ABUNDANT
The Shale Gas Revolution

Source: EIA Annual Energy Outlook, 2011

EIA AEO 2011

862 TCF shale

2,543 TCF total

45% INCREASE
Over one year

Source: EIA Annual Energy Outlook, 2011
Abundant By Any Estimate

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

Sources:
ICF: As reported in MIT Energy Initiative, 2010, The Future of Natural Gas, interim report; Table 2.1
EIA: See http://www.eia.gov/analysis/studies/worldshalegas/
PGC: Potential Gas Committee’s Advance Summary and press release of its biennial assessment; see g
NPC: Realizing the Potential of North America’s Abundant Natural Gas and Oil Resources Johns Hopkins University; Prudent Development Study 2011
Changing The Mix and Increasing Supply

Total U.S. Natural Gas Supplies, 2005 - 2010

Sources: Navigant Consulting Inc., per U.S. Energy Information Administration, Shale production from Lippman Consulting Inc.
Key Assumptions In INGAA Study

- Sufficient midstream natural gas infrastructure, such as gathering systems, processing plants, transmission pipelines, storage fields, and liquefied natural gas (LNG) terminals, is crucial for efficient delivery and well-functioning markets.

- Over $205.2 billion (Real 2010$) or about $8.2 billion per year of total capital expenditures are required over the next 25 years for the combined natural gas and liquids outlook.

- According to FERC data, interstate pipeline expenditures alone met or exceeded $8 billion per year in three of the years between 2006 and 2010.
PRICING & AFFORDABILITY
Natural Gas And Oil Prices Have Decoupled

Natural Gas v. Oil Price
(1997 = 100)

Historic

Projected

Oil
(Brent Spot FOB)

Natural Gas
(Henry Hub Spot)

1997 = 100

Source: Projected Prices: EIA Annual Energy Outlook: 2012 (Early Release)
Historic Prices: EIA reported spot prices
Long-Term Price Stability

Henry Hub Spot Natural Gas Price
($2010 / MMBtu)

Henry Hub Spot prices (EIA reported actual prices included 2000 to 2010)
Stable Supply = Stable Prices

Natural Gas Price Projections
(2009 dollars, $ per million BTU)

Source: EIA Annual Energy Outlook, 2011
Lower 48 Wellhead Prices
Lower Energy Prices For Consumers

• Thanks to lower natural gas prices, U.S. households will save an average of $926 per year in disposable income between 2012 and 2015.

• Shale gas production has resulted in a 10 percent reduction in electricity costs nationally.

Cleaner For Power Generation

When used to generate electricity, natural gas burns cleaner than other fuel sources, with less pollutants and no mercury.

- Reduces CO₂ emissions: 50%
- Reduces NOx emissions: 80%
- Virtually Eliminates SO₂ Emissions: 99.96%
- Virtually Eliminates Particulate Emissions: 99.74%
- Completely Eliminates Mercury Emissions: 100%

Utilization of Electric Generation Capability
(net generation as a percentage of net summer capacity)

- Natural Gas: 28% Utilized (407 GW)
- Coal: 68% Utilized (317 GW)

Source: EIA, 2010 Electric Power Annual
Today’s Electricity Mix

- **42%** coal
- **25%** natural gas
- **19%** nuclear
- **5%** other renewable (wind, biomass, geothermal, solar)
- **1%** other non-renewable

Source: EIA 2011 Electricity Annual
Meeting Growing Electric Sector Needs

Projected Capacity Additions 2009-2035
(178 GW total)

- 63% natural gas
- 24% renewable
- 5% nuclear
- 9% coal
- 2% other

Source: EIA Annual Energy Outlook :2012 (Early Release)
Utilities Choosing Natural Gas

“Ithaca Coal Power Plant Goes All Natural Gas”
Innovation Trail, 3/22/2011

“NAES Begins Operations At 150MW Dave Gates Gas-Fired Station In Montana”
Penn Energy, 7/8/2011

“EPA Rule Would Increase Gas Demand from Power 35 percent by 2014…”
Businesswire, 8/24/2011

“Natural gas-fired power plant planned in Robinson”
Pittsburgh Tribune-Review, 7/29/2011

“MDU Plans Mandan Gas Plant”
Bismarck Tribune, 7/8/2011

“Dominion Virginia Power generation and conversion projects will produce more than $3.3 billion in economic benefits by 2015…”
Associated Press, 8/15/2011

“Southern Union plans to build a $235 million natural gas processing plant”
Houston Chronicle Fueltix Blog, 8/23/2011

“Tenaska turns to natural gas in bid to save Taylorville Energy Center”
Herald-Review, 5/10/2012

“Pa. plant to convert generators from coal to gas”
Philadelphia Inquirer/Associated Press, Dec. 28, 2011

“SemGroup building new natural gas processing plant”
Tulsa World, November 22, 2011

“TVA Completes Purchase Of Mississippi Gas-Fired Plant“
Gas Business Briefing & Platts, September 1, 2011

“Switch away from coal has begun at some Iowa plants”
Business 380, 3/14/2012

“Purdue eyes new natural gas projects”
WBAA, 5/8/2012
Production: The Power of Progress

• Smaller surface impact.
  — The average well site today is just 30% of the size of its 1970s counterpart—and today’s wells can access over 60 times more below-ground area.

