

US Dept of Energy Oil & Gas Research



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National Energy Technology Laboratory



Office of Fossil Energy



National Energy Technology Laboratory

- **Only DOE national lab dedicated to fossil energy**
 - Fossil fuels provide 85% of U.S. energy supply
- **One lab, five locations, one management structure**
- **1,200 Federal and support-contractor employees**
- **Research spans fundamental science to technology demonstrations**



Alaska



Oklahoma



Oregon



Pennsylvania



West Virginia

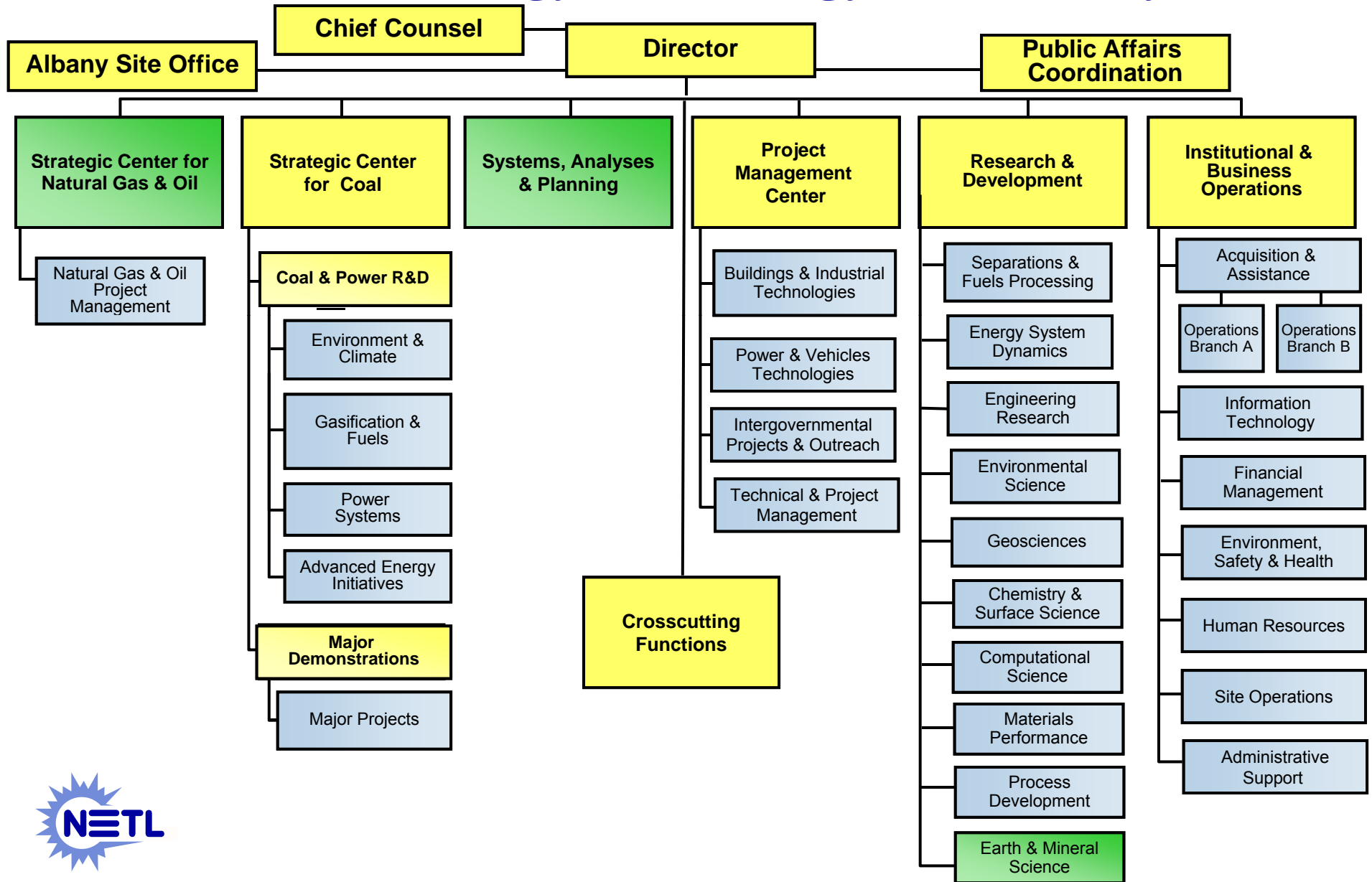


Accomplishing Our Mission

- Implement and manage extramural RD&D
- Conduct onsite research
- Support energy policy development



