

Clean, Abundant, and Secure in the United States

Natural Gas: Helping to Ensure Our Energy Future

April 2011



AMERICAN
PETROLEUM
INSTITUTE



Why Natural Gas? Why Now?

- **Why Natural Gas? Proven contributor to economy, environment and energy security**
 - Jobs and economic growth
 - Creates nearly 3 million jobs – direct and indirect – resulting in \$180 billion in labor income between 2005 - 2010
 - Contributes to economy – over \$3.5 billion per year average in government revenues between 2005 and 2010
 - Contributes to global competitiveness
 - Environmental benefits
 - Low emissions
 - Small land footprint
 - Sustainable
 - Essential to complement renewable energy sources
 - Domestic energy security
 - More than a 100-year supply and growing
- **Why Now? Abundant, secure and domestic**
 - Huge untapped shale gas resource newly unleashed by innovation and technology

2001 to 2011 - A Decade Makes a Difference

Then

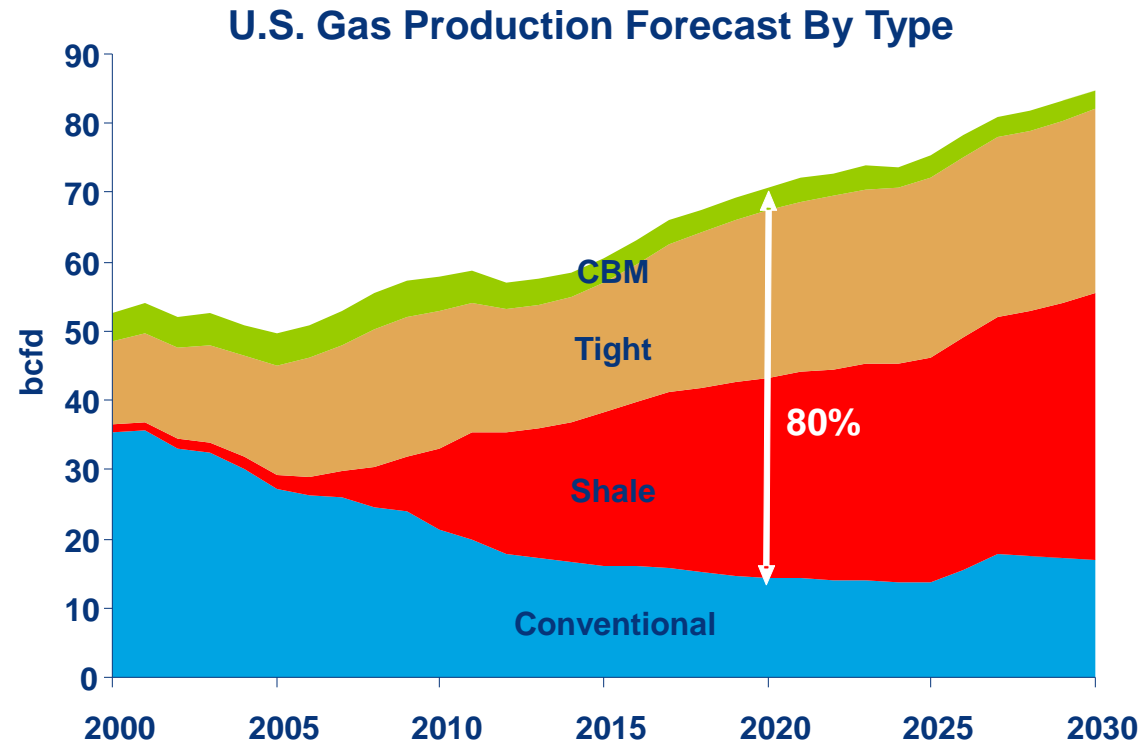
- **60-year supply and falling**
- **Shale known but uneconomic to develop**
- **Underground gas storage primarily traditional reservoir, operationally not very flexible**
- **Pipeline capacity growing incrementally**
- **Rising prices with several spikes**

Now

- **100+ years supply and growing**
- **Flourishing production, vast shale resources now accessible**
- **Storage boom with more flexible salt-cavern facilities and additional market area storage**
- **16,000+ miles of interstate pipeline added since 2000**
- **Plentiful supplies moderate prices and provide supply diversity**

How The Game Has Changed

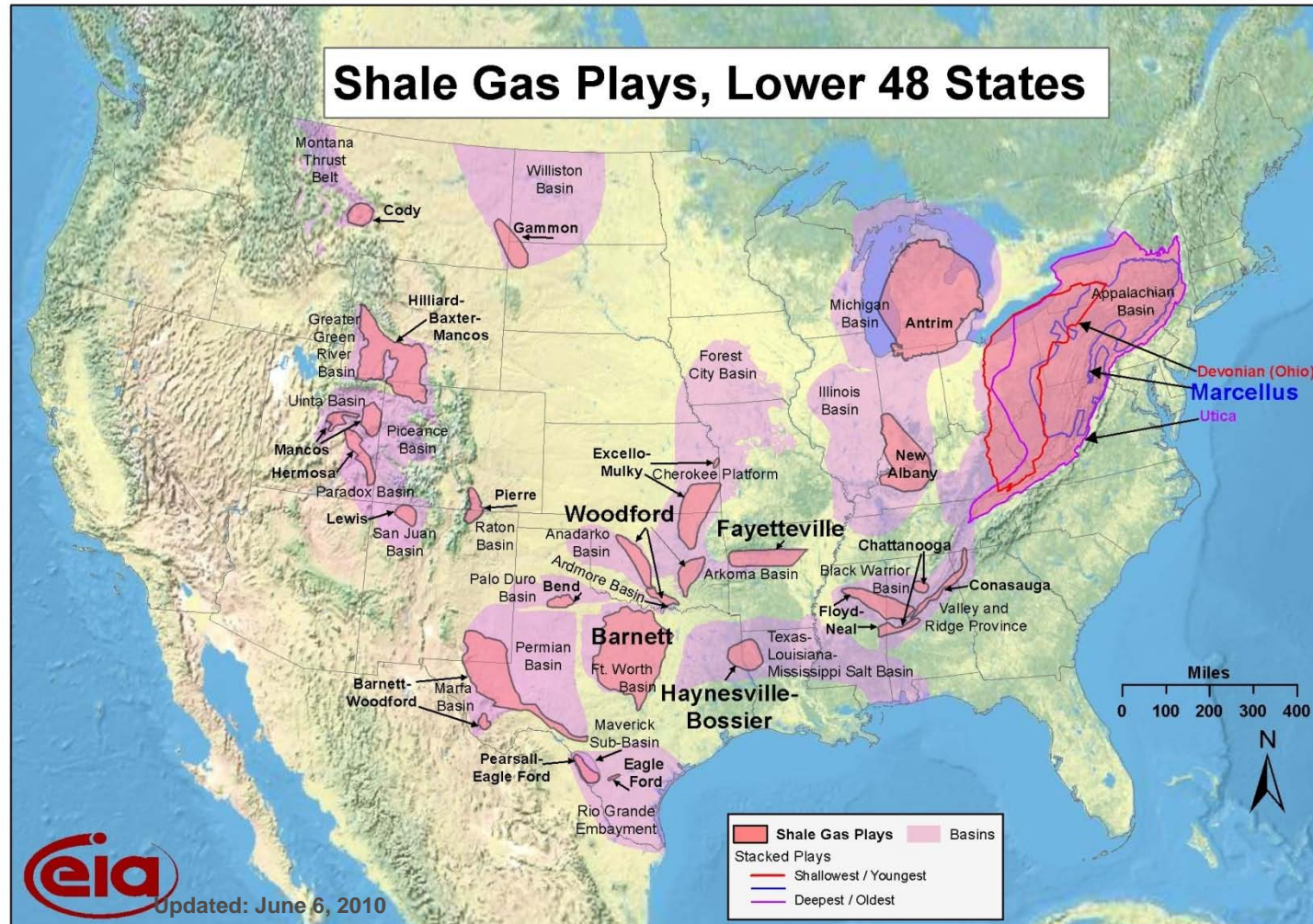
- Improvements in technology brought down costs and greatly increased the scope of resource development
- Shale gas production quadrupled between 2006 – 2010 and is poised to comprise more than 40% of U.S. gas production in 2020
- Shale and other “unconventional” gases could account for over 80% of U.S. gas production by 2020, compared to 66% today
- Diversity of supply complements strong and growing pipeline system, reduces vulnerability to hurricanes, brings natural gas closer to consumers



