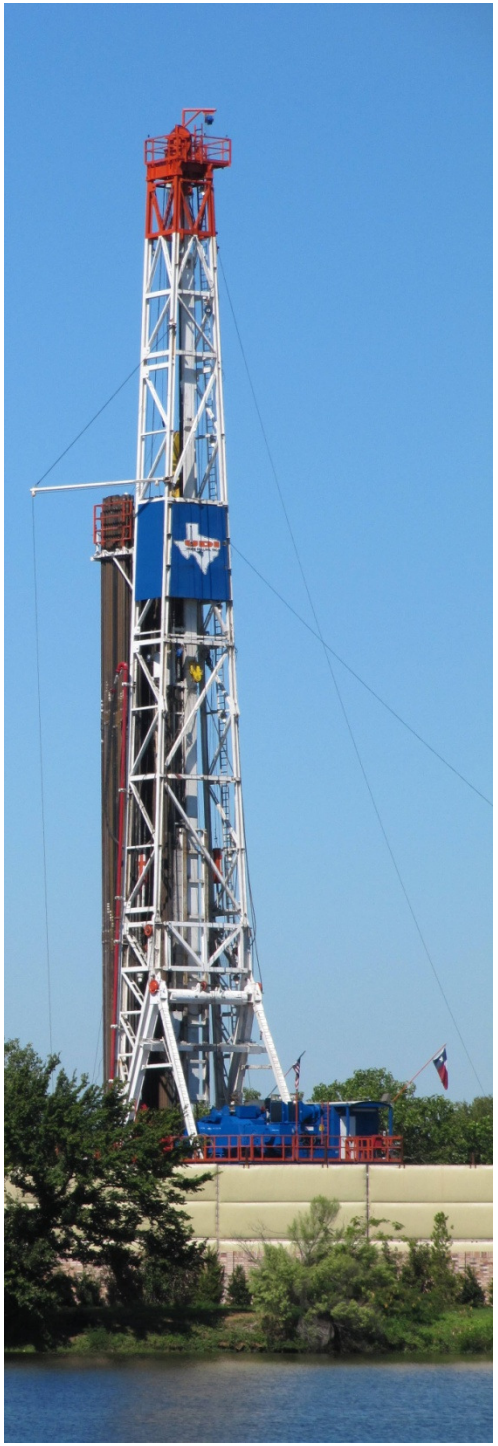
U.S. DEPARTMENT OF ENERGY

Oil and Natural Gas



Shale Gas

Presentation to the
SEAB Natural Gas Subcommittee

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Deputy Assistant Secretary
Office of Oil and Natural Gas

19 May 2011

Discussion Topics

- Natural gas and the American economy
- Challenges
- Department of Energy Research Program
- The road ahead

Winning the Future :: American Energy

Oil and Natural Gas

"…I've asked Secretary Chu, my Energy Secretary, to work with other agencies, the natural gas industry, states, and environmental experts to improve the safety of this [shale gas extraction] process."

PRESIDENT OBAMA, MARCH 30, 2011

When I was elected to this office, America imported 11 million barrels of oil a day. By a little more than a decade from now, we will have cut that by one-third. That is something that we can achieve.

PRESIDENT OBAMA, MARCH 30, 2010

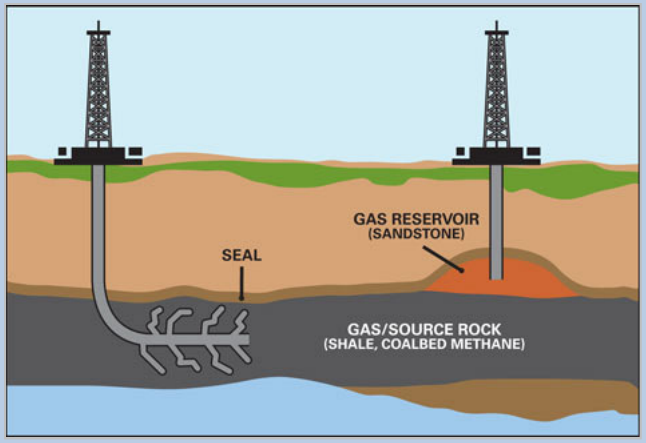
We've got, I think, broad agreement that we've got terrific natural gas resources in this country. Are we doing everything we can to develop those?

