

Growing Oil and Gas Production: *The World Turned Upside Down*

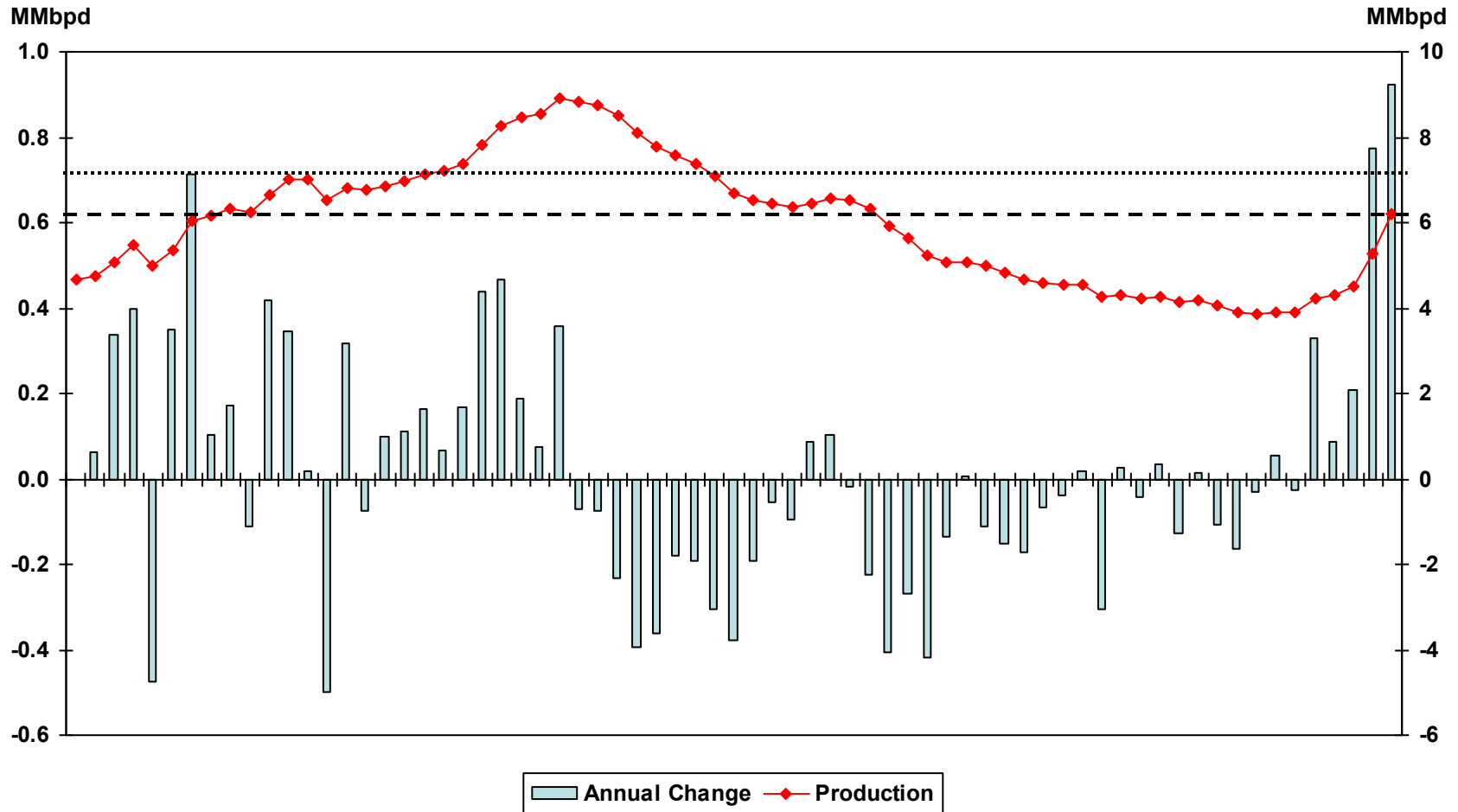
Thomas J. Woods
NCAC Luncheon
September 20, 2013
Washington, DC

**If buttercups buzz' d after bees,...
If ponies rode men and if grass ate the cows,
And cats should be chased into holes by the mouse...
