Solutions for Today ♦ Options for Tomorrow

NETL:
Enabling a Sustainable Energy Future

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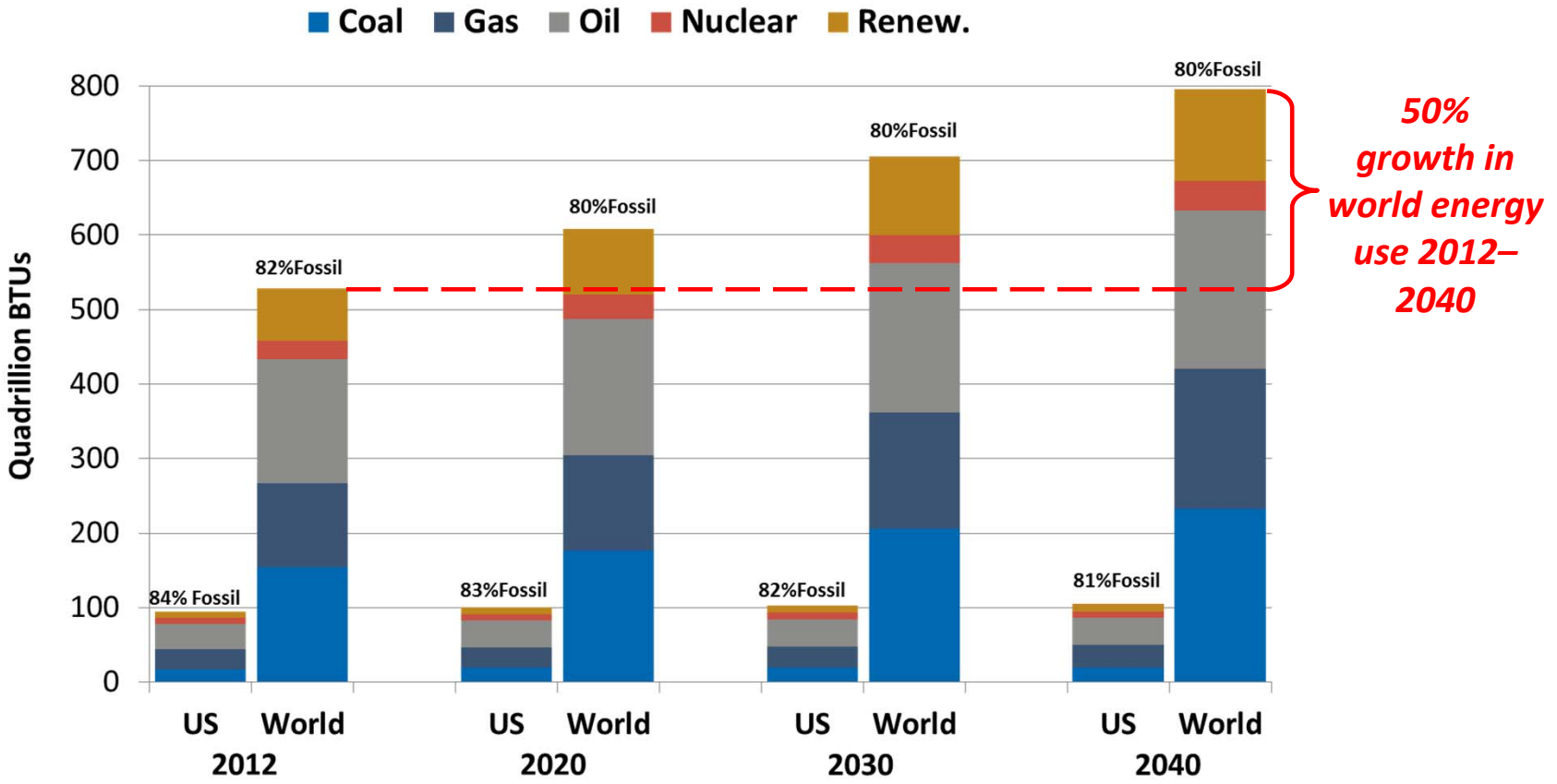
U.S. DEPARTMENT OF ENERGY | National Energy Technology Laboratory

