

Natural Gas Infrastructure Reliability



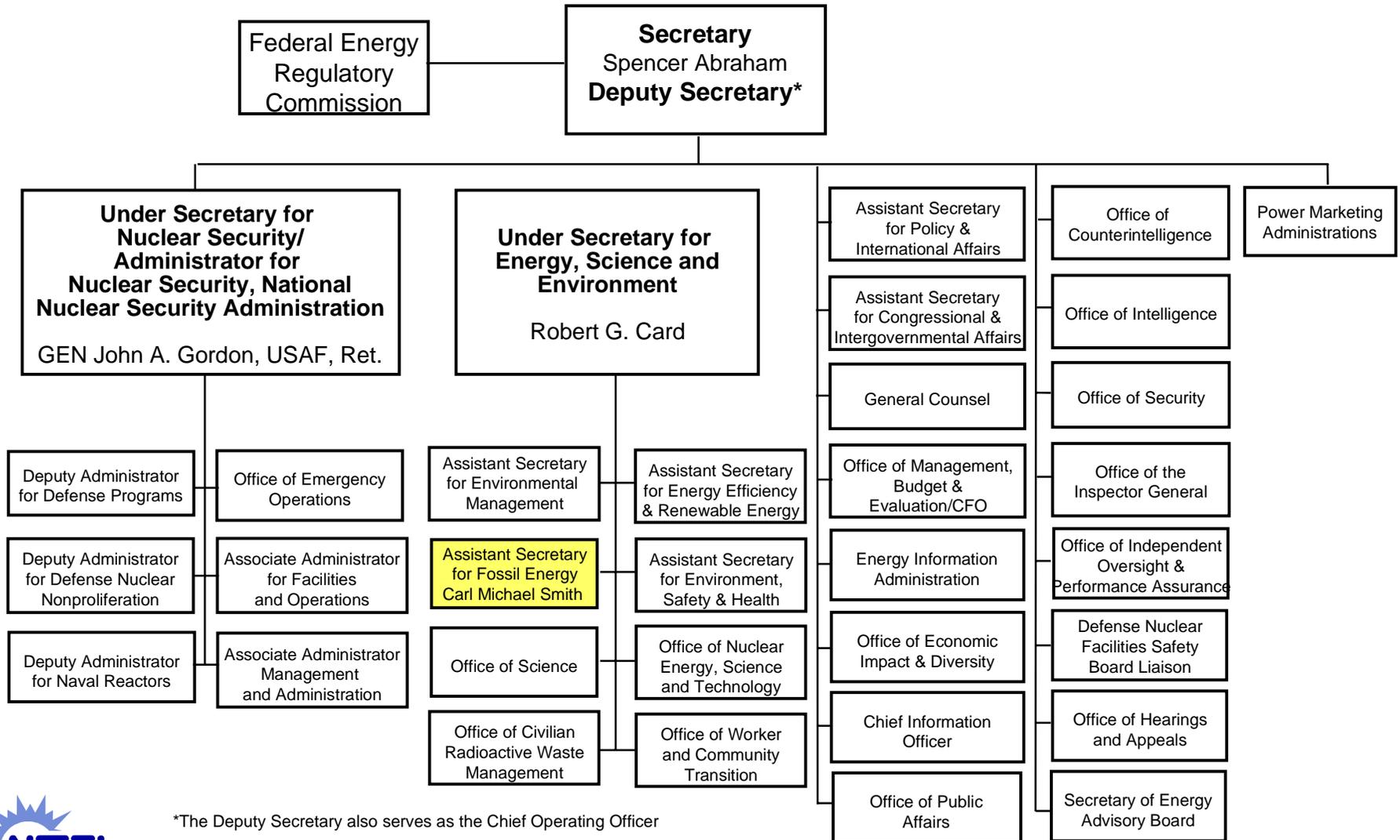
Program Overview
September, 2002

Dr. Rodney J. Anderson
Product Manager

Strategic Center for Natural Gas



Department of Energy



*The Deputy Secretary also serves as the Chief Operating Officer



National Energy Technology Laboratory



- One of DOE's 17 national labs
- Government owned/operated
- Sites in Pennsylvania, West Virginia, Oklahoma, Alaska
- More than 1,100 federal and support contractor employees
- FY 02 budget of \$750 million



Our Mission

- Resolve the environmental, supply, and reliability constraints of producing and using fossil resources
- Support development and deployment of environmental technologies to remediate DOE's weapons complex



Accomplishing Our Mission

- Shape, fund, and manage extramural RD&D
- Conduct onsite research
- Support energy policy development
- Assist in international deployment of energy technologies
- Contribute to best business practices within DOE



NETL FY 2002 Budget

\$762.9 Million

FE Funded

Gas RD&D
\$127.5M

Fuels RD&D
\$36.6M

Oil RD&D
\$56.0M

Fossil Energy
Program
Support
\$87.9M

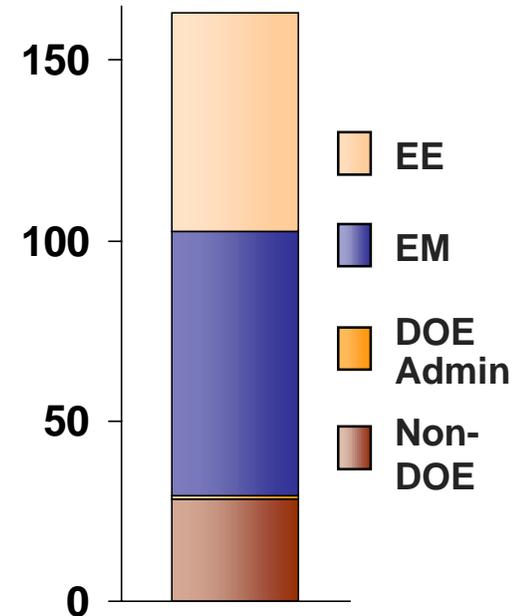
Coal RD&D
\$313.8M*

Clean Coal
Technology
Demonstration
\$9.3M

*Includes \$150M for CCPI

Non-FE Funded

\$ Million



Strategic Center for Natural Gas

Vision:

By 2020, U.S. public is enjoying benefits from an increase in gas use:

- Affordable supply
- Reliable delivery
- Environmental protection



Mission:

Be the focal point for an integrated gas program:

- Spearhead annual DOE-wide gas RD&D planning and program assessment
- Provide science and technology advances through NETL's on-site programs
- Shape, fund, and manage extramural RD&D
- Conduct studies to support policy development





Gas Infrastructure Reliability

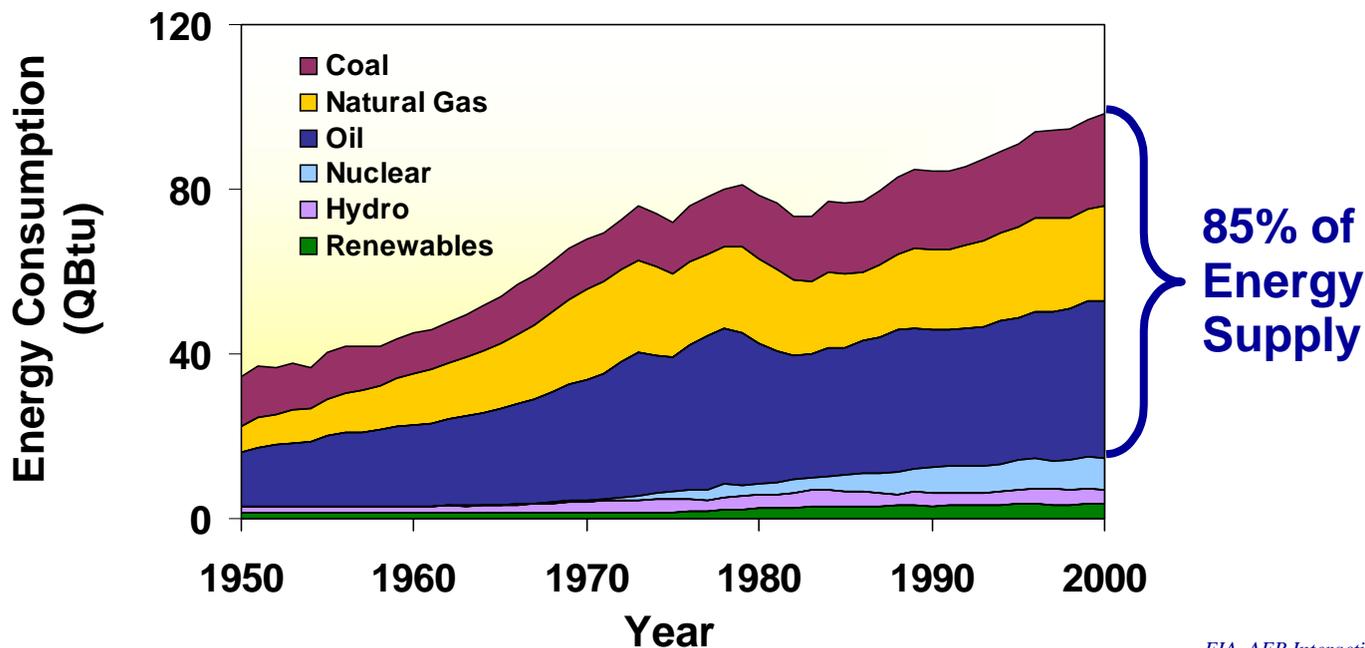


- **Transmission, distribution & storage**
- **Program goals:**
 - Maintain/enhance system reliability and integrity
 - Increase gas deliverability
 - Reduce environmental impact
 - Address gas & electric interdependencies
 - Develop technology for future gas delivery system
 - Support infrastructure security
- **Budget:**
 - \$2.5 million storage technology
 - \$7.5 million infrastructure reliability



Fossil Fuels Today

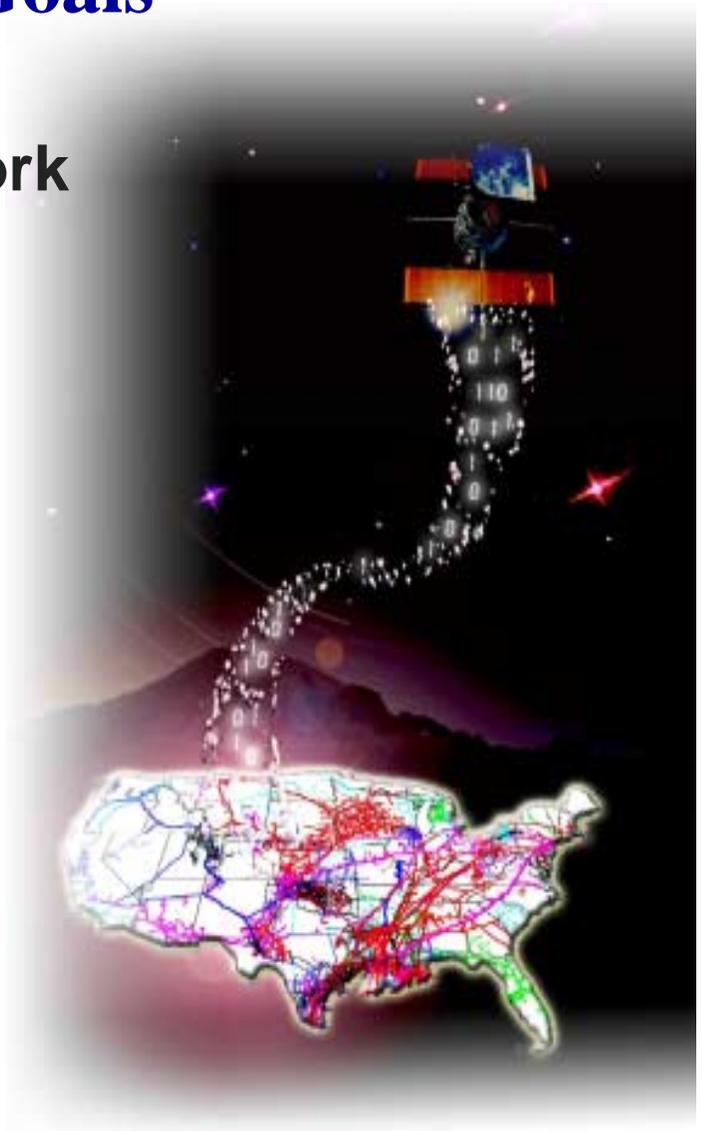
- Provide 85% of U.S. energy
- Will provide 87% of U.S. energy in 2020
- Supply should last throughout this century
- Infrastructure to deliver at low cost