Then all the world would be upside down**

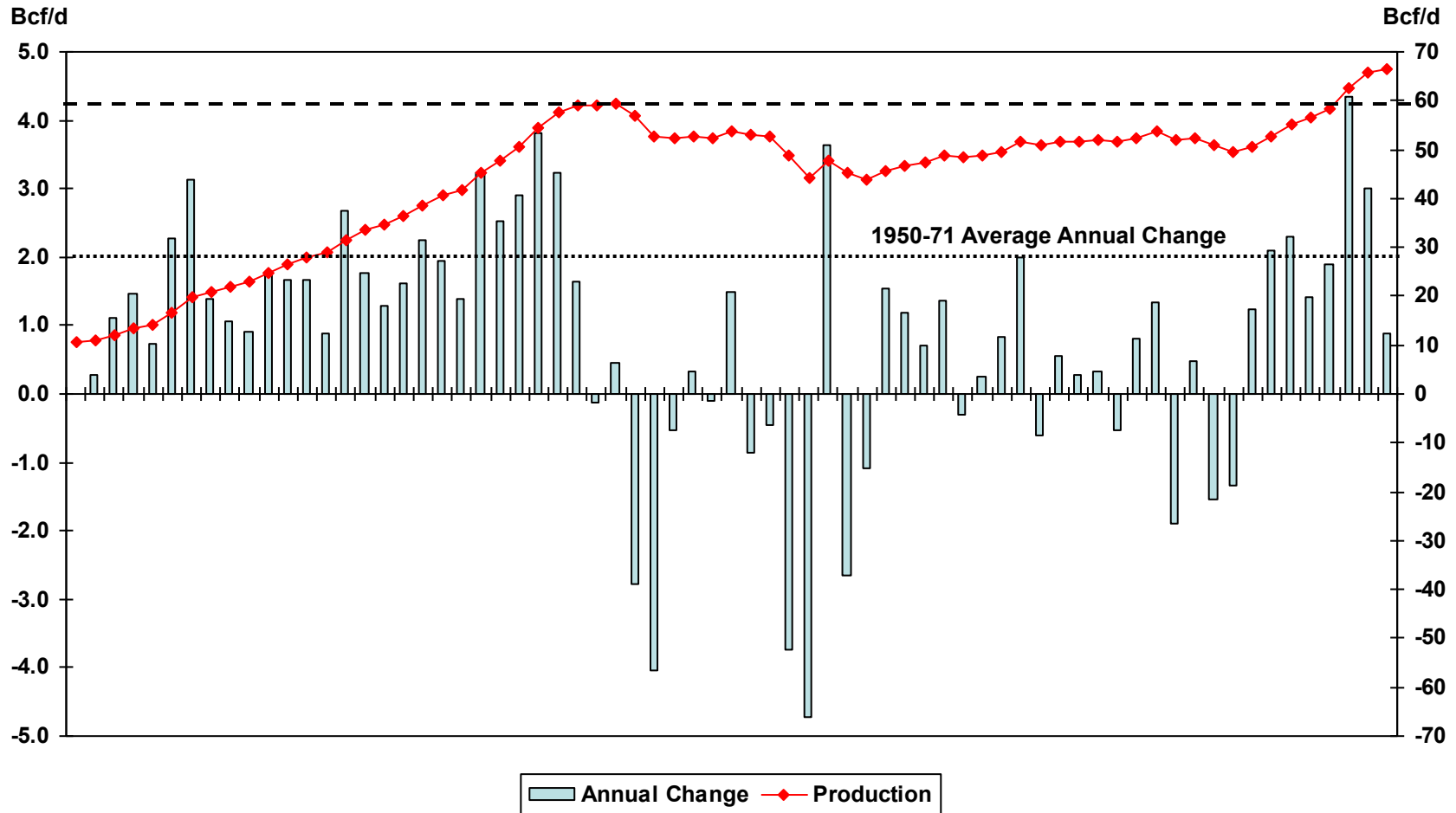
Post-1960s Production Model Factors

- **Declining Production/Depleting Resource**
