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# Perspectives On the Unconventional Revolution in North American Natural Gas

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# Unconventional Gas Considerations

- Game changer in North American natural gas resources & supplies
- Quadruple Whammy!
  - Surge in North American unconventional gas supplies
  - Surge in global LNG supplies
  - Worst recession since WWII: slump in global industrial gas demand
  - Clean energy mandates biased to renewables
- Energy security and clean energy implications
- Realign portfolios to new gas market factors



# Market Factors

- U.S./Can GDP - 3.5% 2009, +1.4% 2010
- World GDP - 2.5% 2009, +1.8% 2010
- World energy demand - 2.0% 2009
- U.S. gas demand - 3.3% (- 2.1 Bcfd) 2009
- U.S. gas rigs - 56% (710 – 09/25/09)
- Canada gas rigs - 85% (87 – 09/25/09)
- World LNG liquefaction + 29% (+ 6.8 Bcfd 2009-2010)
- U.S. LNG capacity ~15.5 Bcfd (2010)
- U.S. LNG Imports ~ 0.9 - 2.1 Bcfd (2009)
- U.S. gas price \$3.30 Mcf (HH Sep 2009)

# US Natural Gas Spot Price 1989 – 2009 (April)



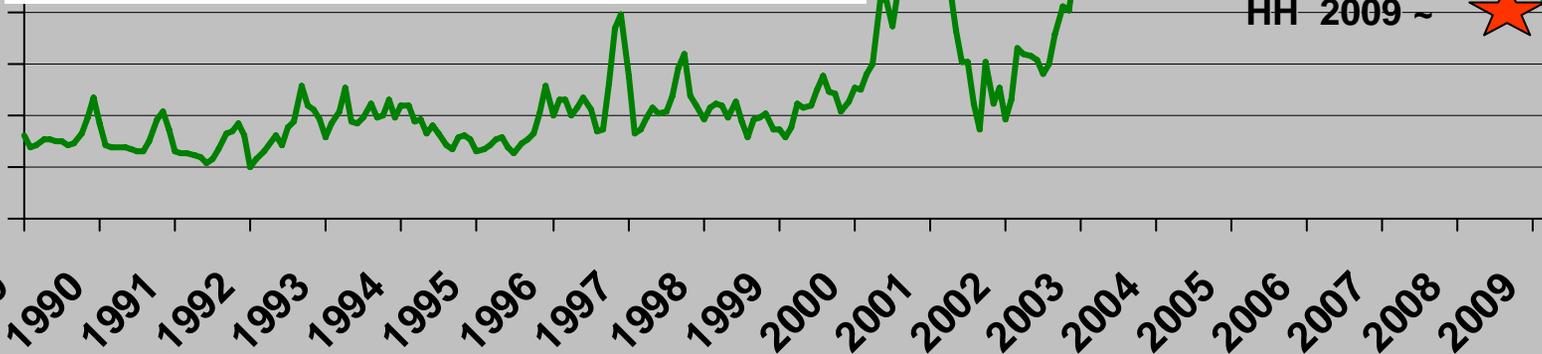
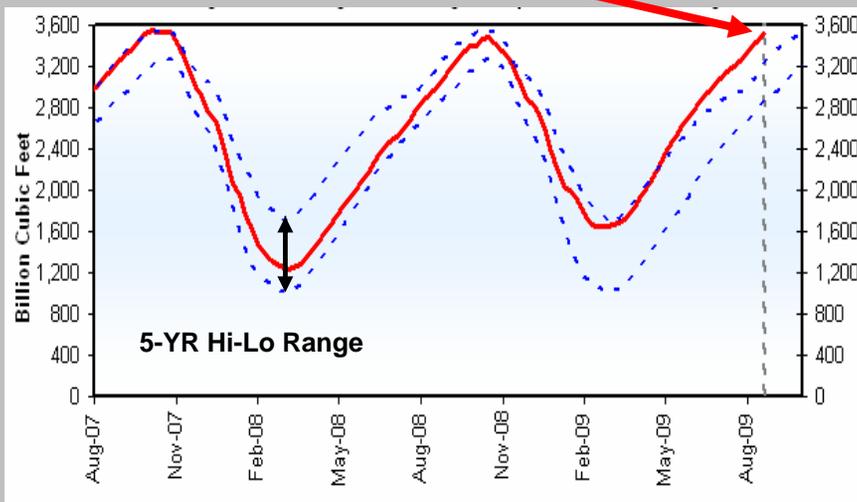
**Record 3,800 Bcf October 2009?**

**US Gas Storage**

**091809**

**Storage 09/18/09 = 3,525 Bcf  
+ 16% vs 5-YR average**

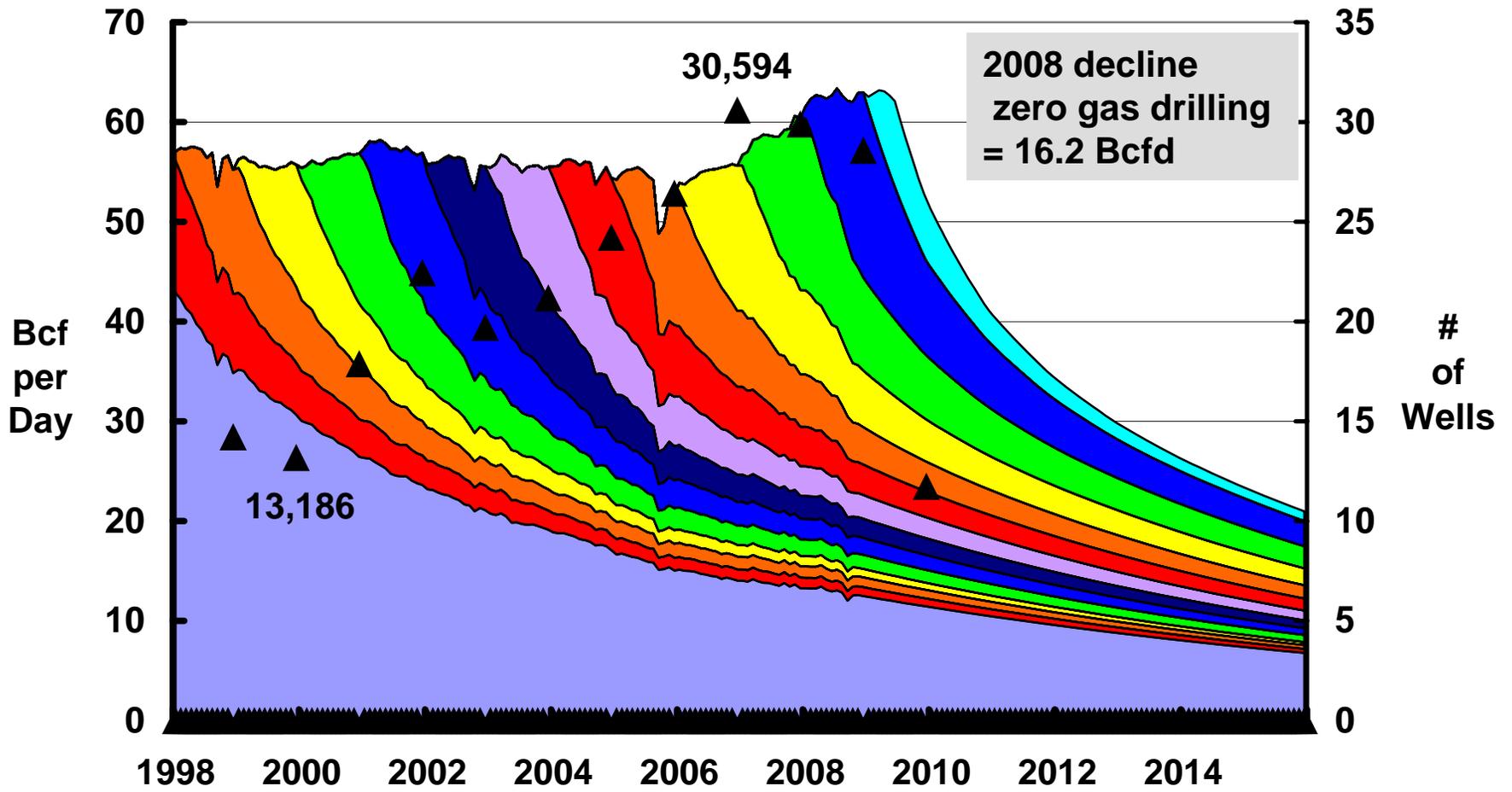
\$13.00  
\$12.00  
\$11.00  
\$10.00  
\$9.00  
\$8.00  
\$7.00  
\$6.00  
\$5.00  
\$4.00  
\$3.00  
\$2.00  
\$1.00  
\$0.00