PRESIDENT OBAMA, NOVEMBER 3, 2011

Shale gas is a potential game changer

Oil and Natural Gas

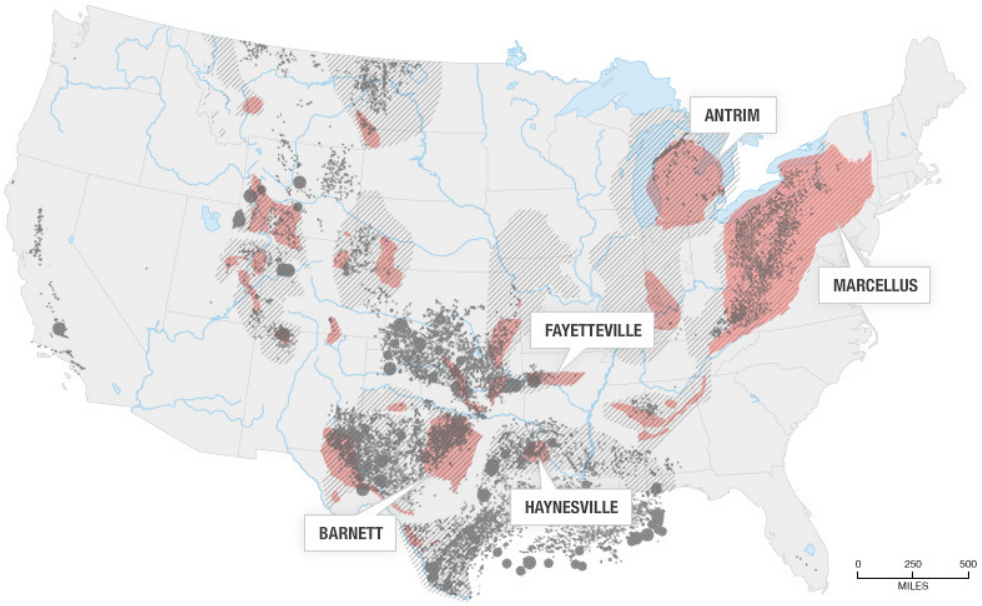
WHAT?



The natural gas stored in shales is no different than that found in conventional reservoirs, but the physical mechanisms trapping the gas in these rocks and the technologies needed to extract it are different, requiring long horizontal laterals and hydraulic fracturing.

The extraction process is more complicated, but exploration risk is much lower.

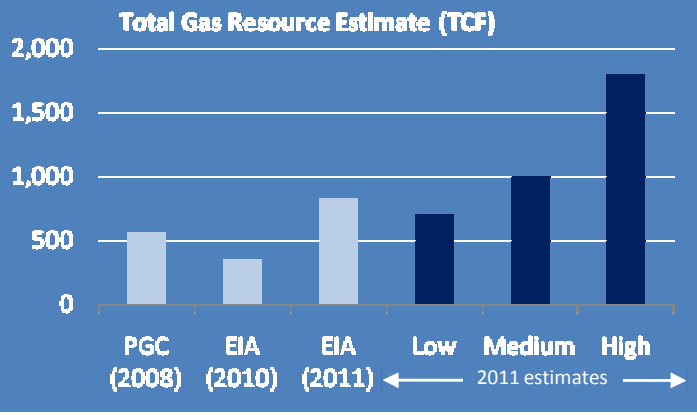
WHERE?



Shale gas can be found in a vary wide range of areas throughout the United State, including regions that don't have extensive recent history with exploration and production activities.

HOW MUCH?

Estimates of commercial shale gas resources have increased substantially in recent years, largely due to improvements in production technology.