EIA, AER Interactive Data Query System

Infrastructure Goals

- **Establish the technology framework for our Nation's future secure natural gas transportation and delivery system**
 - Provide research and technology development
 - Focus federal infrastructure program on public benefit R&D
 - Collaborate with private sector
 - Support infrastructure assurance



Core Areas & Issues

- **Pipelines and distribution systems**
 - Third-party damage
 - Integrity Assessment
 - Leak detection – Remote Sensing
 - Guided boring technology
 - Underground facility location
 - Compressor technology
 - Aging pipeline and distribution systems
 - Growth of distributed power
 - Internal pipe inspection/repair
 - System automation and control
- **Environmental**
 - Environmental impact
 - Federal permitting process



Natural Gas Industry Background

- 270,000 miles of transmission pipelines*
- 952,000 miles of distribution pipelines*
- \$8 billion/yr investment in new infrastructure*
- Energy companies dominating the industry
- R&D viewed as expense, not investment
- FERC-funded R&D loss
- Growing DOE role in infrastructure R&D
- Security difficult with dispersed assets



**NPC Report, December 1999*



Security Issues

Gas

- Dispersed
- Hidden
- Line packing
- Obvious vulnerabilities
- Quickly repairable
- SCADA vulnerable
- Critical energy supply

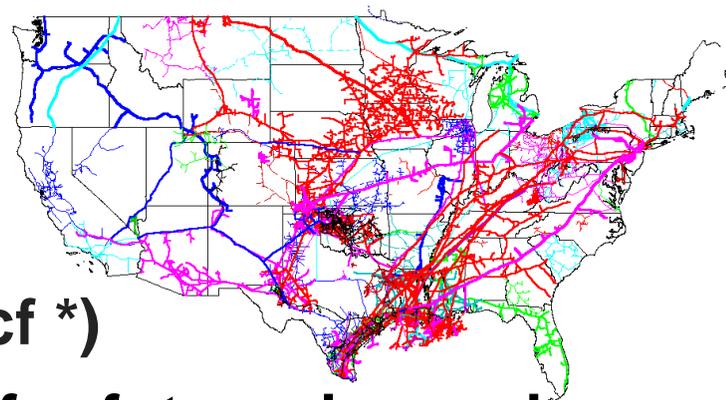
Electric

- Dispersed
- Visible
- Just in time delivery
- Obvious vulnerabilities
- Quickly repairable
- SCADA vulnerable
- Critical energy supply