# U.S. Vintaged Gas Production

## 2007: Transformation to the Shale Gas Era

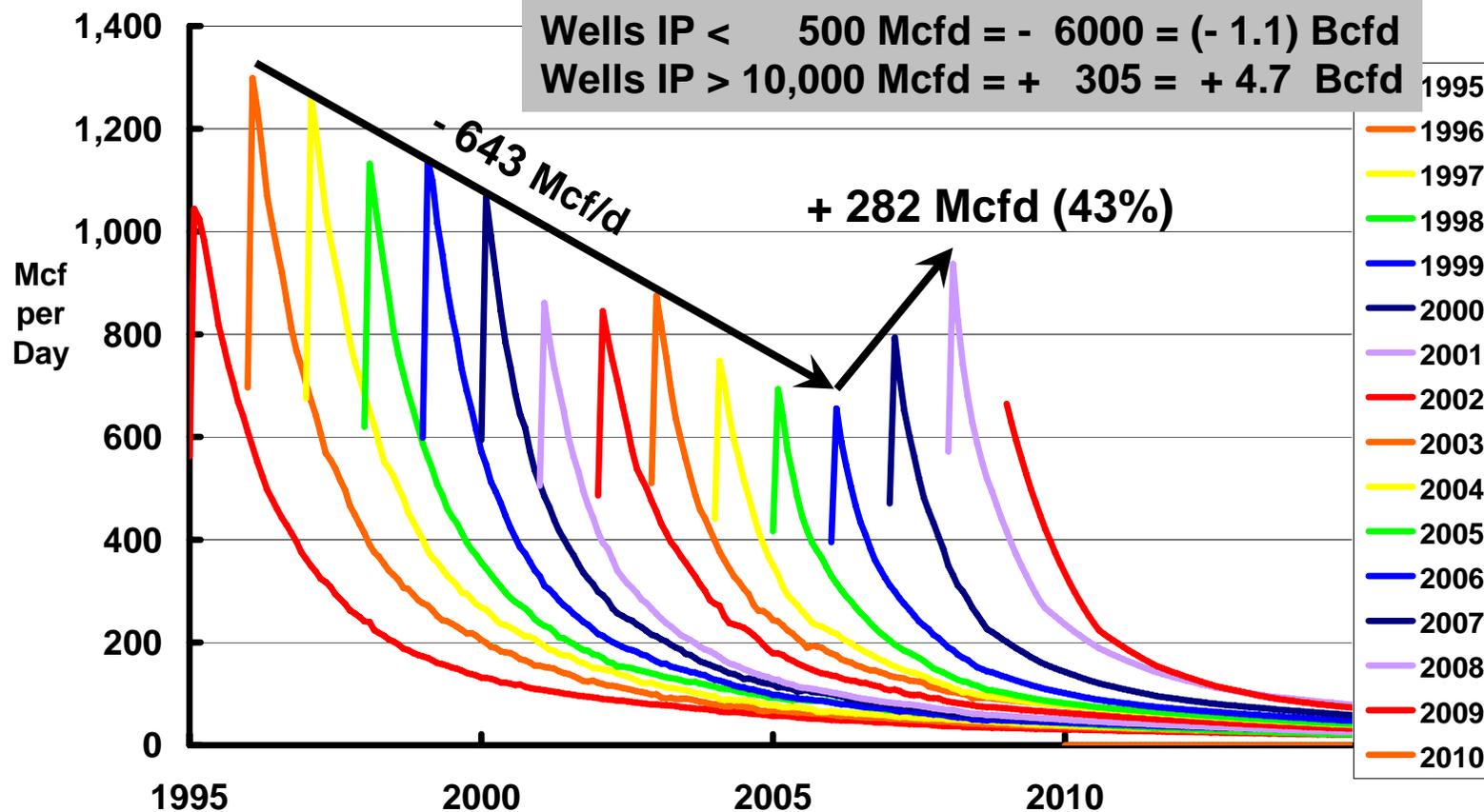


# Reversing the Trend

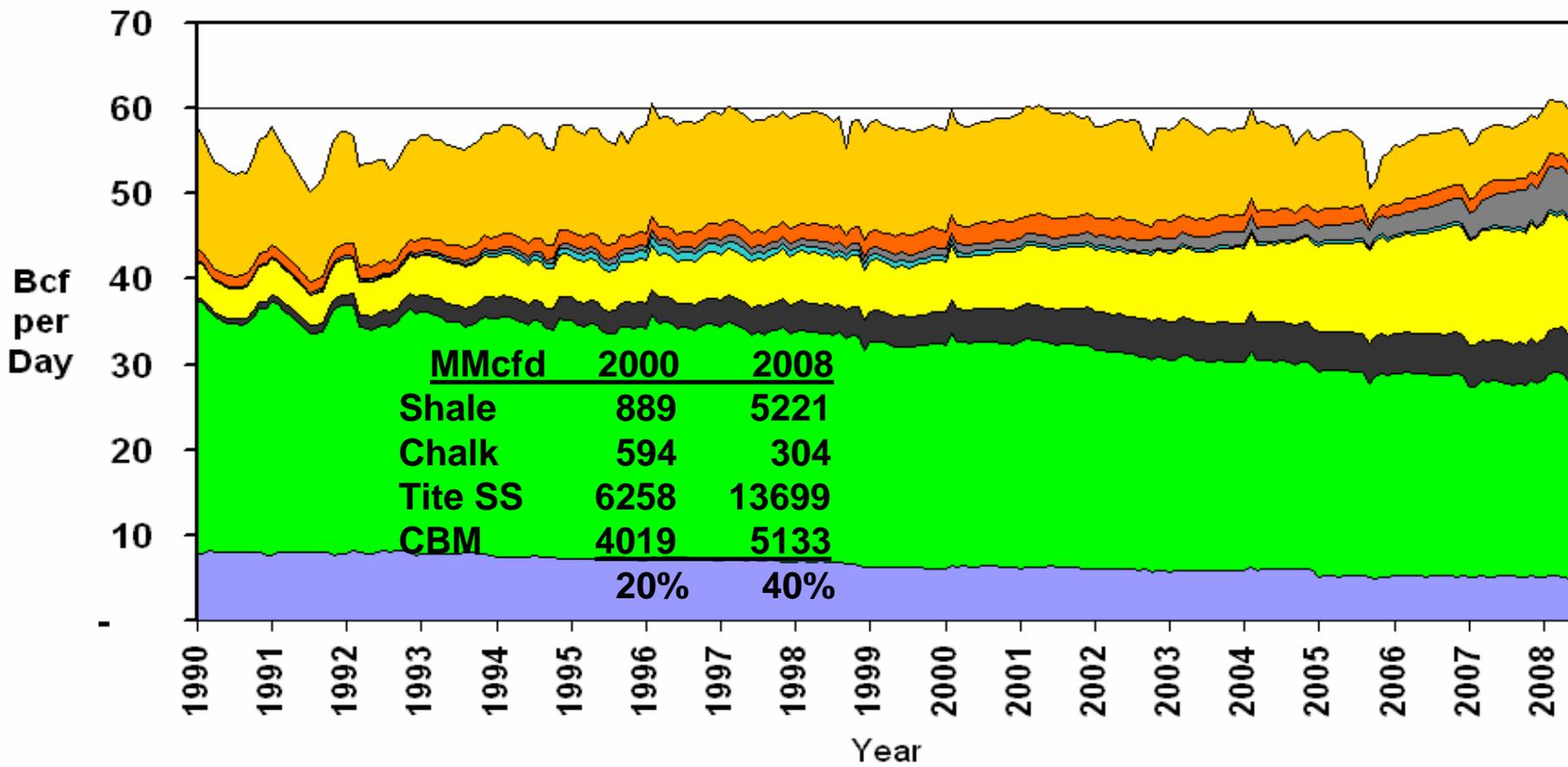
## U.S. Average Annual Well Productivity