Shale gas is having an impact on prices

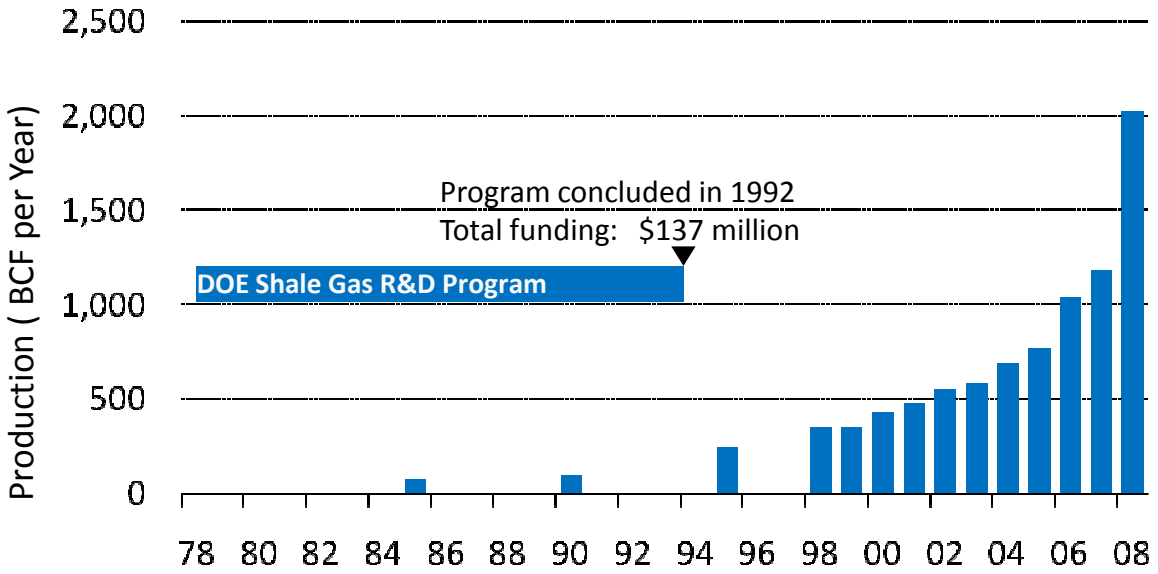
Early government research led to private sector investment in shale technologies.

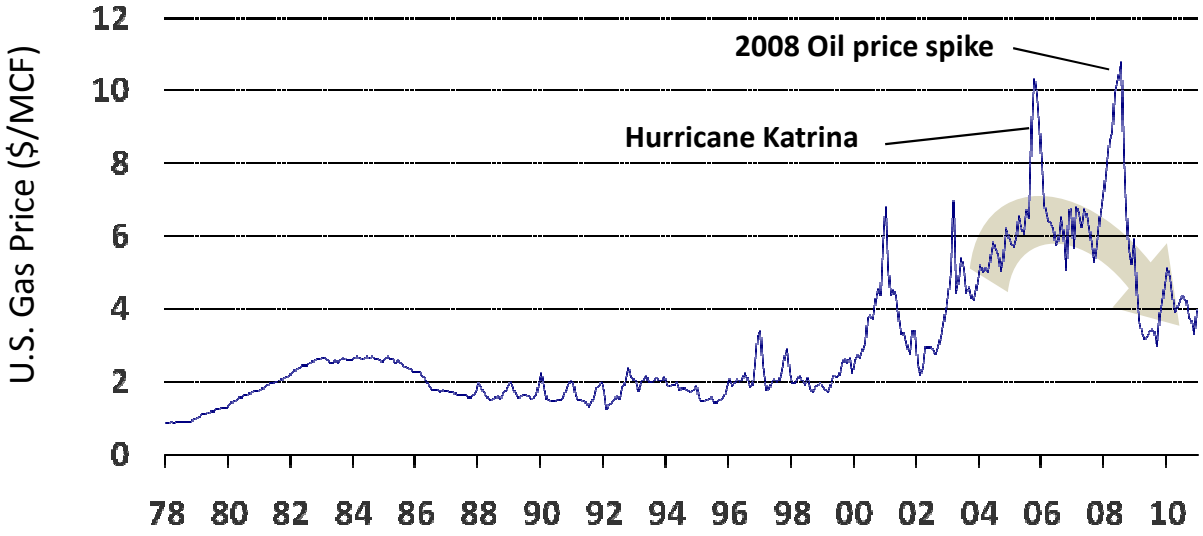
Between 1978 and 1992 the Department of Energy invested approximately $137 million in research that led to breakthroughs in hydraulic fracturing and extended horizontal laterals.