Source: Wood Mackenzie 2010

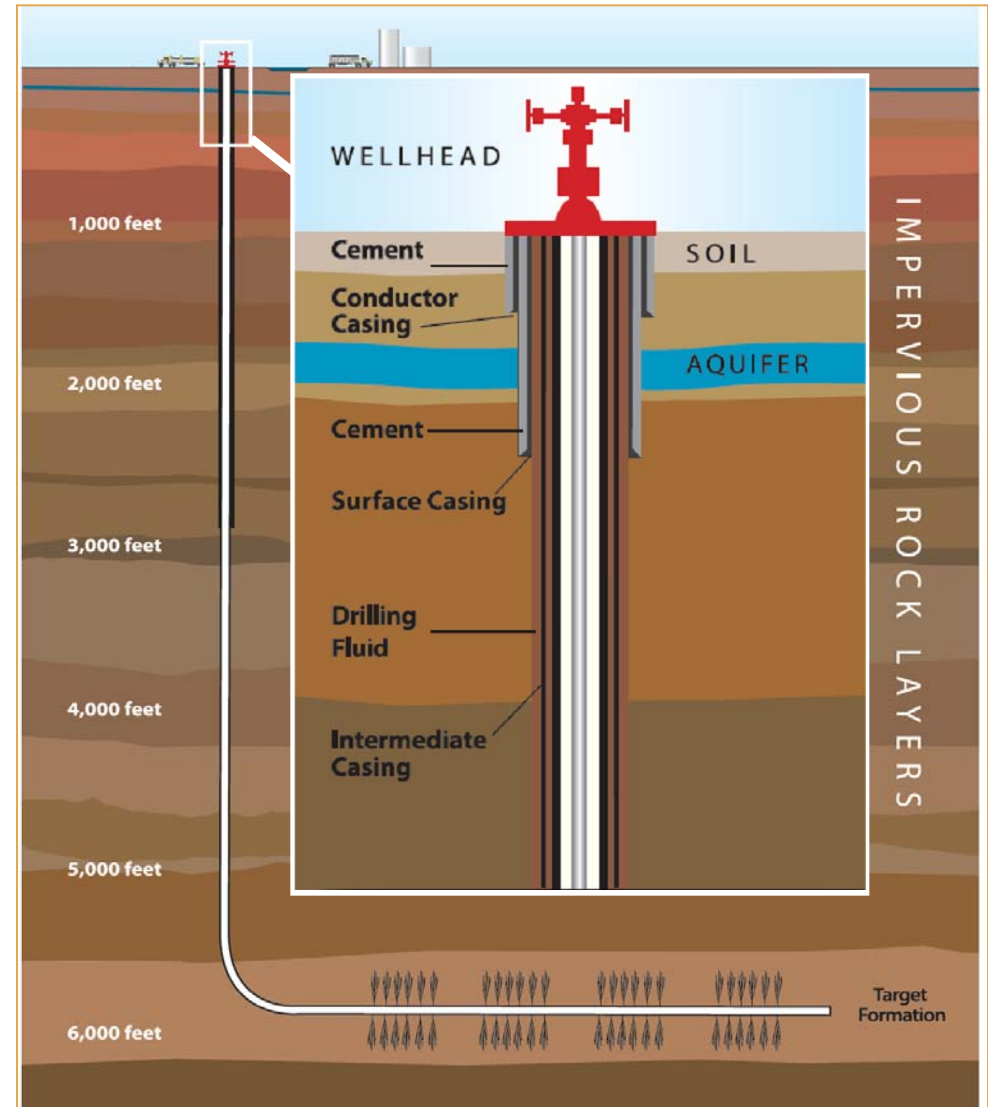
Abundant Unconventional Gas Widespread Across U.S.

U.S. Gas Reserves Increased 22% between 2006 – 2009 Primarily Due to Shale Development



Technology Makes It All Work

- **Drilling technology improvements and efficiencies in shale have emerged**
 - Longer horizontal laterals
 - Multiple-stage hydraulic fractures per lateral
- **Small surface footprint for multiple, extended wells**
- **Horizontal drilling and hydraulic fracturing result in gas wells with long stable production lives**
- **Ground water is separated by thousands of feet and tons of impermeable rock and protected by state and federal regulation**
- **Significant amount of water is recycled**
- **“Micro-seismic” technology evolving and enabling even greater precision in fracturing wells**



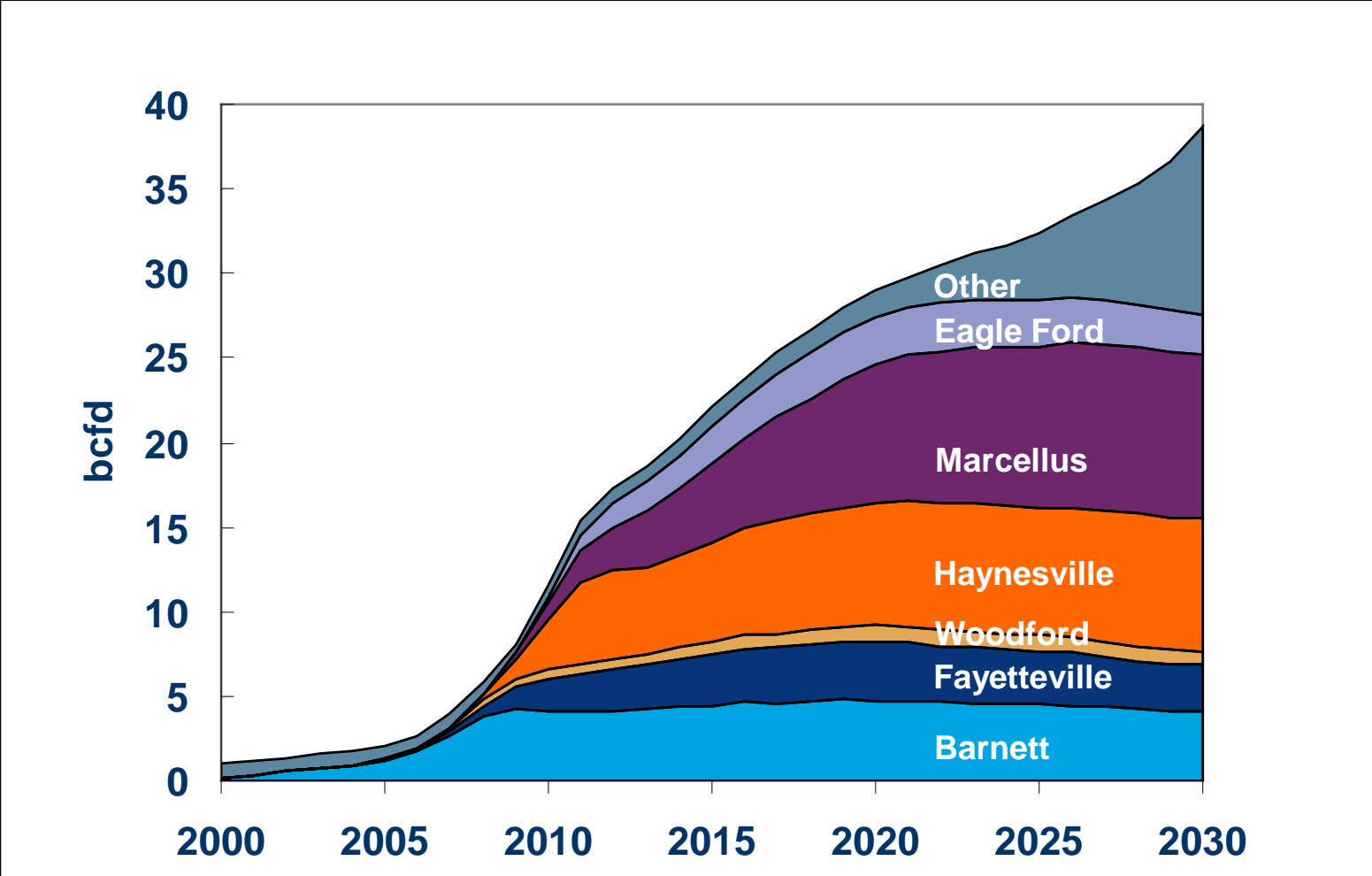
Government Oversight of Natural Gas Production

Regulated by states and under the following federal laws:

- **Clean Water Act** – surface water discharge, storm water runoff
- **Clean Air Act** – air emissions associated with processing equipment and engines
- **Safe Drinking Water Act** – underground injection disposal/reuse of produced water and flowback fluids
- **Federal Land Policy and Management Act** – permitting for federal onshore resources
- **Outer Continental Shelf Lands Act** – permitting for federal offshore resources
- **National Environmental Policy Act** – permits and environmental impact statements
- **Occupational Safety and Health Act** – requires information about chemicals used at every site
- **Emergency Planning and Community Right-to-Know Act** – annual reporting to emergency responders of chemicals stored and used above certain quantities
- **Extensive State Oversight** – implement federal laws and regulate drilling fluids and produced water management
 - Detailed state regulatory information available at www.STRONGERInc.org

Shale Production Grows to Over 30 bcfd by 2025

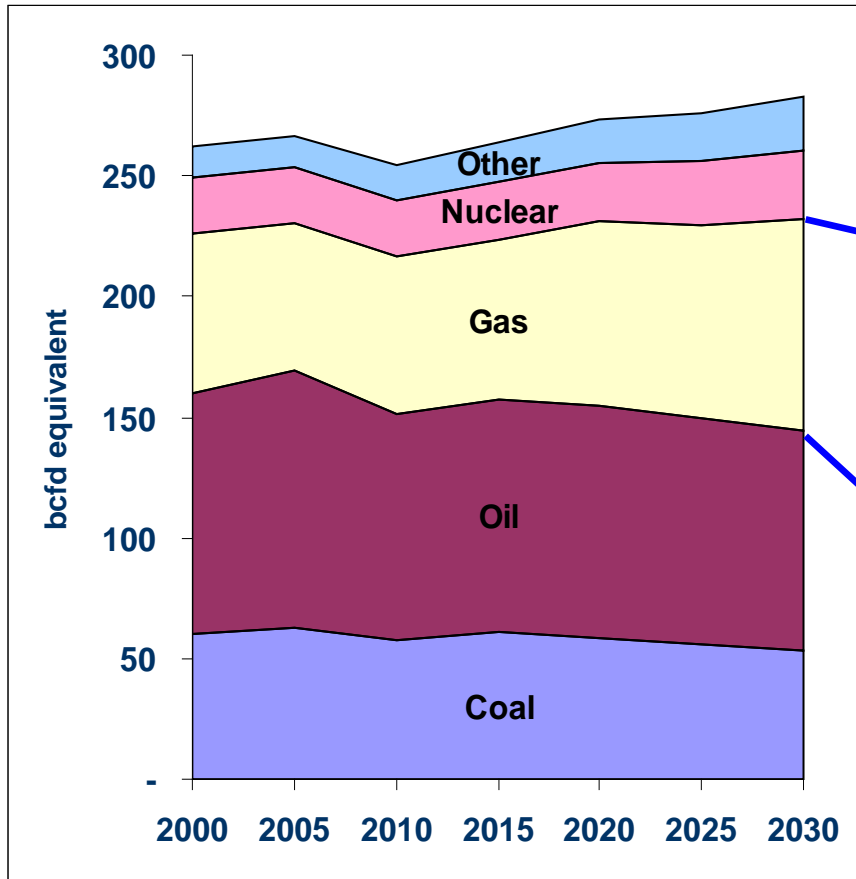
By 2020, shale gas to comprise more than 40% of production, compared to 20% today



