



# The Outlook for Natural Gas Demand: How Shale Gas Will Affect the Global Fuel Mix

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ANH Unconventional Resources Conference, Colombia

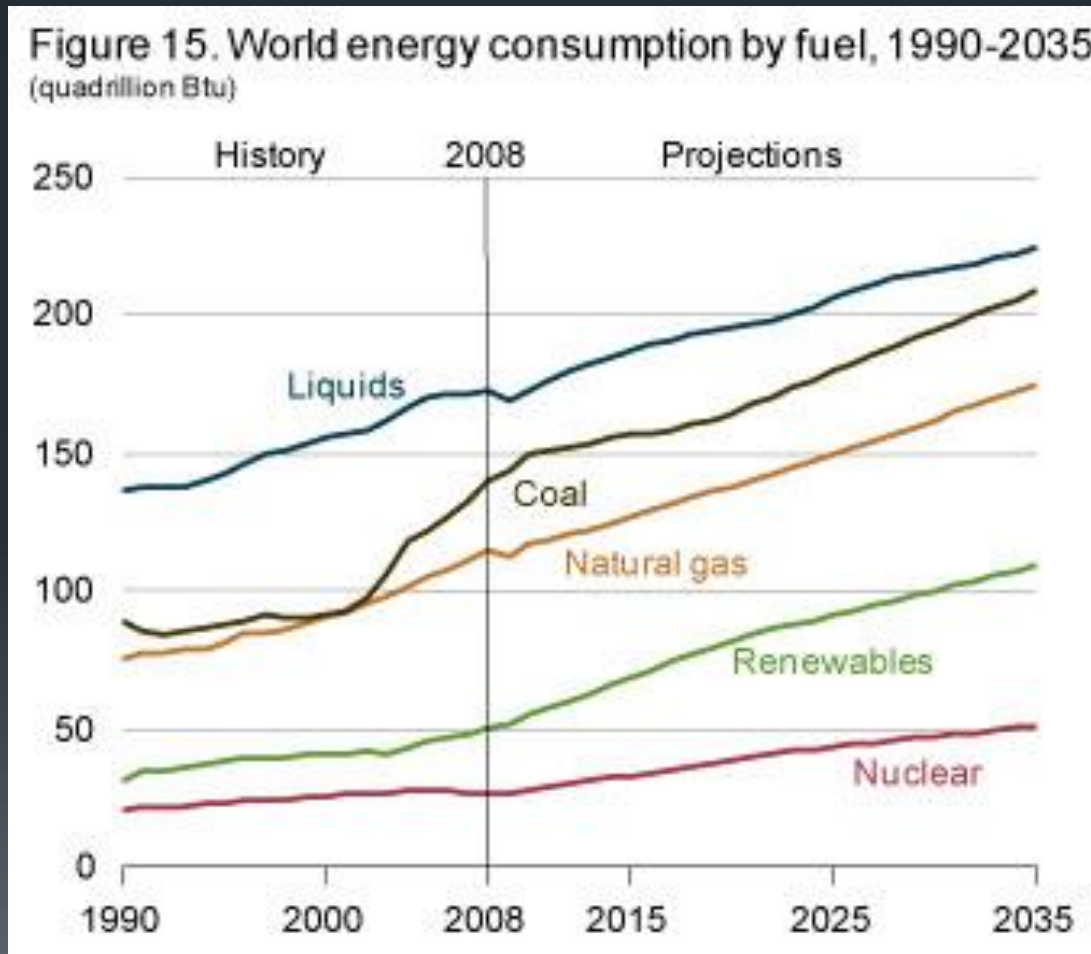
December 4, 2012



# Key Points

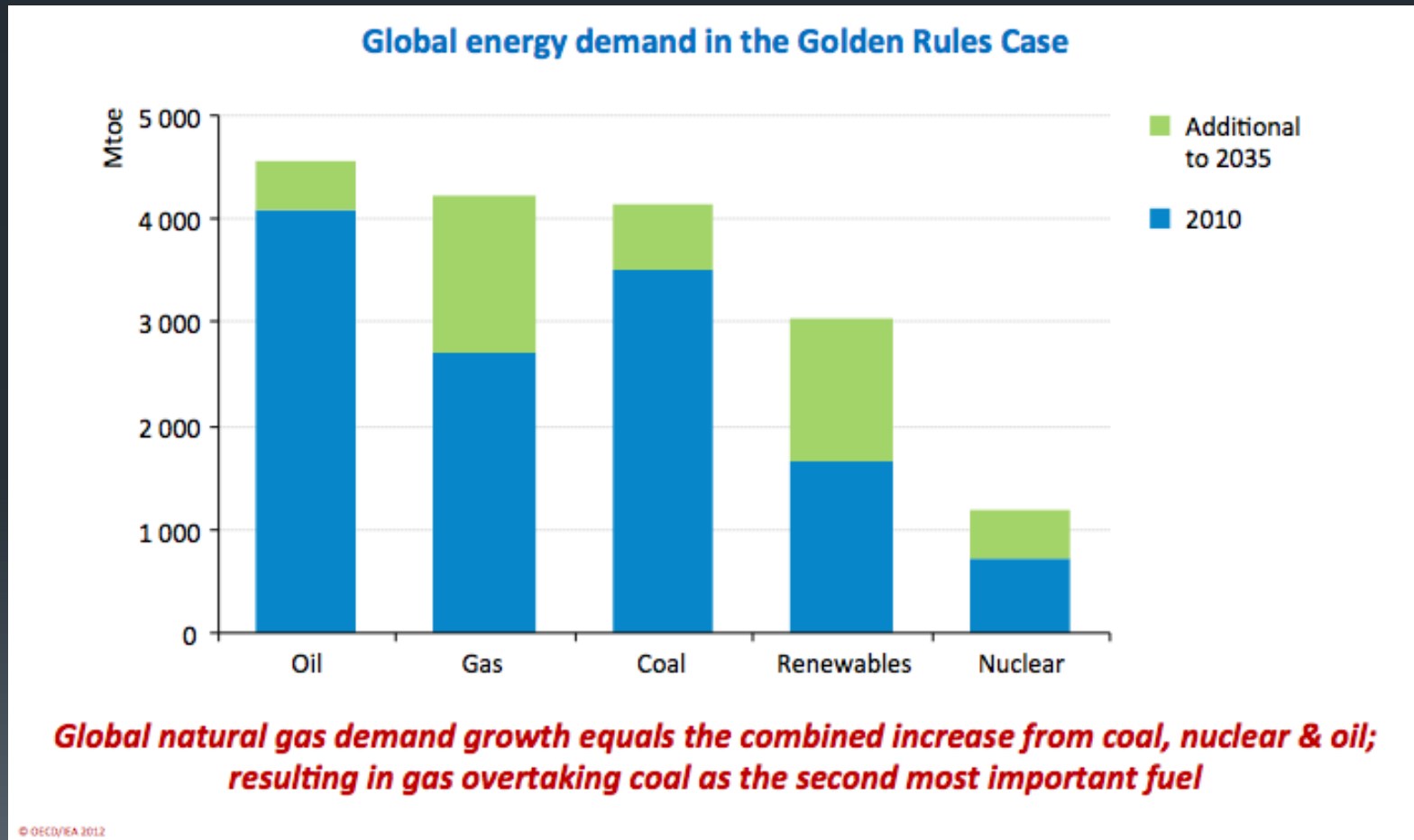
- Outlook for global gas demand is strong, especially developing Asia
- Unconventional gas – potentially 2/3 of supply growth -- has potential to change global and hemispheric energy consumption trends
  - Take market share from coal and oil, change LNG trade flows, increase regional gas trade
  - Demand projections assume competitive price, which assume robust supply
- Supply depends on social acceptance of fracking and other policies
  - Much higher supply with ‘Golden Rules’
  - US and European energy and climate policies impact demand
- Global estimates of shale resources very preliminary
- Actual performance depends on drilling results, technology, policy