These innovations led to private sector investments by independent producers, at which point government funding for research was ended.

The development of the Nation's shale gas resource base has led to increased supply and lower prices.

EIA estimates over 800 trillion cubic feet of shale gas resource in the United States – a significant supply of domestic energy for the U. S. economy.



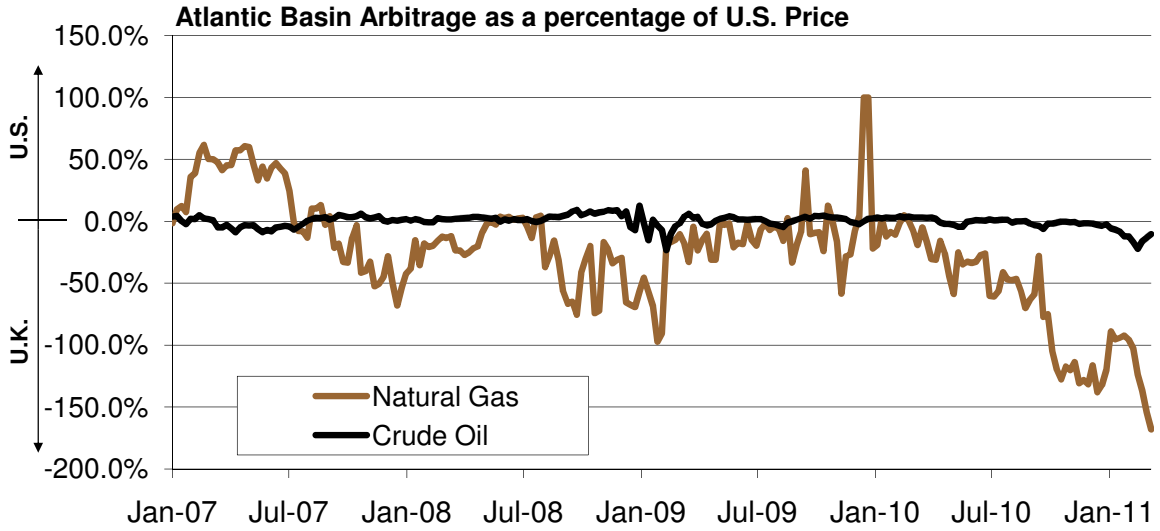


Natural Gas:: a uniquely domestic commodity

This graph shows the Atlantic Basin arbitrage for oil and for gas.

Crude is a globally fungible commodity – WTI moves in lockstep with Brent.

U. S. gas markets, by contrast, move independently to gas markets in other regions. Increases in domestic supply of natural gas has the potential to lower prices which American consumers pay