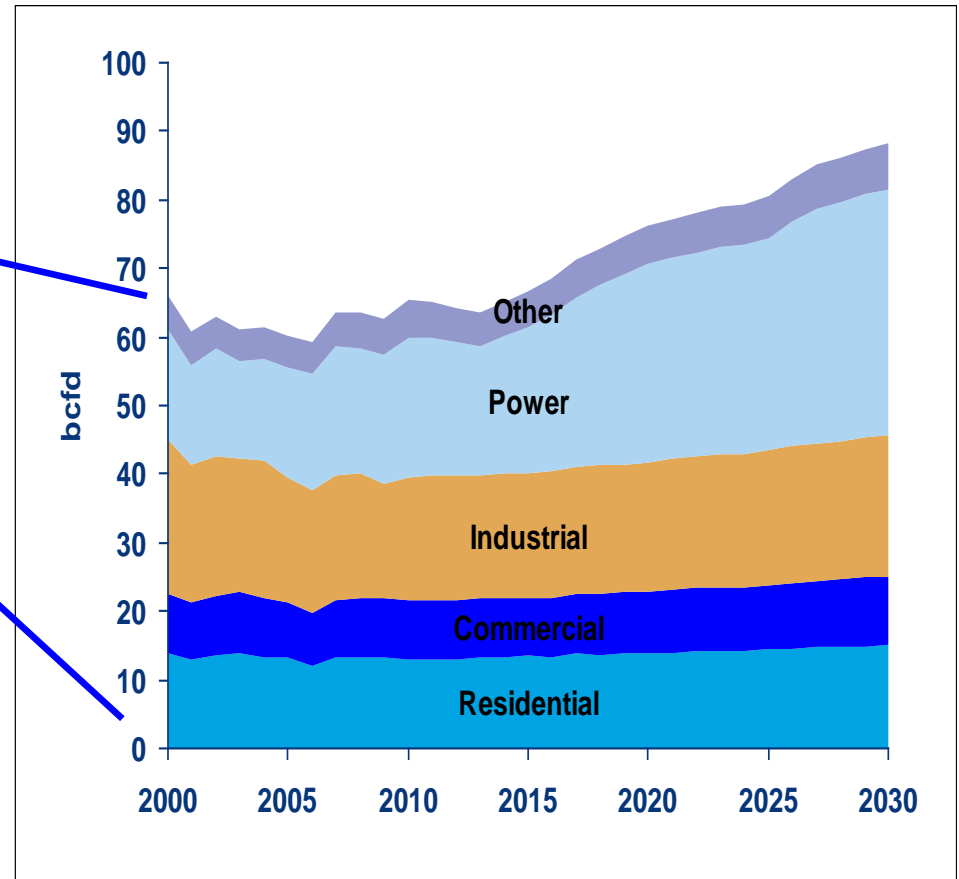
Source: Wood Mackenzie 2010

United States Total Energy and Natural Gas Demand

Total U.S. Primary Energy By Type



U.S. Natural Gas Demand By Sector

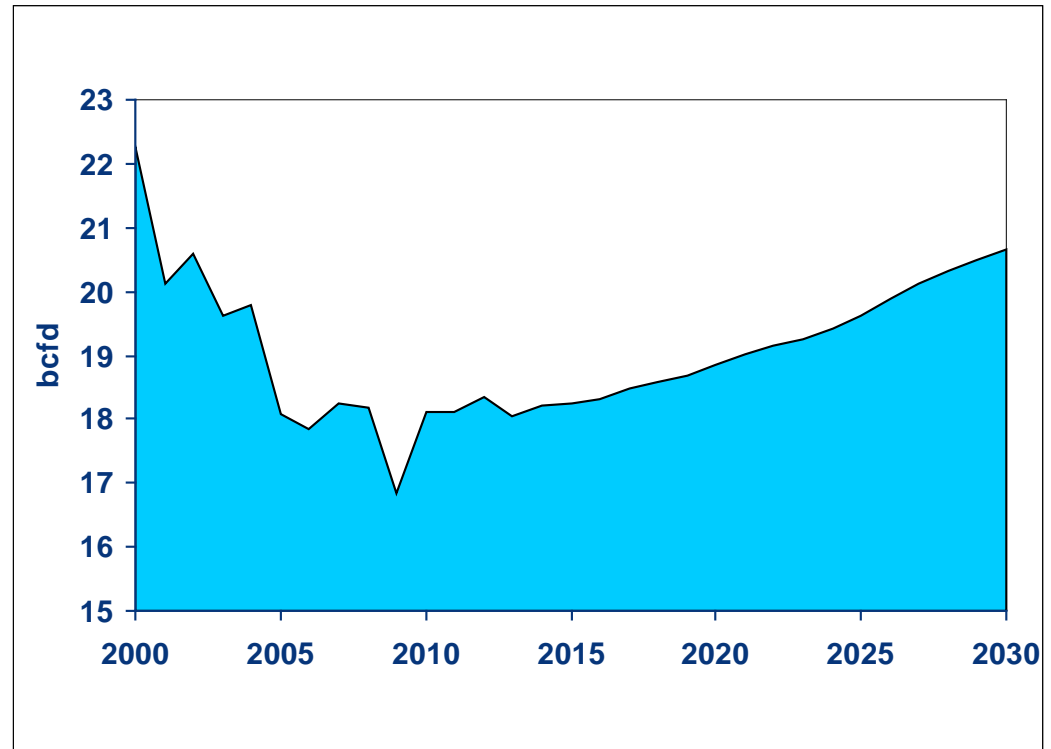


Source: Wood Mackenzie

Adequate Natural Gas Supply at Competitive Prices Helps Grow the U.S. Economy

- Lower gas prices have helped U.S. industry
- Chemical and fertilizer facilities are seeing increased utilization with lower gas prices
- Energy-intensive industry can be more competitive in the global market
- Additional potential demand from natural gas vehicles

U.S. Industrial Demand for Natural Gas



Source: Wood Mackenzie

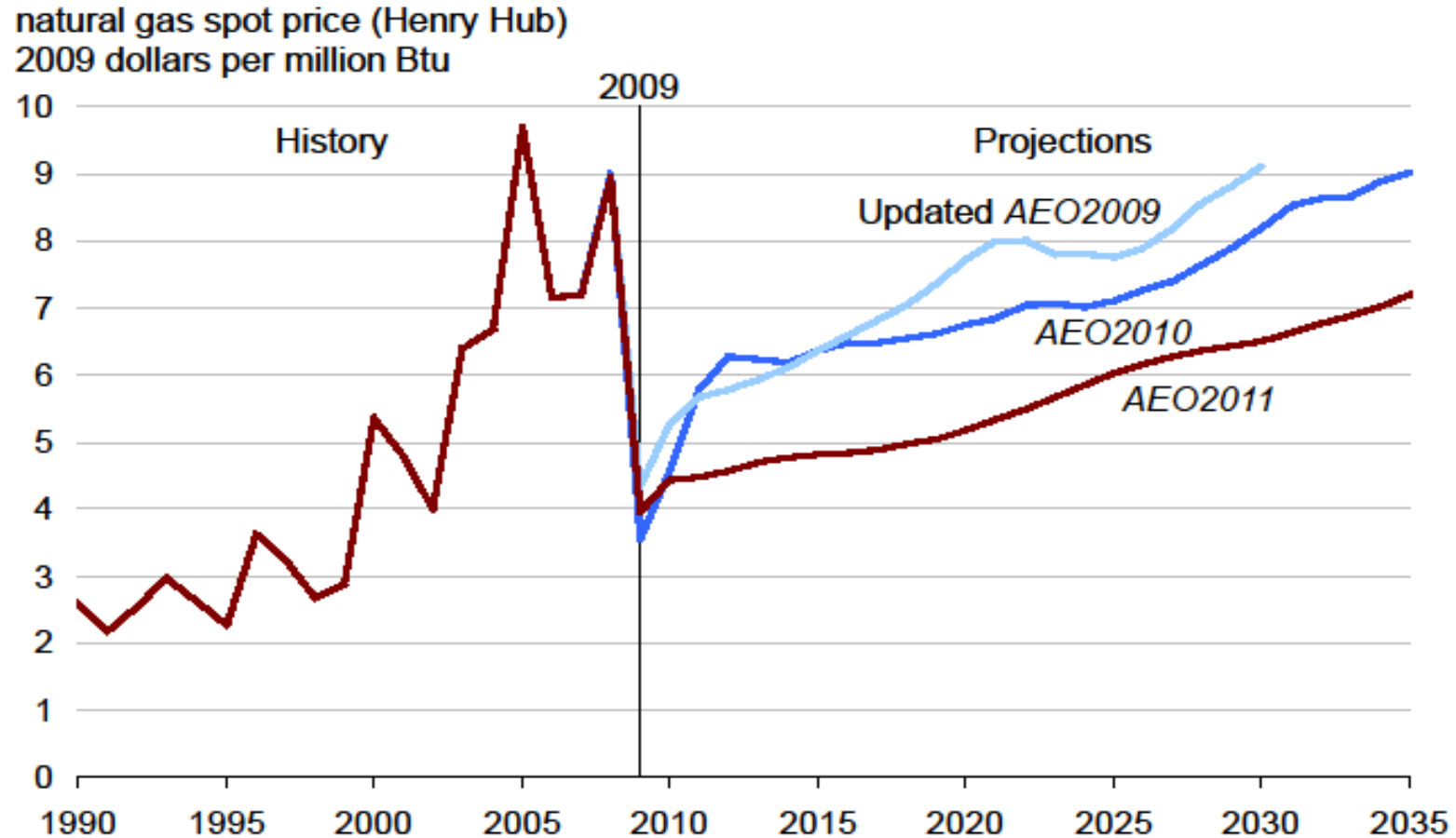
Natural Gas' Impact on the U.S. Economy and Employment



- **Natural gas companies contributed over \$4.4 billion per year on average in gas royalty payments alone to the federal government between 2005 and 2010**
- **Overall contribution to the economy even greater:**
 - \$385 billion to the domestic economy in 2008
 - \$180 billion in labor income alone
- **Nearly 3 million American jobs**
- **Over 600,000 Americans are directly employed by natural gas development**

Sources: IHS Global Insight, 2010
U.S. Department of the Interior's
Office of Natural Resources Revenue