National Energy Technology Laboratory



Strategic Center for Natural Gas & Oil

History of Partnership Approach

- **Implement R&D programs for DOE Office of Fossil Energy**
 - E&P; Deep Trek; EOR; Methane Hydrates; Res Life Extension; Environmental
- **Careful planning with significant industry input**
 - Technology roadmaps, advisory committees, consortiums, merit/peer reviews
- **Cost-shared R&D conducted with partners**
 - Industry, federal agencies, national labs, universities
- **Historically modest oil and gas program budget**
 - \$65–\$80 million / year total
- **Extensive experience**
 - > 35 years in oil and gas R&D
 - R&D successes linked to:
 - 25% of U.S. gas production
 - 13% of US oil production



Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Sec. 999B(j)

Program Review and Oversight

- **National Energy Technology Laboratory, on behalf of the Secretary, shall ...**
 - 1) issue a competitive solicitation for the program consortium,
 - (2) evaluate, select, and award a contract or other agreement to a qualified program consortium, and
 - (3) have primary review and oversight responsibility for the program consortium, including review and approval of research awards proposed to be made by the program consortium.



Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources

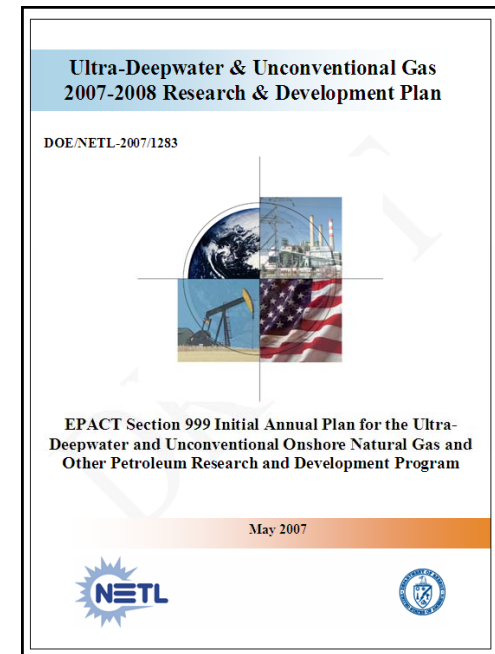
Program Administration

- **NETL selected RPSEA to administer program**
 - Contract effective January 4, 2007
 - Research Partnership to Secure Energy for America
 - Non-profit corporation; >100 member consortium
- **RPSEA will:**
 - Carry out research pursuant to annual plan as approved by DOE
 - Issue research project solicitations
 - Make project awards
 - Disburse research funds to performers
- **NETL will:**
 - Manage the contract between RPSEA & DOE
 - Develop annual plan based on RPSEA input
 - Review/approve research awards made by RPSEA



Annual Plan Development

- RPSEA submitted Draft Annual Plan on April 3, 2007
- NETL developed complementary plan
- NETL developed overall plan and submitted to Federal Advisory Committees (FACAs) on May 11, 2007
- FACA meetings held June 21-22, 2007 and July 24-25, 2007
- Annual Plan approved on August 1, 2007
- Annual Plan published in Federal Register on August 15, 2007
- NETL awaiting release of funds from OMB



Oil and Gas R&D Funding

Department of Energy
Office of Fossil Energy

NETL

\$37.5 MM

FY07 \$14.7 MM
FY08 TBD

\$12.5 MM

Consortium Program

- ♦ Ultra-deepwater \$14.963
- ♦ Unconventional Gas \$13.854
- ♦ Small Producer \$3.206
- ♦ RPSEA administration \$3.562
- ♦ NETL oversight \$1.875

Complementary Program

- ♦ Extreme Drilling
- ♦ Unconventional Oil and EOR
- ♦ Environmental
- ♦ Resource Assessment

Traditional Program

- ♦ E&P
- ♦ Hydrates
- ♦ Environmental
- ♦ RLE/EOR/SWC
- ♦ Infrastructure
- ♦ Deep Trek