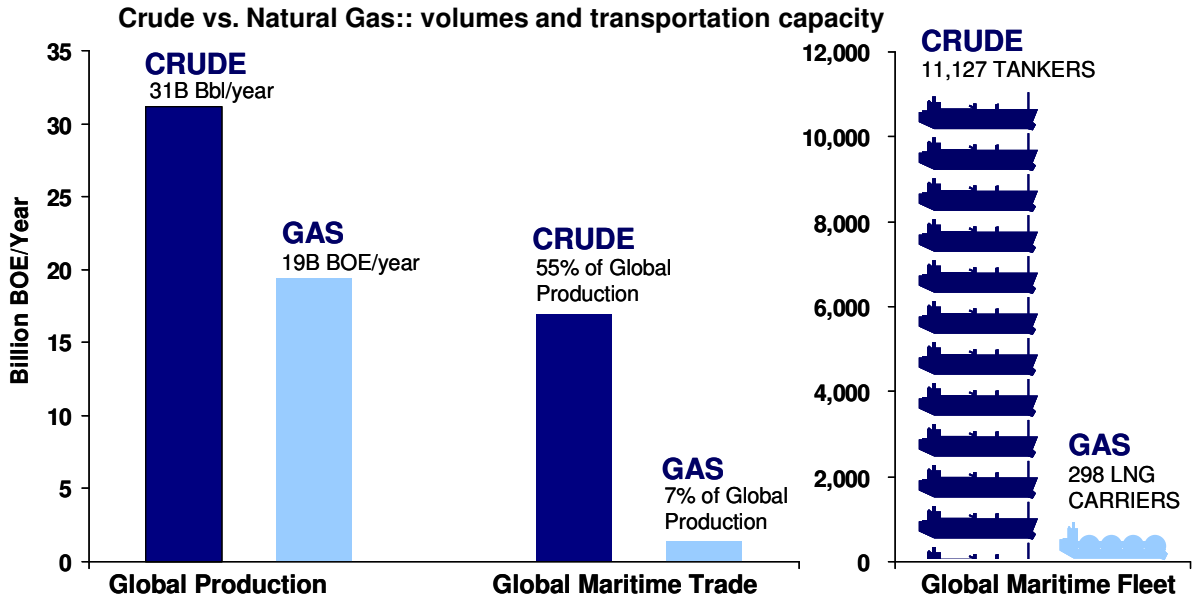


Sources: Energy Information Administration, World Gas Intelligence

Gas is more difficult to transport than crude.

