NETL Overview

the ENERGY lab
### Energy Demand 2011

**United States**
- 97 QFull-Time Manpower (QBTU) / Year
  - 83% Fossil Energy
- **Renewables 9%**
- **Gas 26%**
- **Coal 20%**
- **Oil 36%**
- **Nuclear 9%**

**Renewables**
- **5,498 mmt CO₂**

### Energy Demand 2035

**United States**
- 104 QFull-Time Manpower (QBTU) / Year
  - 81% Fossil Energy
  + 7%
- **Renewables 11%**
- **Gas 30%**
- **Coal 18%**
- **Oil 33%**
- **Nuclear 8%**

**Renewables**
- **5,546 mmt CO₂**

### Energy Demand 2011

**World**
- 519 QFull-Time Manpower (QBTU) / Year
  - 82% Fossil Energy
  + 43%
- **Renewables 13%**
- **Gas 21%**
- **Coal 29%**
- **Oil 32%**
- **Nuclear 5%**

**Renewables**
- **31,162 mmt CO₂**

### Energy Demand 2035

**World**
- 740 QFull-Time Manpower (QBTU) / Year
  - 80% Fossil Energy
  + 43%
- **Renewables 15%**
- **Gas 23%**
- **Coal 29%**
- **Oil 27%**
- **Nuclear 6%**

**Renewables**
- **43,111 mmt CO₂**

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U.S. data from EIA, Annual Energy Outlook 2014; World data from IEA, World Energy Outlook 2013
**Electricity Demand 2011**

- **4,084 BkWh / Year**
  - 68% Fossil Energy
  - Coal 42%
  - Gas 25%
  - Nuclear 19%
  - Oil 1%
  - Renewables 13%

- **2,171 mmt CO₂**

**Electricity Demand 2035**

- **4,980 BkWh / Year**
  - 68% Fossil Energy
  - Coal 34%
  - Gas 34%
  - Nuclear 16%
  - Oil <1%
  - Renewables 16%

- **2,247 mmt CO₂**

**Electricity Demand 2011**

- **22,113 BkWhr / Year**
  - 68% Fossil Energy
  - Coal 41%
  - Gas 22%
  - Nuclear 12%
  - Oil 5%
  - Renewables 20%

- **12,954 mmt CO₂**

**Electricity Demand 2035**

- **39,854 BkWh / Year**
  - 65% Fossil Energy
  - Coal 40%
  - Gas 23%
  - Nuclear 10%
  - Oil 2%
  - Renewables 25%

- **19,122 mmt CO₂**

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U.S. data from EIA, Annual Energy Outlook 2014; World data from IEA, World Energy Outlook 2013
Ensure America’s security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions.
NETL Mission

Advance energy options to fuel our economy, strengthen our security, and improve our environment
DOE Strategic Plan, 2014–2018

Three Strategic Goals

Science and Energy

Nuclear Security

Management and Performance

“This strategic plan provides a roadmap for our work, highlights our major priorities for the next few years, and will be reflected in individual program plans.”

—Secretary Moniz
1910 – Coal research begins in Pittsburgh, PA

1918 – Petroleum research begins in Bartlesville, OK

1943 – Materials research begins in Albany, OR

1946 – Synthesis gas research begins in Morgantown, WV

1949 – All four sites join new U.S. Department of Energy

1977 – PA & WV sites form new Federal Energy Technology Center (FETC)

1996 – All four sites join new U.S. Department of Energy

1999 – FETC becomes National Energy Technology Laboratory (NETL)

2000 – National Petroleum Technology Office in OK joins NETL

2001 – NETL opens Arctic Energy Office in Fairbanks, AK

2005 – Albany Research Center joins NETL

2009 – OK office moves to Sugar Land, TX


NETL: A Century of Energy Innovation
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Enhanced Resource Recovery & Operational Safety

Materials Science & Advanced Metallurgy

Collaborative R&D Management

Climate & Energy

Alternative Fuels

Electricity Delivery & Energy Reliability

Energy Efficiency & Renewable Energy

Systems & Planning Analyses
What is NETL Today?