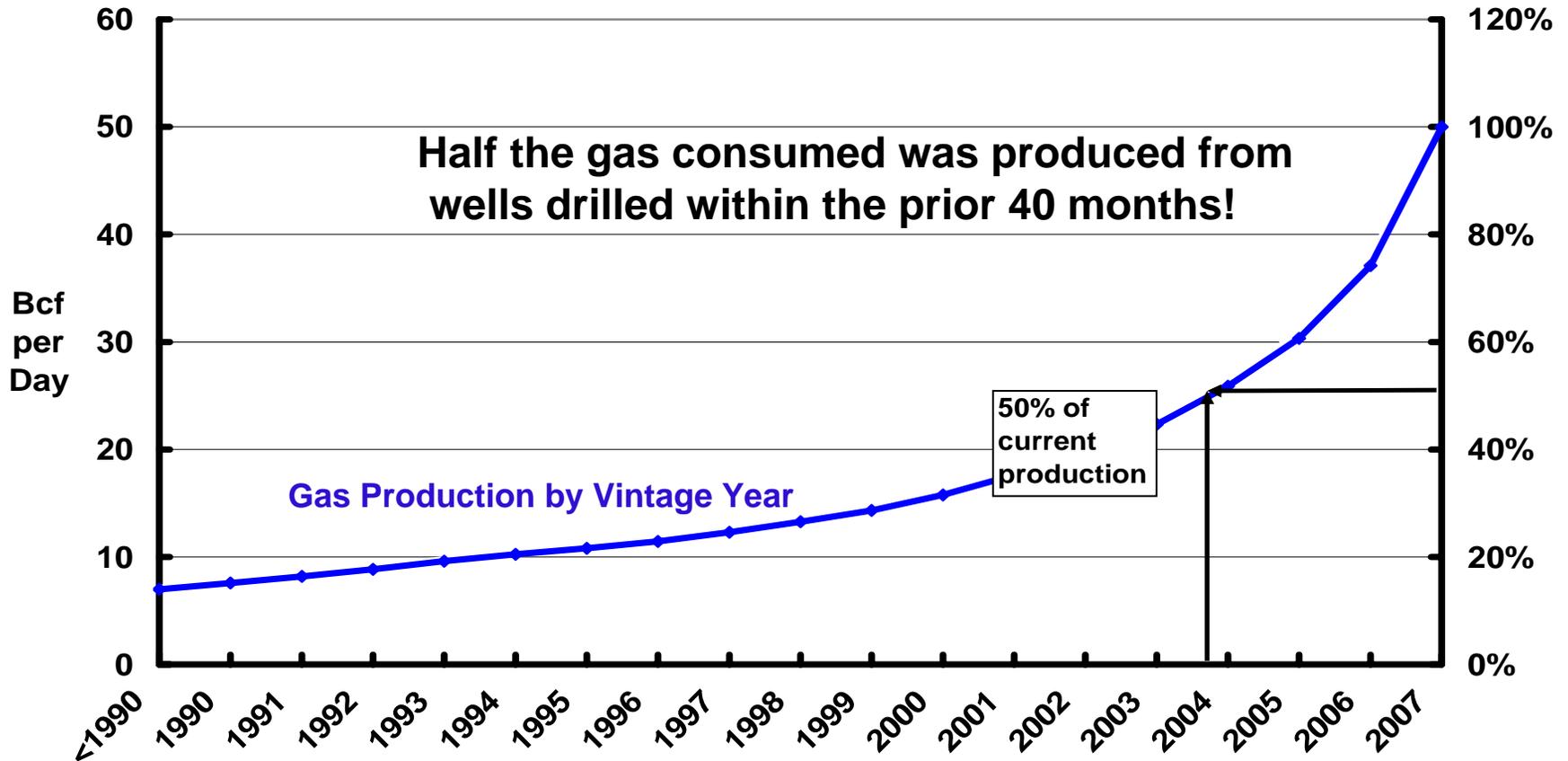
US Gas rigs down 878 -56% 9/25/09  
 2007 - 2009  
 Wells IP < 500 Mcfd = - 6000 = (- 1.1) Bcfd  
 Wells IP > 10,000 Mcfd = + 305 = + 4.7 Bcfd