# Global Energy Demand





# Natural gas poised to enter a golden age

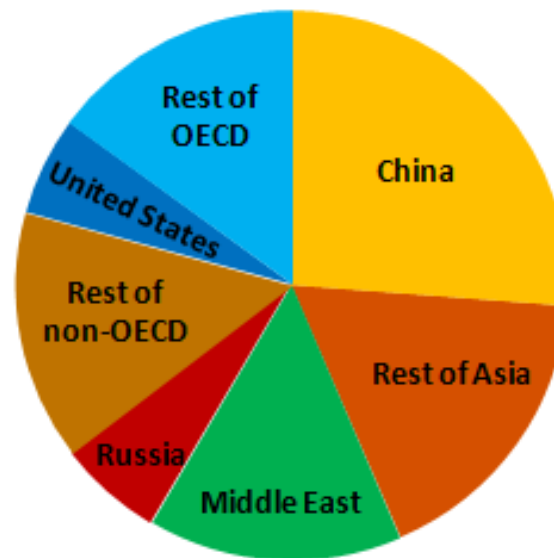


# Natural Gas Demand

## *Emerging economies take the lead*

Natural gas demand growth in the Golden Rules Case, 2010-2035

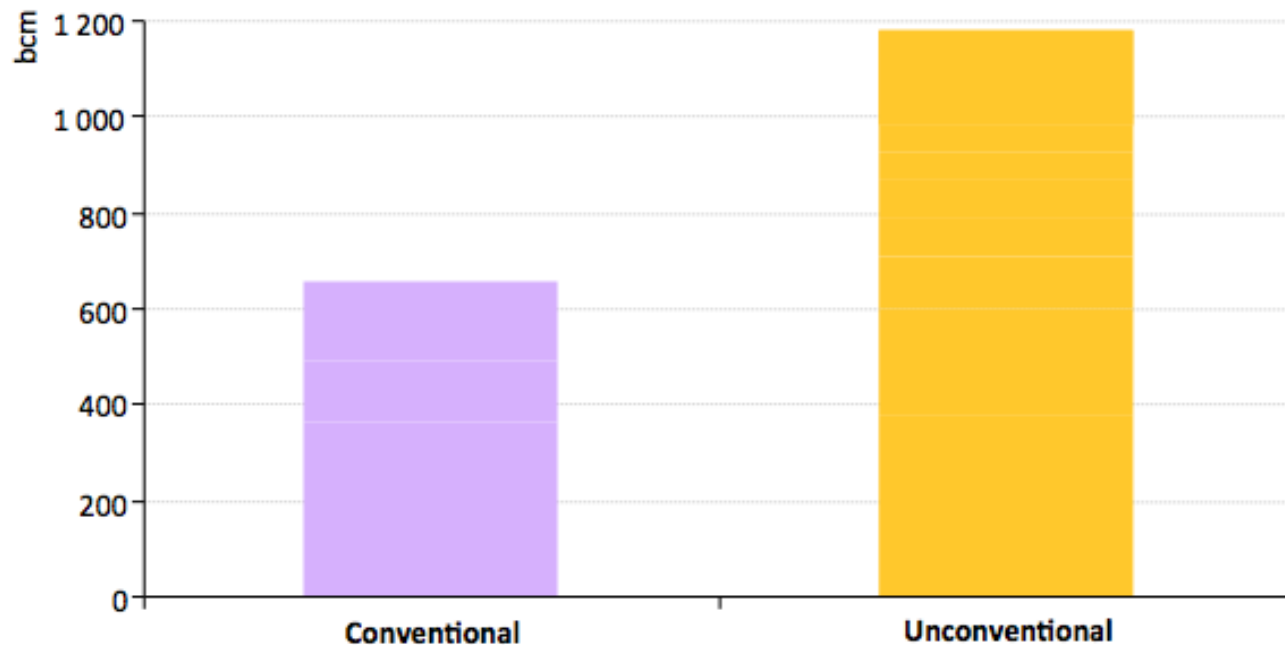
Total = 1 842 bcm



***80% of growth in gas use comes from outside the OECD; chiefly in Asia & the Middle East ...***

# Fracturing the Status Quo

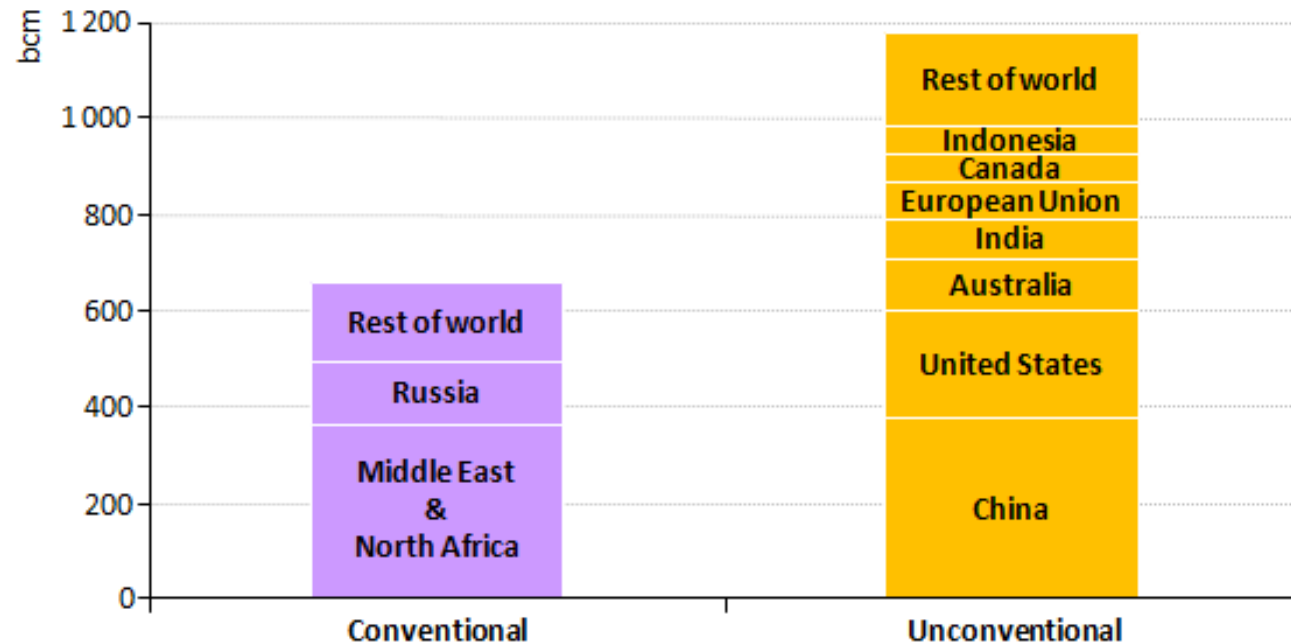
Natural gas supply growth in the Golden Rules Case, 2010-2035



**Total gas production grows by 55% to 2035; unconventional gas accounts for nearly two-thirds of the growth & its share in total output rises from 14% today to 32% in 2035**

# Natural Gas Supply

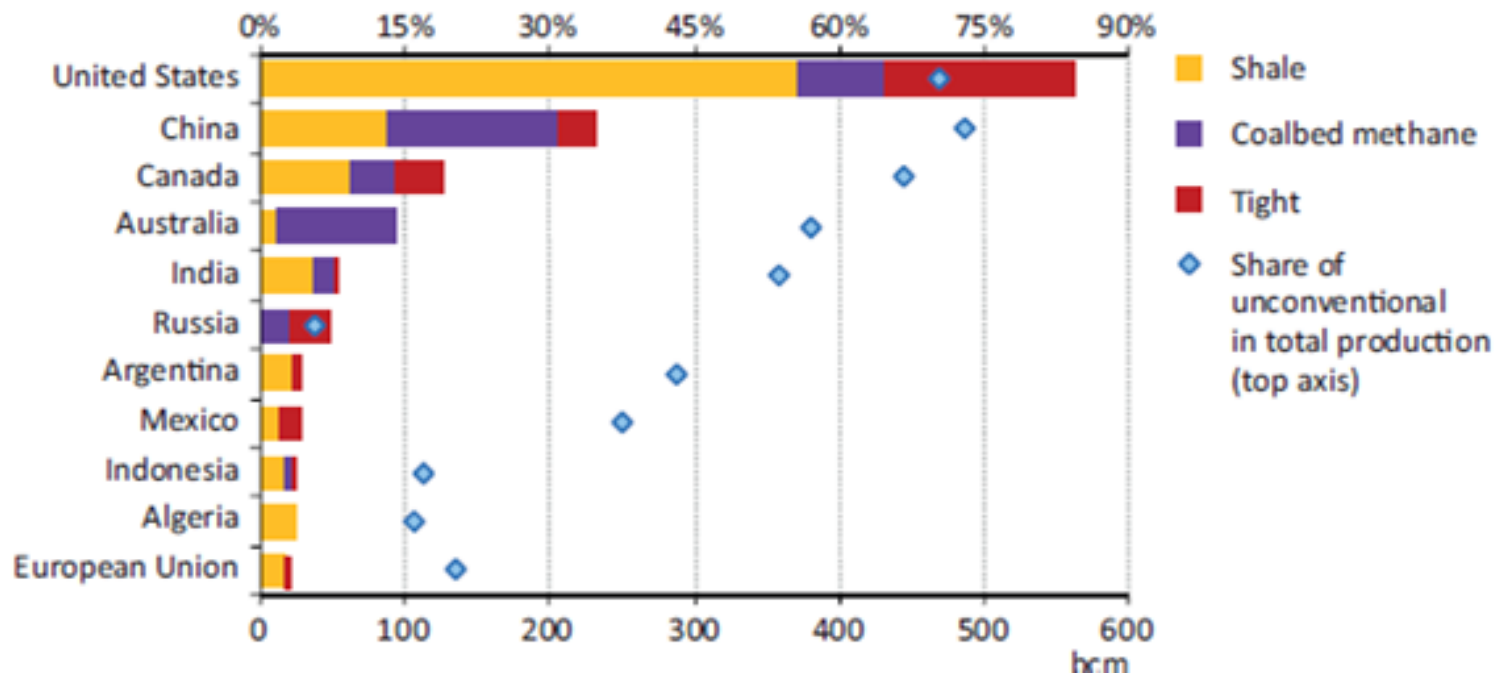
Natural gas supply growth in the Golden Rules Case, 2010-2035



***Combined unconventional gas output growth from the United States, China & Australia surpasses that of all conventional producers - mainly the MENA region & Russia***

