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# Natural Gas

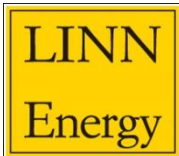
Smarter Power Today

MARC Annual Meeting

Rapid City, SD

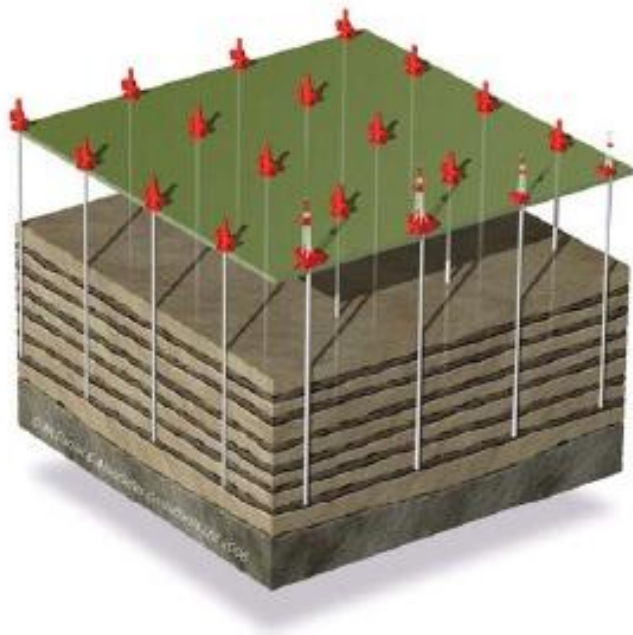
June 6, 2011

# ANGA Members

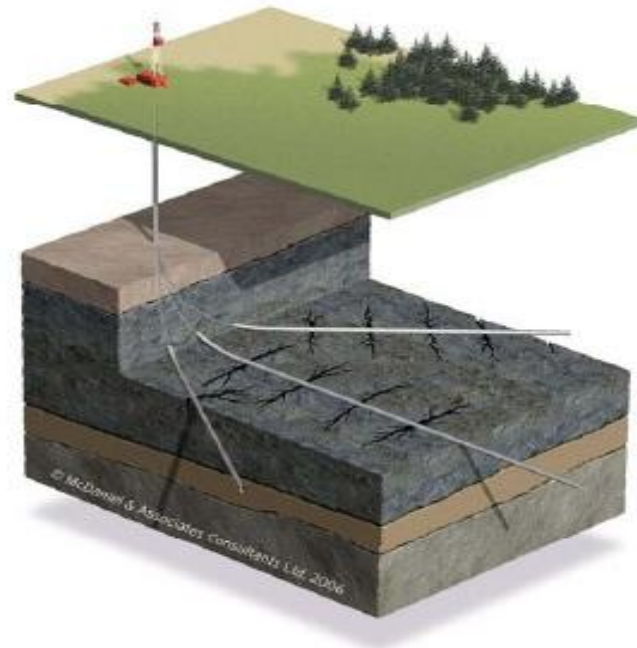


# Horizontal Drilling

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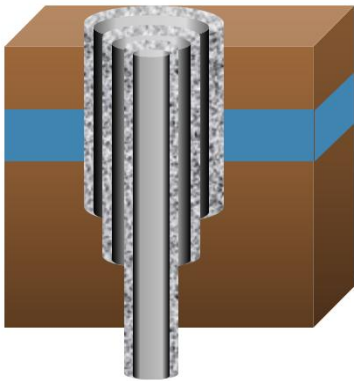
Traditional Wells