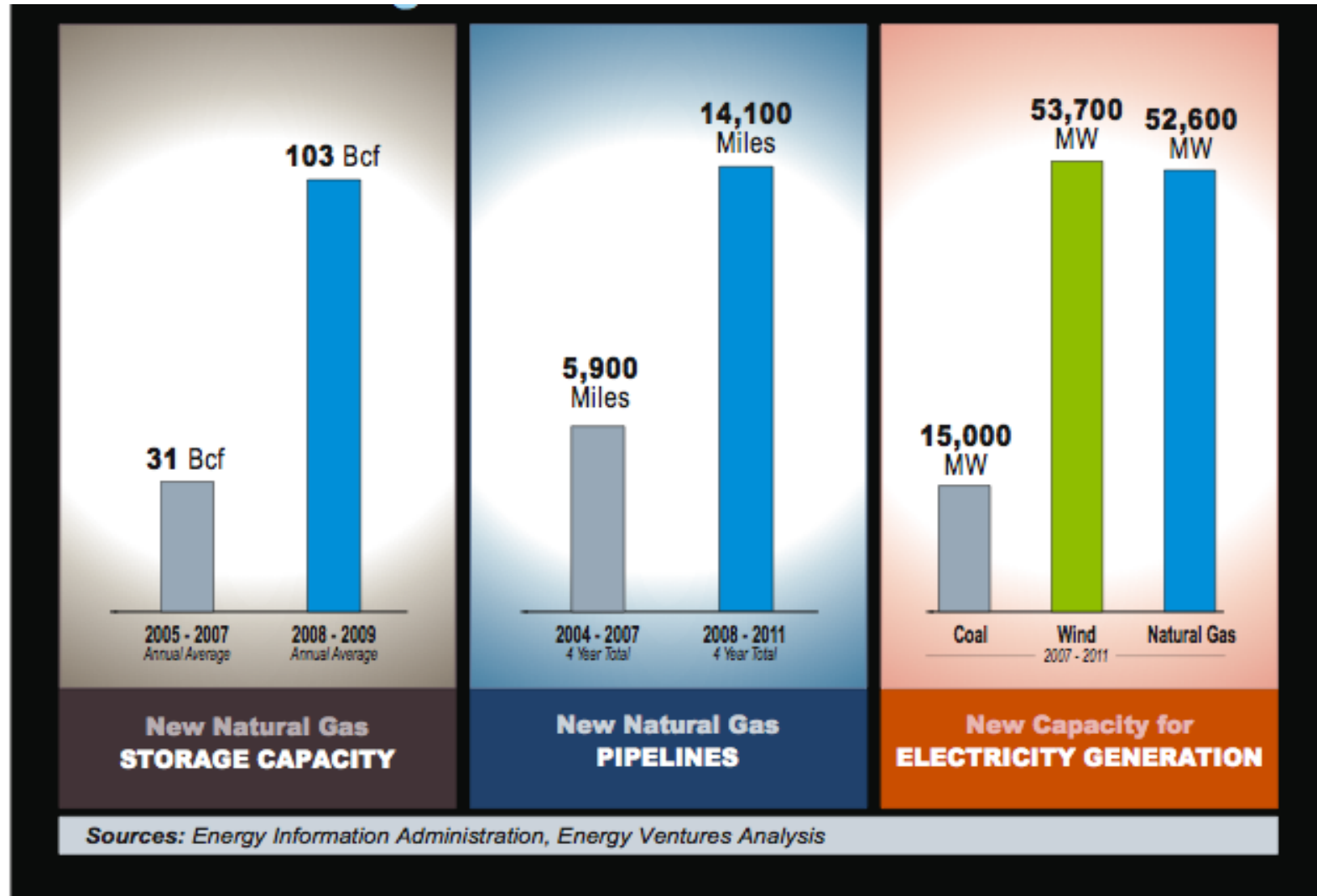
As Supply Increases, Price Forecasts Have Dropped, With Henry Hub Now Forecast Under \$6.00 to Mid - 2020s



Source: EIA, Annual Energy Outlook 2011

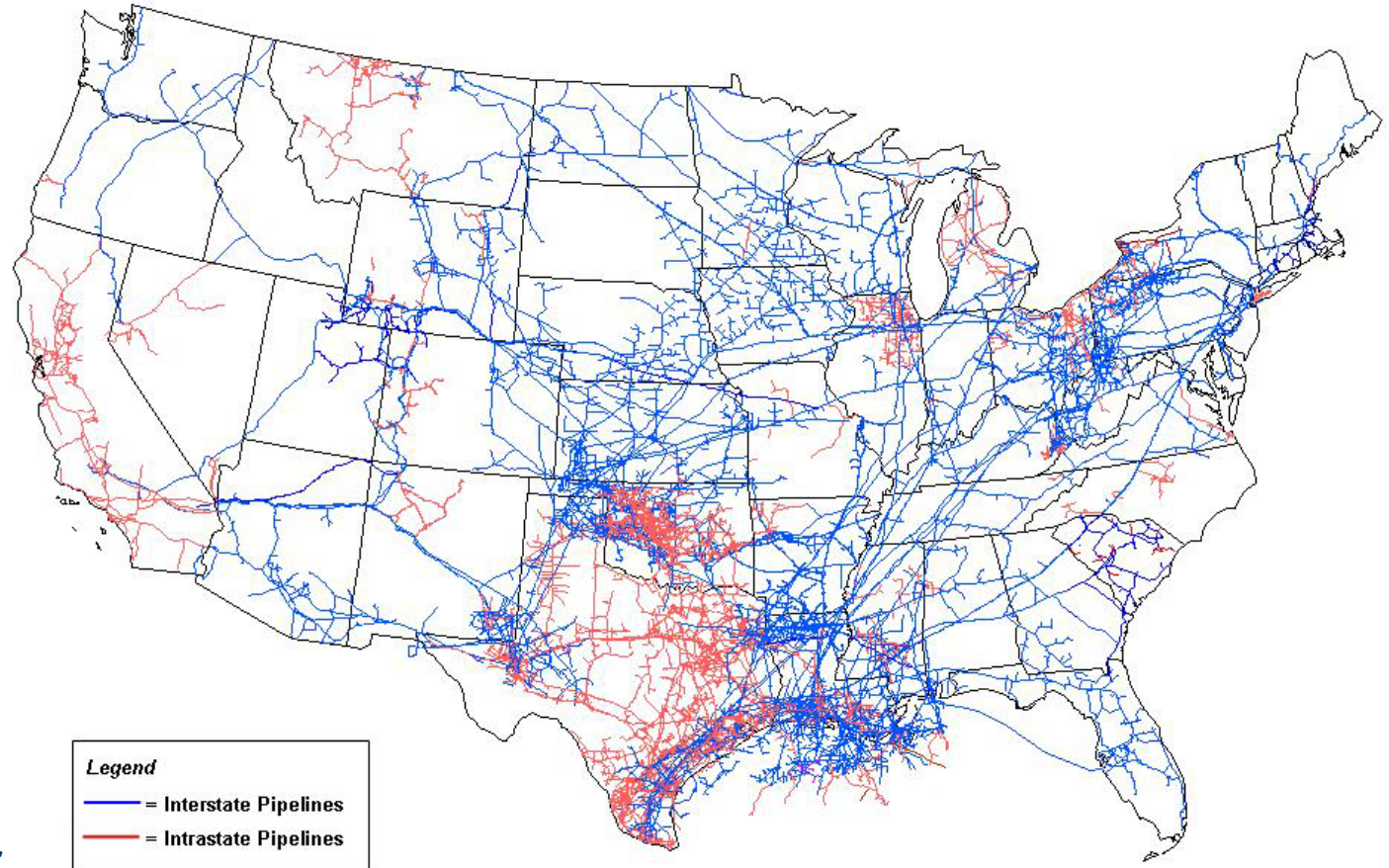


Industry Already Recognizing Importance of Natural Gas by Investing in Storage, Pipelines, and Gas Generation



Pipeline System Extensive and Expanding at Record Pace

- Between 2000 and 2010, FERC approved more than 16,000 miles of new interstate pipeline, with capacity to move an additional 113 bcf per day
- Pipeline system connects U.S. with Canada and Mexico
- Storage capacity grew 22% from 2006 - 2010
- Half of new storage is flexible high-turnover salt dome and is closer to customers