# Unconventionals by Volume and Share of Natural Gas Production

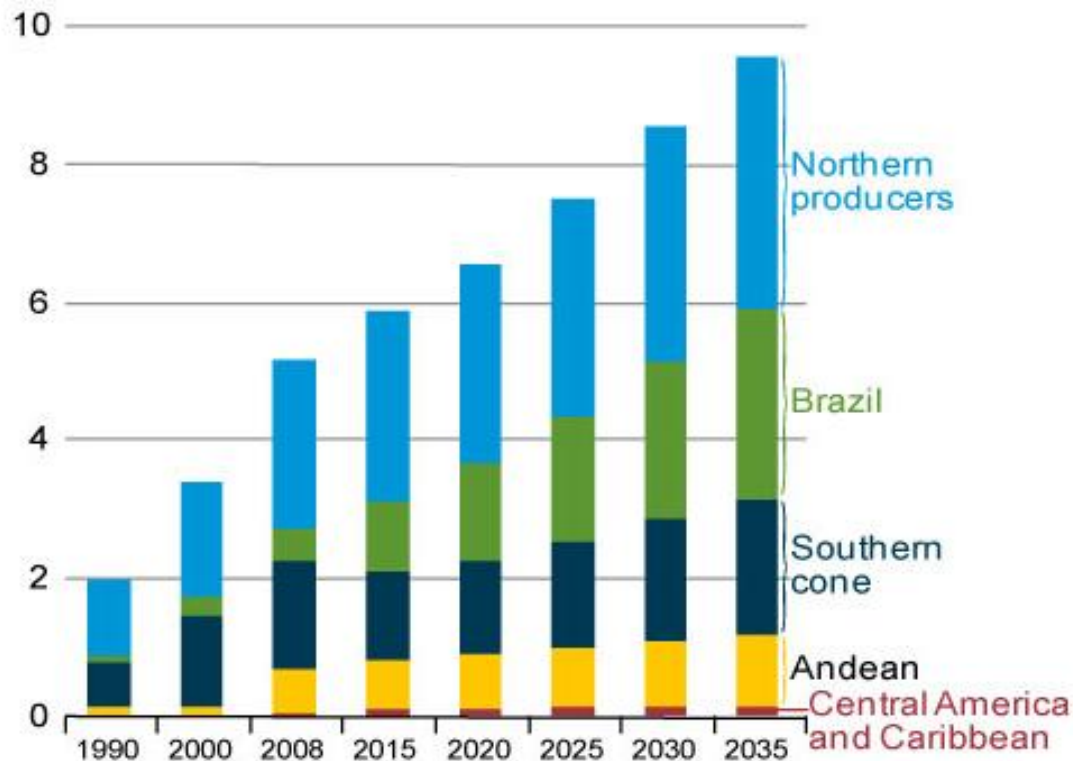
**Figure 4.5** ▶ Unconventional gas production in leading countries in the New Policies Scenario, 2035





# Natural Gas Supply: Latin America

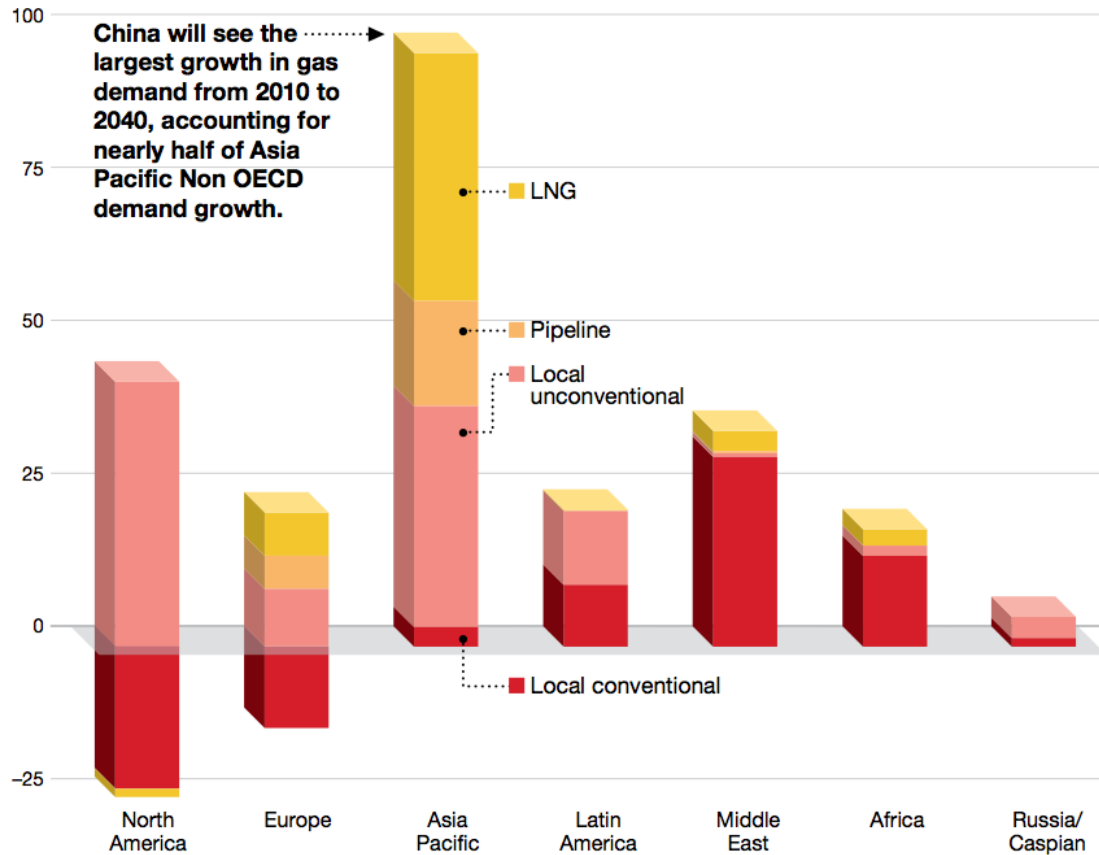
Figure 55. Non-OECD Central and South America natural gas production, 1990-2035  
(trillion cubic feet)



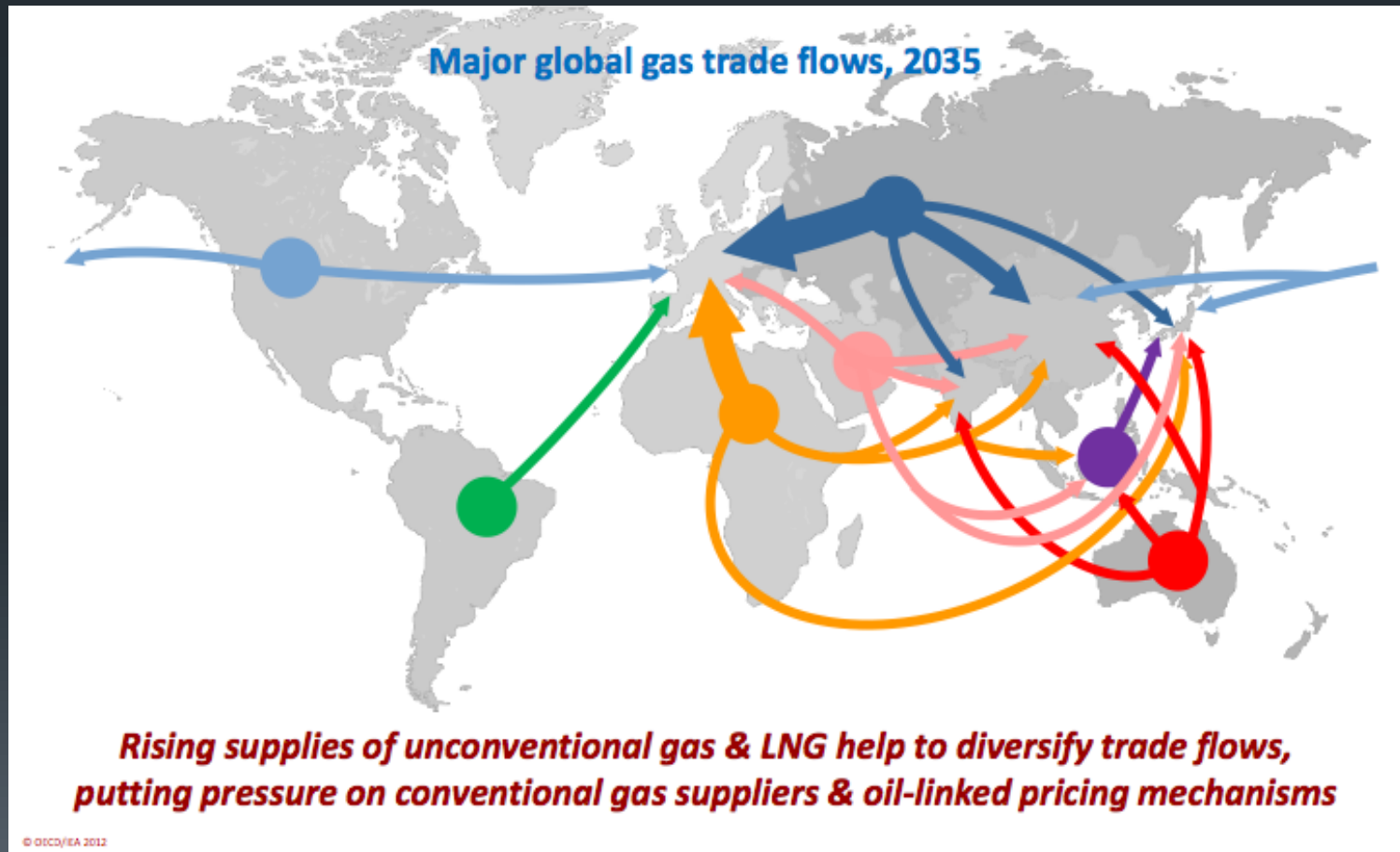
# Changes in Gas Consumption and Sources