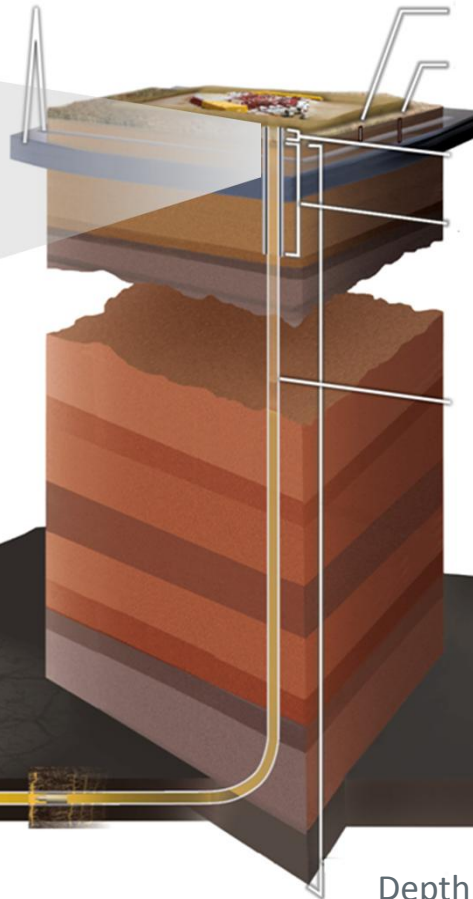
Horizontal Drilling

# Hydraulic Fracturing

Multiple protective layers extend from surface to below aquifers.



Groundwater aquifers



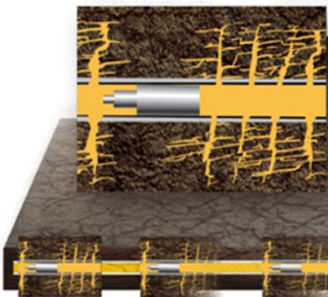
Private well, about 500 feet deep

Public well, about 1,000 feet deep

Several layers of steel tubes encased in cement protect groundwater supplies

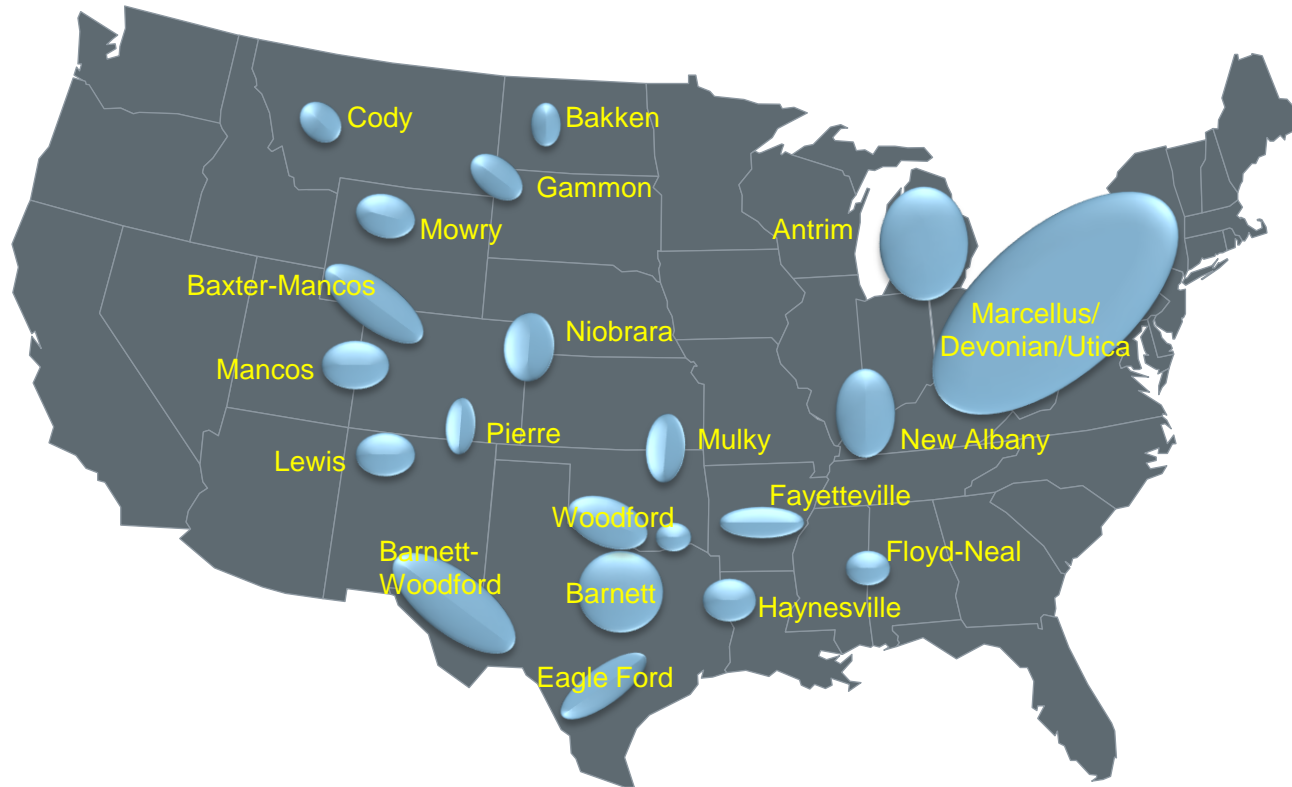
Protective steel casing encased in cement extends to shale depth