A Full-Service National Laboratory

FE’s implementing “program” laboratory

EERE’s & OE’s implementing “project” laboratory

Premier research national laboratory

Procurement, financial, technical & human resources capabilities to support any Departmental mission
National Energy Technology Laboratory
Where Energy Challenges Converge and Energy Solutions Emerge

• Full service DOE national laboratory
• Dedicated to energy RD&D, domestic energy resources
• Fundamental science through technology demonstration
• Unique industry – academia – government collaborations

Oregon  Pennsylvania  West Virginia
National Energy Technology Laboratory

• Full-service DOE federal laboratory
  – Program planning
  – Budget formulation and execution
  – Procurement
    • Contracting & financial assistance
  – Project management
    • Including NEPA
  – Legal
  – Financial management & reporting
  – Onsite research
  – Program performance & benefit analysis

• Dedicated to energy RD&D, domestic energy resources
  – Fossil Energy
  – Support Offices of Electricity and Energy Efficiency

• Fundamental science through technology demonstration
• Unique industry–academia–government collaborations
**Responsible for Substantial Infrastructure**

- **Pittsburgh, PA, and Morgantown, WV**
  - Facilities 65 miles apart
  - 61 acres (Pittsburgh) and 137 acres (Morgantown)
  - 80 permanent and temporary buildings, > 969,000 sq. ft.

- **Sugar Land, TX, and Anchorage, AK**
  - Housed in leased space
    - 3,100 sq. ft. (Texas)
    - 750 sq. ft. (Alaska)

- **Albany, OR**
  - 44 acres
  - 38 buildings, > 258,000 sq. ft.

- **Fleet of ~65 federal vehicles**
*NETL also financially manages an additional $1.1 billion for EERE’s PMC (Golden/NREL)
Site-Support Contractors Assist Lab Operations

**The Majors**

- **Alliant Enterprises JV, LLC**
  Small Business
  *Information Technology Operations & Maintenance Support Services (ITOMS)*

- **Booz Allen Hamilton, Inc.**
  Large Business
  *Energy Sector Planning and Analysis Services (ESPA)*

- **Goldbelt Eagle, LLC**
  Alaska Native Small Disadvantaged 8(a) Business
  *Site Operations Services (SOS)*

- **KeyLogic Systems, Inc.**
  Small Business
  *Project Execution and Integration Services (PEI)*

- **Leonardo Technologies, Inc.**
  Small Business
  *Program and Performance Management Services (PPM)*

- **Smart Data Solutions**
  Small Disadvantaged Veteran- and Minority-Owned 8(a) Business
  *Support Administrative Services (SAS)*

- **URS Corporation (URS Washington Division)**
  Large Business
  *Research and Engineering Services (RES)*

R. Boyle, 11/06/2014
A Well-Trained Workforce

Contractor statistics as of 09/30/2014; Federal statistics as of 10/22/2013; headcount of employees who are employed by NETL half-time or more.
Some NETL Vital Statistics

- Provide $200M per year to local economies through operations
- Nearly 1,400 employees: 40% federal, 60% support contractors
- Strongly technical-based staff

<table>
<thead>
<tr>
<th>Federal Employees</th>
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<tbody>
<tr>
<td>Scientists</td>
<td>16%</td>
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<tr>
<td>Engineers</td>
<td>42%</td>
</tr>
<tr>
<td>Technical</td>
<td>4%</td>
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<tr>
<td>Professional</td>
<td>15%</td>
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<tr>
<td>Administrative</td>
<td>20%</td>
</tr>
<tr>
<td>Other</td>
<td>4%</td>
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</table>

<table>
<thead>
<tr>
<th>Site Support Contractors</th>
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<tbody>
<tr>
<td>Scientists</td>
<td>7%</td>
</tr>
<tr>
<td>Engineers</td>
<td>19%</td>
</tr>
<tr>
<td>Technical</td>
<td>19%</td>
</tr>
<tr>
<td>Professional</td>
<td>23%</td>
</tr>
<tr>
<td>Administrative</td>
<td>12%</td>
</tr>
<tr>
<td>Other</td>
<td>19%</td>
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</tbody>
</table>

Contractor statistics as of 09/30/2014; Federal statistics as of 10/22/2014; headcount of employees who are employed by NETL half-time or more.
NETL’s Investment in West Virginia

**Impacting Economy Through Onsite Operations**

- Contributed $72M through federal & contractor salaries
  - Supports 628 full-time jobs
- Obligated $31M to WV small businesses through site-support contracts
- Draw more than 1,000 visitors to Morgantown area per year

**Impacting Economy Through R&D**

- Managed multi-year agreements & contracts with total award value of $127M, including $113M in federal funds
  - Generates 1,225 job-years*

*Job estimate based on the President’s Council of Economic Advisors Guidance, May 2009*
NETL’s Investment in Pennsylvania

**Impacting Economy Through Onsite Operations**
- Contributed $70M through federal & contractor salaries
  - Supports 553 full-time jobs
- Draw nearly 1,500 visitors to Pittsburgh area per year

**Impacting Economy Through R&D**
- Managed multi-year agreements & contracts with total award value of $1.7B, including nearly $856M in federal funds
  - Generates 9,305 job-years*