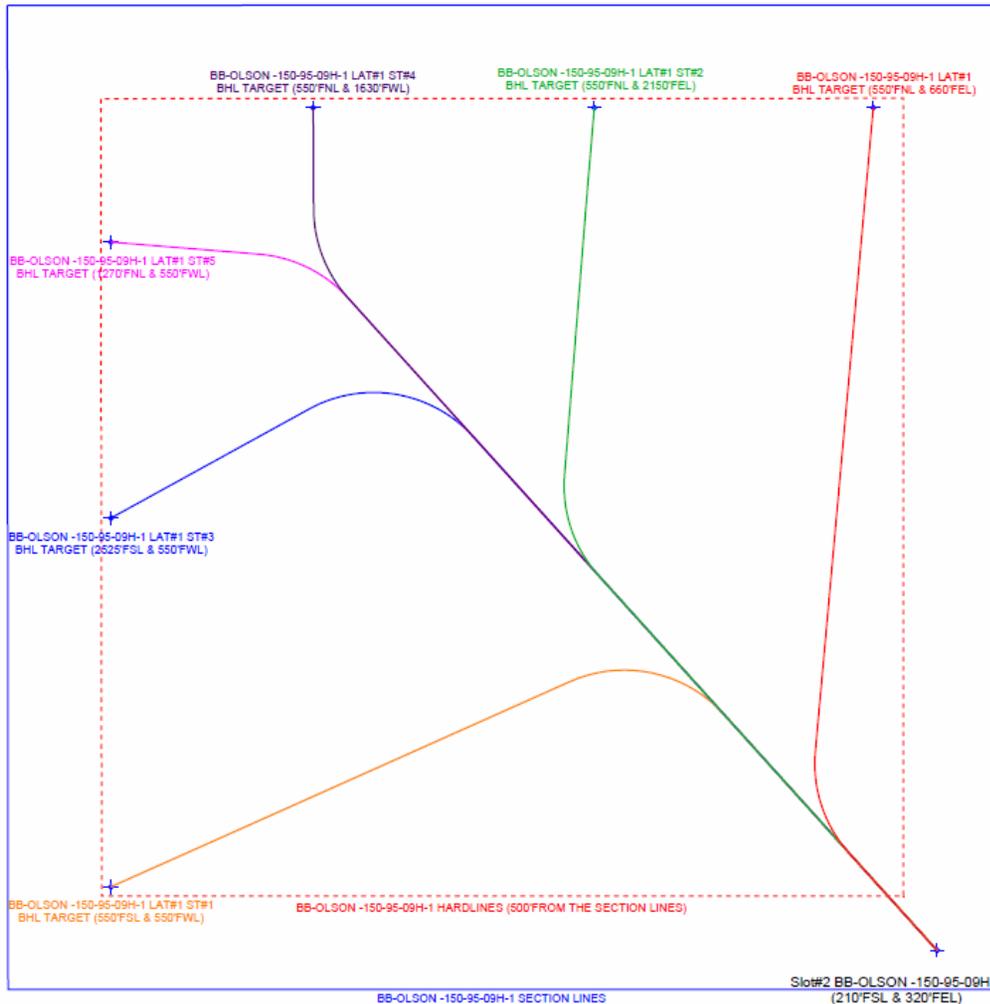
# U.S. Daily Gas Production by Type



# US Vintaged Daily Gas Production Contribution to December 2007 Volume



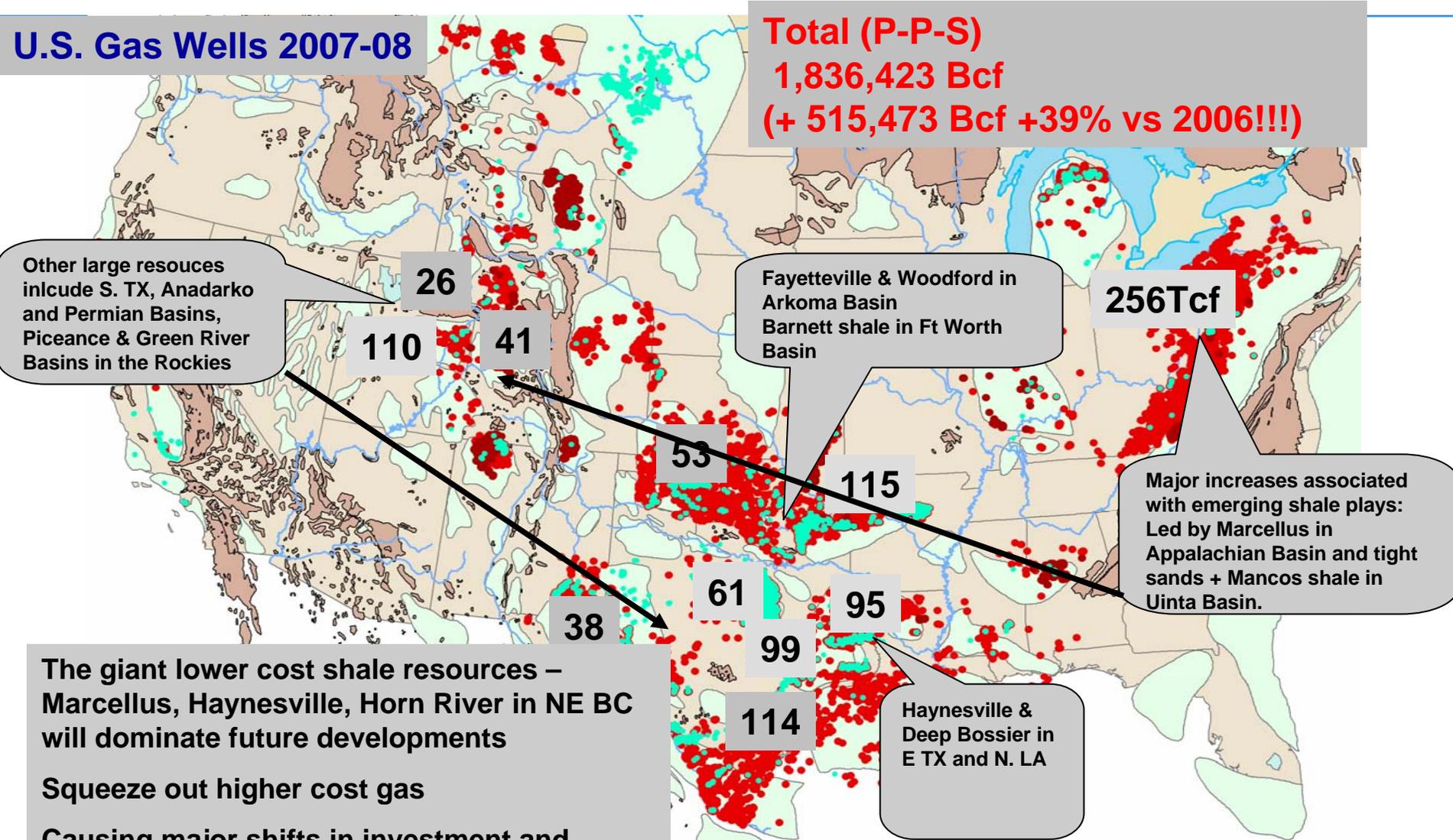
# Multilateral Horizontal Wells Drilling From Pads