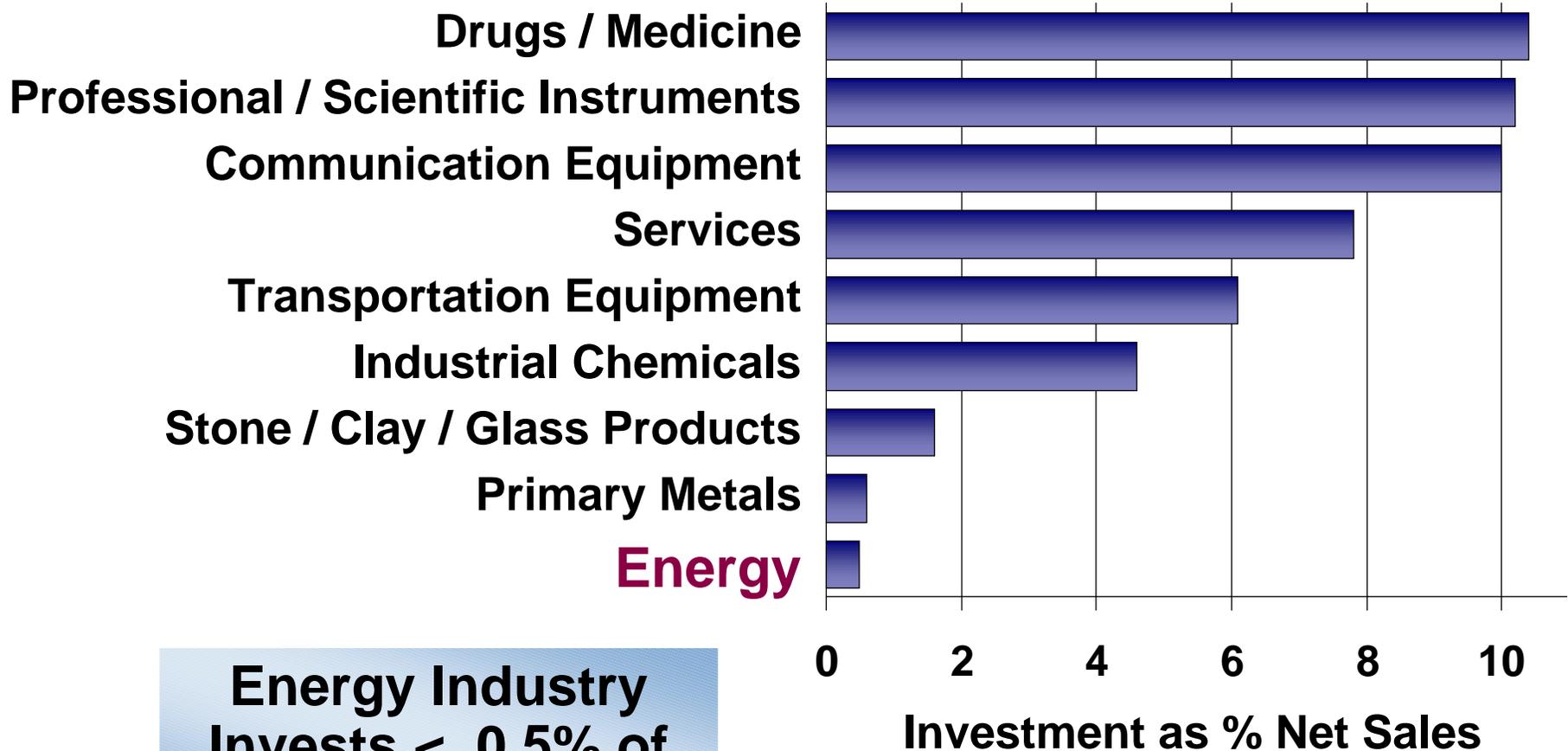


Infrastructure Drivers

- Gas demand increase by 50% (to 34 tcf) by 2020 *
- Electric generators demand for gas to almost triple (grow by 6 tcf *)
- Aging infrastructure inadequate for future demand
- Consolidation and competition limits gas industry investment in long-term public benefit R&D
- Distributed power drive infrastructure changes
- Gas *critical* for U.S. climate change strategies
- Increasing environmental sensitivities
- Heightened security concerns



Energy Sector R&D Investments Low



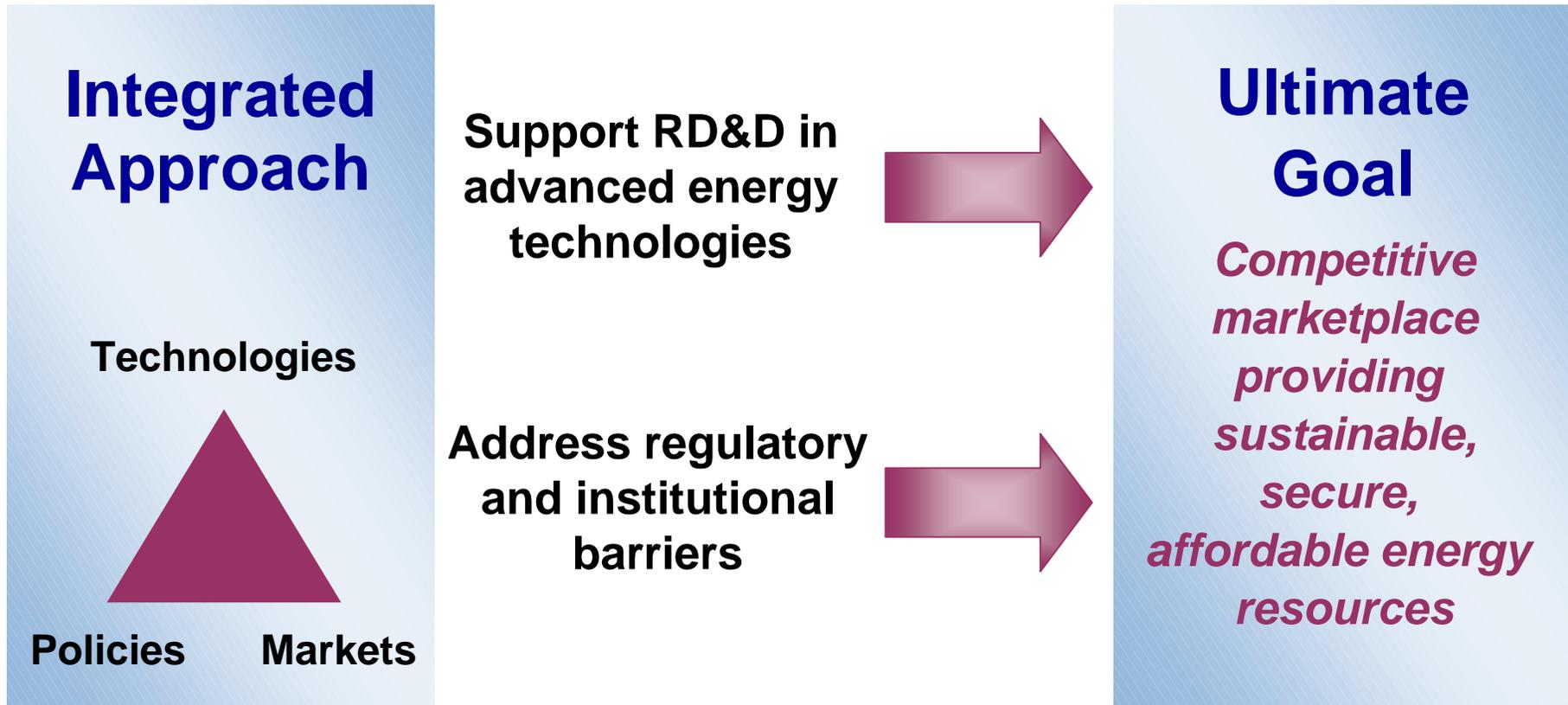
**Energy Industry
Invests < 0.5% of
Sales**



1995 Data - NSF) Margolis & Kammen, Science, 1999

Strategic Center for Natural Gas

Federal Role



FY02 Infrastructure Activities

Goals

Elicit stakeholder input

- Portfolio gaps
- Innovation
- Infrastructure security

Determine government role

Roadmap Update Workshop

January 29 & 30, Pittsburgh, PA
40 industry experts

National Labs

July Lab Call
Focus on innovation

Competitive Solicitation

6 awards
Various stages of development

Broad-Based Financial Assistance

4 awards
Various stages of development



Roadmap Update Workshop Summary

- **Re-affirmed major priorities of Roadmap**
 - Inspection tools for integrity and reliability
 - 3rd Party Damage
 - ROW intrusions
 - Environmental issues
- **Identified importance of infrastructure security**
 - Personnel intrusion monitoring
 - Secure SCADA systems
 - National emergency monitoring system
 - Vulnerability assessments
- **Emphasized need for industry/gov't collaborations**
- **Industry focused on near-term R&D (50-30-20)**