*Job estimate based on the President’s Council of Economic Advisors Guidance, May 2009  
FY 2013
NETL’s Investment in Oregon

**Impacting Economy Through Onsite Operations**
- Contributed $14M through federal & contractor salaries
  - Supports 115 full-time jobs
- Draw more than 200 visitors to Albany area per year

**Impacting Economy Through R&D**
- Managed multi-year agreements & contracts with total award value of $161M, including $82M in federal funds
  - Generates 893 job-years*

*Job estimate based on the President’s Council of Economic Advisors Guidance, May 2009

FY 2013
Focus on Education

• 500 extramural projects with academic institutions
• 50 intramural projects, 100 academic collaborators
• 65 research associates
• Community initiatives
  – Speakers’ bureau
  – Donation of computers & equipment
  – Science Bowl
  – Education webpage
  – Job shadowing for high school students
  – Laboratory tours
  – Science training for K-12 teachers
  – Minority mentoring
  – Teaming
    • National Geographic JASON project
Developing the critical science and technology to discover and commercialize advanced energy systems that efficiently utilize domestic resources in an environmentally sustainable manner.
Office of Research and Development

Innovating Energy Technologies

Computational & Basic Sciences
• Integrate computation with experimental research
• Model from atomic- to device- to facility-scale

Geological & Environmental Sciences
• Investigate clean power generation and gas & oil technologies
• Enhance proven, unconventional, new, and renewable resources

Materials Science & Engineering
• Seek new and improved materials
• Design and fabricate metals, alloys, and ceramics

Energy Systems Dynamics
• Conceive and develop pre-commercial technologies
• Improve in-plant devices and processes
Establishing Strong National Laboratory Research Alliances

**Carbon Capture Simulation Initiative (CCSI)**
- Identify Promising Concepts
- Develop Optimal Designs
- Quantify Technical Risk in Scale-up

**National Risk Assessment Partnership (NRAP)**

*Accelerate Learning During Development & Deployment*
Systems, Analyses, and Planning
Informing Energy Policy Development & Technology Deployment

**Analyses**
- Technology evaluation
- Process & cost engineering
- R&D targets

**Technologies**

**Benefits**
- Policy scenarios
- Market deployments
- National benefits of R&D

**Situations & Trends**
- Current conditions
- Future scenarios

**Integrated Electric Power Systems**
- Cost of electricity
- System design & integration

**Drivers**

**Drivers Analyses**
- Renewable
  - 8%
- Coal
  - 21%
- Gas
  - 25%
- Oil
  - 37%
- Nuclear
  - 9%
- Renewables
  - 8%
- Nearly 1,100 activities nationwide
- Total award value more than $23 billion
- Private sector cost-sharing nearly $13 billion
NETL Program Areas

Strategic Center for Coal

Strategic Center for Natural Gas and Oil

Energy Project Management
Strategic Center for Coal

Critical R&D Challenges to Near-Zero Emissions from Coal

**Near-Term Plants**

*Pulverized Coal*
- Power generation
- Improve efficiencies
- Minimize criteria pollutants
- Minimize water usage
- Minimize greenhouse gases

**Future Plants**

*Advanced Coal*
- Power and multiple products
- Improve reliability
- Maximize efficiencies
- Near-zero criteria pollutants
- Near-zero water usage
- Near-zero greenhouse gases

Technology Bridge to Near-Zero Emissions

2005 – 2020

2020 – 2050
Strategic Center for Natural Gas and Oil
Advancing Technologies Supporting Development of Domestic Unconventional Resources

- Tens of billions of barrels of residual oil recoverable via CO₂ enhanced oil recovery in mature fields in 22 states
- Potentially thousands of trillion cubic feet of natural gas from methane hydrate in Alaska and the Gulf of Mexico
- Hundreds of trillion cubic feet of natural gas in shales and tight gas sands across the country

Shales photo courtesy of Statoil
Energy Project Management

NETL Expertise Used to Help Other Government Organizations

- Non-FE extramural RD&D
- Helping to implement other DOE, government programs for 25+ years
  - Office of Engineering and Construction Management
  - Environmental Management
  - Legacy Management
  - Department of Homeland Security
  - Department of Defense
- Technical, administrative, and project management support
  - Documented procedures, policies
  - Disciplined process with tracking
- Implementation activities
  - Acquisition (contracts)
  - Financial assistance (can only be awarded by Federal personnel)

Electricity Delivery & Energy Reliability
- Grid modernization
- Reliable & secure energy supplies
- Disaster response