**Critical to capture borehole geometry, coring, testing and treatment operations**

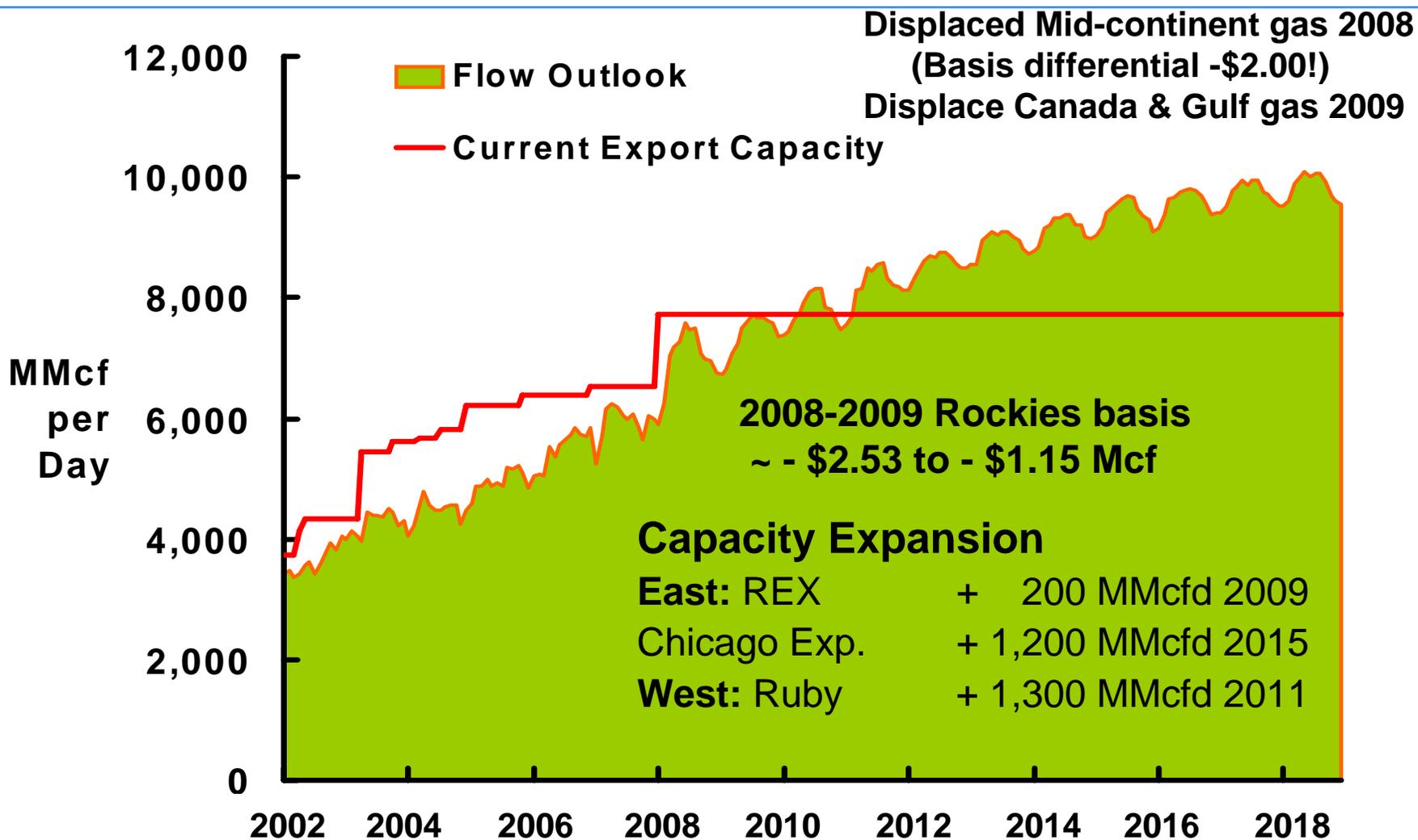
# Potential Gas Committee

## U.S. Gas Resources End-2008

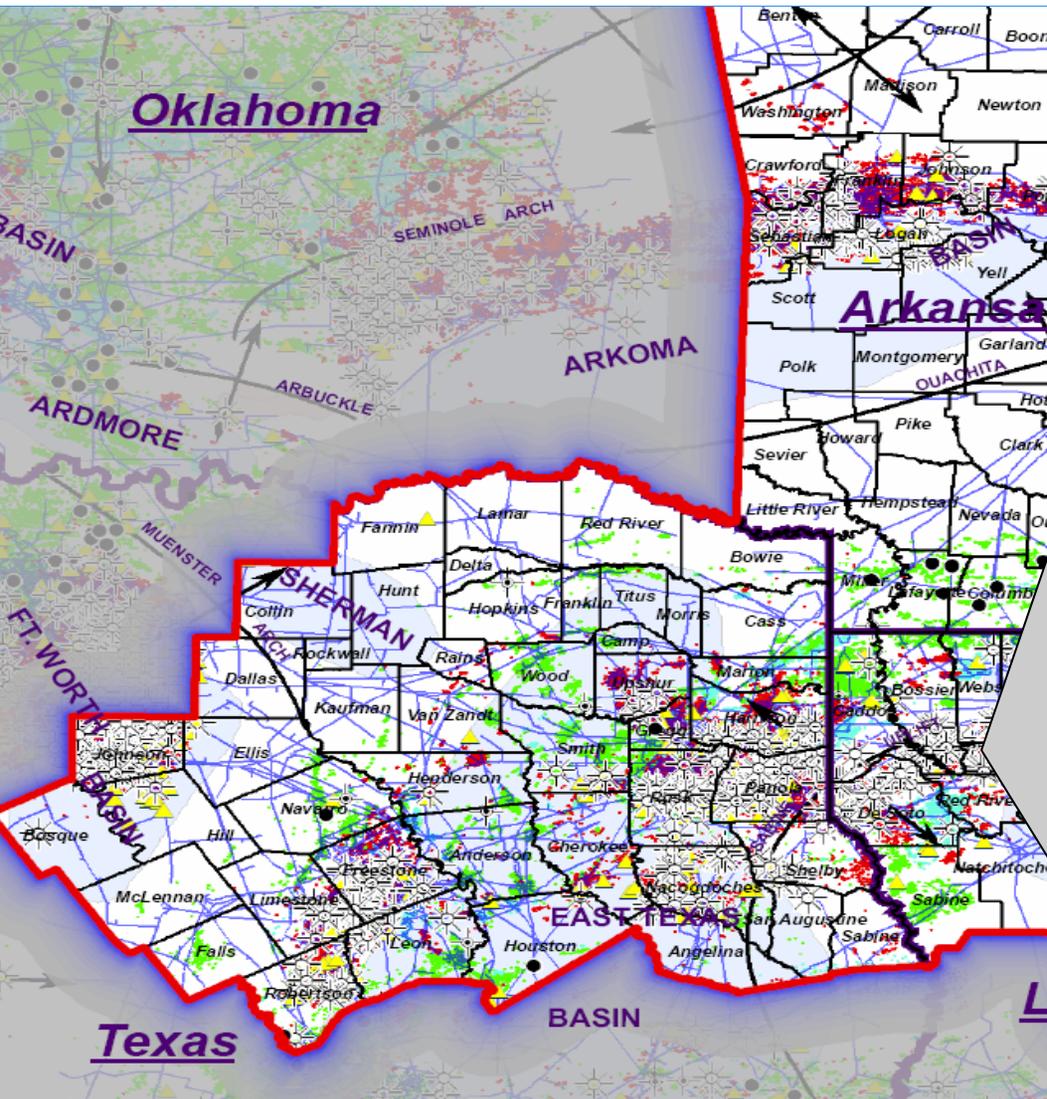


# Rebalance Supplies & Markets

## Rockies East Flows and REX Pipeline



# Southeast Ark La Tex



Haynesville Shale Recession Proof  
Almost 100 rigs drilling  
Lease protection  
250 Tcf potential reserves????

Chesapeake most active driller in the play  
with 29 rigs  
Expect to produce 275 mmcfe net per day by  
end 2009.  
Estimated average yield per well is 6.5 bcfe

Currently holds more than 510,000 net acres  
of leasehold in the play—largest leaseholder  
Lease sale bonuses fall 95% from record

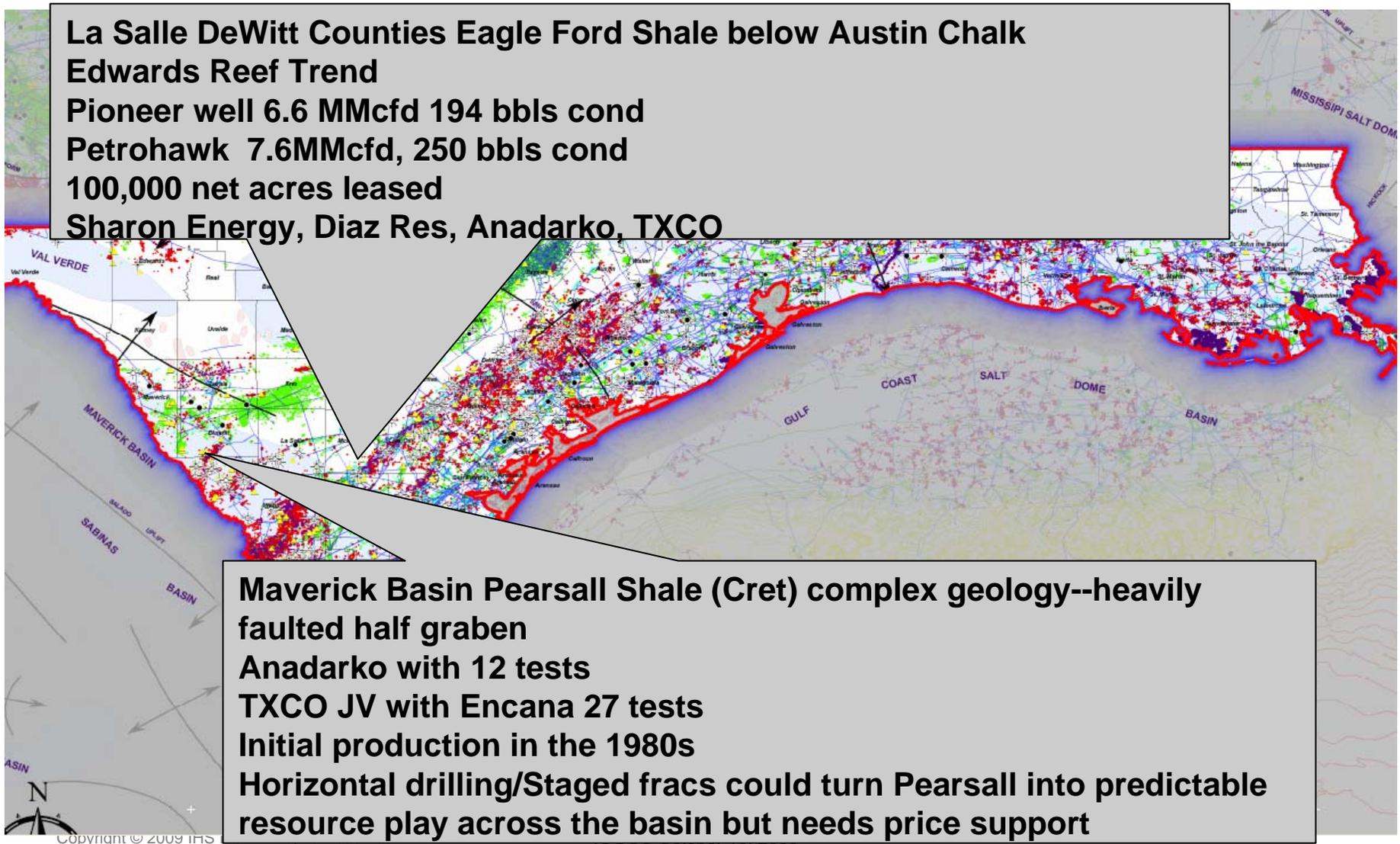
Recent PetroHawk IPs 9.6 to 16.3Mmcf/d in LA  
and E TX  
Questar's 1<sup>st</sup> well Red River Parish IP  
16MMcf/d