Shale Fractures



Depth from surface is typically more than a mile

# The Shale Gas Revolution



EIA: 2011

**862**TCF shale

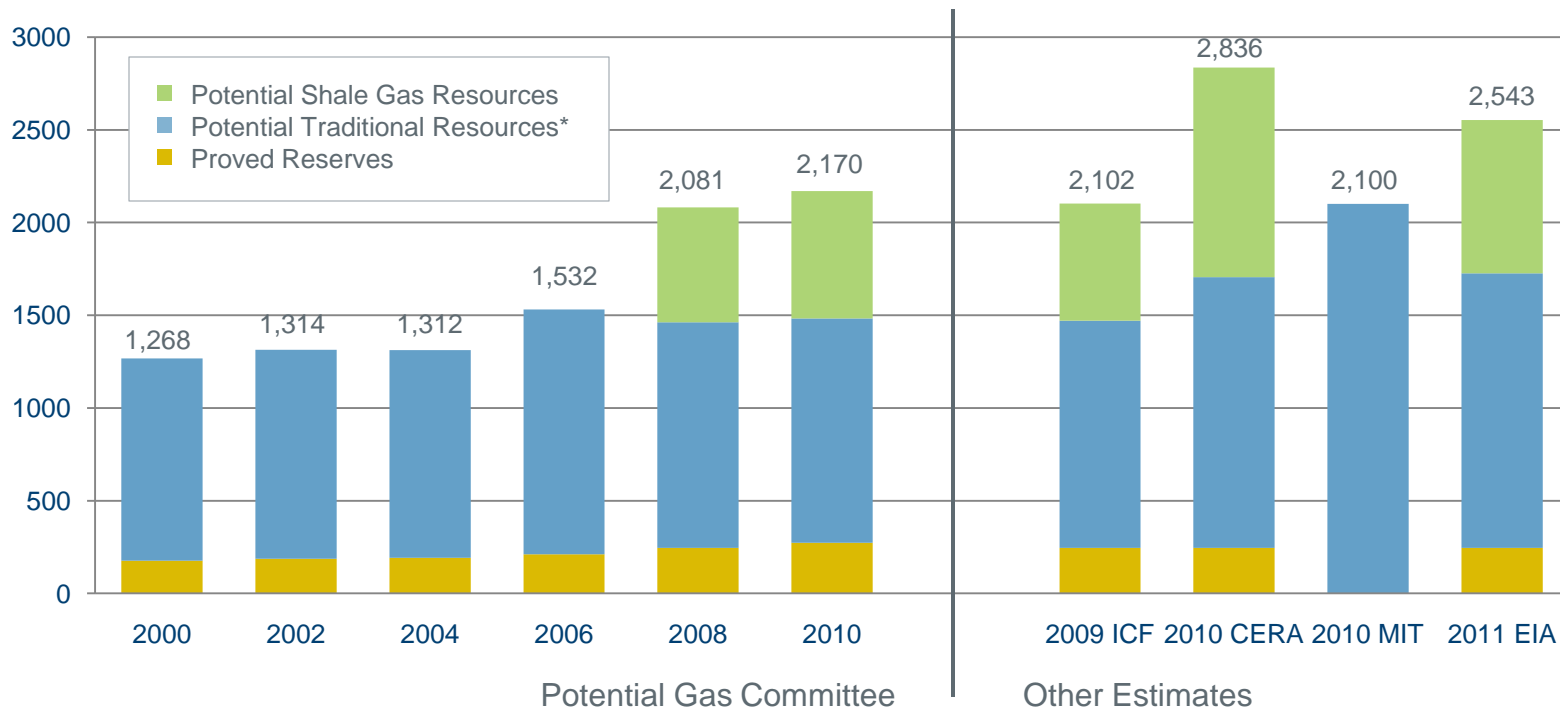
**2,543**TCF total

**67% INCREASE**  
in just three years

Source: EIA Annual Energy Outlook, 2008 to 2011

# Abundant by Any Estimate

Estimates of U.S. Recoverable Natural Gas  
(TCF – trillion cubic feet)



Sources:  
 ICF: As reported in BPC: <http://www.bipartisanpolicy.org/projects/energy/naturalgas> (Task Force on Ensuring Stable Natural Gas Markets)  
 EIA: See <http://www.eia.gov/analysis/studies/worldshalegas/>  
 PGC: Potential Gas Committee's *Advance Summary* and press release of its biennial assessment; see [www.potentialgas.org](http://www.potentialgas.org)  
 CERA: IHS CERA, 2010, *Fueling North America's Energy Future: The Unconventional Natural Gas Revolution and the Carbon Agenda*  
 MIT: MIT Energy Initiative, 2010, *The Future of Natural Gas*, interim report

# 2016 Expected Costs

## Levelized Cost of New Generating Technologies - 2016

Plant Type	Capacity Factor (%)	Total System Levelized Cost (¢ per KWH)
Natural Gas – Combined Cycle	87	6.31
Natural Gas – Conventional	87	6.61
Natural Gas – Combined Cycle with CCS	87	8.93
Coal – Conventional	85	9.48
Coal – Advanced	85	10.94
Coal – Advanced with CCS	85	13.62
