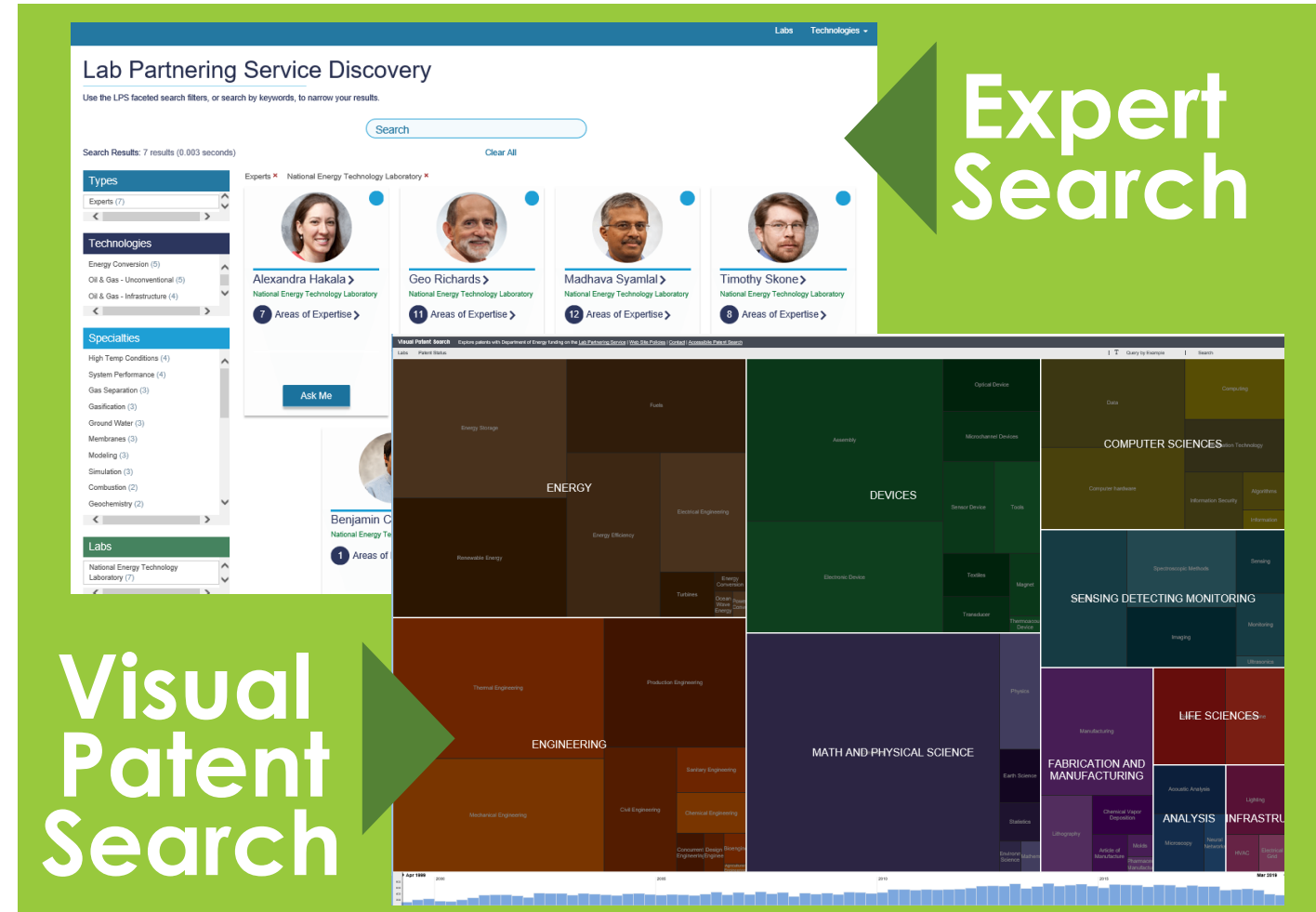
A categorized selection of lab-identified leading experts across multiple technology areas