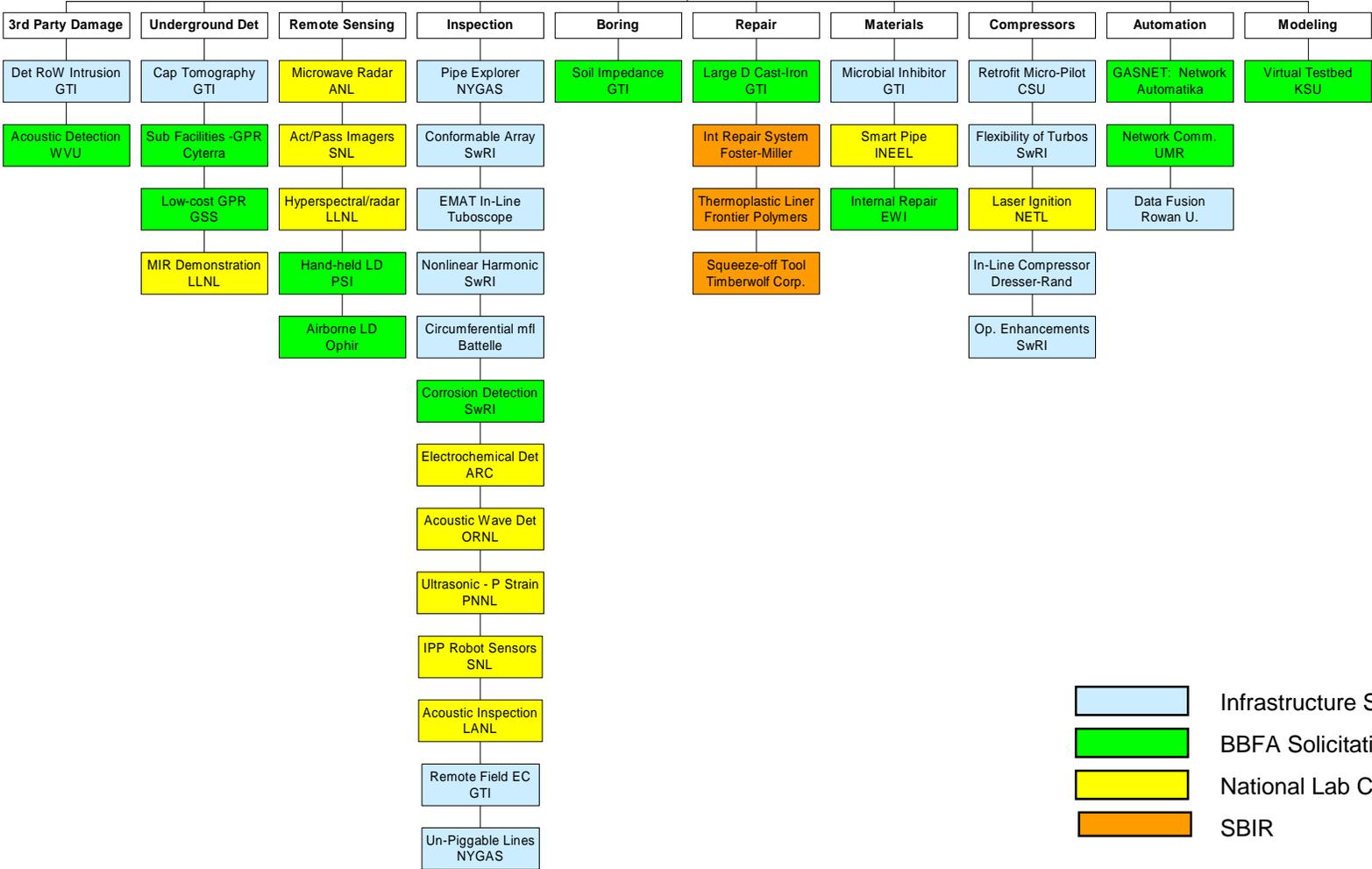
Implementation Strategy

- Focus on high risk, innovation, and leap frog technologies
- **Balanced R&D program**
 - Distribution, transmission, & crosscuts
- **Most funding dedicated to private sector projects**
- **National laboratory efforts focused on innovation**
- **Industry participation**
- **Collaborations & cost sharing**
- **Some quick wins to demonstrate progress**



Project Portfolio

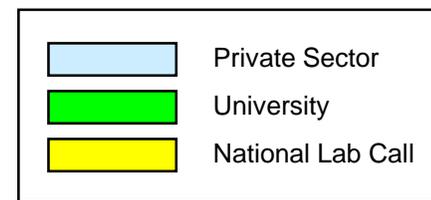
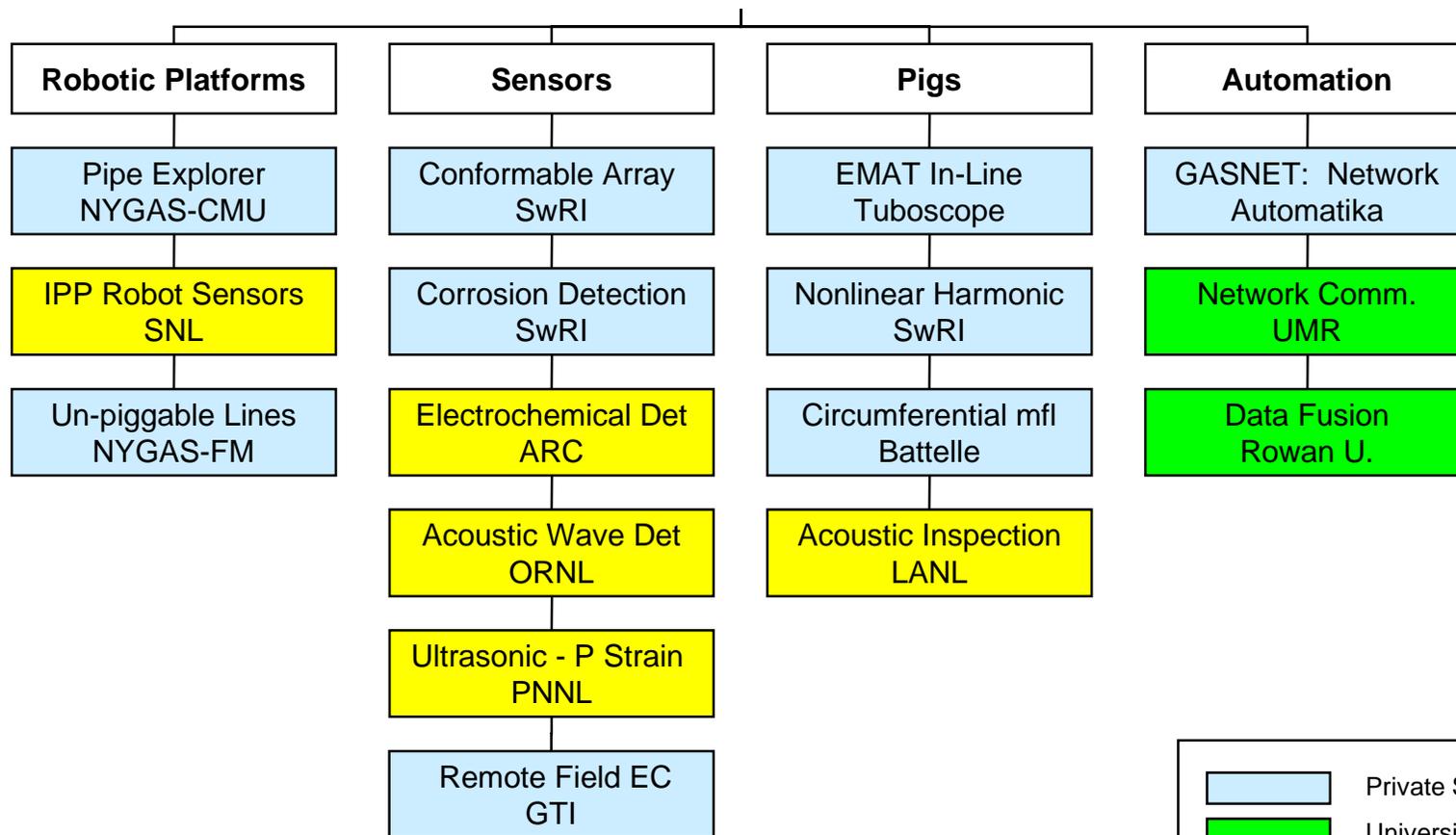
Natural Gas Infrastructure Reliability