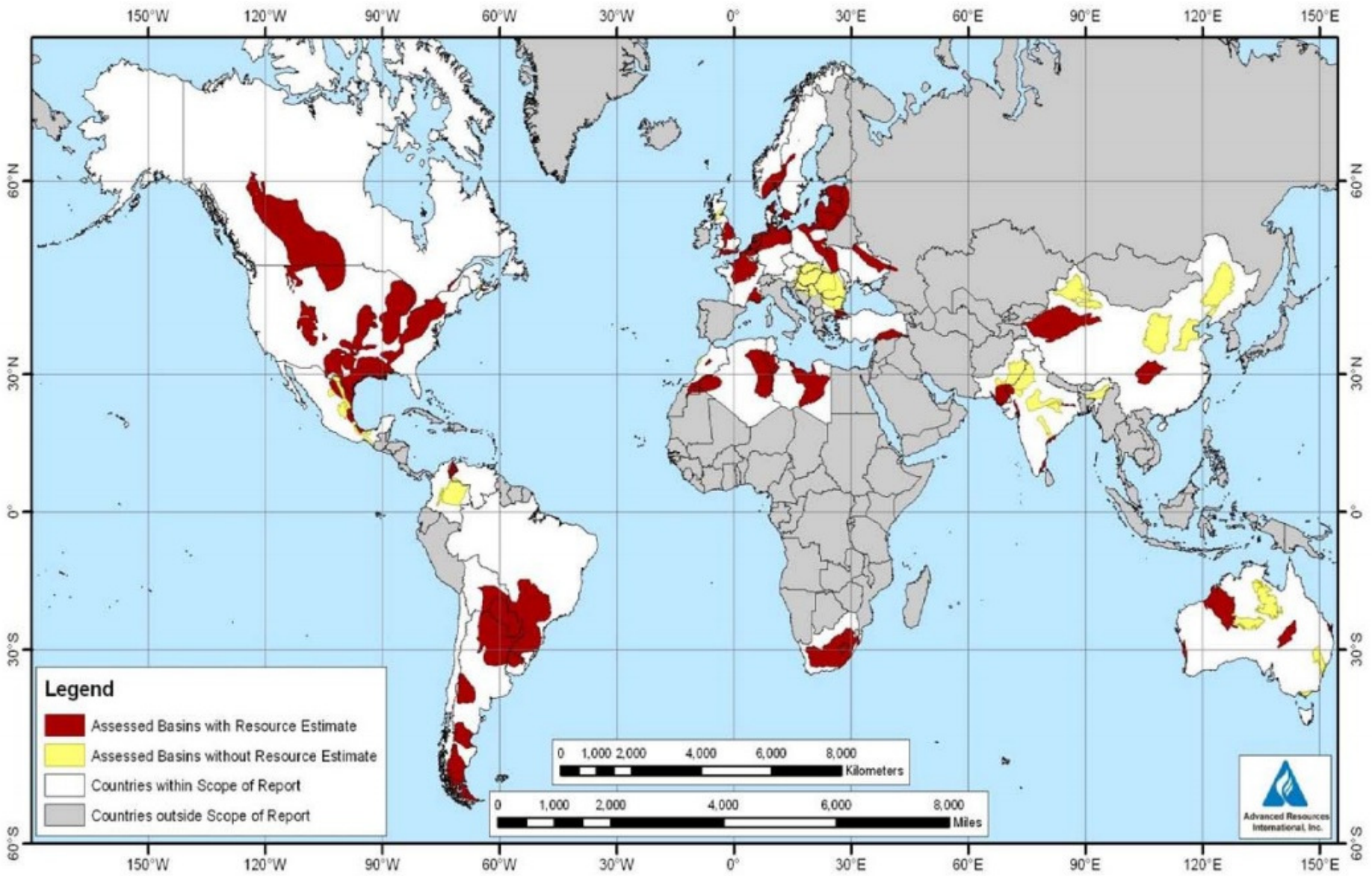
A significant percentage of global crude production is internationally traded, connecting regional markets and closing arbitrages.