- **Technical Summaries**

Information on DOE's numerous technologies associated with patents, patent applications & publications available for licensing

- **Visual Patent Search**

A unique, visually facilitated search of DOE-funded R&D





# Lab Partnering Service (LPS)

Single Access Point for Patents, Intellectual Property (IP), Partnerships, & Subject Matter Experts (SMEs)

## NETL's Presence on the LPS Website

7

Experts

110

Technologies

21

Patents

## Overview of LPS Offerings

20

Labs/ Plants

157

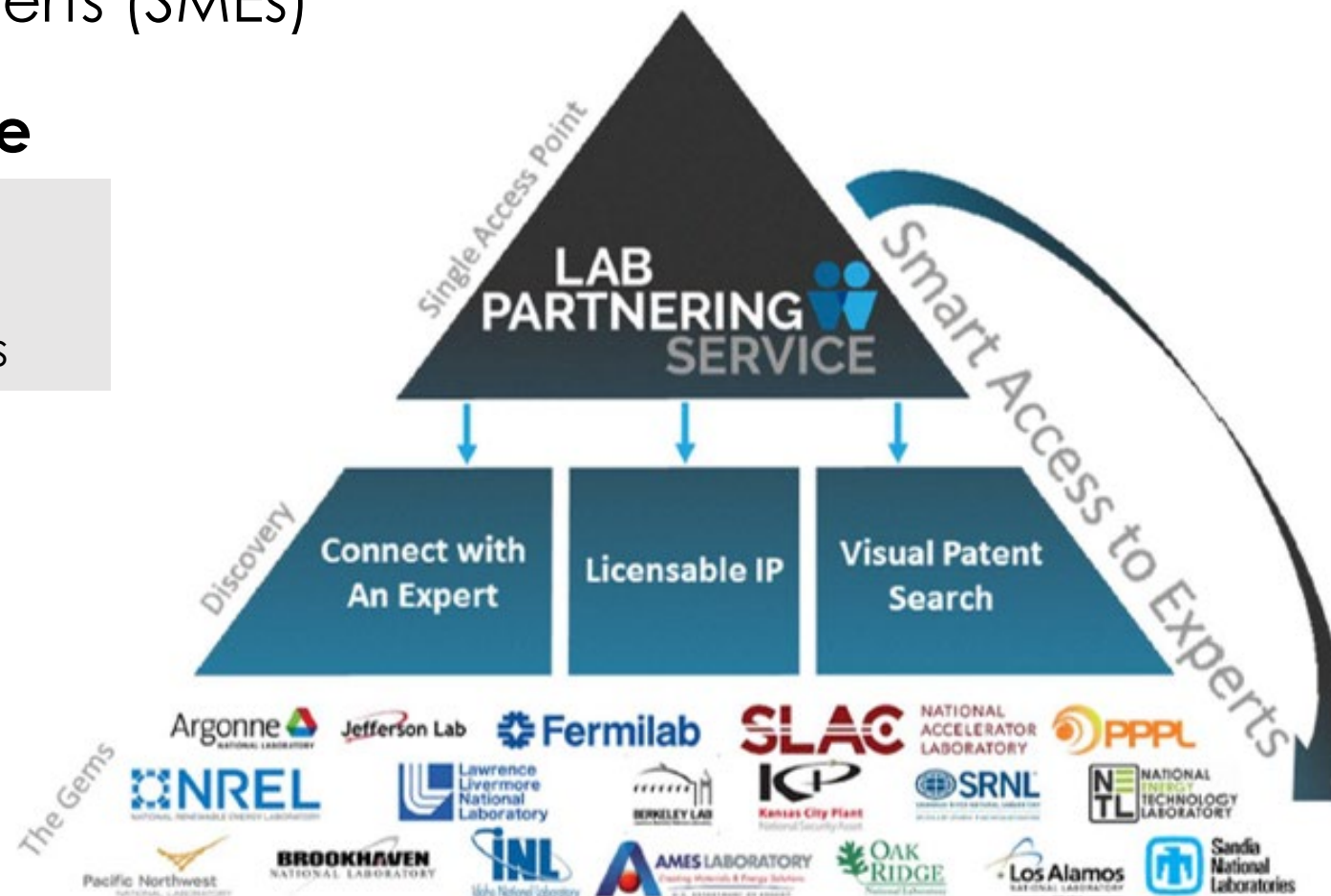