**Gas supply growth by region from 2010 to 2040**

Billions of cubic feet per day

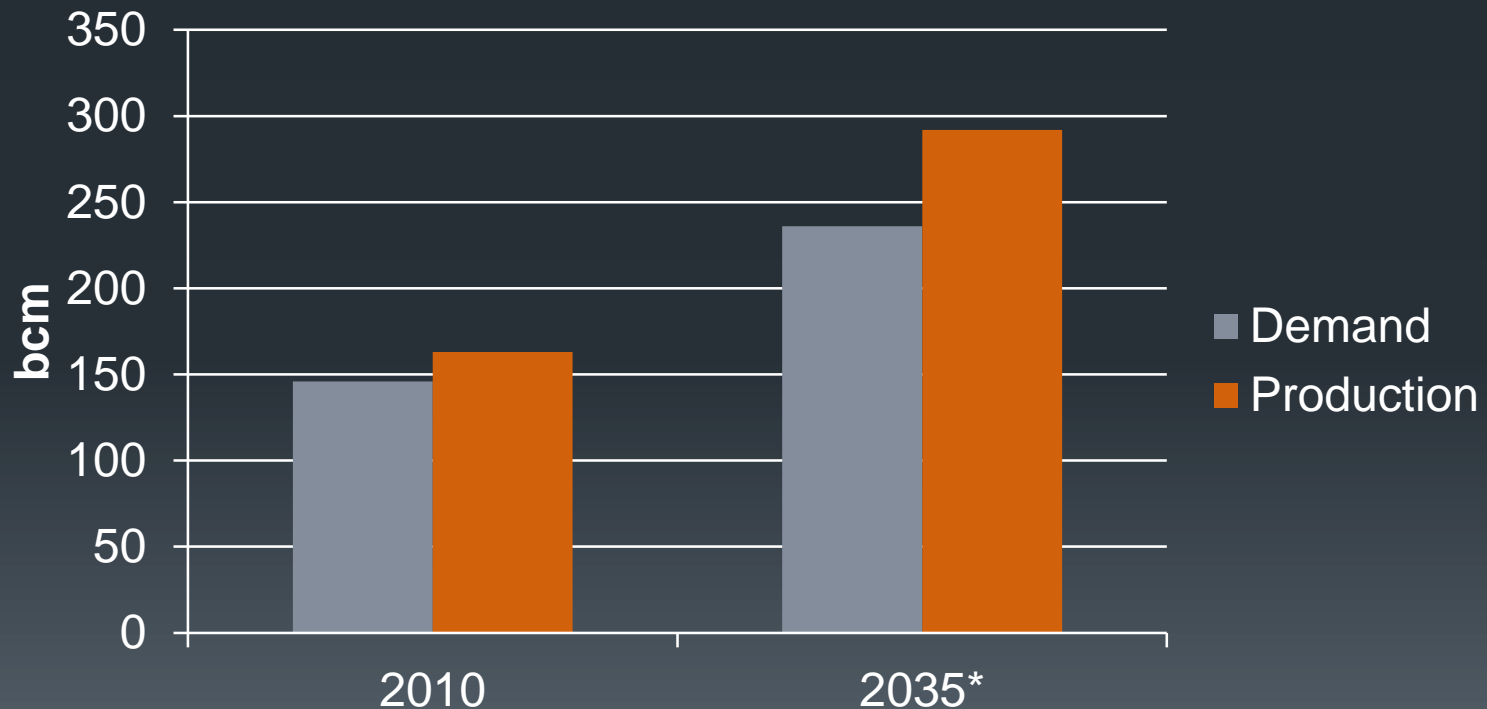


# Projected Gas Trade Flows

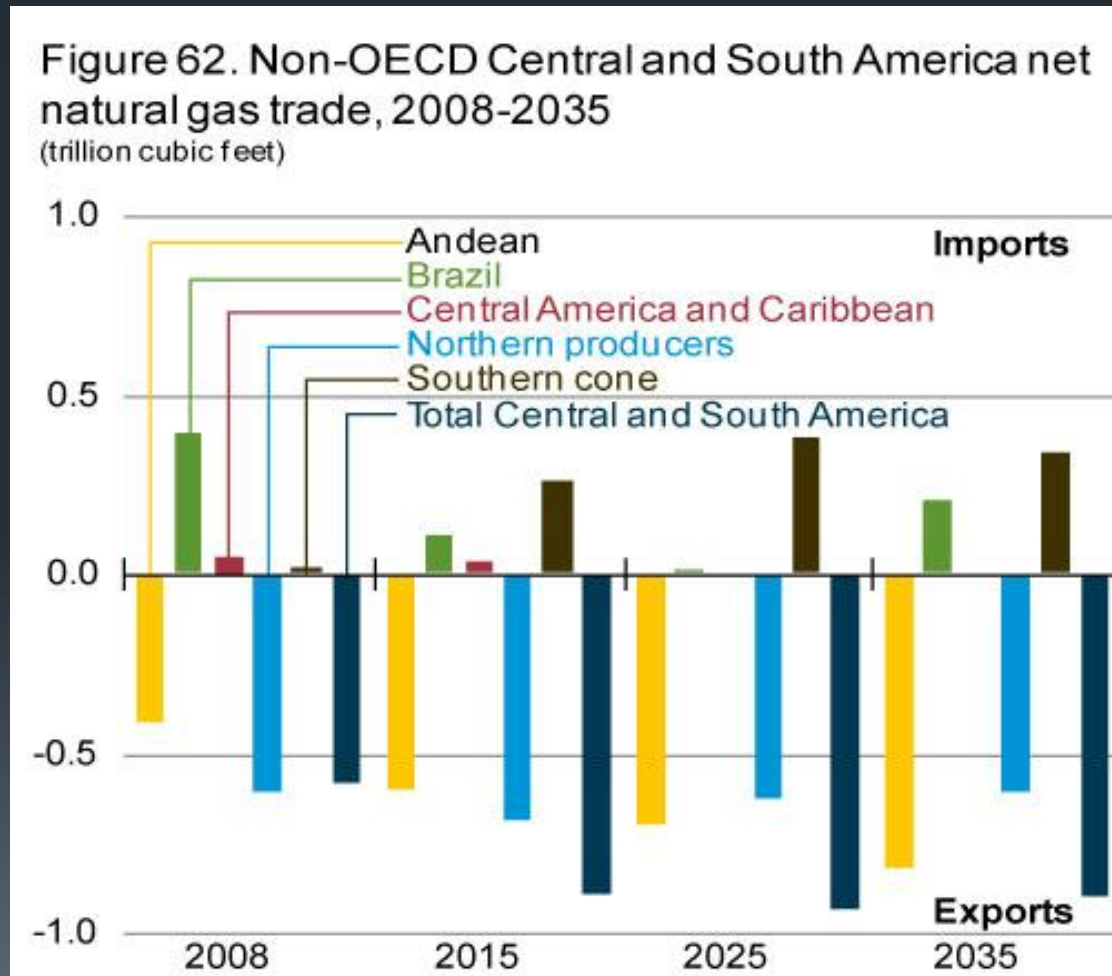




# Latin America Gas Balances



# Natural Gas Trade Balances: Latin America





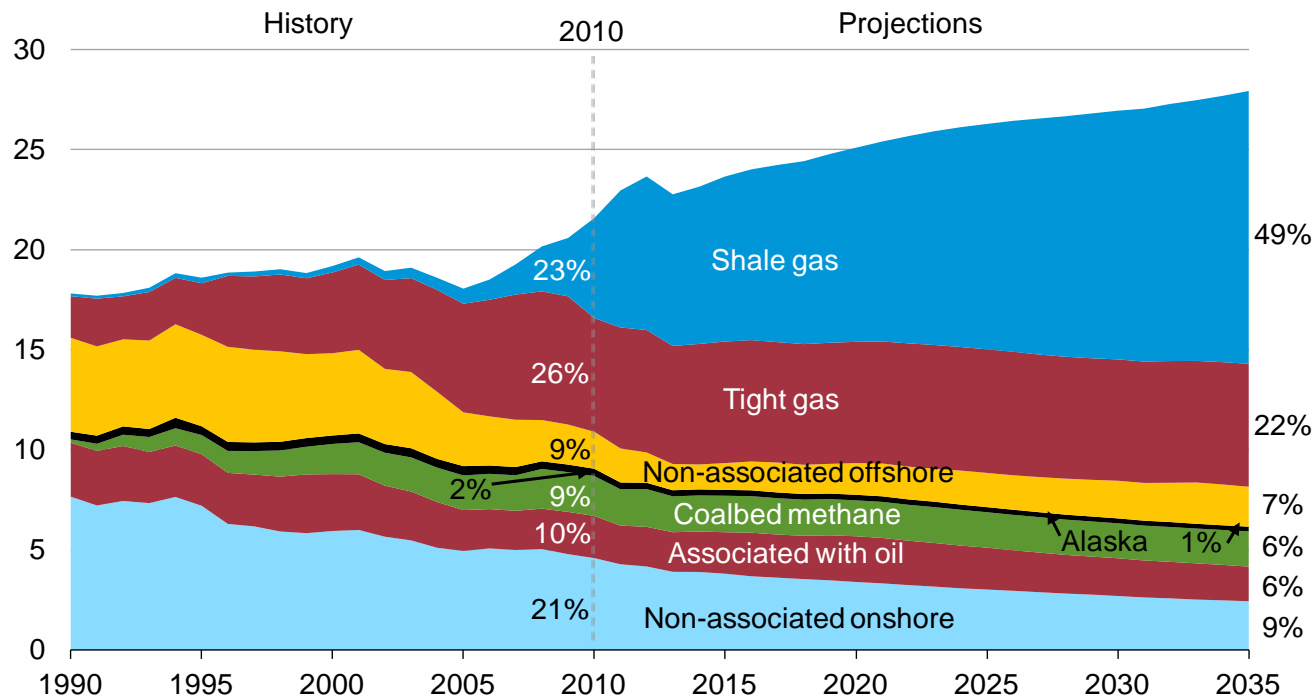
# U.S. Experience

- Rapid growth in domestic natural gas production
- Decline in LNG imports
- Falling domestic natural gas prices
- Improvements in technology for production and processing
- Development of robust NGL market