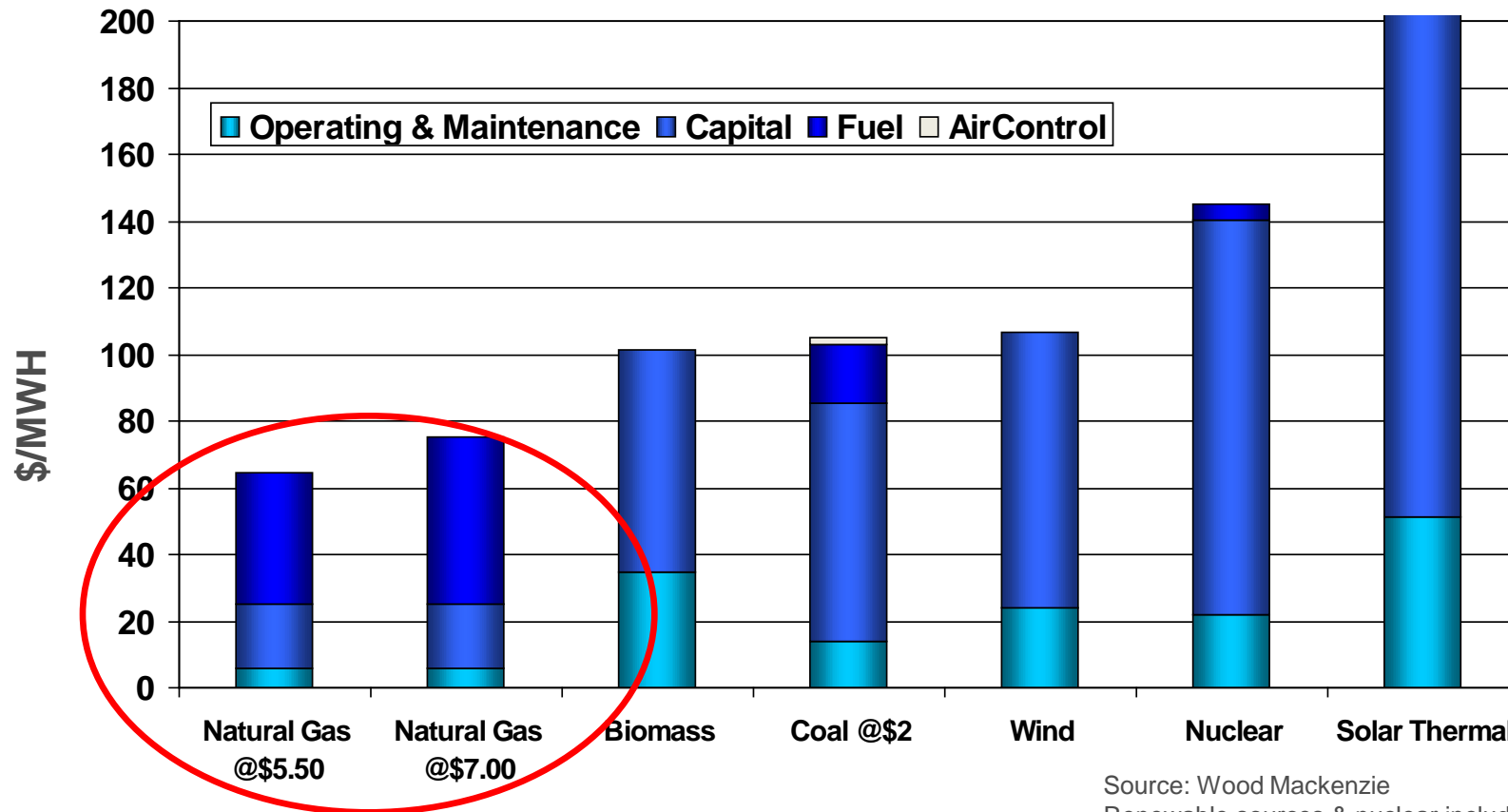


Source: Energy Information Administration, Office of Oil & Gas, Natural Gas Division, Gas Transportation Information System

Natural Gas and Power Generation

- Low capital and operating costs relative to other technologies
- Clean burning – low carbon, GHGs, mercury, particulates, SO_x, NO_x
- Low water use compared to other technology
- Small land footprint
- Easier to permit, finance and build
- Natural gas key to making intermittent resources viable

Capital and Operating Costs Make Gas a Preferred Choice for Power Generation



Source: Wood Mackenzie
Renewable sources & nuclear include a federal tax credit
Assumes \$2.00/mmbtu coal prices

A combined-cycle gas turbine (CCGT) natural gas facility is the least expensive, full-cycle generation alternative.

Natural Gas Is Among the Cleanest Electric Generation Alternatives

Tons per year per thousand households	Biomass (Wood)	Coal	Natural Gas	Nuclear & Renewables
Carbon Monoxide (CO)	51	5.8	1.5	0.0
Carbon Dioxide (CO2)	Low	9,362	3,558	0.0
Nitrogen Oxides (NOx)	28	3.4	0.3	0.0
Particulate Matter	2.7	0.9	0.0	0.0
Volatile Organic Compounds (VOC)	5.6	0.2	0.0	0.0
Sulfur Dioxide (SO2)	2.8	5.0	0.2	0.0
Mercury	0.0	0.0001	0.0	0.0

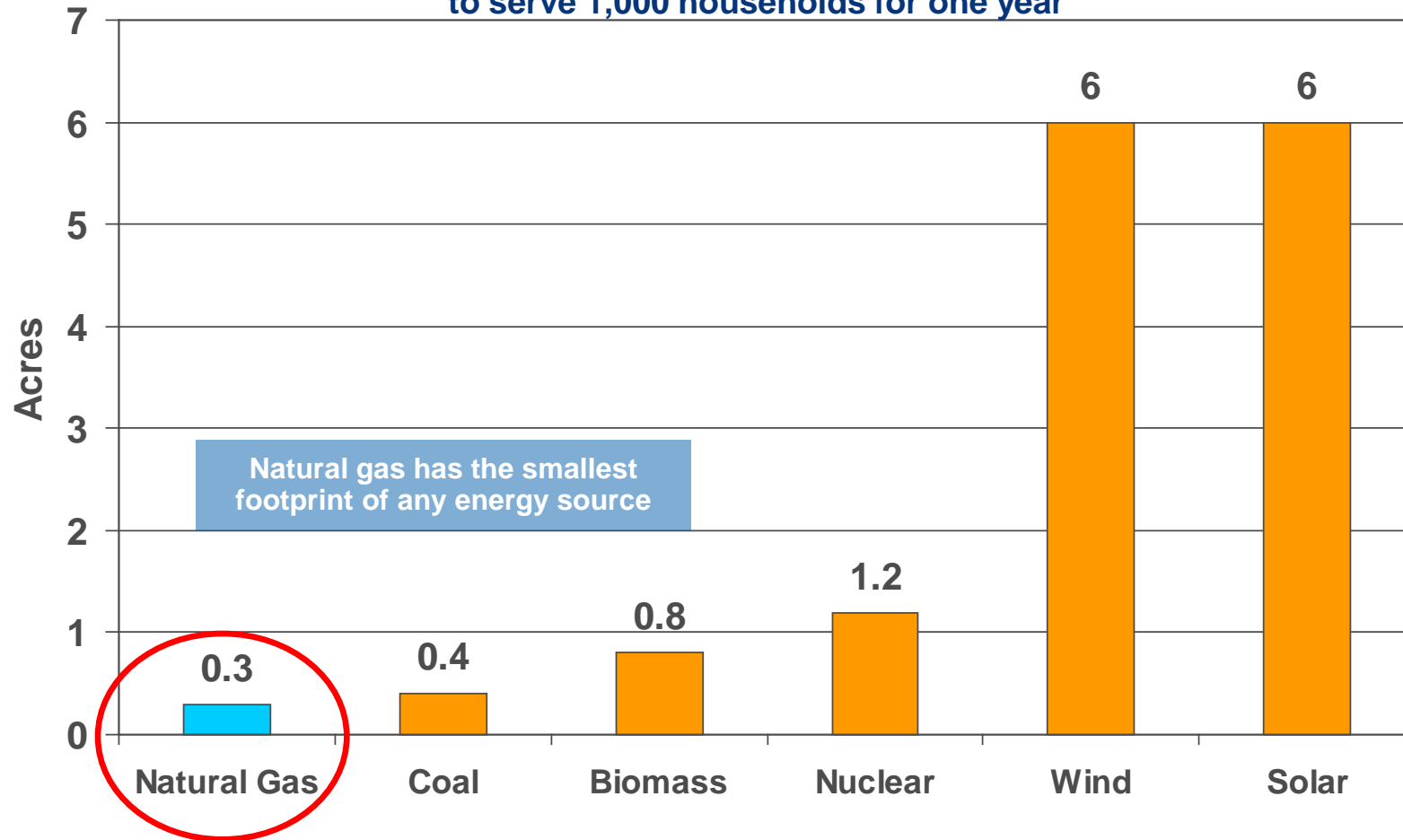
Natural gas is clean burning

Most emissions Middle emissions Least emissions

Sources: R.W. Beck data and, EPA "Mercury in Petroleum and Natural Gas Report"

Land Usage Also Makes Gas a Preferred Choice for Power Generation

Acres of land needed to produce the fuel and generate enough electricity to serve 1,000 households for one year



Source: R.W. Beck and Black and Veatch for NGSA

To Make It All Happen, Industry Is Committed to Good Stewardship

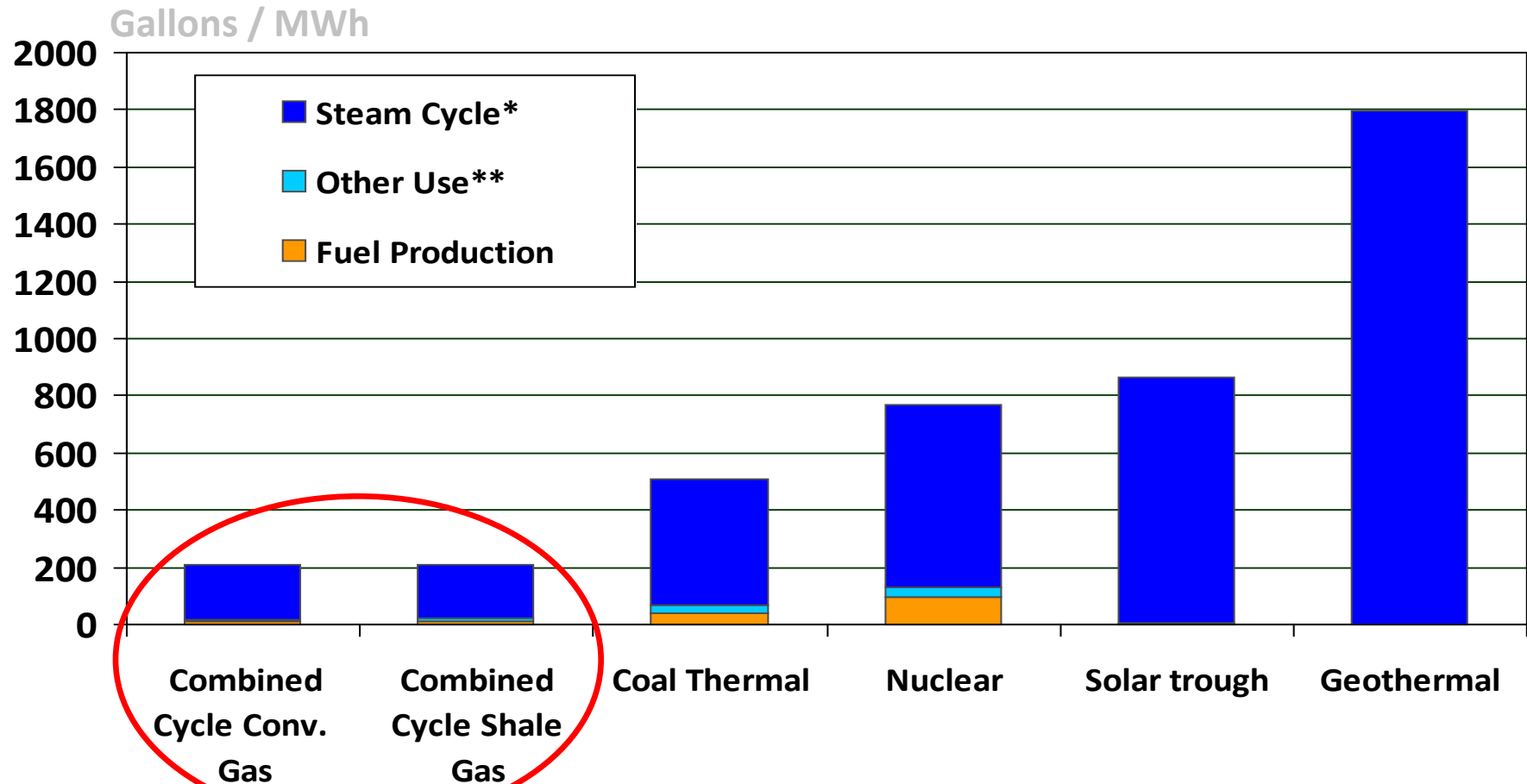
- Listening to and addressing community concerns
- Use of stringent industry and government standards on land reclamation, well construction, water management and pipeline safety
- Responsible hydraulic fracturing practices
- Minimizing surface effects on land and infrastructure
- Offshore safety and spill containment