• Fewer wells, more clean energy.
  — Half as many wells are needed to produce the same amount of clean energy as 20 years ago.

• Less waste.
  — We can retrieve the same amount of gas while producing 30% less waste than a decade ago.

• Fewer air emissions.
  — More efficient operations also means less energy consumption, and thus less air emissions, per unit of natural gas produced.
Horizontal Drilling

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

Depth from surface is typically more than a mile
Safety At The Surface

Multiple Layers of Groundwater Protection

Aquifer

- Surface Casing Cement
- Steel Surface Casing
- Production Casing Cement
- Steel Production Casing
- Production Tubing
Small Environmental Footprint

- **Drilling**: 2 – 4 weeks
- **Fracturing**: 3 – 5 days
- **Producing**: decades
  surrounding land reclaimed
Frack Fluid Makeup

Water & Sand 99.5%

Additives - 0.5%
- Acid
- Friction Reducer
- Surfactant
- Gelling Agent
- Scale Inhibitor
- pH Adjusting Agent
- Breaker
- Crosslinker
- Iron Control
- Corrosion Inhibitor
- Antibacterial Agent
- Clay Stabilizer
Voluntary Disclosure System

Chemical Disclosure & Operation Updates

- **FracFocus.org** created by GWPC and IOGCC
  - 254 companies participating
  - Information is currently posted on over 16,000 wells
  - 231,081 website visits
  - GWPC has funding proposal to enhance website including: improved data integration, electronic data exchange and batch submissions, state regulator compliance and search & filtering options. (Total cost ~ $600M)
How Much Is 5 Million Gallons Of Water?

- A typical deep shale gas well stimulation = ~ 5 million gallons
- It’s the same amount of water consumed by:

  1,000 MWh coal-fired power plant in 11 HOURS
  1,000 MWh nuclear power plant in 6 HOURS
  Corn Field over 5 ACRES per SEASON
  Avg. golf course every 37 DAYS
Innovations In Production

**Water Innovations**
- Onsite Water Recycling
- Wastewater Treatment Facilities
- Hybrid Stimulation
- Abandoned Coal Mine Water
- Reuse of Municipal Wastewater
- Development of Electrocoagulation
- Greener Fluids
- Increased Efficiencies
- Water Pipelines Reducing Truck Traffic
- Involving Small Businesses in Water Reuse & Recycling
- “The Marcellus Effect” and Water Purification Developments

**Non-Water Innovations**
- Emissions Reductions
- Natural Gas STAR
- Horizontal Drilling
- Development of Natural Gas Turbines
- Improving Estimates for Technically Recoverable Gas
Regulation At The State Level

• Interstate Oil and Gas Compact Commission

• Groundwater Protection Council

• AOGC Rule B-19

• Pennsylvania DEP Rule 78
States Leading the Way

“Colorado is a great example of oil and gas development balanced with extraordinary environmental values. State regulation covers every aspect of drilling, including hydraulic fracturing. Oil and gas companies’ best management practices and state regulation emphasize preventing groundwater contamination in the two most important areas: surface fluid management and well casing and cementing.”

Tisha Conoly Schuller, President & CEO
Colorado Oil & Gas Association

“We should have regulation, but it's better to have people who are knowledgeable about it and can deal with various variations from state to state, rather than have the EPA use one size to fit all.”

Bob Anthony Oklahoma Corporation Commission Chairman,
in WaterWorld February 26, 2010

“State oil and gas regulations are adequately designed to directly protect water resources through the application of specific programmatic elements such as permitting, well construction, well plugging, and temporary abandonment requirements.”

National Ground Water Protection Council
May 2009

“We’re having compliance and no problems. It’s been well received by the industry and, I believe, the conservation groups.”

Tom Doll, superintendent, Wyoming Oil and Gas Conservation Commission
Colorado’s Clean Air Clean Jobs Act

This law represents a historic milestone in energy policy as it:

• Created a new framework for coordination and cooperation among industry, policymakers and regulators.

• Achieved significant air pollution reductions from power generation by replacing aging coal-fired generation with cleaner, more flexible natural gas-generating units.

• Increased use of a quick-starting fuel, which creates a technology platform to enable higher penetrations of renewable energy sources such as wind and solar.

• Designed to mitigate long term financial risk to both utilities and ratepayers from pending U.S. Clean Air Act regulations.

• Set an emission reduction target for nitrous oxide (NOx) emissions of 70 to 80 percent below 2008 limits and greatly improves air quality and allows the state to meet current and reasonably foreseeable air quality requirements.
Texas Jobs from Shale Gas

For the past two years, UTSA has conducted a study that shows employment data in the Eagle Ford Shale counties.

In 2010, the study found that natural gas development supported 12,600 full-time direct and indirect jobs in 24 counties.

In 2011, the study found that the shale development supported 47,000 full-time jobs in the 20 counties directly and indirectly engaged in production.
A study conducted by West Virginia University “found that the most notable increase in demand in the Morgantown market area is a result of natural gas exploration and drilling related to the Marcellus Shale natural gas development.”