Natural gas markets are becoming more global via LNG, but currently a very small percentage of natural gas is traded across regional basins.



A global story…

Oil and Natural Gas



Challenges

Oil and Natural Gas

OFFSHORE (DEEPWATER)

Technically complex

As producers push to find and produce oil and gas in ultra-deep environments they must deal with tremendous technical challenges. This provides a high barrier to entry.

Unified regulatory environment

The Federal government has clear regulatory responsibility over exploration and production activities offshore.

ONSHORE (SHALE)

Accessible technology

The technical hurdles to producing shale gas have been tackled by domestic independent producers. Compared to deepwater and ultra deepwater operations the barriers to entry are low.

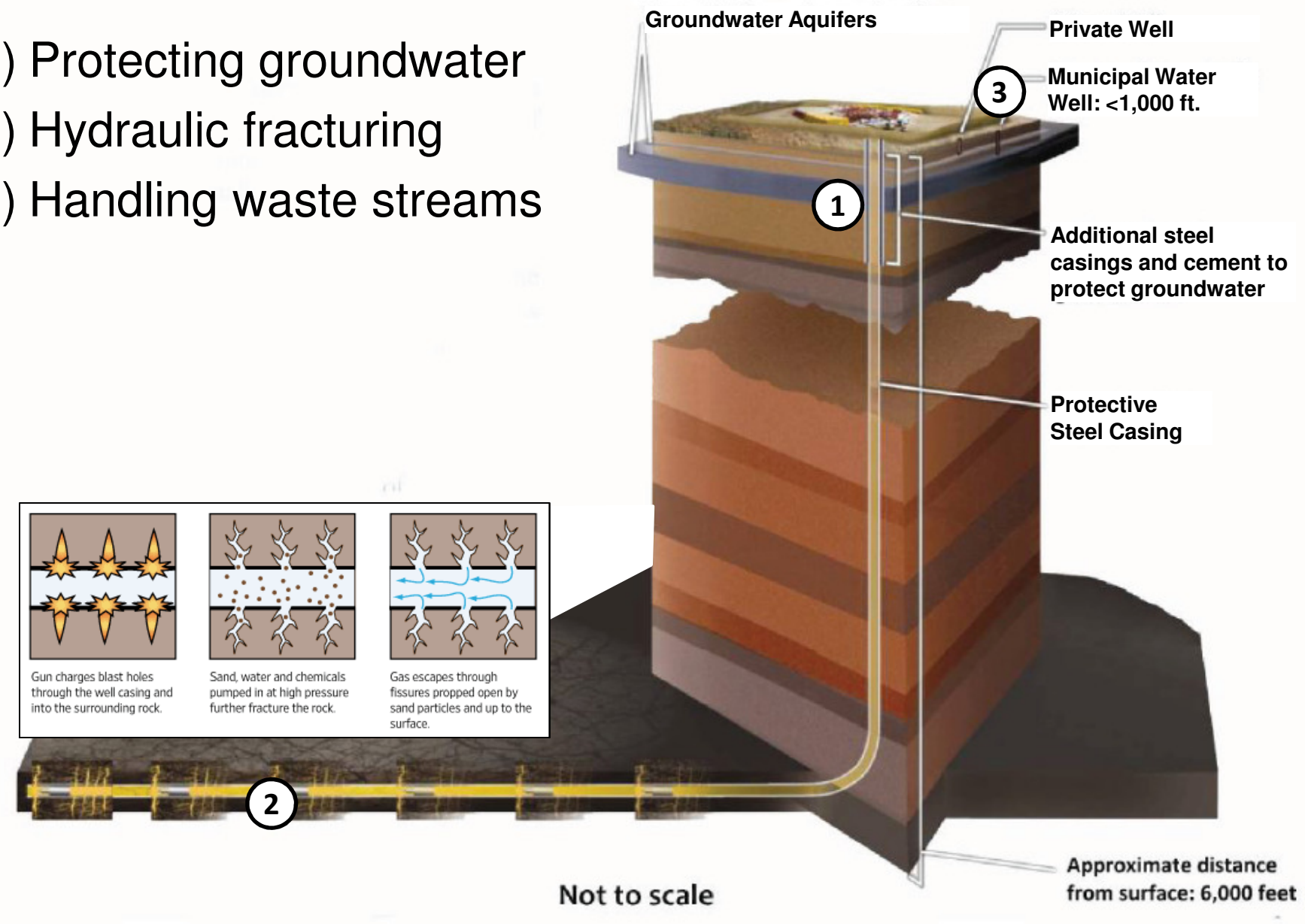
Fragmented regulatory environment

Shale gas and hydraulic fracturing are governed by a complex set of federal, state, and local laws. Exploration and production operations, consequently, are carried out by individual operators according to their own individualized engineering approaches within each unique play, under the regulations that apply in each state where these plays are being developed.

Horizontal drilling / hydraulic fracturing

Oil and Natural Gas

1) Protecting groundwater
2) Hydraulic fracturing
3) Handling waste streams



Steps to safer drilling

Oil and Natural Gas

1 Evaluate Stratigraphic Confinement

2 Well Construction Standards

3 Evaluate Mechanical Integrity of Well

4 Monitor Frac Job & Producing Well

Winning the Future :: American Energy

Oil and Natural Gas

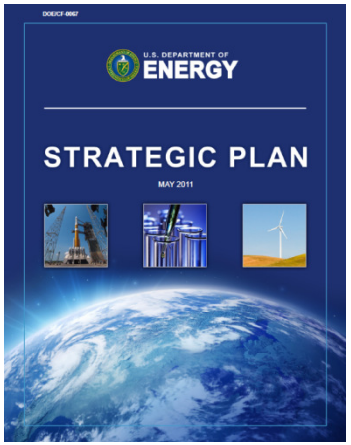
There have been instances where natural gas has been appearing in water supplies where it should have never appeared …. And so the question is, what is the cause of that? Can they be mitigated and prevented?

SECRETARY STEVEN CHU, APRIL 25 2011

The oil and gas industry will continue to meet our economy's immediate needs by pushing into increasingly difficult frontiers, including deepwater operations offshore and unconventional gas onshore.

The Department will ensure that the federal government's understanding of the risks associated with these operations keeps pace. This will be accomplished through scientific assessment of the risks, potential impacts, and adequacy of current response and mitigation technologies.