- Infrastructure Solicitation
- BBFA Solicitation
- National Lab Call
- SBIR



Inspection Technologies



Inspection Technologies

- **Robotic Platforms**

- NYGAS-CMU “Design, Construction & Field Demonstration of EXPLORER: Long Range Untethered Live Gasline Inspection Robot System”.
- SNL “Sensor Development for the IPP Robotic Vehicle for Internal Detection of Gas Pipeline Defects”.
- NYGAS-FM “Development of an Inspection Platform and a Suite of Sensors for Assessing Corrosion and Mechanical Damage in Un-Piggable Transmission Mains”.

- **Pigs**

- Tuboscope “Development of an EMAT In-Line Inspection System for Detection, Discrimination and Grading of Stress Corrosion Cracking”.
- SwRI “Development of Nonlinear Harmonic Sensors for Detection of Mechanical Damage”: Advanced electromagnetic technology.
- Battelle “Circumferential MFL In-Line Inspection for Cracks in Pipelines”: Detect and size axial cracks in steel pipelines.
- LANL “Natural Gas Energy Meter and Multi-purpose Sensor”: Swept frequency acoustic interferometry technology.



Inspection Technologies (continued)

- **Sensors**

- SwRI “Conformable Array for Mapping Corrosion Profiles”: Device to quickly map the corroded surface of a pipe, without cleaning of the pipe surface.
- SwRI “Monitoring Technology for Early Detection of Internal Corrosion for Pipeline Integrity”: Detect minute changes in pipe wall thickness
- ARC “Electrochemical Noise Sensors for Detection of Localized and General Corrosion of Natural Gas Transmission Pipelines”.
- ORNL “New Acoustic Wave Pipe Inspection System”: New waveguide pipe flaw detection technique to detect pipeline flaws.
- PNNL “Ultrasonic Measurements of Plastic Strain in Pipelines”: Nondestructive test method to detect and evaluate third party damage in pipelines.
- GTI “Remote Field Eddy Current Inspection of Un-Piggable Pipelines”: Innovative sensor for integrity assessment.



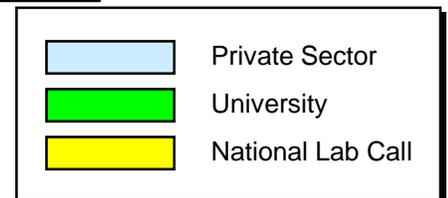
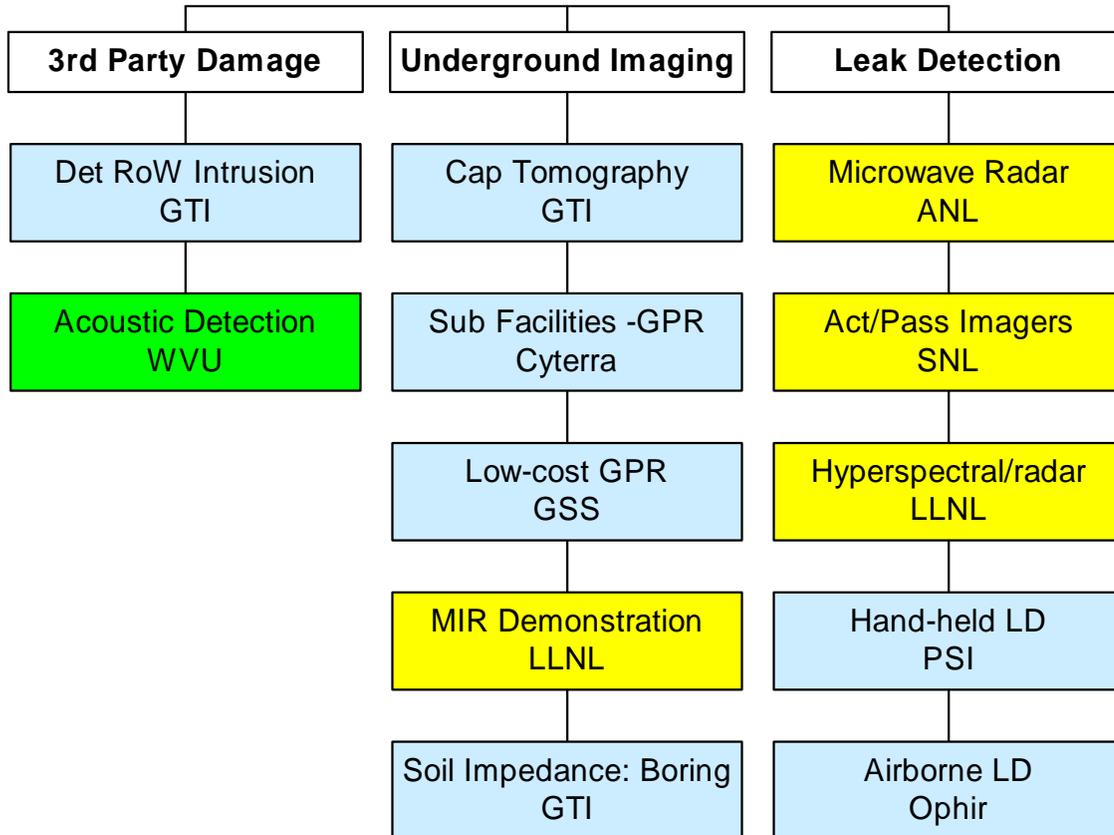
Inspection Technologies (continued)