- **Declining Yields/Increasing “Costs”**
- **Tight Supply/Demand Balance**
- **Finding Supply to Meet Demand**
- **Oil and Gas Prices “Linked”**

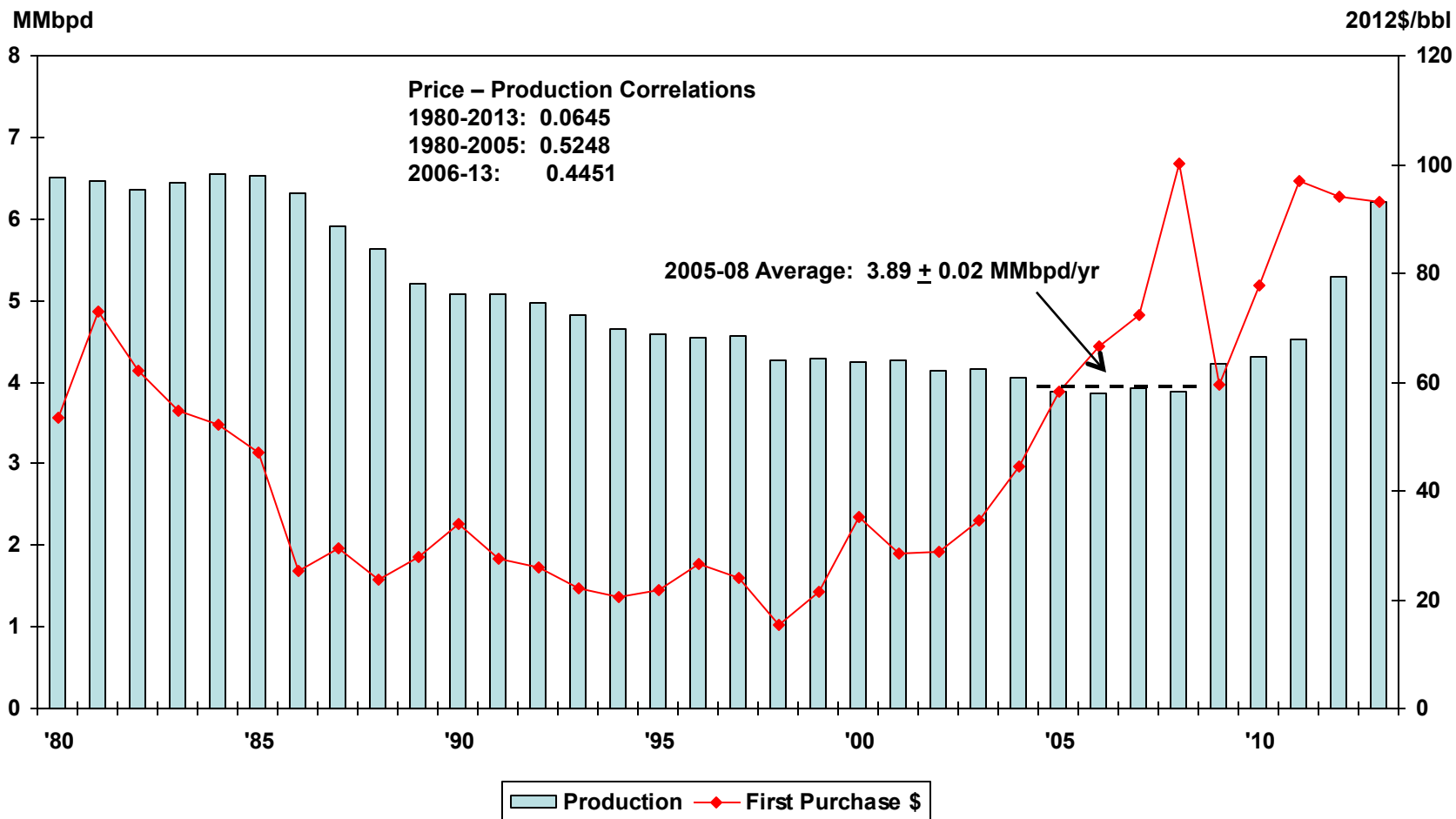
Lower-48 Crude Oil Production Trends 1945-2013



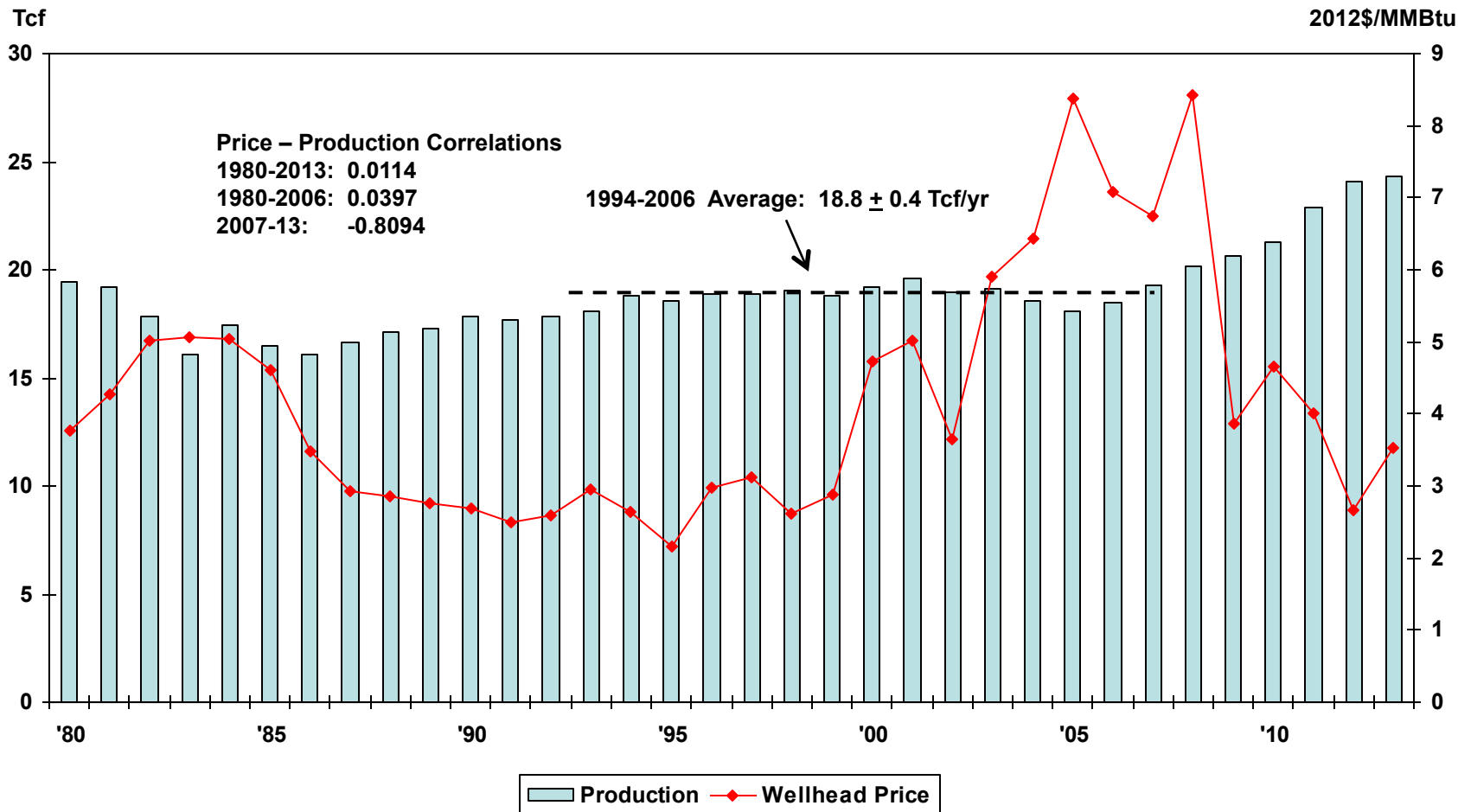