# Shale Gas Grows Faster than Conventional Sources

Shale gas offsets declines in other U.S. natural gas production sources

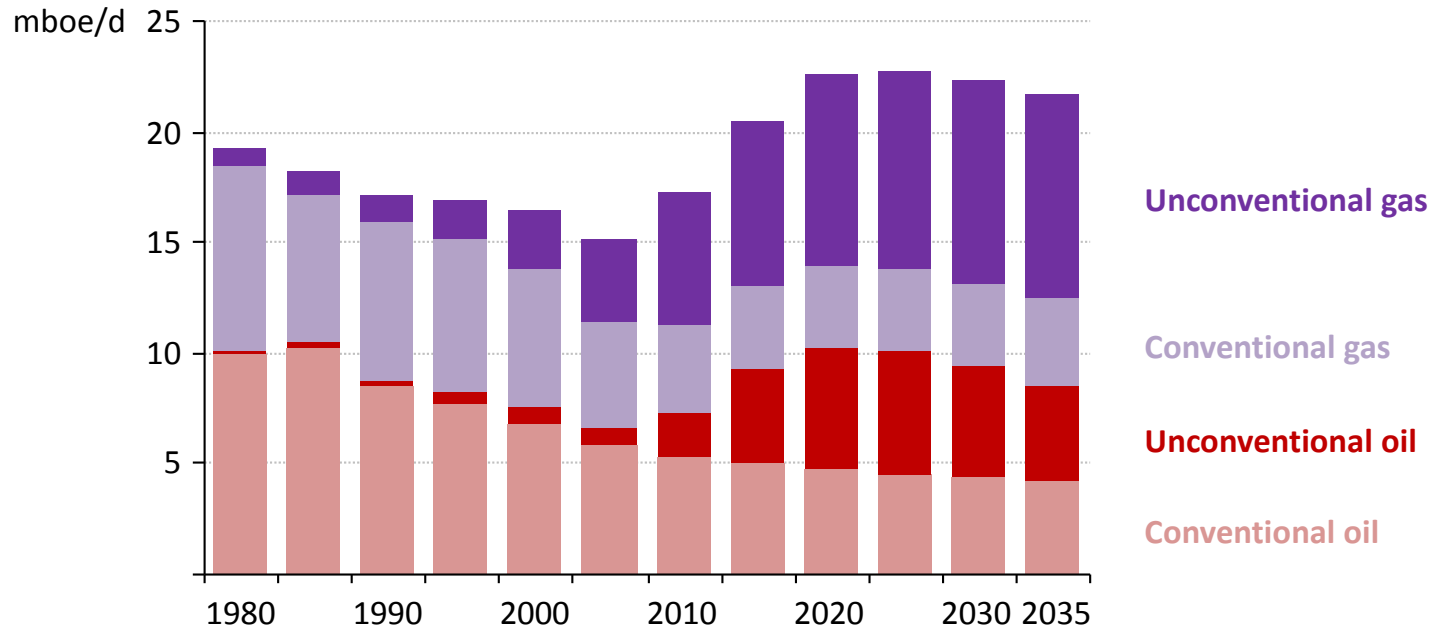
U.S. dry gas production  
trillion cubic feet per year



Source: EIA, Annual Energy Outlook 2012

# Changing U.S. Oil and Gas Picture

US oil and gas production



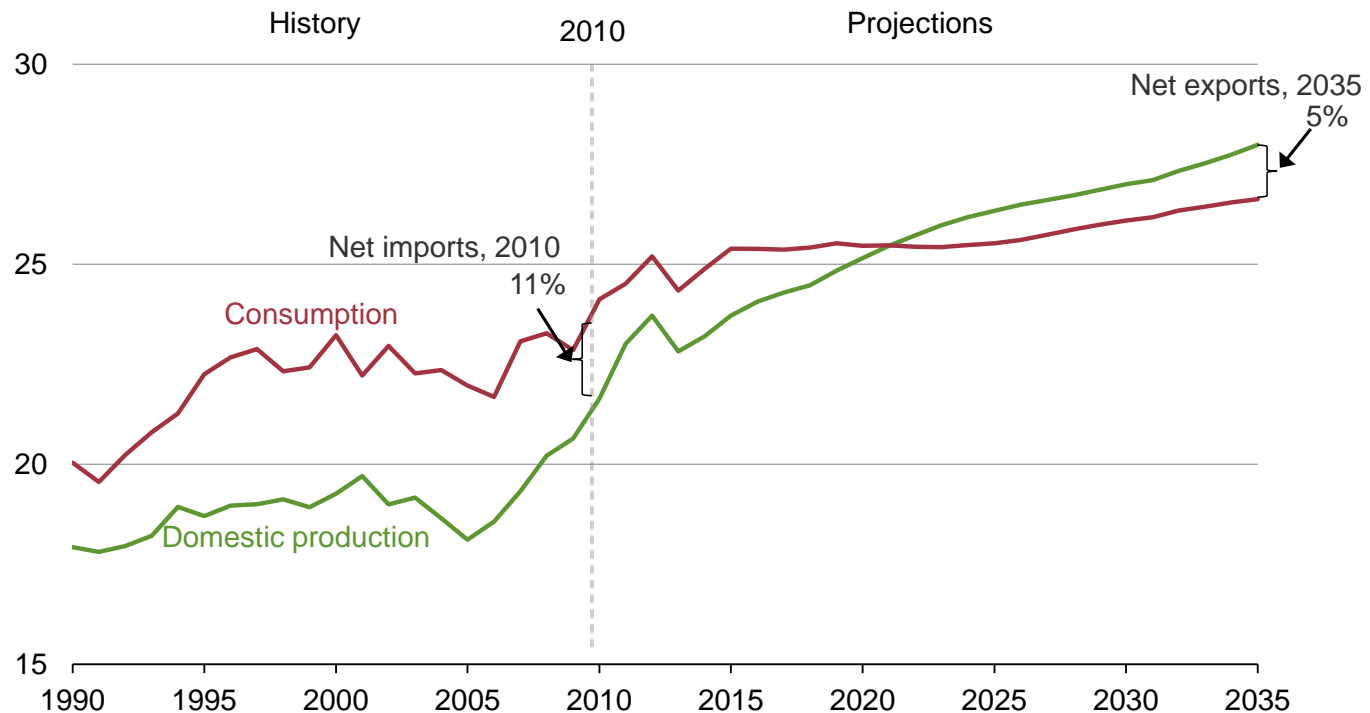
***The surge in unconventional oil & gas production has implications well beyond the United States***