- **Automation**

- Automatika “GASNET: Gasline Sensor Network System”: Wireless network of small pipeline sensors to monitor the real-time operations.
- UMR “Pipelines as Networked Communication Links”: Strategy for along and through pipe real-time communications.
- Rowan U “Data Fusion System for the Non-Destructive Evaluation of Non-Piggable Pipes”: Techniques for handling and analyzing large quantities of inspection and operating data.



Remote Sensing



Remote Sensing

- **3rd Party Damage**

- GTI “Detection of Unauthorized Construction Equipment in Pipeline Right-of-Ways”: Optical fiber intrusion detection device.
- WVU “Acoustic Detecting and Locating Gas Pipeline Infringement”: Detect unique sound waves associated with pipeline anomalies.

- **Underground Imaging**

- GTI “Capacitive Tomography for the Location of Plastic Pipe”: Low-frequency capacitive tomography detection system.
- CyTerra “Detection of Subsurface Facilities Including Non-Metallic Pipe”: Ground penetrating radar technology.
- GSSI “A Low-Cost GPR Gas Pipe & Leak Detector”: Ground penetrating radar technology.
- LLNL “MIR Demonstration for Pipe/Facilities Locator”: Ground penetrating radar technology.
- GTI “Differential Soil Impedance Obstacle Detection”: Obstacle-detection sensor that can be installed in the drill bit of horizontal directional drilling system.



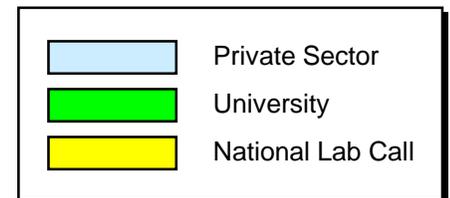
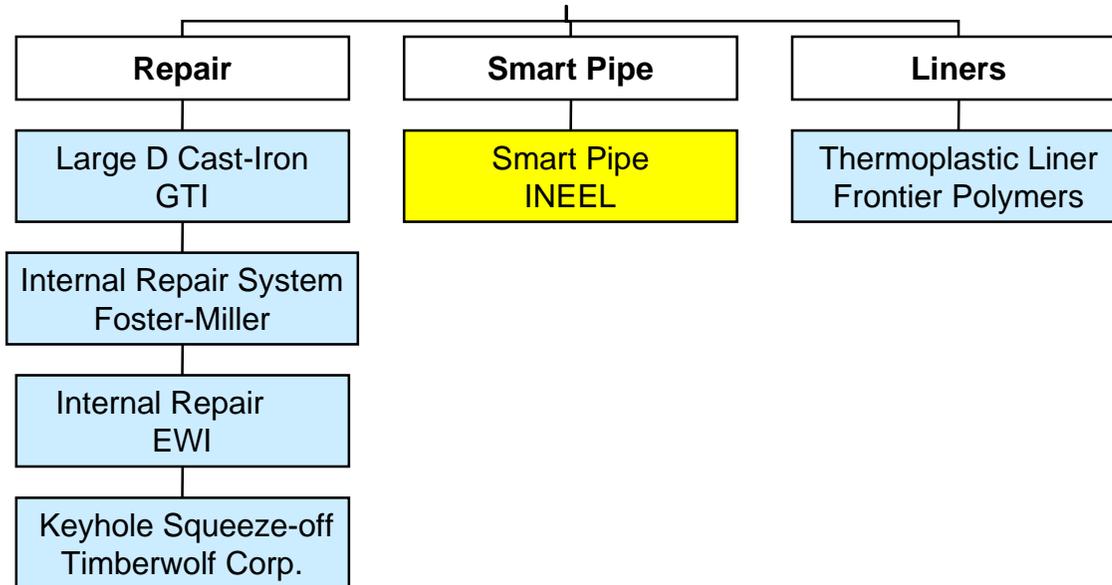
Remote Sensing (continued)

- **Leak Detection**

- ANL “Microwave Radar Sensing of Gas Pipeline Leaks”: Pulsed microwave radar imaging system.
- SNL “Evaluation of Active and Passive Gas Imagers for Transmission Pipeline Remote Leak Detection”.
- LLNL “Remote Sensing Techniques for Natural Gas Transmission Infrastructure Systems Using Hyperspectral and Radar Imaging”.
- PSI “Handheld Sensor for the Remote Detection of Natural Gas Leaks”: Includes ethane detection to distinguish natural gas and extended range up to 500 feet.
- Ophir “Airborne Optical Sensing of Methane & Ethane for Natural Gas Pipeline Leaks”.



Materials Development



Materials Development

- **Repair**

- GTI “Sealing Large-Diameter Cast-Iron Pipe Joints Under Live Conditions”: Tethered robotic system to seal joints.
- Foster-Miller “Internal Pipe Repair System”: Self-expanding narrow band of composite material to seal leaks and joints. SBIR project.
- Edison-Welding “Internal Repair of Pipelines”: Welding-based internal repair techniques for use with robotic platforms.
- Timberwolf “Keyhole Squeeze-off Tool to Enable Repair of Large (4” to 6”) Polyethylene Gas Pipes”: SBIR project.