Lower-48 Natural Gas Production Trends 1945-2013



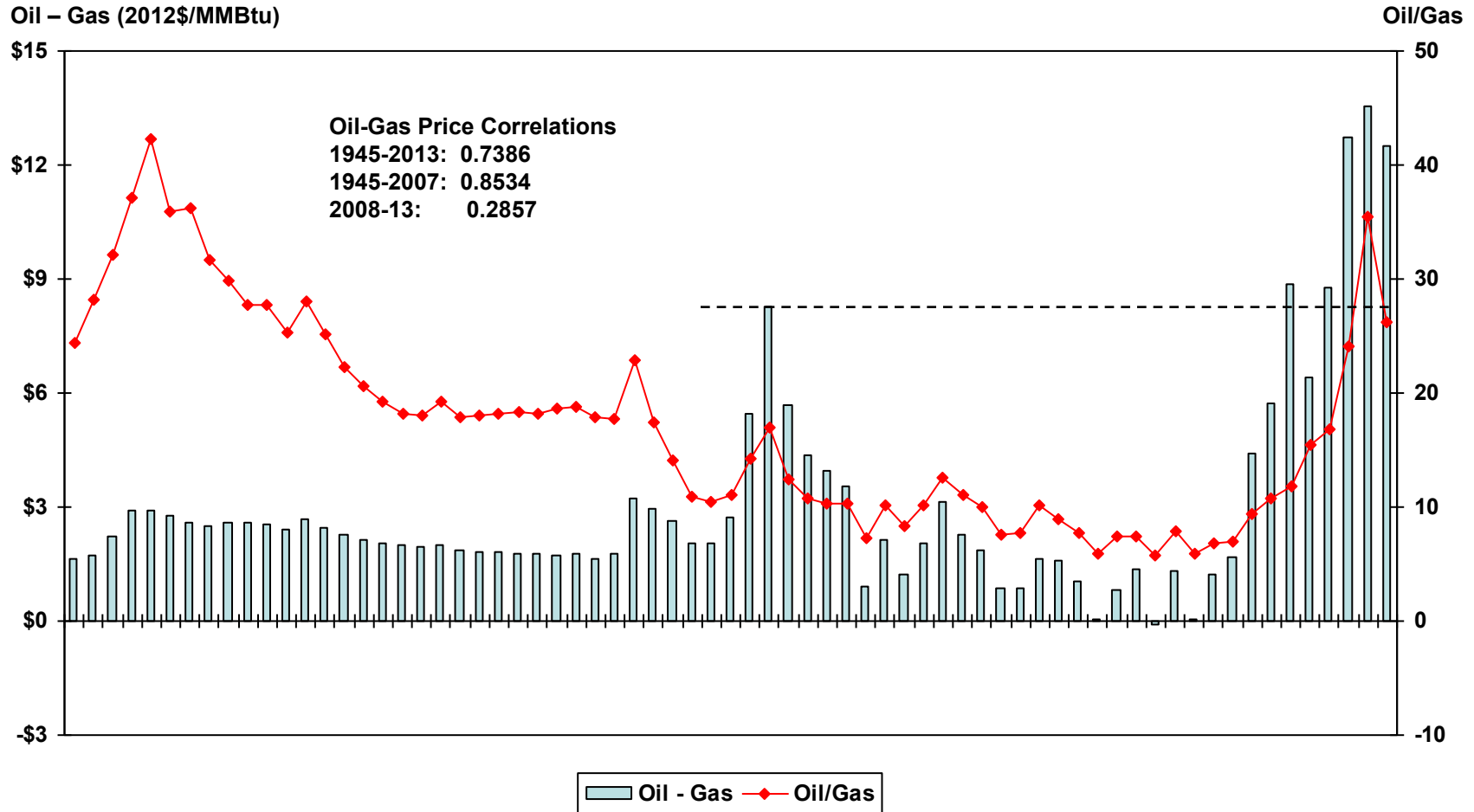
Lower-48 Crude Oil Production vs First Purchase Price