# U.S. to be a net exporter

## U.S. becomes a net natural gas exporter in 2022

U.S. dry natural gas  
trillion cubic feet

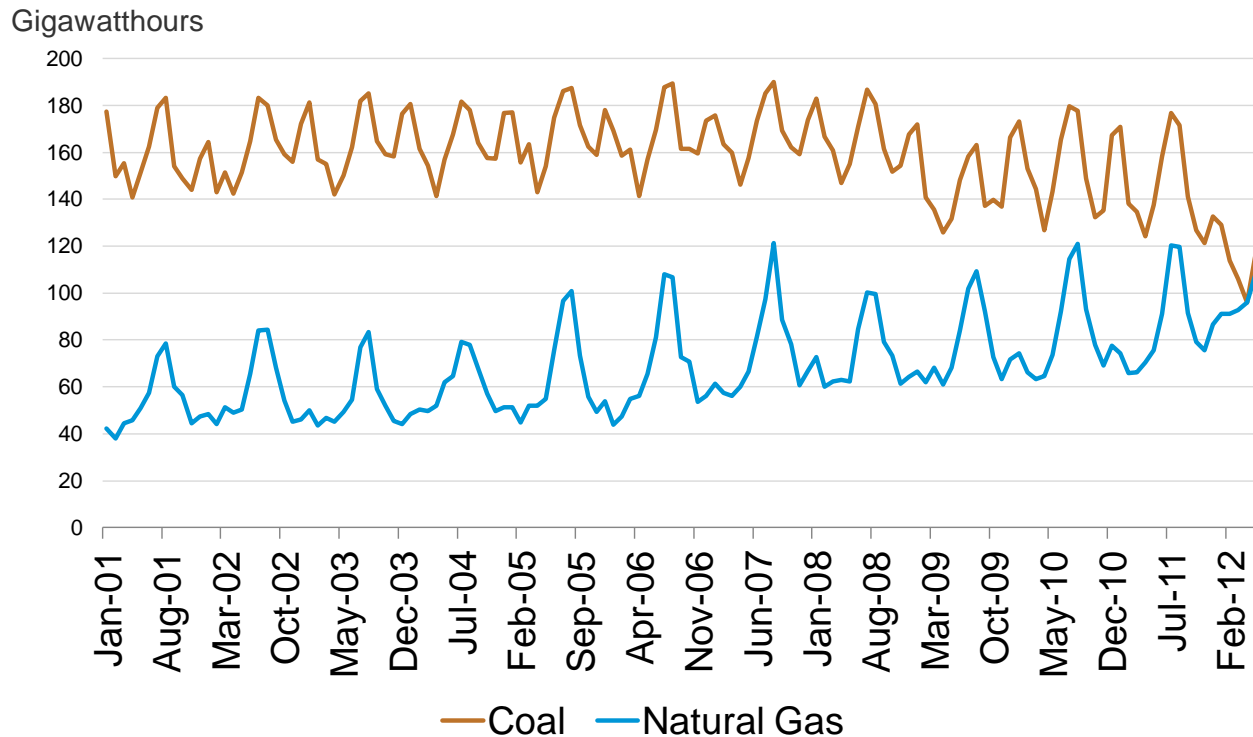


Source: EIA, Annual Energy Outlook 2012



# U.S. Experience: Gas Displaces Coal

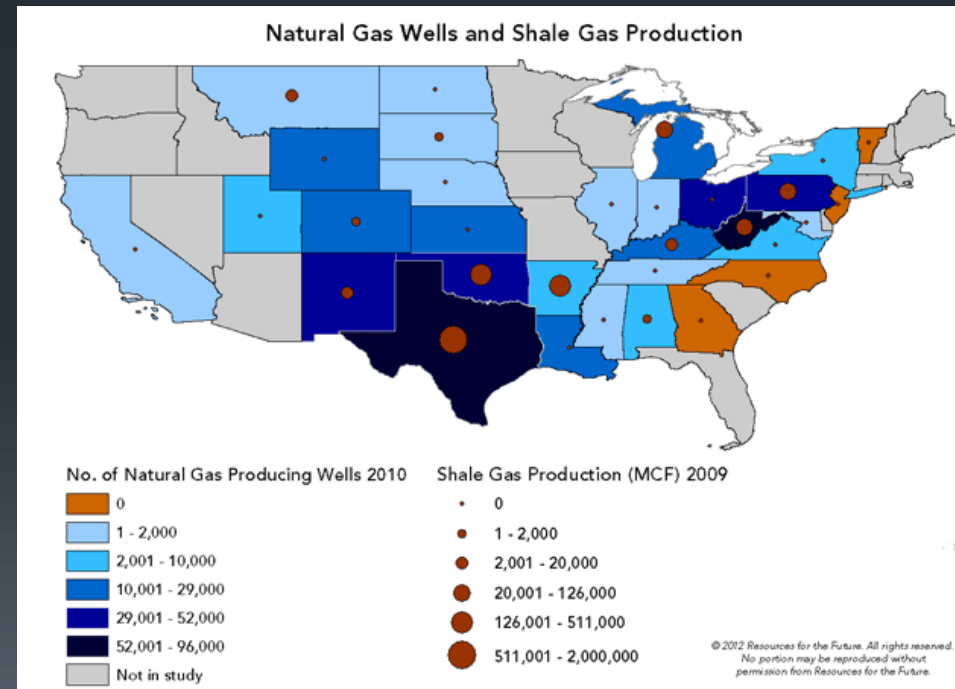
## U.S. Electricity Output from Natural Gas and Coal



Source: U.S. Energy Information Administration Electric Power Monthly

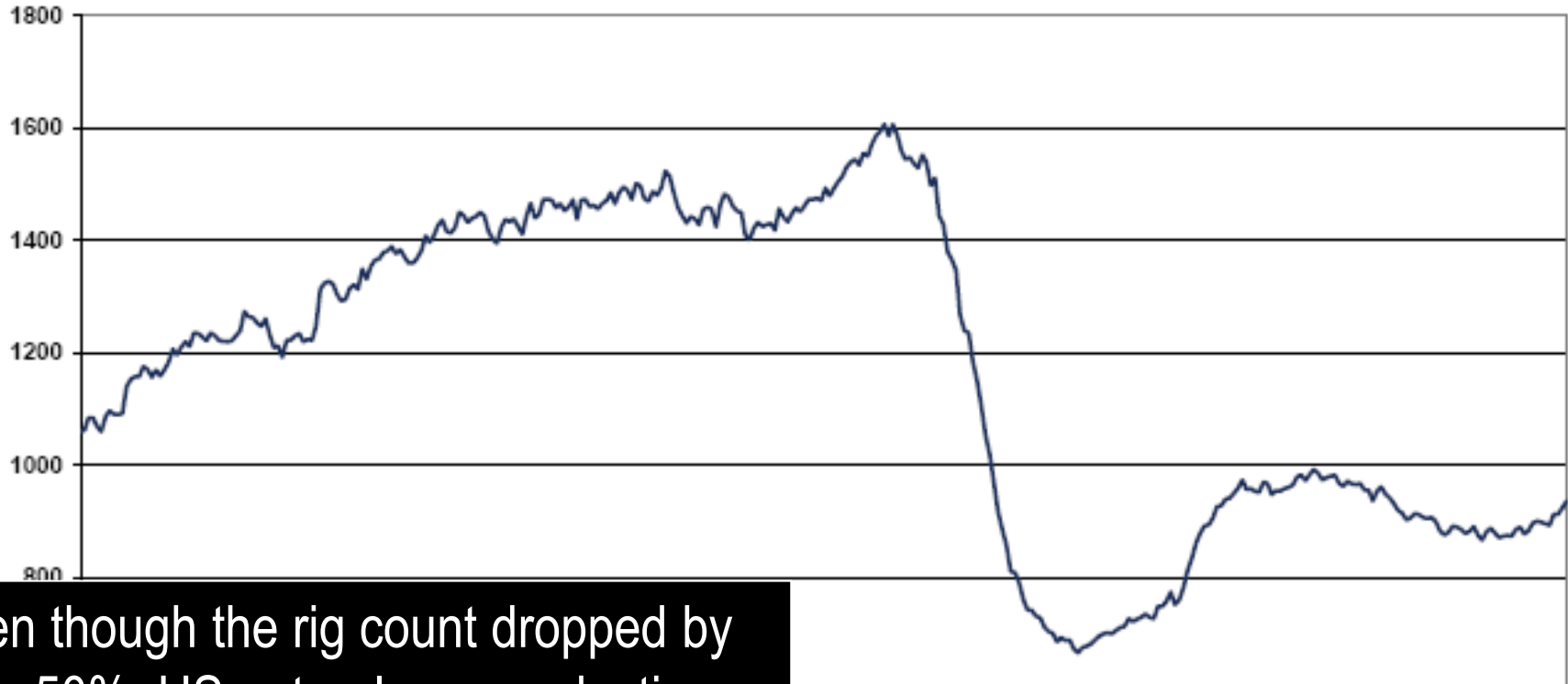
# Rig Count declining, Production up

- U.S. rig counts are down, production is up
- Better ability to identify sweet spots
- Companies are re-fracturing wells



# United States Natural Gas Rotary Rig Count

2005-2011



Even though the rig count dropped by over 50%, US natural gas production has continued to climb.

This is due to better completions, producing more gas with less rigs!!