NETL Complementary R&D *Program Philosophy*

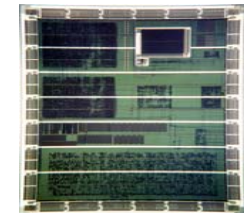
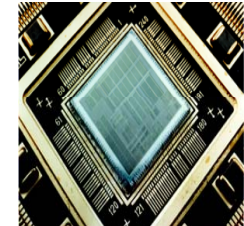
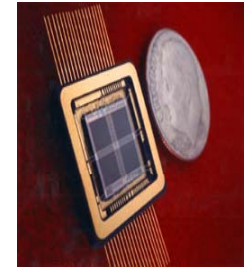
- **Conduct unique, high-value, non-duplicative work under EPACT 999**
- **Coordinate with RPSEA & traditional program**
- **Focus:**
 - Fundamental science
 - Long-term research providing basis for next-generation technologies
 - Unbiased environmental science
- **Technical areas:**
 - Drilling under extreme conditions
 - Environmental impacts of oil & gas development
 - Enhanced & unconventional oil recovery
 - Resource & technology assessment
- **Conduct annual merit review**



Drilling Under Extreme Conditions

EPACT 999 plan

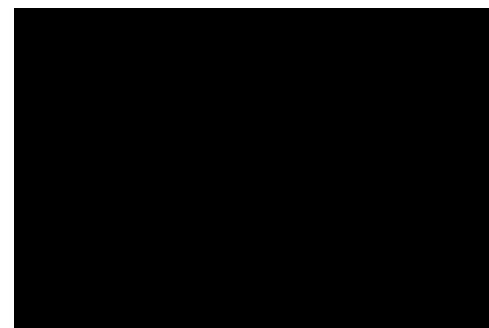
- **Ultra-deep single cutter Drilling Simulator (UDS)**
 - FY2008: UDS becomes fully operational
 - FY2012: Publish results of 8 studies of impact on ROP of different fluids as a function of P, T, and rock type
- **Novel drilling fluids**
 - FY2008: Initial nanofluid tests/characterizations
- **HP/HT electronics and sensors**
 - FY2008: Initiate work on HP/HT sensors, contacts, semiconductors and other electronic components
 - FY2012: Motor and control components and wireless silicon carbide electronics tested to 350°C
- **HP/HT materials**
 - FY2008: Benchmark tubular performance in HT/HP sour settings
 - FY2008: Investigate application of NETL High Interstitially Strengthened Steel (HISS) to HP/HT settings
 - FY2012: Complete materials development work initiated during earlier program assessments



Ultra-deep single cutter Drilling Simulator (UDS)

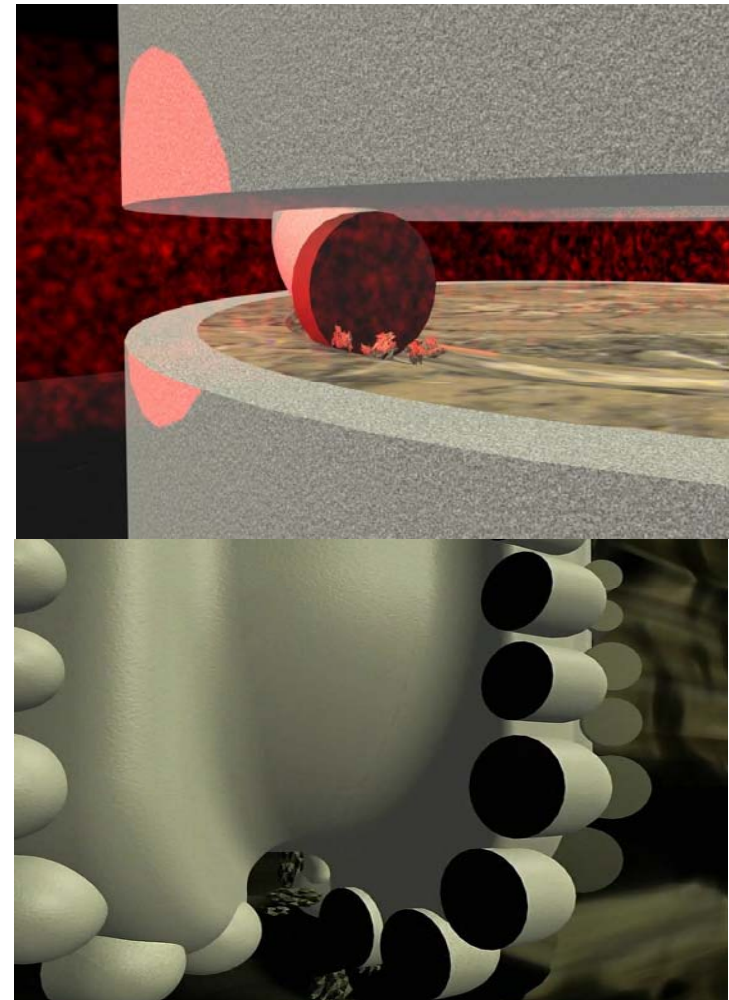
Developed with TerraTek, a Schlumberger company, under DE-FC26-05NT42654