Experts across 12 Labs

1,200

Technology Summaries

37,000

Patents/Applications



# Energy I-Corps

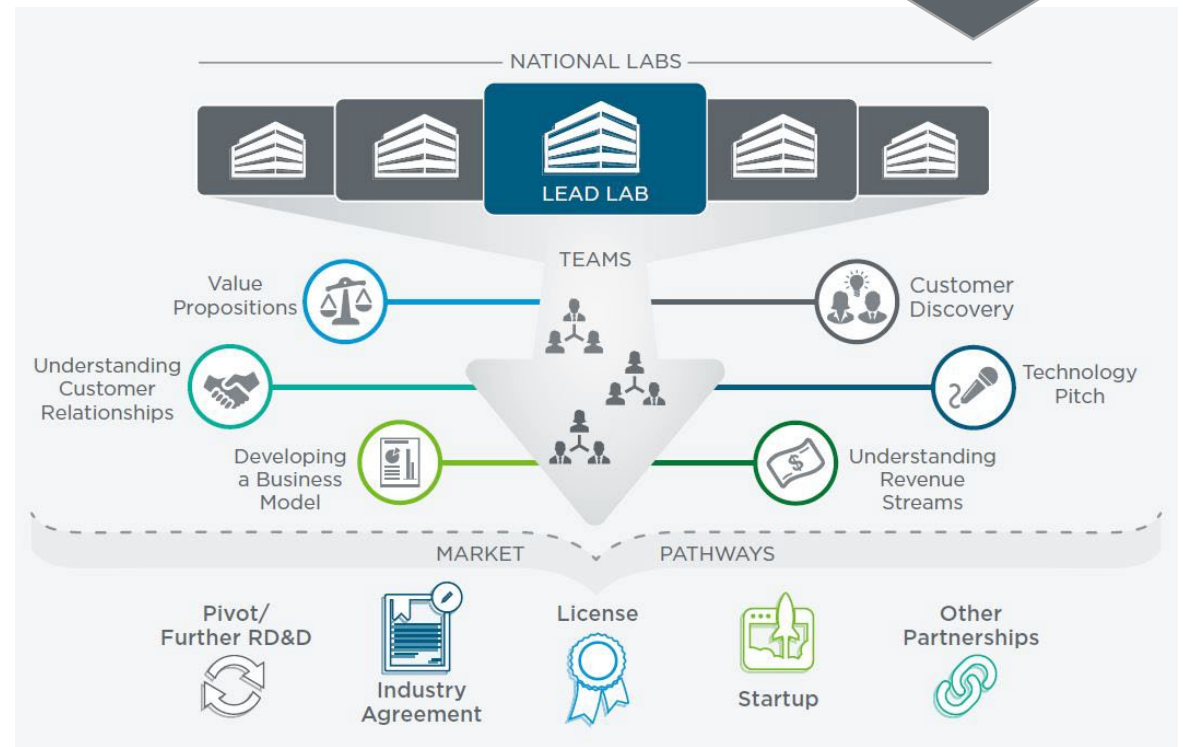
Teaming National Lab Researchers with Industry Mentors

<https://energyicorps.energy.gov>



- The team is built around a lab-developed technology ready for commercialization;
- Consists of a Principal Investigator, Entrepreneurial Lead, and Industry Mentor.
- Teams identify potential market pathways as well as identify opportunities where further development could lead to commercial value.