## Lower 48 Land Gas Production



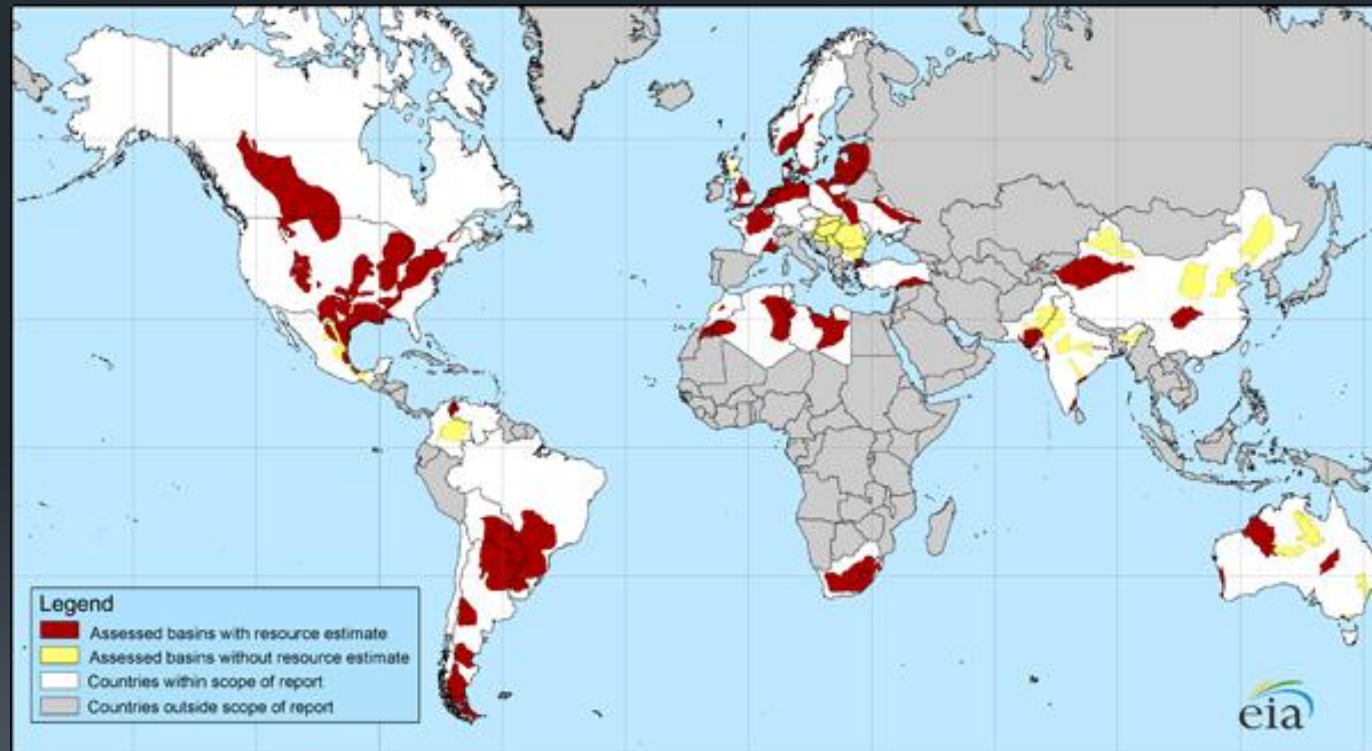


# Do Resource Estimates Matter?

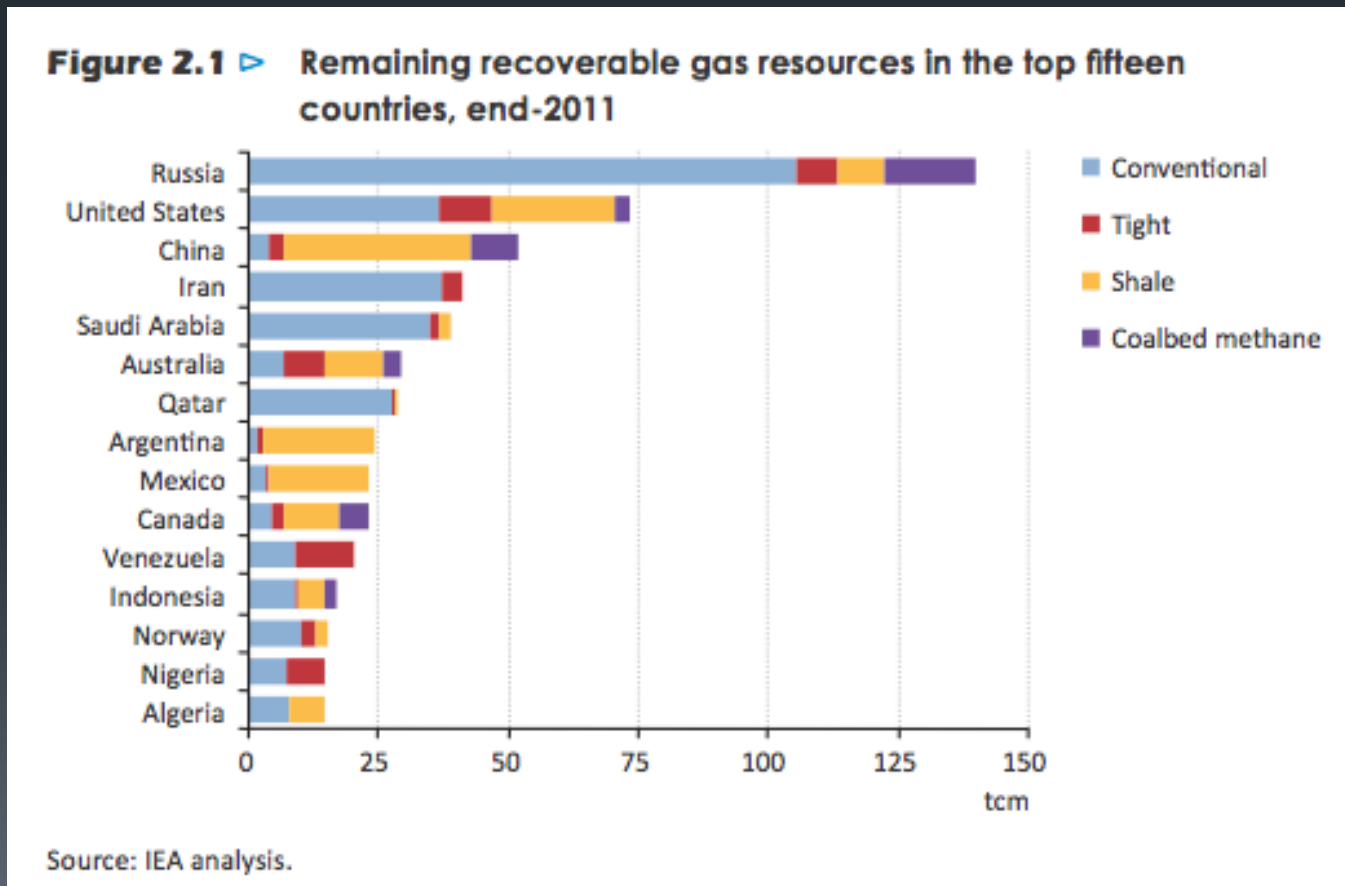
- Don't know until you drill
- Technically recoverable does not equal economically recoverable
- Investment framework, EUR, infrastructure, and policy matter
- Examples: Poland, Argentina, China

# Estimates

- The EIA/ARI report from April 2011 found technically recoverable resources of 6,622 tcf in 32 countries around the world
- 862 tcf of those global resources in the U.S.



# IEA Estimates of Global Natural Gas Resources by Type



# Top Ten Shale Gas Resource Bases (tcf) by Country and Status

Resource	Status
1. China: 1,275	1. China: 1 active well, 8 planned
2. USA: 862	2. USA: Thousands of wells/rigs
3. Argentina: 774	3. Argentina: Nationalized YPF
4. Mexico: 681	4. Mexico: Proposed shale gas plan
5. South Africa: 485	5. South Africa: Moratorium lifted (Sept 7, 2012)
6. Australia: 396	6. Australia: Leasing and Vertical test wells
7. Canada: 388	7. Canada: Exploration
8. Libya: 290	8. Libya: No Action
9. Algeria: 231	9. Algeria: No Action
10. Brazil: 226	10. Brazil: Planning





# Other Producing Countries by Resource (tcf) and Status

## Resource

- Poland: 187
- France: 180
- India: 63
- Ukraine: 42
- Hungary, Romania, Bulgaria: 19
- Tunisia: 18
- Germany: 8
- Lithuania: 4

## Status

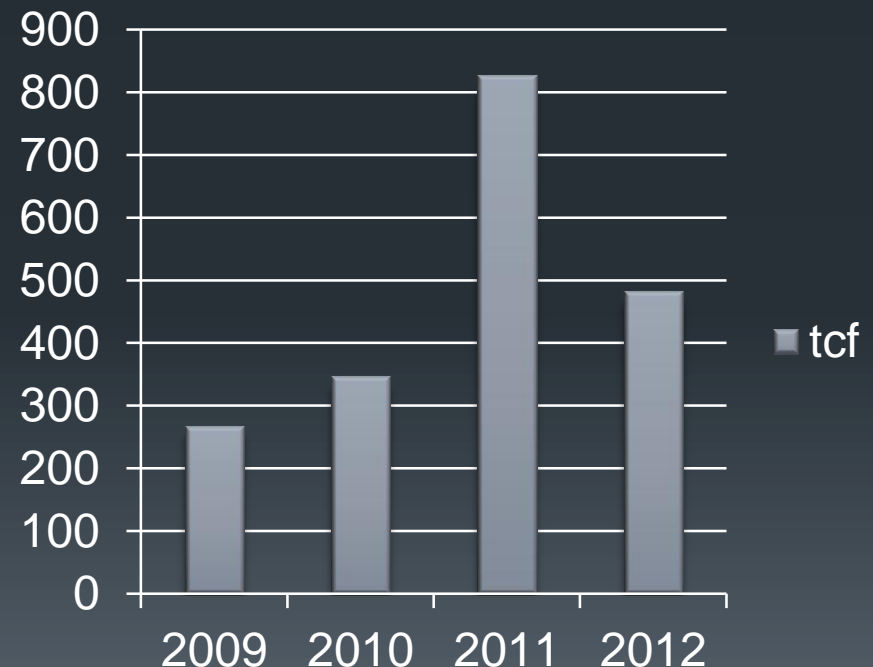
- Poland: 25 wells, Exxon Mobil exited
- France: Moratorium
- India: Leasing
- Ukraine: Contracting, Study
- Hungary: Test wells in 2009, no action since
- Bulgaria and Romania: Moratorium
- Tunisia: Leasing, exploration
- Germany: Exploration halted
- Lithuania: No drilling, study



# Estimates: U.S. Example

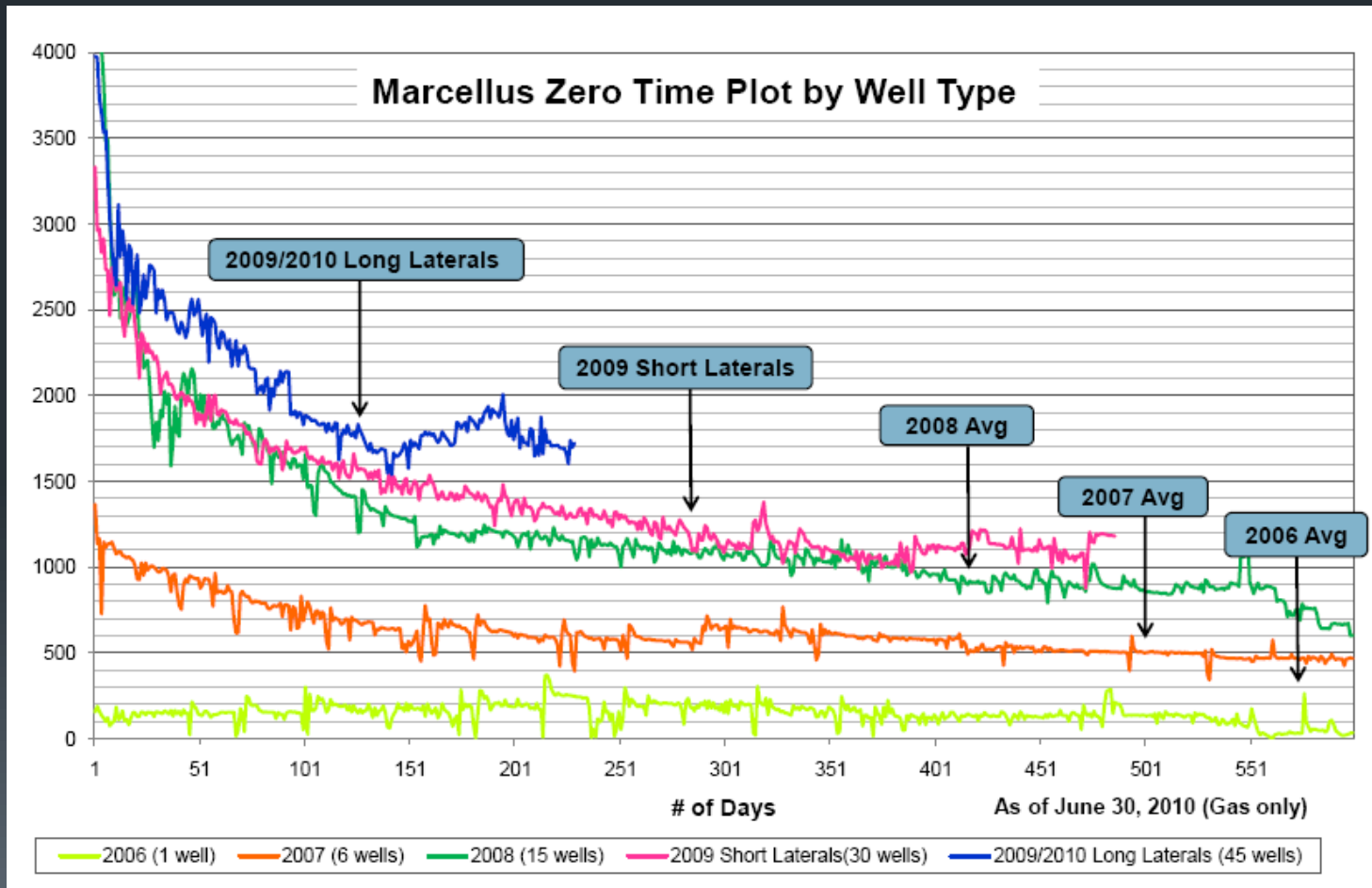
- TRR estimates from EIA increase significantly year-on-year as a result of:
  - Improved technology
  - Drilling proved resources
  - Productivity increased with advent of horizontal drilling, later wells, etc.
- Price