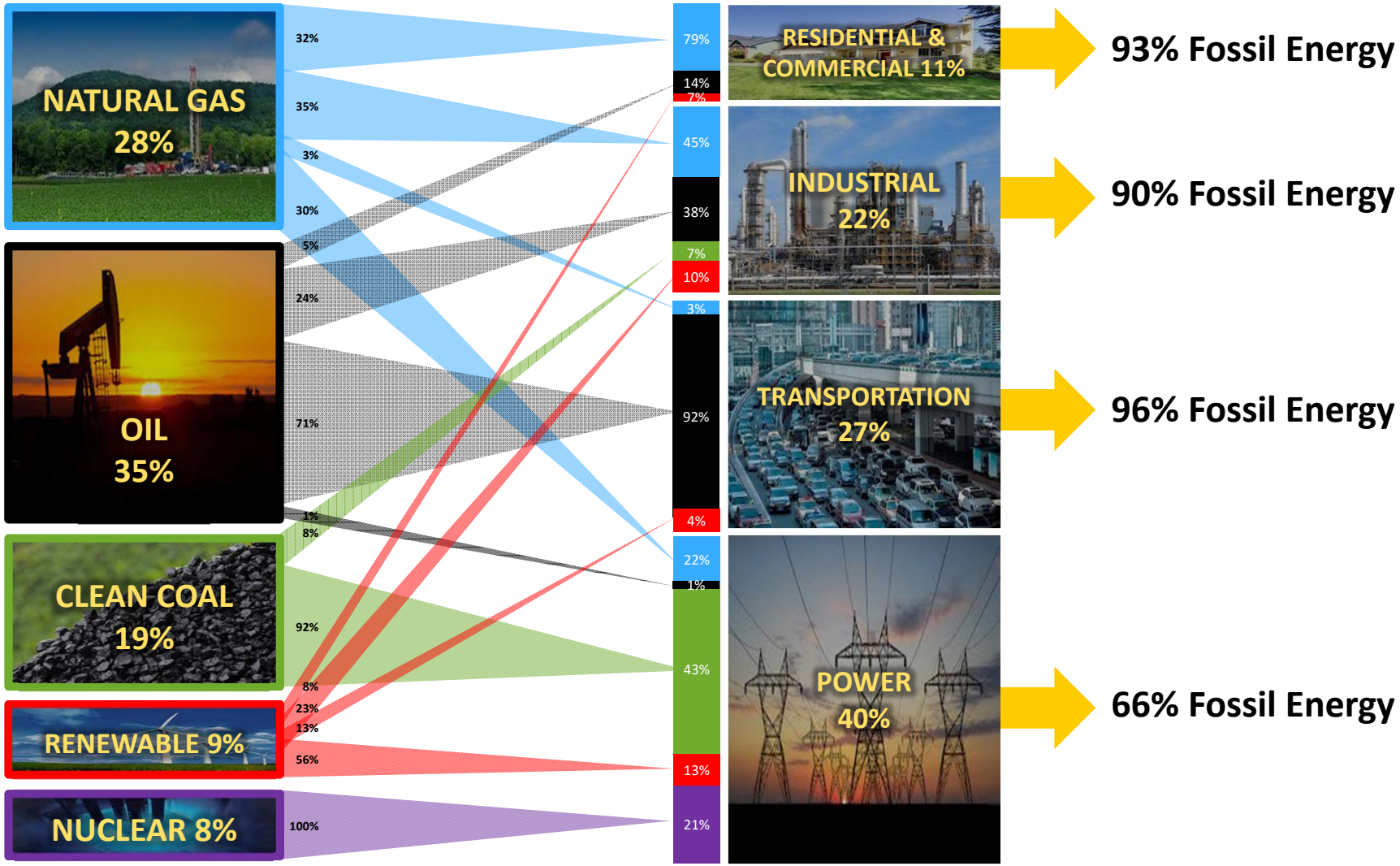
Global Drivers

The World and U.S. Energy Future



≥80% Fossil Energy Today AND Tomorrow
Dominated by Global Growth

Delivering To All Domestic Sectors



EIA, Annual Energy Outlook 2015, Reference Case.