Materials Development (continued)

- **Smart Pipe**

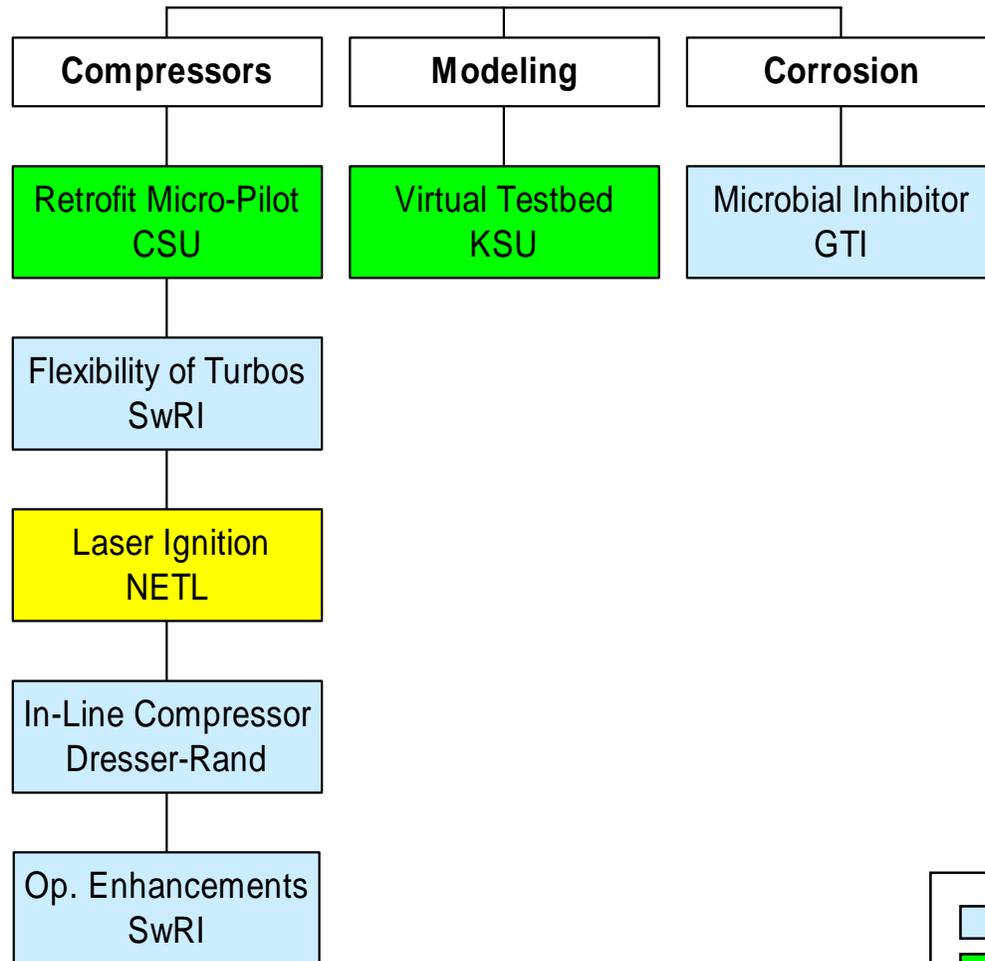
- INEEL “Integral Communication, Damage Detection and Multiple Sensor Application in Pipelines”: Thermally sprayed conductive traces to imbed communication, sensor, and power capabilities into pipe.

- **Liners**

- Frontier “Assure Natural Gas and Oil Pipeline Reliability by Cost-Effective, High-Performance Thermoplastic Liners”: Improved liners with higher temperature rating, better hoop strength, greater gas barrier, and reduced cost 50-70%. SBIR project.



Operational Technologies



Operational Technologies

•Compressors

- CSU “Improvement to Pipeline Compressor Engine Reliability through Retrofit Micro-Pilot Ignition System”.
- SwRI “Increased Flexibility of Turbo-Compressors in Natural Gas Transmission through Direct Surge Control”: Incipient Surge Detector.
- NETL “Laser Ignition System for Reciprocating Engines”. Improved engine efficiency, reduced emissions, and reduced operating costs.
- Dresser-Rand “Enclosed In-Line Electric Motor Driven Gas Compressor”: Distributed compressors of this type could increase pipeline capacity up to 20% and increase security.
- SwRI “Technologies to Enhance Operation of the Existing Natural Gas Compressor Infrastructure”: Incremental performance improvements could reduce fuel costs by 1%.



Operational Technologies (continued)

- **Modeling**

- KSU “Virtual Pipeline System Testbed to Optimize the U.S. Natural Gas Transmission Pipeline”: Computer model

- **Corrosion**

- GTI “Development of an Environmentally Benign Microbial Inhibitor to Control Internal Pipeline Corrosion”: Natural chemical compounds.





Solicitation Information

DE-PS26-02NT41613

“Development of Technologies and Capabilities for Developing Coal, Oil and Gas Energy Resources”

(Proposals due October 28, 2002)



Available on the NETL Website at:

<http://www.netl.doe.gov/business/solicit>

Or

<http://e-center.doe.gov>





April 18, 2002

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The Strategic Center for Natural Gas

*Integrating All Elements of DOE's
Natural Gas Research
From Borehole to Burner Tip*

Natural Gas Infrastructure Reliability Industry Forums

The Strategic Center for Natural Gas (SCNG) at the NETL will conduct a series of Natural Gas Infrastructure Reliability Industry Forums in September 2002. [Read More!](#)

Natural Gas Technology – Investment in a Healthy U. S. Energy Future

Time is running short to register for the "Natural Gas Technology – Investment in a Healthy U.S. Energy Future" conference. [Read More!](#)

DOE Kicks Off "Deep Trek" to Develop Deeper, Smarter Drilling Technology

To develop a new high-tech "smart" drilling system that can tap into deep reservoirs, the DOE is beginning "Deep Trek." [Read More!](#)

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