... And Government Must Do Its Part As Well

- Fair access to onshore and offshore resources
- Continued strong and effective state regulation of hydraulic fracturing
- Level playing field: avoid picking winners and losers through mandates
- Tax policy must be fair, not burdensome, and compatible with resource development and job creation
- Financial regulations must not create “economic drain” on investment
- Current regulatory model for pipelines ensures safe, reliable operations and infrastructure investment

Back-up Slides

Water Intensity for Various Power Generation Technologies



Gas-fired combined cycle power plants use much less water than thermal power plants with only a small contribution from gas production

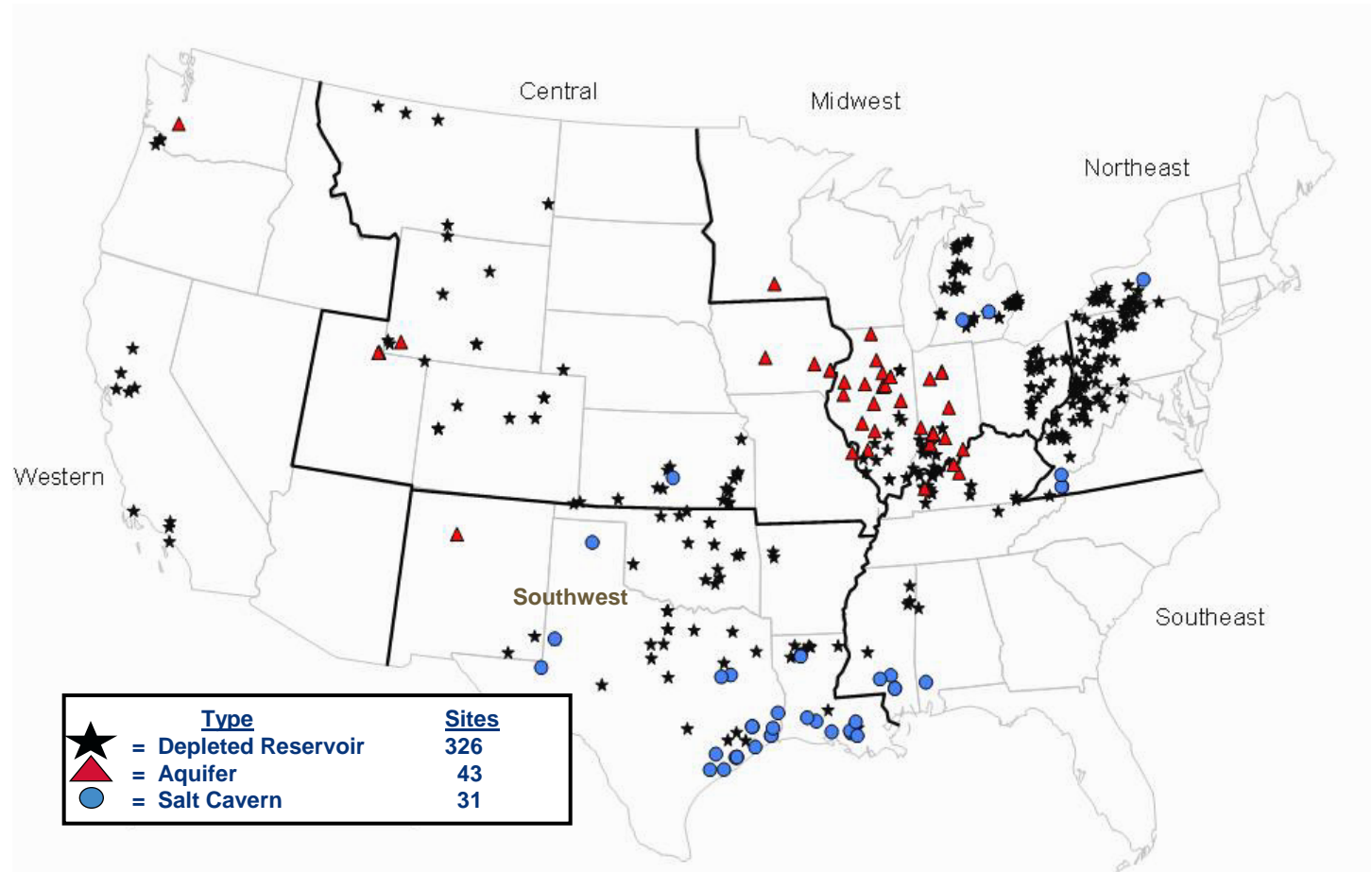
Sources: U.S. Department of Energy, "Energy Demands on Water Resources", December 2006; NREL, "A Review of Operational Water Consumption and Withdrawal Factors for Electricity Generating Technologies," March 2011; Chesapeake for shale gas water use

* Assumes closed loop cooling tower

**Other use includes water for other process uses such as emissions treatment, facilities

Storage Allows Flexibility and Reliability in Delivery

- Natural gas storage capacity grew 22% between 2006 and 2010 to over 4.3 Tcf working capacity
- Much of the new storage capacity has been high delivery, flexible salt storage
- The new storage provides additional reliability to the pipeline system, as well as allowing quick response to peaking electric generation requirements

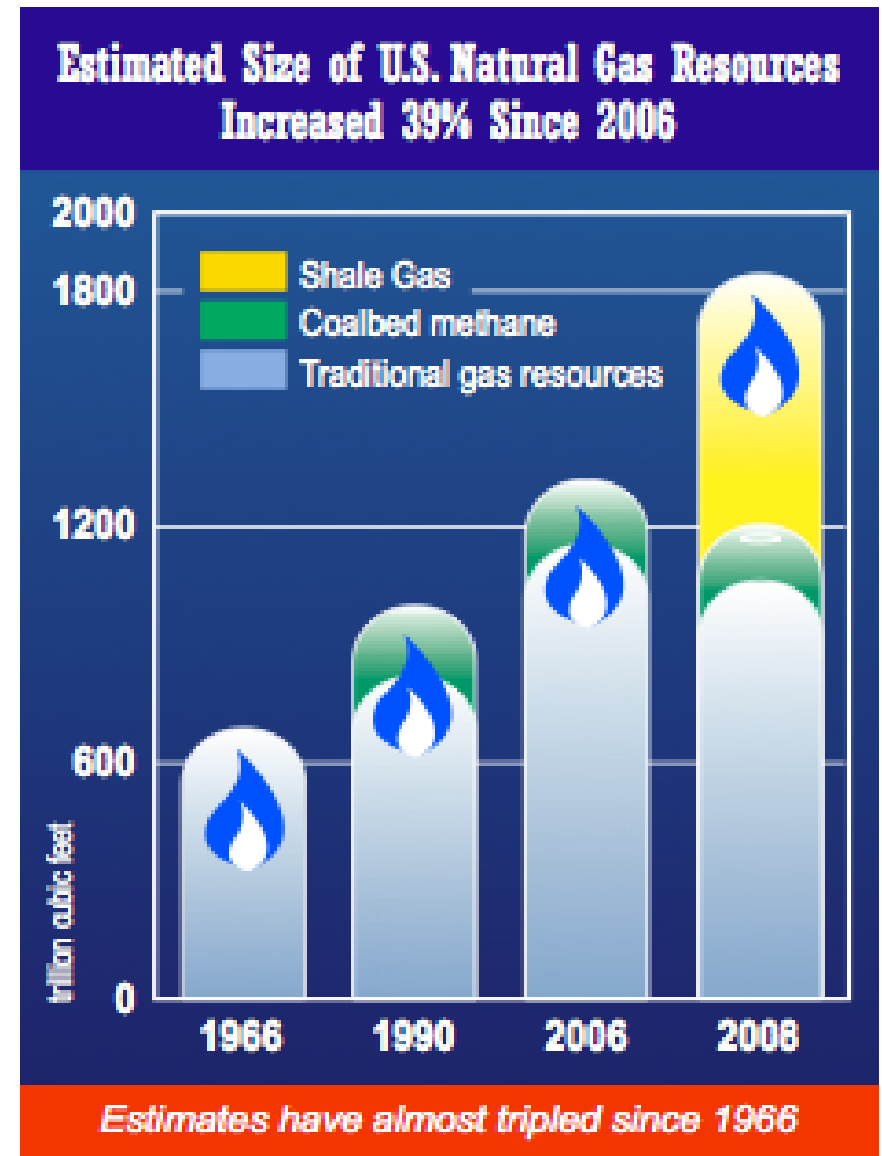


Source: Energy Information Administration, Office of Oil & Gas, Natural Gas Division Gas, Gas Transportation Information System, December 2008.