NETL is….

the Nation's Fossil Energy Laboratory

- 1,400 employees
  - Internationally Recognized Expertise in Fossil Energy
- Three R&D laboratories in OR, PA, and WV
  - World Class Facilities Designed to Address FE Issues
- FY2016 R&D Portfolio
  - 1,400 R&D projects/50 states

Technology Readiness…Maturing Technology

EXTRAMURAL

INTRAMURAL & EXTRAMURAL

Technology Demonstration

TRL 8-9

Process Engineering & Integration

TRL 5–7

Applied Research

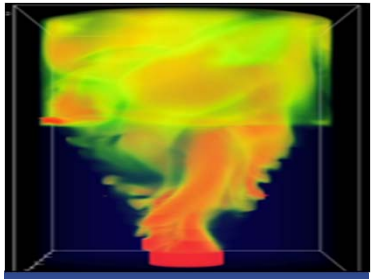
TRL 2-4

Energy Solutions for Today

Energy Options for Tomorrow

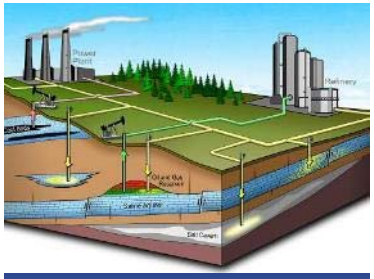
TRL=Technology Readiness Level

Core Competencies & Technology Thrusts



Computational Engineering

Materials Engineering & Manufacturing



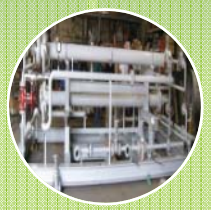
Geological & Environmental Systems

Energy Conversion Engineering

Systems Analysis & Engineering

Carbon Storage

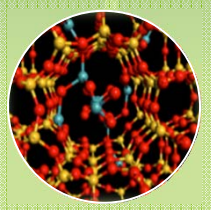
Carbon Capture



Sensors

Advanced Materials

Advanced Computing



Advanced Energy Systems

Enhanced Resource Production

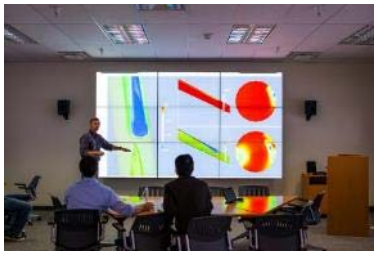
Environmentally Prudent Development

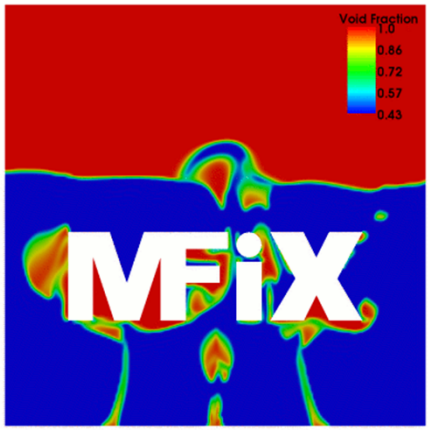
Transmission & Delivery

Methane Hydrates

Computational Science & Engineering

- **Modeling and simulation critical to all NETL research, development and deployment**
  - Accelerating development continuum
- **NETL's Joule**
  - 0.5 PFLOP (top 200)
  - One of the most energy efficient supercomputers in the world
  - Over 95% utilization (national asset)
- **Current Research Thrusts:**
  - Code development spanning and linking orders of magnitude (angstroms to meters)
  - Uncertainty quantification, data technology (i.e. informatics, AI)