- **One-of-a-Kind research facility capable of recreating bottom-hole drilling environments of ultra-deep wells**
- **Capability:**
 - Pressure up to 30,000 psi (2068 bar)
 - Temperature up to 481 °F (250 °C)
- **Operates on “real” drilling mud**
- **Visualization through X-Ray video system**
 - Images of cutting at down-hole conditions (i.e. HPHT)
 - Cutter and rock immersed in an optically opaque drilling fluid
- **Available for operation – June 2008**



Degrees of Freedom in UDS Experiments

- **Cutter Type**
 - Material, Size, Shape, Back rake
- **Rock Type**
 - Seek analogs to formation rocks w.r.t. hardness, porosity, permeability
- **Drilling Fluid Formulation**
- **Drilling Fluid Hydrodynamics**
 - ΔP_{nozzle} , T , Re_D , Nozzle placement
- **Weight on cutter**
- **Cutter Speed**
 - Radial position, rotation speed
- **Pore Pressure Control**
 - ΔP_{core} , $P_{\text{confining}}$, rock permeability



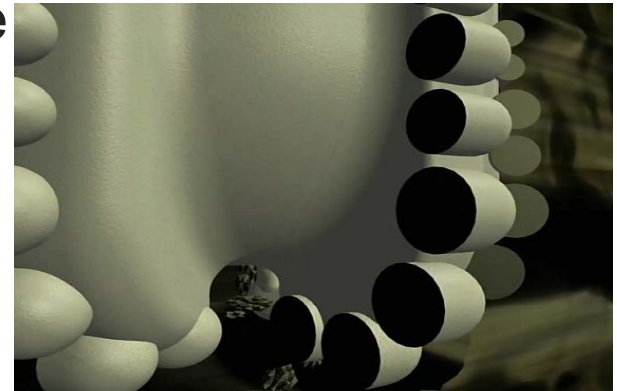
Examples of Future UDS Tests

- **Parametric Studies**

- Drilling Fluids (vary base fluid, weight, viscosity, etc.)
- Fluid Injection (nozzle placement, Reynolds number)
- Weight on Cutter and/or Displacement rate control

- **Fundamental Investigation**

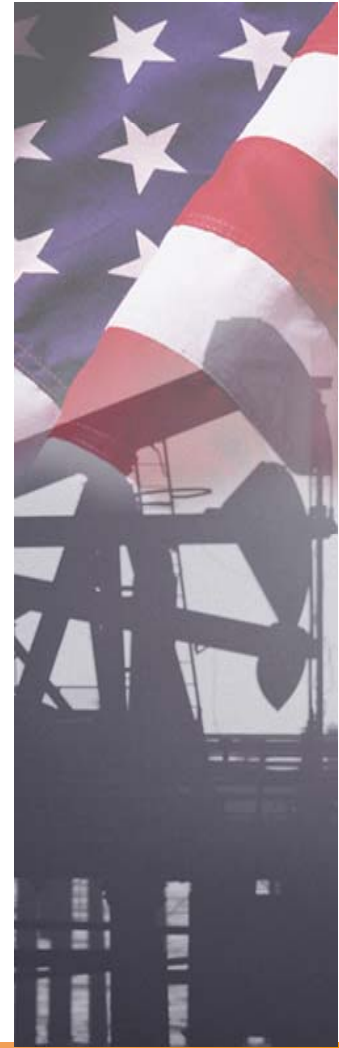
- Seek out evidence of filter cake formation on rock during very small time increments (i.e. between cutter passes)
- Effects of fluid transfer between rock/wellbore
- Role of volume changes in rock phase
- Importance of particle size distribution of dissolved solids



Enhanced and Unconventional Oil Recovery

EPACT 999 plan

- **Reservoir Characterization**
 - FY2008: create reservoir characterization data archives from historic EOR and oil shale projects
- **New EOR Technologies**
 - FY2008: develop new technologies for improving the mobility control of CO₂ floods
 - FY2012: investigate new and novel thermal practices for heavy oil
- **Sensor and Catalyst Development**
 - FY2008: initiate the development of an inexpensive, disposable, and readily dispersed catalytic agent for in situ production of oil from oil shale
 - FY2017: progress on development of nanosensors for real-time in situ data collection
 - FY2017: develop and test new catalyst for in-situ pyrolysis of oil shale