Wind – Onshore	34	9.70
Wind – Offshore	34	24.32
Solar – PV	25	21.07
Solar – Thermal	18	31.18
Biomass	83	11.25
Nuclear	90	11.39

Source: Institute for Energy Research, using data from EIA Annual Energy Outlook 2011.

# Utilities Choosing Natural Gas

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**“Replacing coal with natural gas may well provide years of breathing room for cleaner-energy technologies to catch up and become more affordable.”**

*Washington Post editorial, 1/31/2011*

**“Traverse City Light & Power Scraps Plan for Biomass Plant, Opts for Gas.”**

*Bloomberg, 6/28/2010*

**“Calpine Approved for 600MW Natural Gas-Fired Plant”**

*Power-Gen Worldwide, 2/4/2010*

**“Tennessee Valley to Build Natural Gas Power Plant”**

*Associated Press, 6/4/2009*

**“Natural Gas Should Be Key In Energy Planning...”**

*San Antonio Express-News, 6/2/2010*

**“N.C. Regulators Approve Plan to Build Natural Gas-Fueled Power Generation”**

*WWAY News, 6/9/2010*

**“Natural Gas is Good for Texas and the Environment”**

*Corpus Christi Caller-Times, 7/2/2010*

**“Renewables Need Helping Hand From Gas”**

*San Diego Union-Tribune, 5/23/2010*

**“Move to Natural Gas Helps Clear the Air...”**

*Denver Post, 4/4/2010*





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