**PARTNER UP!** Chesapeake leverages finding  
costs below \$1.00/mcf through joint ventures  
with PXP

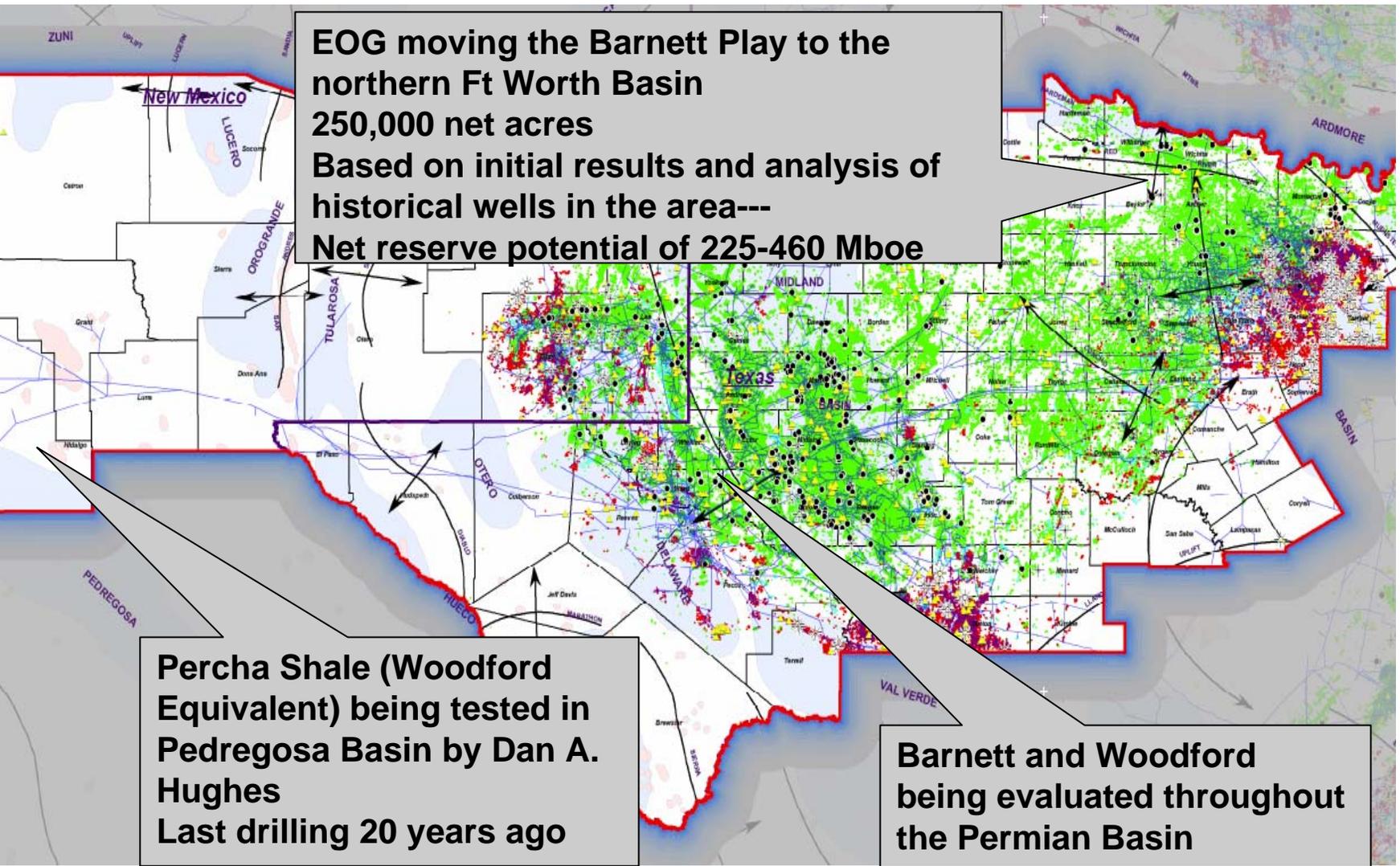
# Gulf Coast

**La Salle DeWitt Counties Eagle Ford Shale below Austin Chalk  
Edwards Reef Trend  
Pioneer well 6.6 MMcfd 194 bbls cond  
Petrohawk 7.6MMcfd, 250 bbls cond  
100,000 net acres leased  
Sharon Energy, Diaz Res, Anadarko, TXCO**

**Maverick Basin Pearsall Shale (Cret) complex geology--heavily faulted half graben  
Anadarko with 12 tests  
TXCO JV with Encana 27 tests  
Initial production in the 1980s  
Horizontal drilling/Staged fracs could turn Pearsall into predictable resource play across the basin but needs price support**



# SE New Mexico/West Texas



**EOG moving the Barnett Play to the northern Ft Worth Basin**  
**250,000 net acres**  
**Based on initial results and analysis of historical wells in the area---**  
**Net reserve potential of 225-460 Mboe**

**Percha Shale (Woodford Equivalent) being tested in Pedregosa Basin by Dan A. Hughes**  
**Last drilling 20 years ago**

**Barnett and Woodford being evaluated throughout the Permian Basin**



# Arkoma

Fayetteville Shale only “brand new” play in the Mid-continent in years—needs gathering system infrastructure