**AEO Shale Gas Resources**



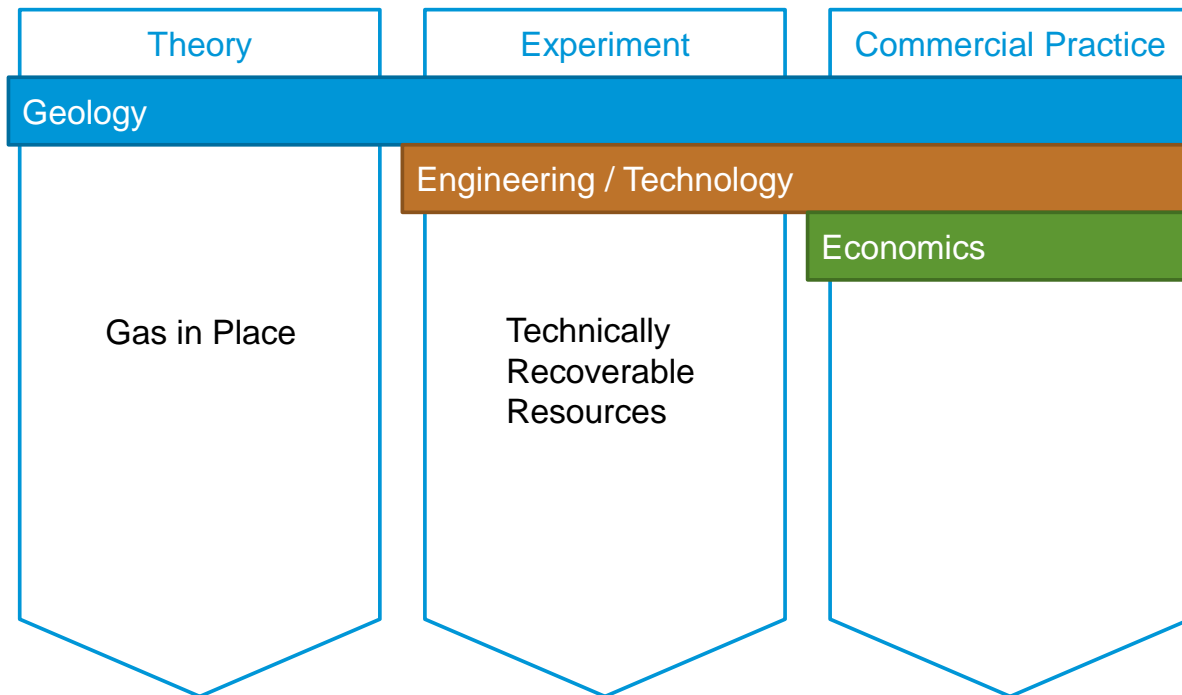
# Recoverability and Technology- Better Results with Time and Experience

## Marcellus Well Results – Range Resources



# Estimates

Technically recoverable resources are dynamic and reflect changing understanding of geology, technology and economics





# Estimates: Apples and Oranges

- It's hard to compare the estimates by different agencies, because they use different measurements/baselines
  - EIA estimates TRR
  - USGS estimates undiscovered resources and based on unweighted historical data
  - Commercial estimates project based on current technology
- Drilling results impact estimates
- Cost-effectiveness, market price and other economic factors may be a better gauge of viability than changing geological estimates

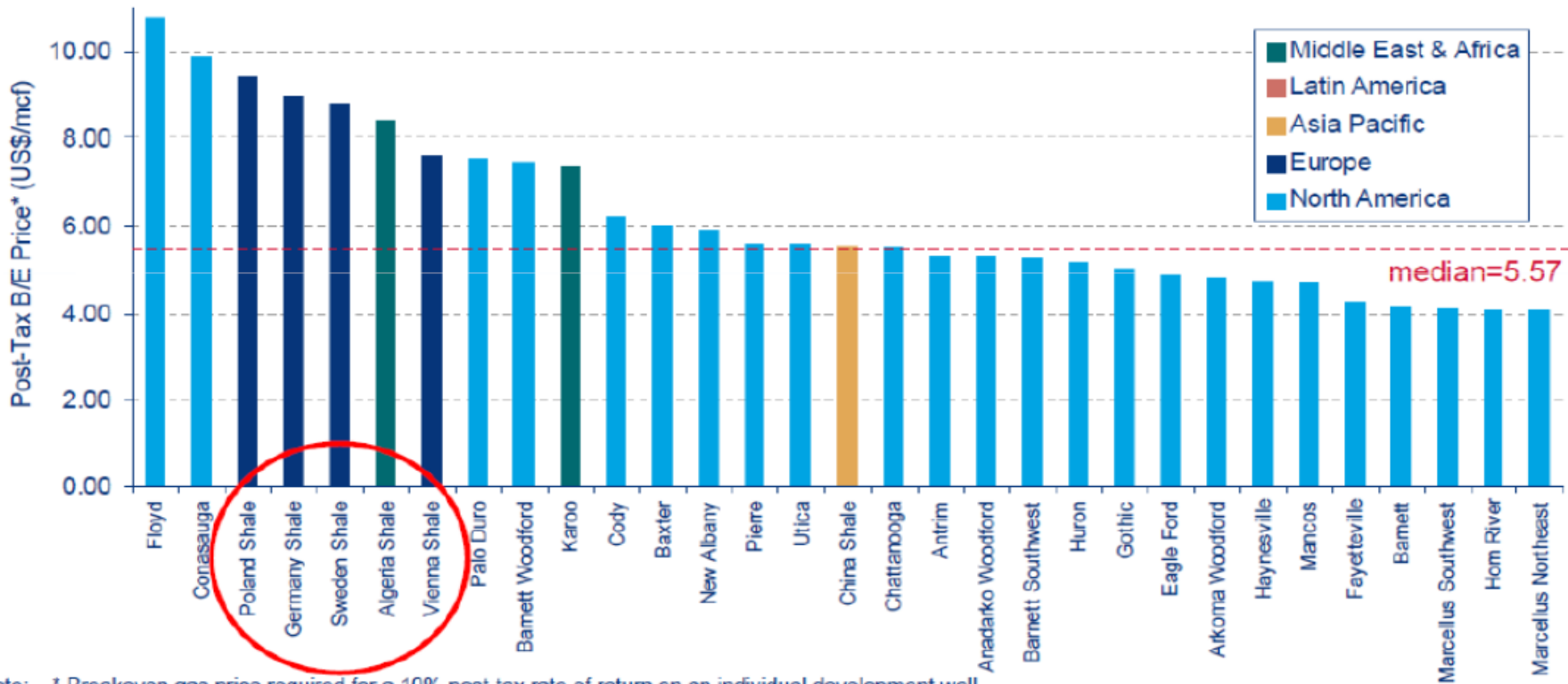
# Polish Example

- EIA/ARI estimate: TRR 187 tcf (April 2011)
  - 5.3 tcm
- 2012 Polish Geological Institute Study: between 12.2 tcf and 27.1 tcf
  - 346 bcm and 768 bcm
- USGS: 1,345 bcf (July 2012)
  - 38 bcm
- These estimates were made from wells drilled in the 1960s and 1970s, not shale gas wells of past 2 years



# Economically Recoverable

**Figure 20: Unconventional Gas Pre-Tax Breakeven**



Note: \* Breakeven gas price required for a 10% post-tax rate of return on an individual development well  
Source: Wood Mackenzie Unconventional Gas Service



# Conclusions

- Plenty of demand potential
- Supply estimates will change based on geology, technology, policy and politics
- Ability of any nation to compete depends on social acceptance, framework, geology, and global market conditions
- Two of the three factors can be impacted by policy