Revitalized Supply Picture

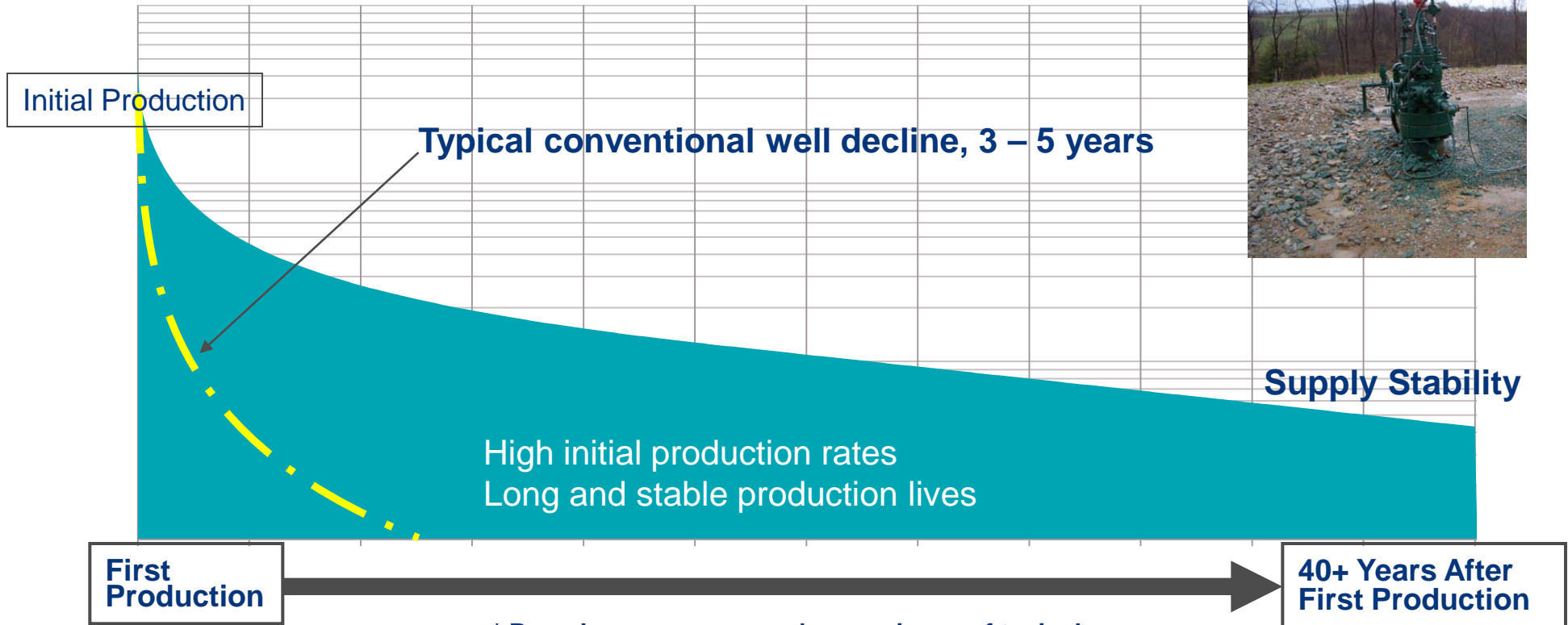
- › Shale gas increased the size of the natural gas resource base by 39% from 2006 to 2008
- › Improvements in technology brought down costs to develop
- › Diversity of supply complements strong and growing pipeline system, reduces vulnerability to hurricanes, brings natural gas closer to consumers
- › Resource size has increased with each successive PGC report, even though 825 Tcf has been drawn down during this time

Source: U.S. Potential Gas Committee Biennial Report, 2009



Typical Shale Well: Horizontal Drilling and Hydraulic Fracturing Provide Long, Stable Production Life

Initial Production from Typical Shale Well
2 to 15 million cubic feet per day*



* Based on one company's experience of typical production from the Haynesville shale wells

What's in Hydraulic Fracturing Fluid

Public State-based Registry of Hydraulic Fracturing Fluids Launches April 11, 2011

- Fluid is 99% water and sand, less than 1% chemical additives
- Registry created and managed by state regulators – the Ground Water Protection Council and the Interstate Oil & Gas Compact Commission
- Endorsed by America's Natural Gas Alliance, American Exploration & Production Council, American Gas Association, American Petroleum Institute, Independent Petroleum Association of America, Interstate Natural Gas Association of America, Natural Gas Supply Association
- Searchable public database with well-by-well information and glossary of chemicals

Water Management

Recycling wastewater reduces environmental footprint, transportation costs and reliance on groundwater or municipal sources of water

- Drilling companies in the Marcellus recycled more than 66 % of water June 2008-May 2010
- Re-used 44 million gallons of water & disposed of 21 million gallons (*Source: Penn State University Hydrologist David Yoxtheimer*)

Producer goal: Recycle 100% of produced water in Pennsylvania

State wide test results show recycled water meets all federal radium standards

- Quote: “...all samples tested ... showed levels at or below the normal naturally occurring background levels of radioactivity.” (*Pennsylvania Department of Environmental Protection, March 7, 2011*)

State and local testing of water to continue on regular basis, with strong support from natural gas companies

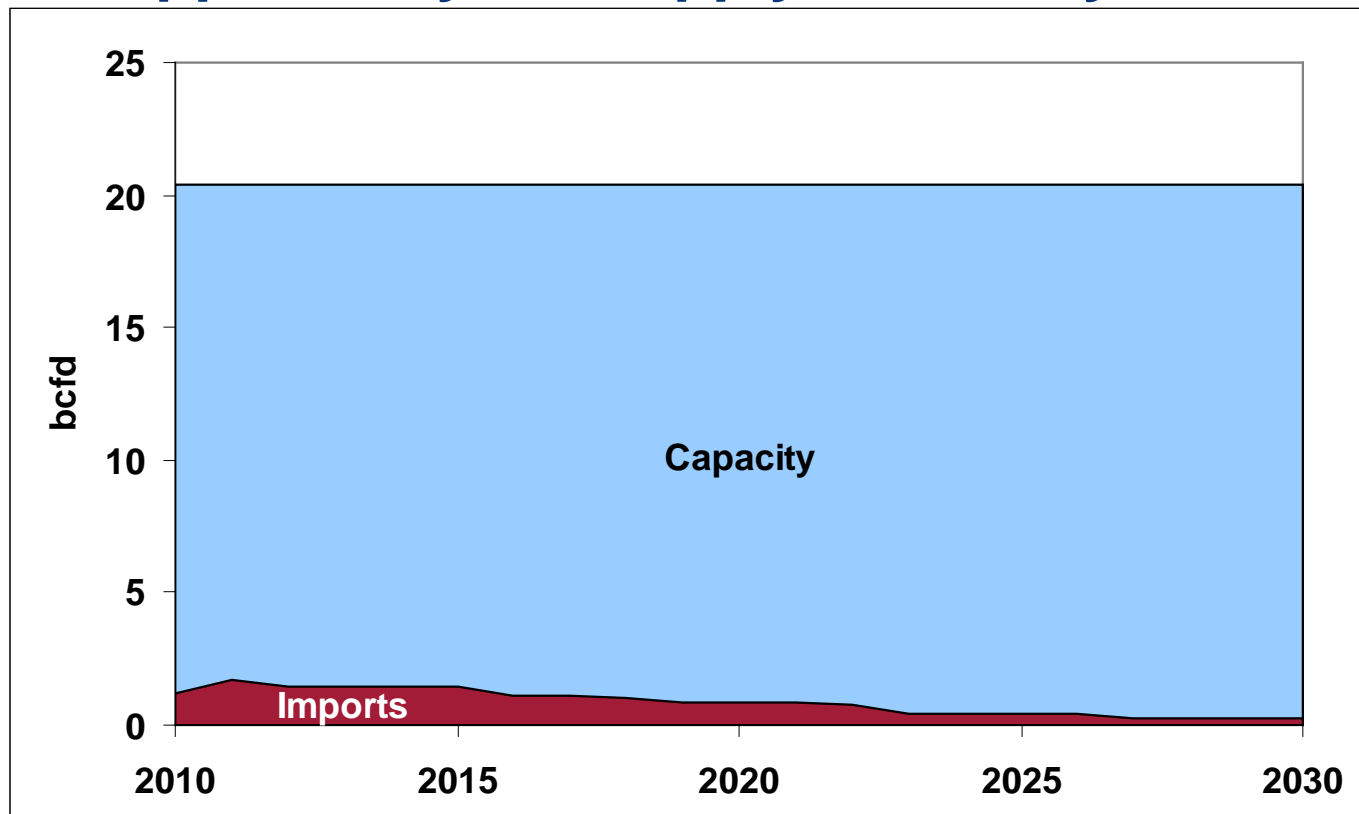
How Much Is 5 Million Gallons?

The 5 million gallons of water needed to drill and fracture a typical deep shale gas well is equivalent to the amount of water consumed by:

- New York City** in approximately **seven minutes**
- A 1,000 megawatt coal-fired **power plant in 12 hours**
- A **golf course in 25 days**
- 10 acres of cotton** in a season

While these represent continuing consumption, the water used for a gas well is a one-time use.