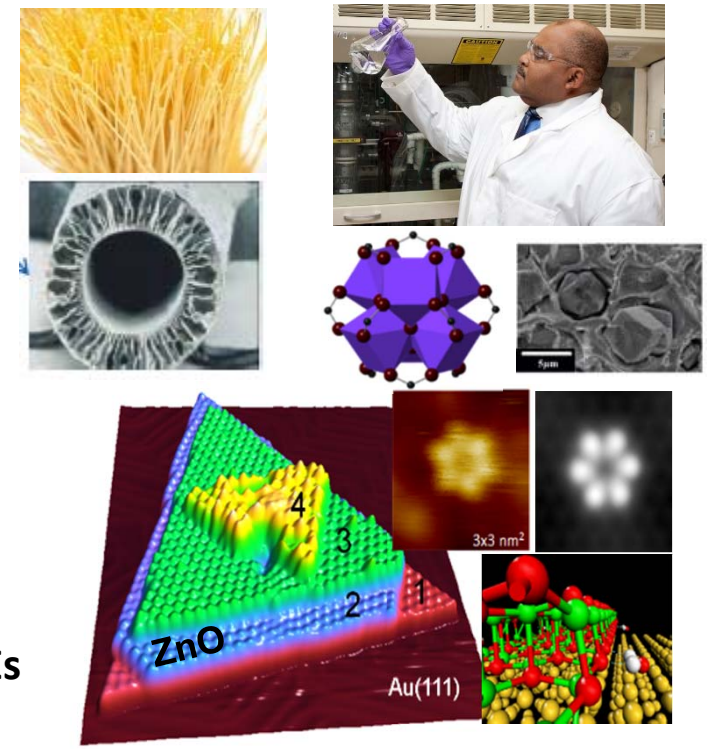




EDX TOOLS

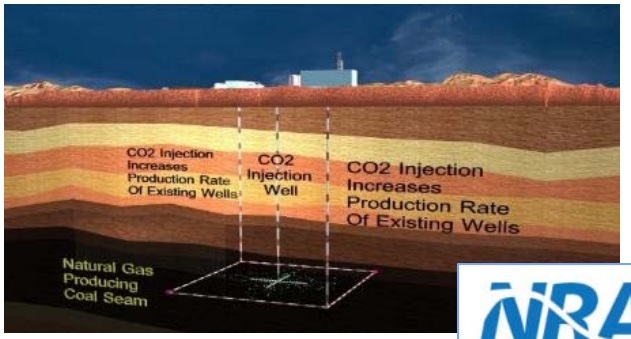
Materials Engineering & Manufacturing

- **Performance driven materials design to enable technology solutions**
  - Designing materials (and manufacturing processes) across size scales to control macroscopic properties
- **Research facilities to synthesize and fabricate materials, and evaluate them under "real" environments**
- **Current Research Thrusts:**
  - **Carbon Capture Materials**
  - **Extreme Environment Materials**
  - **Oxygen-Generating Materials**
  - **SOFC Electrode Development**
  - **Atomically-Precise Catalysts**
  - **Separation Materials & Processes for extracting REEs from Coal and Coal By-Products**

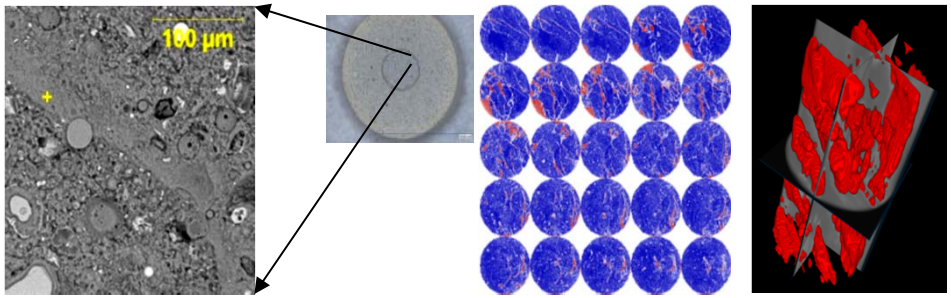


Geologic & Environmental Systems

- **Enabling the production and use of our Nation's fossil fuels in an environmentally safe manner through engineering the subsurface.**
- **Research capabilities to evaluate and predict subsurface behavior across space & time scales.**
- **Current Research Thrusts:**
  - **National Risk Assessment Partnership (NRAP)**
  - **CO_2 Storage**
    - **Reservoir Seal Performance**
    - **Ground Water Impacts**
    - **Resource Assessments**



NRAP
National Risk Assessment Partnership

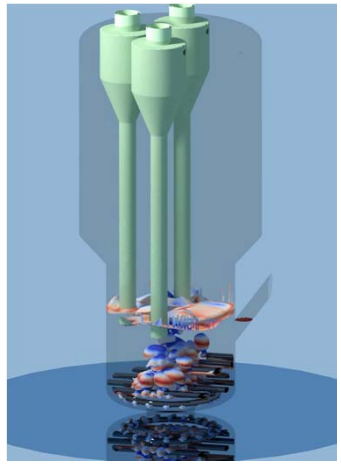


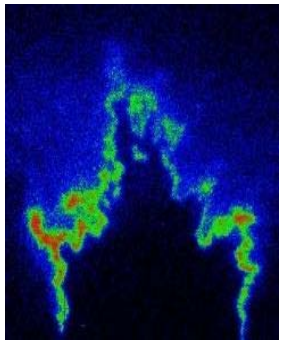
Energy Conversion Engineering

- **Pioneering innovative efficient energy-conversion systems that can enable affordable utilization of fossil resources in an environmentally-constrained world.**