Southwestern Energy (SEECO) biggest leaseholder with 900,000 acres

Laterals over 3,000ft, multi-well pads,

IPs >5 MMcfd

Currently drilling with 8 rigs

SEECO asks for 183,000-acre Ozark Highlands Unit

Conway, Johnson, Pope and Van Buren counties

Entirely within Ozark National Forest

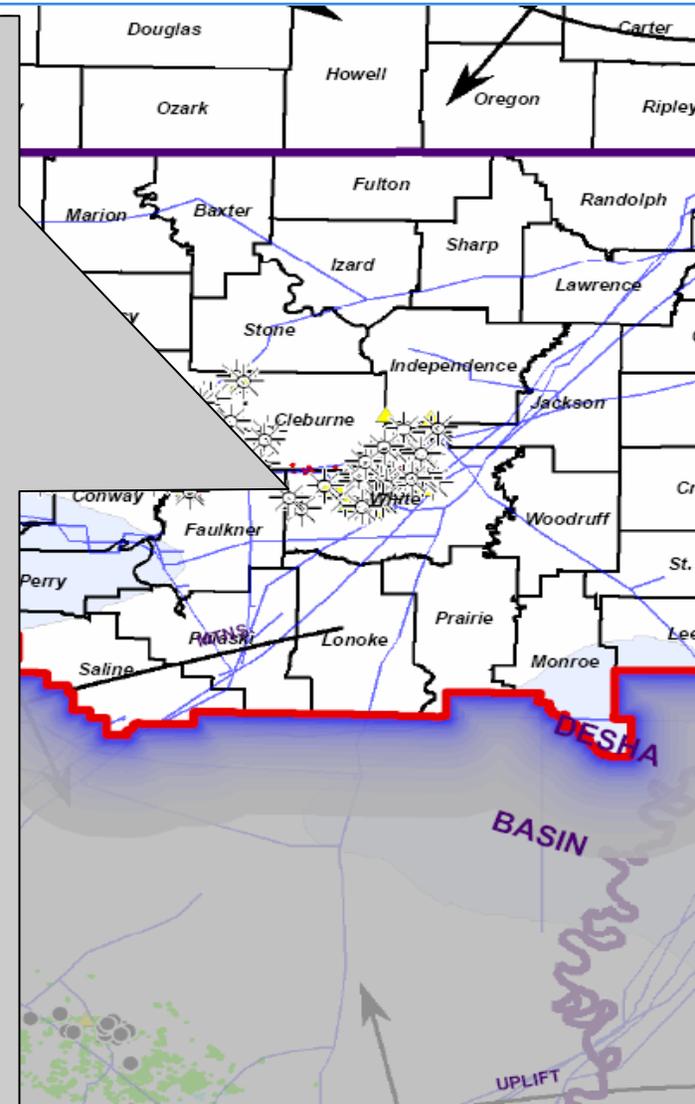
SEECO reported gross operated production from

Fayetteville shale play area last fall exceeded 300 MMcfd,

up from 84 MMcfd the year before

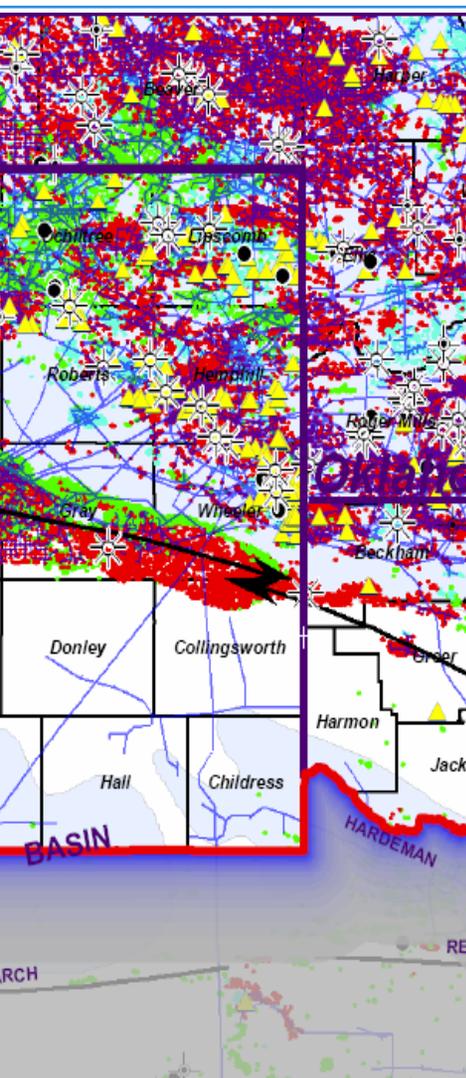
Chesapeake has 16 rigs drilling on its 420,000 acres at the play’s core

Others: XTO, PetroHawk





# Oklahoma Woodford East

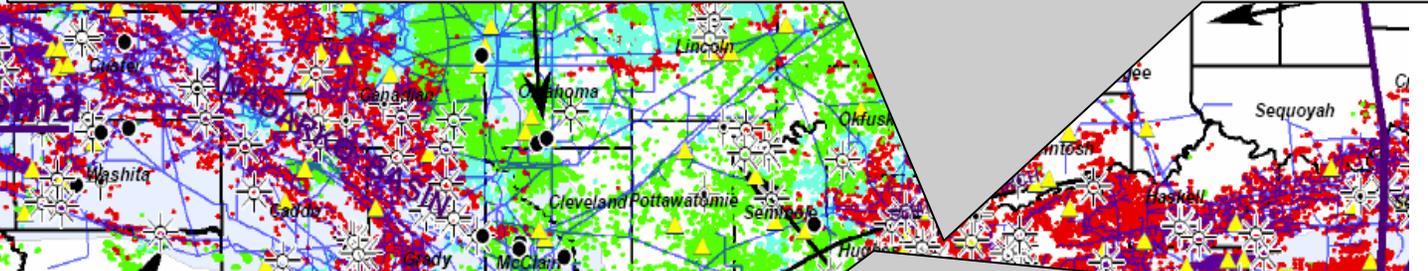


**Newfield high volume producers in extended lateral drilling--one well at 12 MMcfed**

**Study of longer term production from nearly 100 horizontal Woodford wells est avg ultimate recovery per frac stage at 600 MMcfe**

**Company's net daily production >165MMcfgd**

**Newfield curtails some gas production until prices rebound**



**Continental Resources also active Hughes Cty**

**3 Woodford horizontal wells—two part of simultaneous frac pilot program**

**IPs 6.2 to 7.2 MMcfd after frac**

**More two-well simultaneous fracs planned**







# Texas Panhandle Western Oklahoma



**Chesapeake Colony Granite Wash play wells flowing 5-10 MMcfg with cond**  
**Proved reserves of 316 Bcfe Average 5.7 Bcfe per well**  
**Expects to drill 50 wells by end of 2010**  
**Company says play is its highest rate of return thanks high oil and natural gas liquids content**

**Des Moines Granite Wash Horizontal Play**  
**Depths from 10,000-15,000ft**  
**Began in Buffalo Wallow Field, Hemphill county**  
**3,000-4,000ft laterals**

**Wheeler County's Stiles Ranch and Britt Ranch fields are in the "heart" of play**

**Newfield in Wheeler County**  
**Recent Discovery 7H McCoy online flowing 25 MMcfg, 1,900 bbls cond**  
**Other wells area flowing from 8-21 MMcfg with 300-1,200 bbls cond**





# What information is needed by the industry to continue the growth and development of unconventional resources?



- **Tight Gas Sands**

- Pad drilling
- Perf breakdowns, fracs and treatments, all stages, fluids, proppant , pressures, including fracture success/extent
- Production tests before and after treatment stages
- Permeability and porosity
- Core description/analysis