U.S. Import and Receiving Terminal Capacity Provides Significant Opportunity for Supply Flexibility



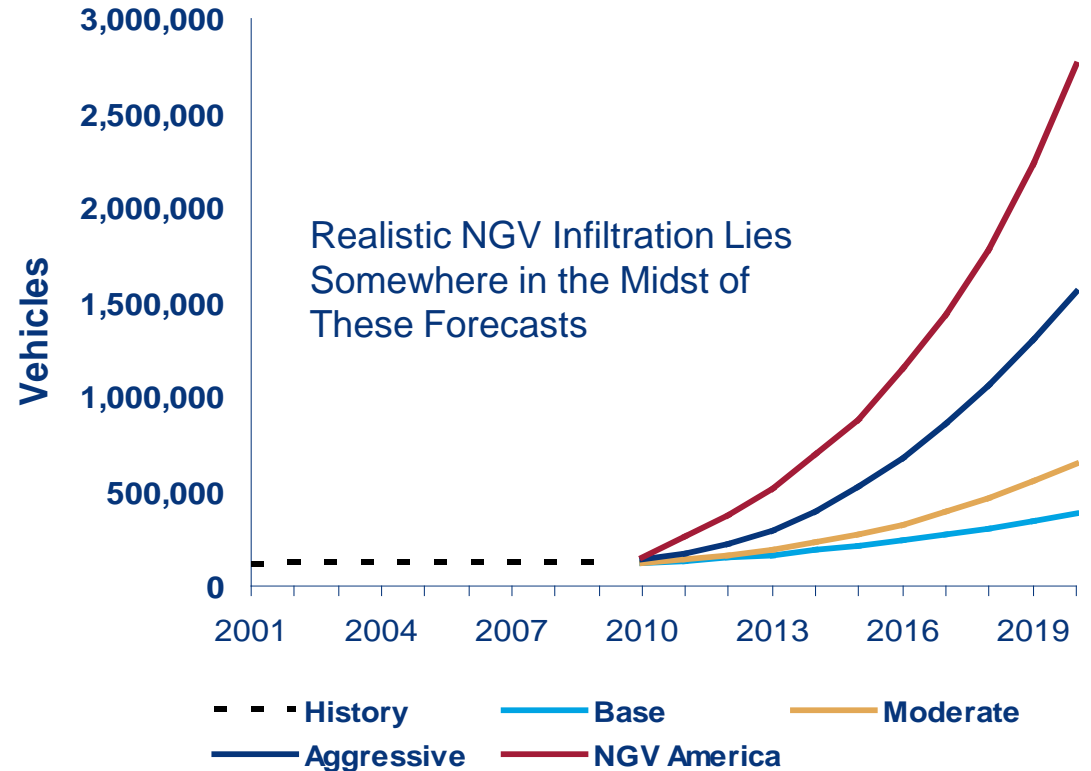
Source: Wood Mackenzie 2010

- **LNG import facilities have over 20 bcfd delivery capability into U.S.***
- **Shale gas has minimized the current need for much of the capacity**
- **Excess capacity can be used to supplement U.S. production if ever needed**

* Includes Canaport, Costa Azul, and 3 floating buoy systems

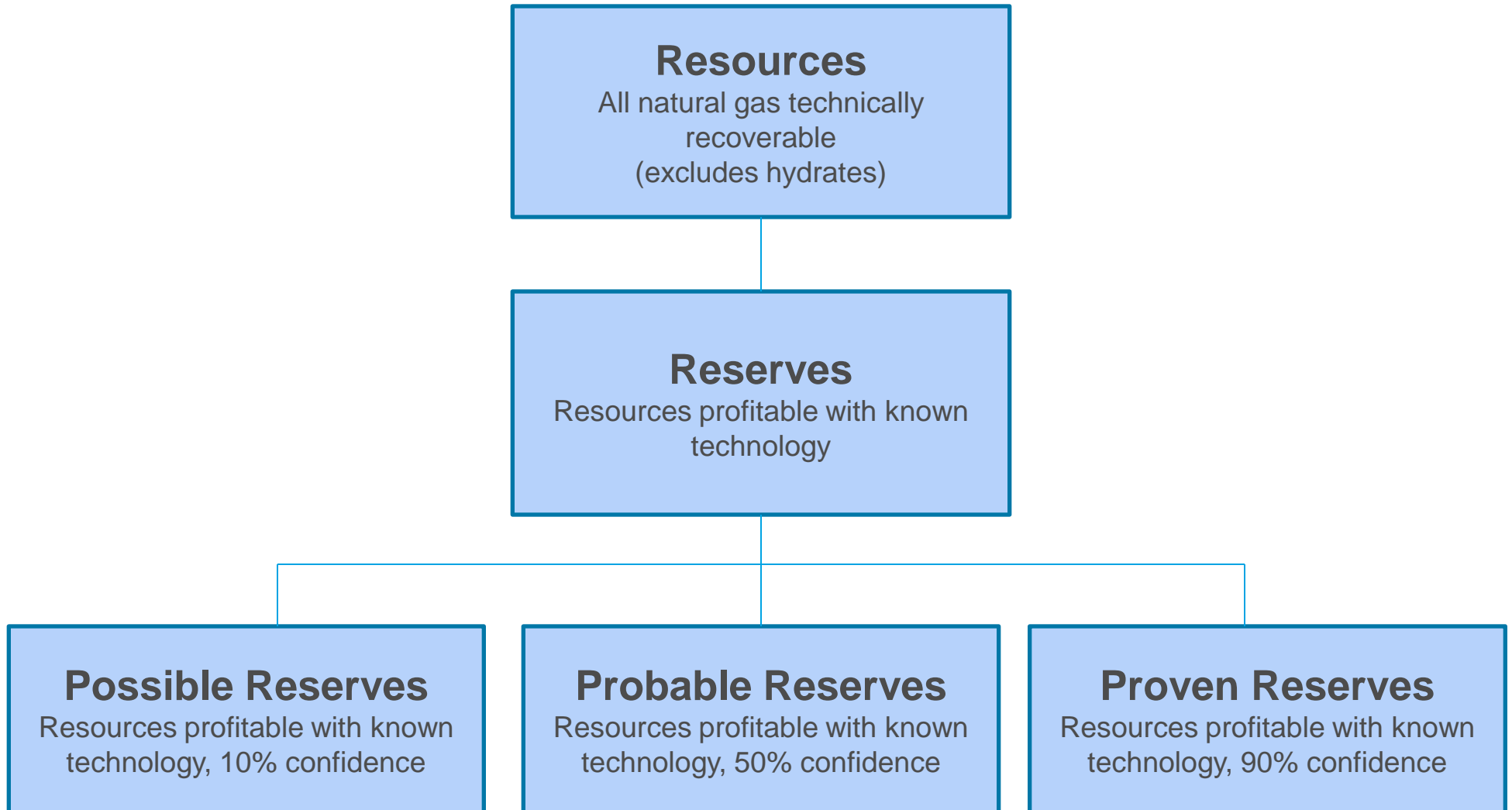
Natural Gas for Transportation Can Make Sense in Heavy-Duty Fleet Vehicles

- Long term success of passenger NGVs linked to consumer confidence, not government subsidies
- Heavy-duty truck conversions to natural gas can provide very healthy returns, but will be most successful in fleets
- Reduces oil imports and improves energy security

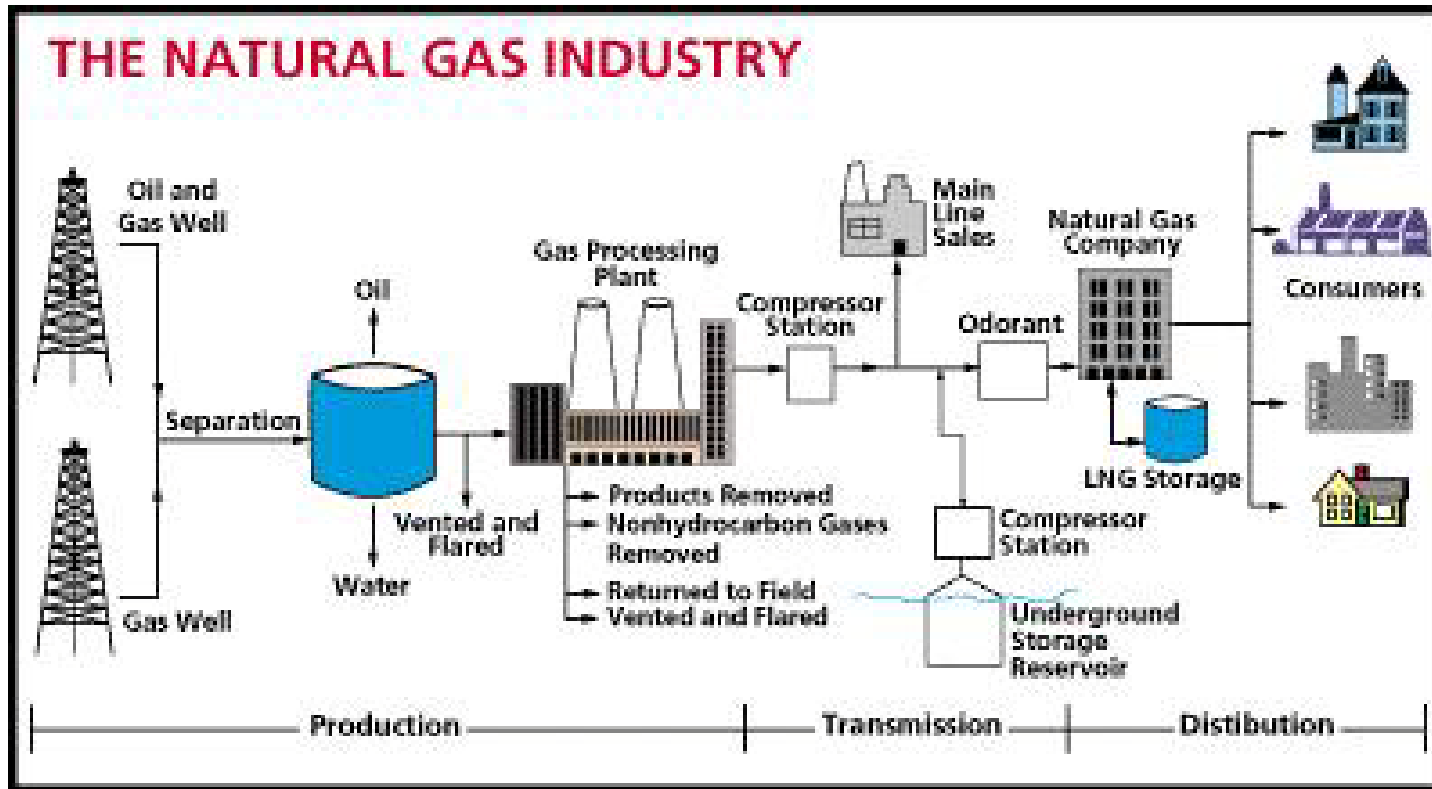


Sources: Wood Mackenzie/NGV America

Natural Gas Supply Terminology



Industry Structure in the U.S. Physical Flow of Gas



Source: EIA