- **Simulation-based design, coupled with focused experiments**
  - **Increased RD&D efficiencies**
  - **Reduces risks and costs**

- **Current Research Thrusts**
  - **Reacting, multi-phase flow**
  - **Micro- and modular-devices**
  - **Extreme pressure reactions**
  - **Gas-phase rotating detonations**
  - **Non-equilibrium ionization and microwave chemistries**
  - **Cyber-Physical process/system optimization**



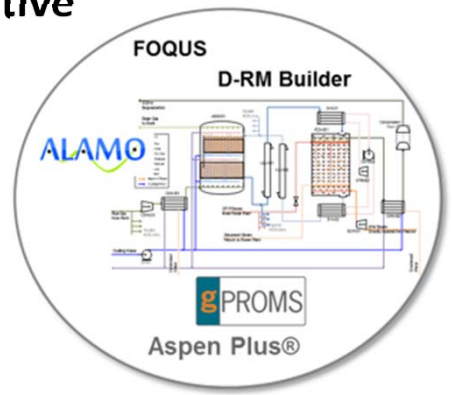


Systems Engineering & Analysis

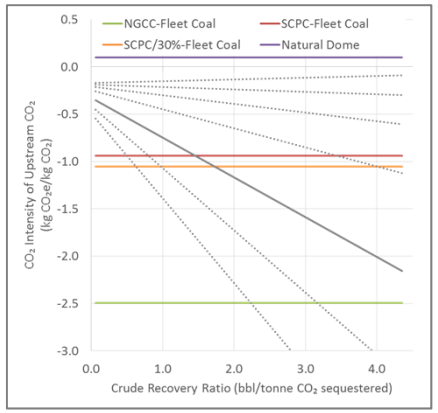
- **Accelerating technology innovation & development utilizing a variety of multi-scale computational tools and approaches to support decision-making and provide in depth, objective analysis**

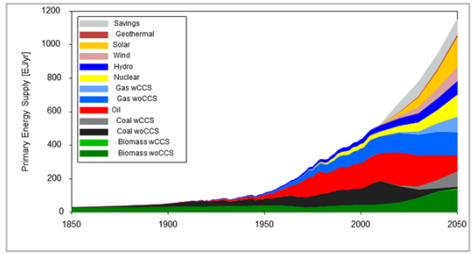
- **Expertise in:**
  - **Process Systems Engineering**
  - **Techno-Economic Assessment of Advanced Energy Systems**
  - **Integrated Energy Systems/Market Analysis**

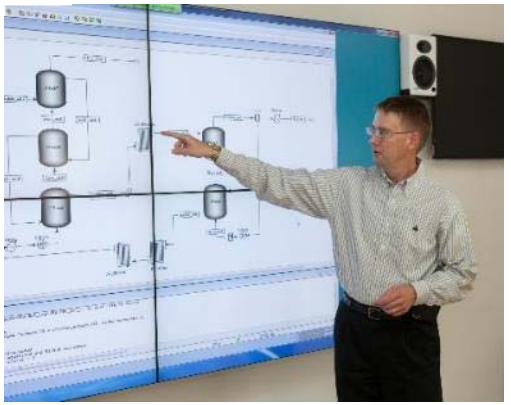
- **Current Research Thrusts:**
  - **IDAES**
  - **CCSI²**
  - **Updates to NETL Cost & Performance Baselines for FE Systems**
  - **Tools to improve Techno-economic assessments of carbon capture systems**
  - **Integration of NETL Energy-Water module and CO_2 & EOR cost model updates into energy-economy forecasts**



CCSI
Carbon Capture Simulation Initiative







History of Enabling Fossil Fuels

40-fold Increase in Shale Gas Production

16M tons NOx avoided

10-Fold Increase in CO_2-EOR

37M tons SOx Avoided

Up to 75% Cost Reduction in Hg control

GHG Reductions

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For More Information, Contact NETL

the ENERGY lab

www.netl.doe.gov