## Energy I-Corps Training at-a-Glance



# Appalachian Regional Commission



- **Appalachian Regional Commission (ARC)** is a regional economic development agency that represents a partnership of federal, state, and local government.
- Composed of the governors of the 13 Appalachian states (420 total counties)
- **ARC has 5 primary goals:**
  - **Economic Opportunities**
  - **Ready Workforce**
  - **Critical Infrastructure**
  - **Natural and Cultural Assets**
  - **Leadership and Community Capacity**
- ARC provides funding for several hundred projects in a wide range of program areas.
- Special resources are targeted to the most economically distressed counties.
- There is an opportunity for the community to apply for grants, and finding both federal and non-federal sources of project funds



# Appalachian Regional Commission



**POWER: Partnerships for Opportunity and Workforce and Economic Revitalization**

- **POWER is a Congressionally-funded initiative that targets Federal resources to help communities and regions that have been affected by job losses in coal mining, coal power plant operations, and coal-related supply chain industries due to the changing economics of America's energy production.**
- **POWER in Appalachia in 2019:**
  - **36 POWER Investments**
  - Total investment of **\$26.2 million**
  - Create or retain over **1,100 jobs**
  - Benefit over **5,200 students and workers**
  - Leverage more than **\$22.8 million in private investment** into manufacturing, agriculture, technology, substance abuse recovery, broadband development, and other industry sectors





# Appalachian Regional Commission



## POWER: Partnerships for Opportunity and Workforce and Economic Revitalization

- Since 2015, the ARC POWER has or will have:
  - 185 POWER Investments
  - Total investment of over **\$148 million**
  - Created or retained over **17,500 jobs**
  - Created or improved more than **7,200 businesses**
  - Leveraged more than **\$772 million in private investment** into manufacturing, agriculture, technology, substance abuse recovery, broadband development, and other industry sectors
- Since 2015, West Virginia has received more POWER grants than any other state.
- For more information, please visit: [www.arc.gov](http://www.arc.gov)



# U.S. Economic Development Administration



## A bureau within the U.S. Department of Commerce

- Mission:
  - To lead the federal economic development agenda by promoting innovation and competitiveness, preparing American regions for growth and success in the worldwide economy.
- EDA's investment priorities contribute to the strongest positive impact on sustainable regional economic growth and diversification. The framework to guide the investments include:
  - Recovery and Resilience
  - Critical Infrastructure
  - Workforce Development and Manufacturing
  - Exports and Foreign Direct Investment
  - Opportunity Zones
- EDA Programs include:
  - Public Works
  - Economic Adjustment
  - Planning
  - Regional Innovation Strategies
  - Trade Adjustment Assistance for Firms
  - University Centers
  - Research and National Technical Assistance
  - Local Technical Assistance
  - Economic Development Integration
- EDA also works with multi-agency initiatives, disaster recovery and university centers.



# U.S. Economic Development Administration



## 2019 Regional Innovation Strategies Program Notice of Funding Opportunity

- The U.S. Economic Development Administration (EDA) is committed to **fostering connected, innovation-centric economic sectors** that support the **conversion of research into products and services, businesses, and ultimately jobs through entrepreneurship.**
- **Multi-stakeholder partnerships and collaborations** that draw upon the resources of **community and regional public, corporate, university, nonprofit, and philanthropic organizations** foster dynamic, resilient regional economies, job growth, and globally competitive communities.
- For more information, please visit: <https://www.eda.gov/oie/ris>



- **Eligible Applicants:**
  - States
  - Indian tribes
  - Cities or other political subdivisions of States
  - An entity whose application is supported by a State or a political subdivision of a State, and that is --
    - A nonprofit institution
    - An institution of higher learning
    - A public-private partnership
    - A science or research park
    - A Federal Laboratory, or
    - An economic development organization or similar entity
- Applications must provide a matching share from non-Federal sources of at least 50 percent of the total project cost.