Energy Efficiency & Renewable Energy
- Vehicle Technologies
- Solid State Lighting
- Advanced Manufacturing
## FE Research — The Return on Investment

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<tr>
<td>$111 billion in benefits¹</td>
<td>Clean Coal Program</td>
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<td>Clean Coal Program</td>
<td>Natural Gas &amp; Petroleum Technologies Program</td>
<td>Natural Gas &amp; Petroleum Technologies Program</td>
<td>Mercury Control Program</td>
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<td>$13 return for every $1 invested¹</td>
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<td>Natural Gas &amp; Petroleum Technologies Program</td>
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<td>37 million tons of avoided SO₂²</td>
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<td>16 million tons of avoided NOₓ¹</td>
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<tr>
<td>1.2 million jobs created¹</td>
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<td>Thousands of researchers trained</td>
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<td>40-fold increase in shale gas production since 1990²</td>
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<td>10-fold increase in EOR using CO₂ injection since 1980³</td>
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<td>50–75% cost reduction in mercury control at coal-fired power plants⁴</td>
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## Return on Investment from Fossil Energy R&D

### FE Research — The Return on Investment

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Amount</th>
<th>Source</th>
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<tbody>
<tr>
<td>16 million tons of avoided NO\textsubscript{x} emissions 2000–2020\textsuperscript{1}</td>
<td></td>
<td>(1) Bezdek, R., Wendling, R., The Return on Investment of the Clean Coal Technology Program in the USA. Energy Policy, Vol. 54, March 2013, pp. 104–112.</td>
</tr>
<tr>
<td>1.2 million jobs created 2000–2020\textsuperscript{1}</td>
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<tr>
<td>37 million tons of avoided SO\textsubscript{2} emissions 2000–2020\textsuperscript{2}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thousands of scientists and engineers trained</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$111 billion in benefits 2000–2020\textsuperscript{1}</td>
<td></td>
<td>(2) Institute of Clean Air Companies, <a href="http://www.icac.com/?page=Mercury_Controls">http://www.icac.com/?page=Mercury_Controls</a>, Updated Commercial Hg Control Technology Bookings (October 2011), accessed 08/21/13.</td>
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<td>$13 return for every $1 invested\textsuperscript{1}</td>
<td></td>
<td>(3) EPA Base Case, IPM analysis of EGU GHG NSPS, downloaded from <a href="http://www.epa.gov/airmarkets/progsregs/epa-ism/proposedEGU_GHG_NSPS.html">http://www.epa.gov/airmarkets/progsregs/epa-ism/proposedEGU_GHG_NSPS.html</a>, 08/21/13.</td>
</tr>
<tr>
<td>650 U.S. fossil energy patents 1976–2013\textsuperscript{4}</td>
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<tr>
<td>58 GW of mercury-control technology installed\textsuperscript{2}</td>
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<td>148 GW projected by 2015\textsuperscript{3}</td>
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<tr>
<td>$1.9 trillion in health benefits\textsuperscript{5}</td>
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<tr>
<td>FE research contributes to EPA-estimated health benefits from reduced pollution 1990–2020</td>
<td></td>
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\textsuperscript{2} Institute of Clean Air Companies, http://www.icac.com/?page=Mercury_Controls, Updated Commercial Hg Control Technology Bookings (October 2011), accessed 08/21/13. 
\textsuperscript{3} EPA Base Case, IPM analysis of EGU GHG NSPS, downloaded from http://www.epa.gov/airmarkets/progsregs/epa-ism/proposedEGU_GHG_NSPS.html, 08/21/13. 
\textsuperscript{4} USPTO online search 08/29/13 on ABST/("fossil fuel* OR coal OR oil OR petroleum OR "natural gas" OR methane OR hydrate") AND electric* OR energy OR power OR generator OR turbine) AND (AN/"department of energy" OR GOVT/"department of energy"). 
Notable Program Successes

**Advanced Coal Power Systems**
- World’s largest circulating fluidized bed combustion (CFBC) power plant
- Two “super-clean” coal-based integrated gasification combined cycle (IGCC)

**HAPs/Mercury Control**
- Reduced cost by 50–70% while achieving 80–90%+ Hg capture
- Developed technology (e.g., ACI) commercially deployed on today’s power plants

**Advanced Pollution Controls**
- Installed on 75% of U.S. coal plants
- 1/2 to 1/10 cost of older systems

**Flue Gas Desulfurization (FGD) Scrubbers**

**Low-NOx Burners**

**Jacksonville Electric CFBC**

**Tampa IGCC**

**Wabash IGCC**
For More Information

NETL Customer Service
1-800-553-7681

Office of Fossil Energy
energy.gov/fe/office-fossil-energy

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