DEPARTMENT OF ENERGY STRATEGIC PLAN, MAY 2011



DOE resources, experience and capabilities

Oil and Natural Gas

Capabilities

- Geospatial engineering and modeling
- Underground containment in engineered natural systems
- High performance computing
- Fluid flow in porous media
- Image processing
- Mechanical/structural stress analysis
- Complex fluid flow simulations
- Systems analysis and human factors engineering

Recognized by

- National Research Council of the National Academies
- President's Council of Advisors on Science and Technology

Section 999 of EPAct 2005

Oil and Natural Gas

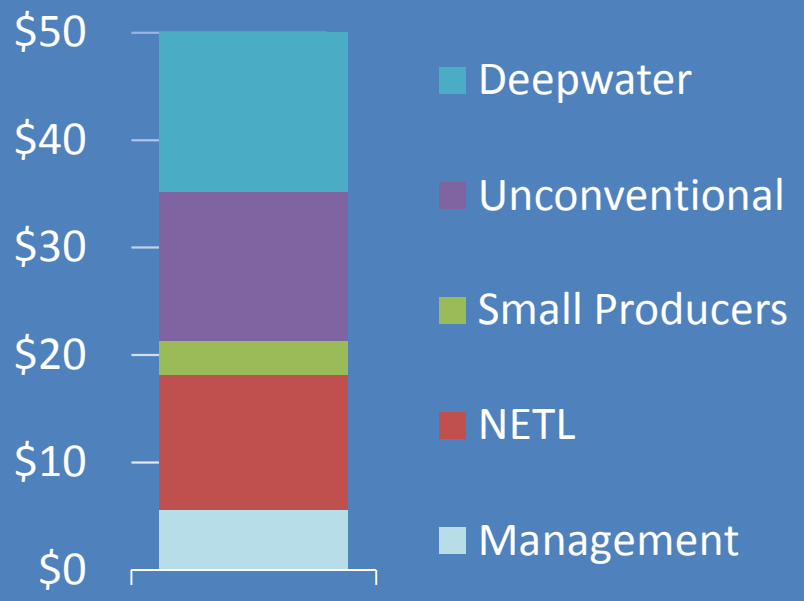
- Section 999 of the Energy Policy Act of 2005 created an oil and gas R&D program funded by royalties paid by companies producing on public lands.
- $50 million per year
- Administered by NETL and RPSEA

National Energy Technology Laboratory

Research Partnership to Secure Energy for America

Programs:

- Deepwater
- Unconventional
- Small Producers
- Complementary (NETL)
- Program Administration



Research Topic

Oil and Natural Gas

- Topic 1: **Evaluation of the effectiveness of current measures to protect groundwater** from contamination during shale drilling, casing and cementing and production operations. Budget Estimate: $10 million
- Topic 2: **Improve best practices for handling and treating harmful constituents in waste streams** including naturally occurring radioactive material. Budget Estimate: $4 million
- Topic 3: **Evaluation of and quantification of the risks associated with propagation and communication of induced fractures** with abandoned wells and/or naturally occurring fractures. Budget Estimate: $5 million
- Topic 4: **Evaluation of the risks and impacts of induced micro-seismic activity**. Budget Estimate: $5 million
- Topic 5: **Development of cost effective water treatment technologies** that will reduce water usage by maximize fracturing flowback water recycling. Budget Estimate: $8 million
- Topic 6: **Evaluation of fugitive methane emissions during shale gas development**. Budget Estimate: $2 million
- Topic 7: **Geospatial Characterization of the Marcellus Shale** & Associated Shallow Groundwater Aquifers –Systems Atlas & Resource Assessment. Budget Estimate: $3 million
- Topic 8: **Comparative Field characterization of baseline environmental impact signals** and those signals resulting from development and production of Marcellus shale gas resources. Budget Estimate: $8 million
- Topic 9: **Determination of fundamental interactions between frack fluids and shale**. Budget Estimate: $2 million
- Topic 10: **Integrated Assessment of Potential Risks Associated with the Development and Production of Marcellus Shale Gas Resources**. Budget Estimate: $2 million
- Topic 11: **Improve IT infrastructure for transparent public disclosure of data** of interest to the public, to include chemicals used in hydraulic fracturing. Budget Estimate: $5 million
- Topic 12: **Establish a collaborative public-private research program** to continually inform the government on evolving unconventional exploration and production. Budget Estimate: $10 million/year starting in 2014