Environmental Impacts of Oil and Gas Development

EPACT 999 plan

- **Unbiased information for sound policy**

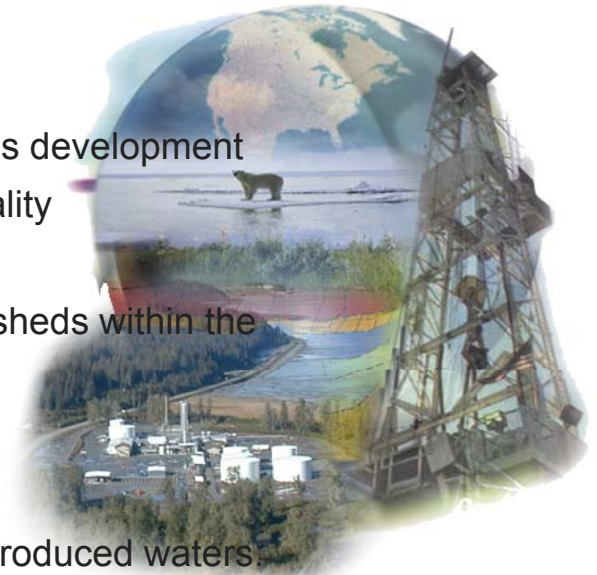
- FY2008: catalogue regulatory barriers/best practices relating to gas development
- FY2008: assess the impact of oil and gas E&P activities on air quality
- FY2012: publish new models for air emission impacts from E&P
- FY2012: report on ecological impact of E&P within selected watersheds within the Appalachian basin using

- **Managing produced water**

- FY2008: catalogue existing technology and solutions for treating produced waters.
- FY2008: evaluate subsurface drip irrigation as a beneficial use for produced waters.
- FY2012: complete scientific assessment of produced water impacts and treatment options in the Powder River Basin
- FY2012: deliver report evaluating alternative produced water management strategies

- **Oil Shale water-use minimization**

- FY2008: initiate environmental assessment of next generation oil shale retort technologies
- FY2012: provide refined upper and lower limits to water quality and quantity required to support oil shale production as a function of production method and rate



Resource and Technology Assessments

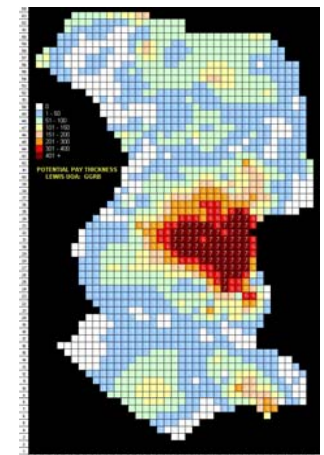
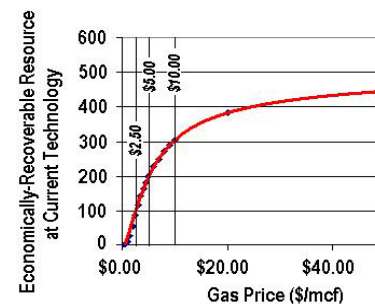
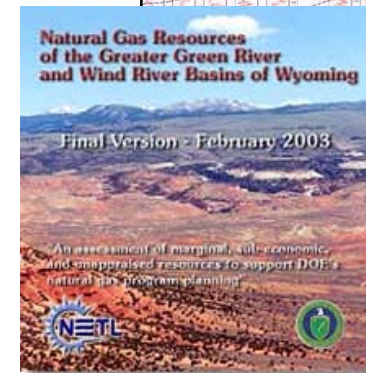
EPACT 999 plan

- **Resource Assessment**

- FY2008: delineate most promising plays in the Appalachian basin (AB)
- FY2010: complete initial AB assessment on CD
- FY2012: complete 2nd round AB assessments
- FY2012: identify need for additional assessments

- **Technology Assessment**

- FY2008: initiate the development of the Knowledge Management Database
- FY2008: document current state of advanced technology usage in the Appalachian basin
- FY2010: complete assessment of historical trends in advanced technology adoption in mature basins
- FY2012: develop capability for reliable modeling of technology impacts



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*Office of Fossil Energy's
website:*

www.fe.doe.gov



NETL's website:
www.netl.doe.gov



Strategic Center for Natural Gas and Oil