- **Coalbed Methane**

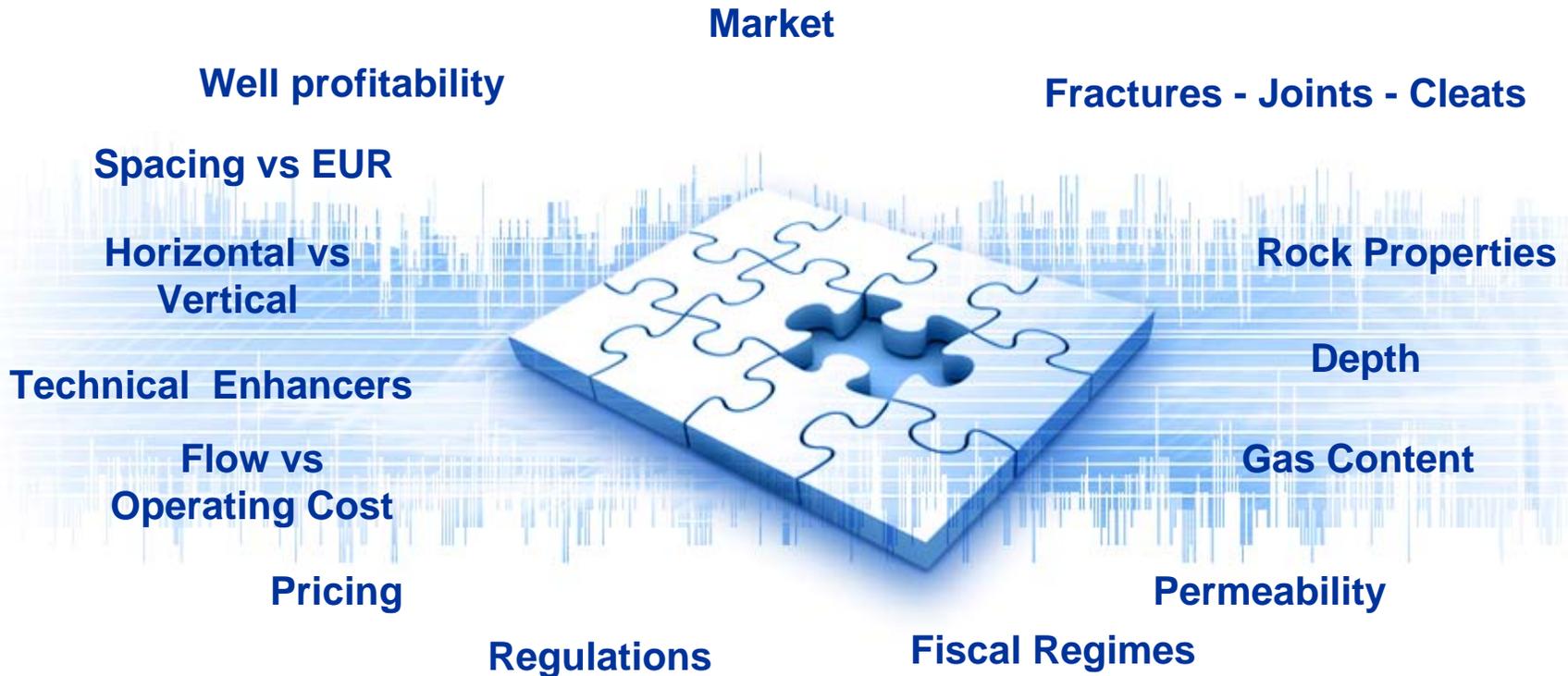
- Coal type
- Water gauges/water disposal
- Barefoot completions
- Cavitation
- Palm/pinnate lateral leg IDs
- Coal Thickness, Grade and Gas

## Content

- **Shale Gas (and oil from Shale)**

- Total Organic Content (TOC) and content percentage
- Thermal maturity/vitrinite reflectance
- Rock properties—e.g. brittleness, permeability/porosity, water saturation
- Kerogen type
- Gas sample analyses, (all from core analysis, any available geochem?)
- Fracture matrices including orientation and density (microseismic mapping)

# The Performance Puzzle Putting it Together



# Take Aways

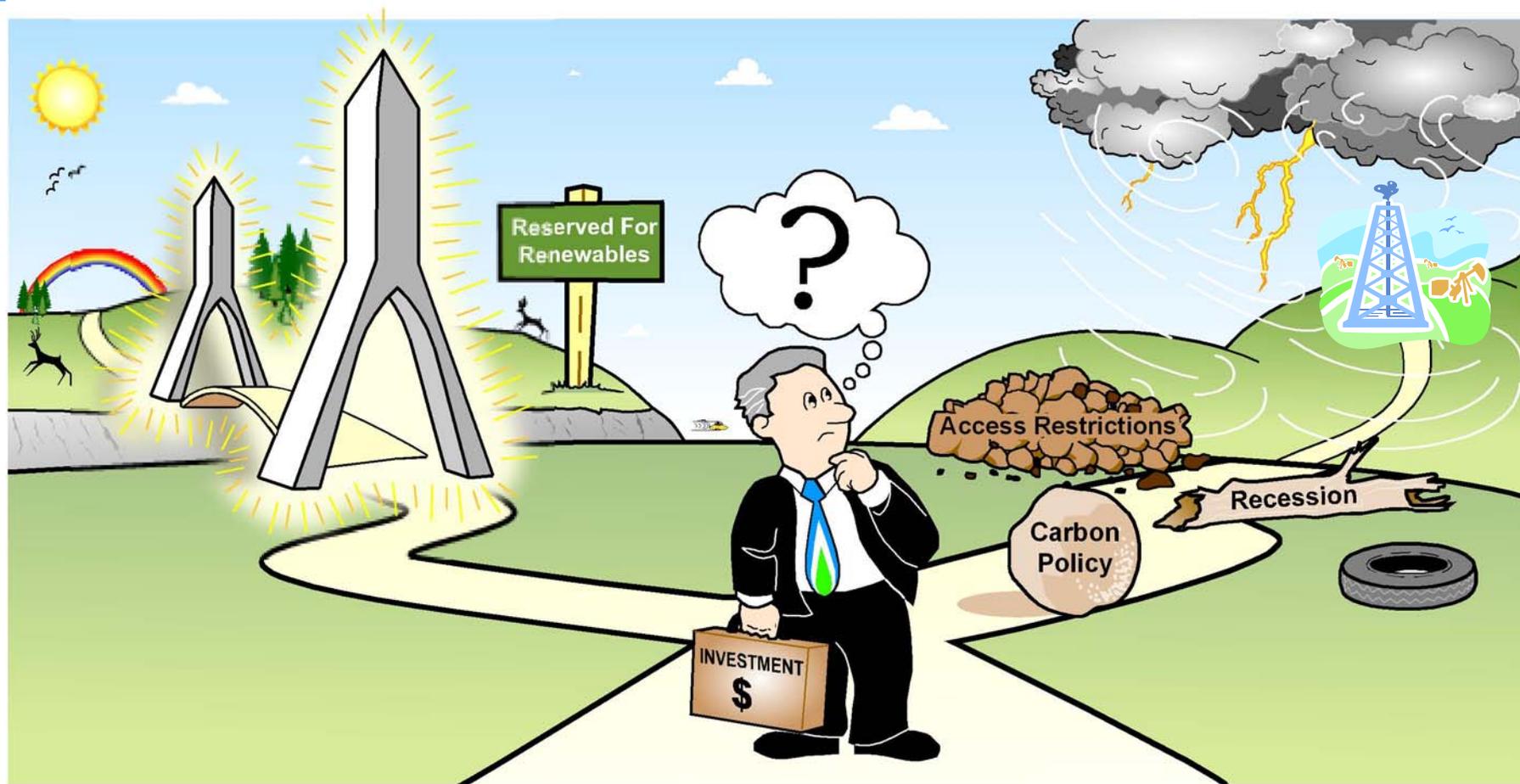
## Revolution in Unconventional Gas



- Huge increase in shale gas resources & potential supplies transforms North American gas
- Shift from decade of tight supplies to era of under-demand.
  - Good news for energy security and consumers
  - Huge opportunity to facilitate transformation to clean energy
- Operators retool portfolios and operations
  - Focus: high productivity, low cost plays with markets (shales are king!)
  - Continuous process, technology & cost improvements
  - Alliances and partners (A&D)
- Market benefits of abundant, clean gas
  - Power generation – replace coal & complement renewables
  - Transportation fuel – CNG in fleets

# Investment and Uncertainty

## What is the Role of Natural Gas in the Energy Future?



Source: IHS Cambridge Energy Research Associates.  
90402-5



# North American Gas Play Performance Analysis Coming Soon!

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303-736-3245



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