Lower-48 Gas Production vs Wellhead Price



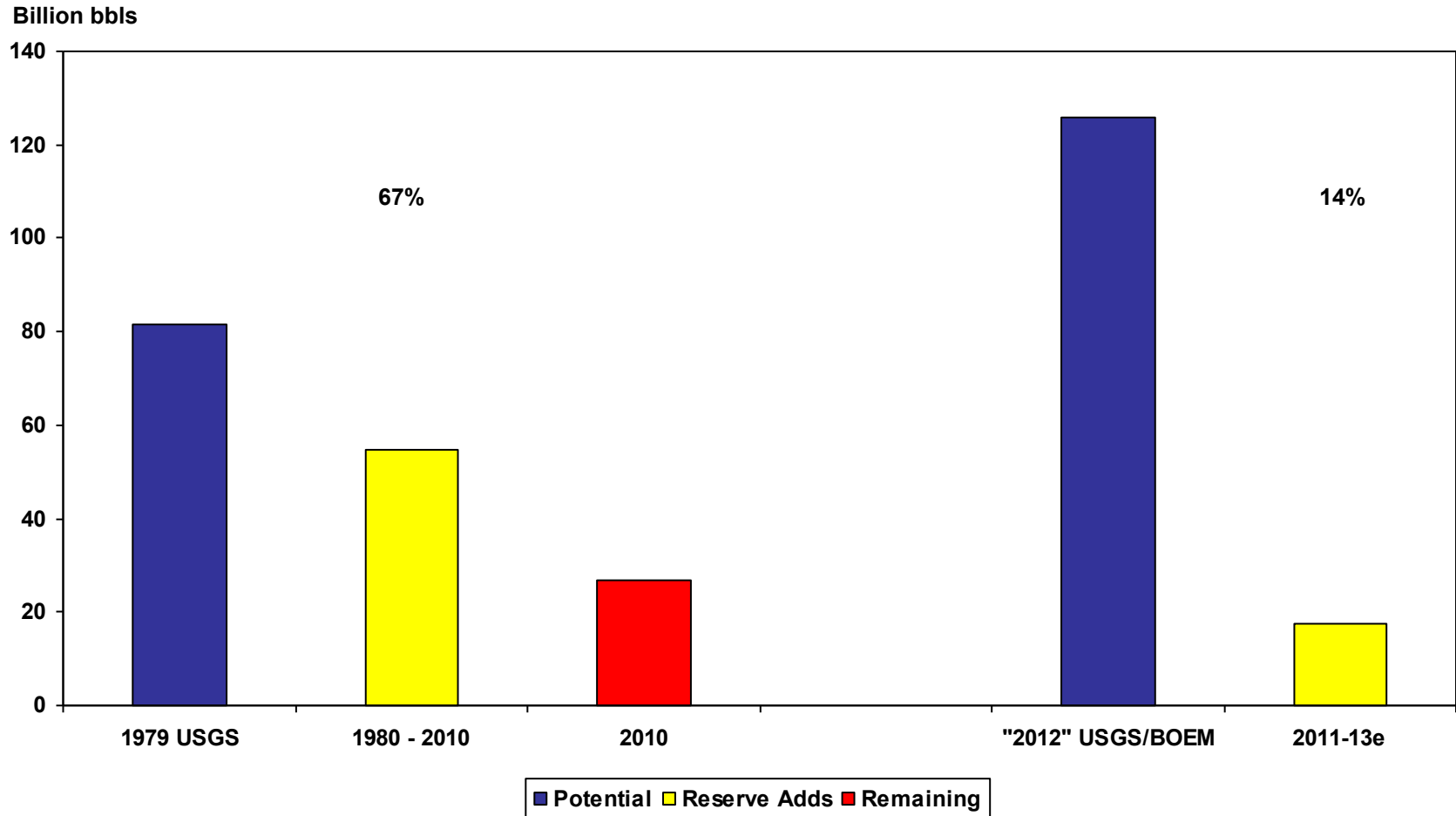
Real Oil and Gas Price Relationships 1945-2013



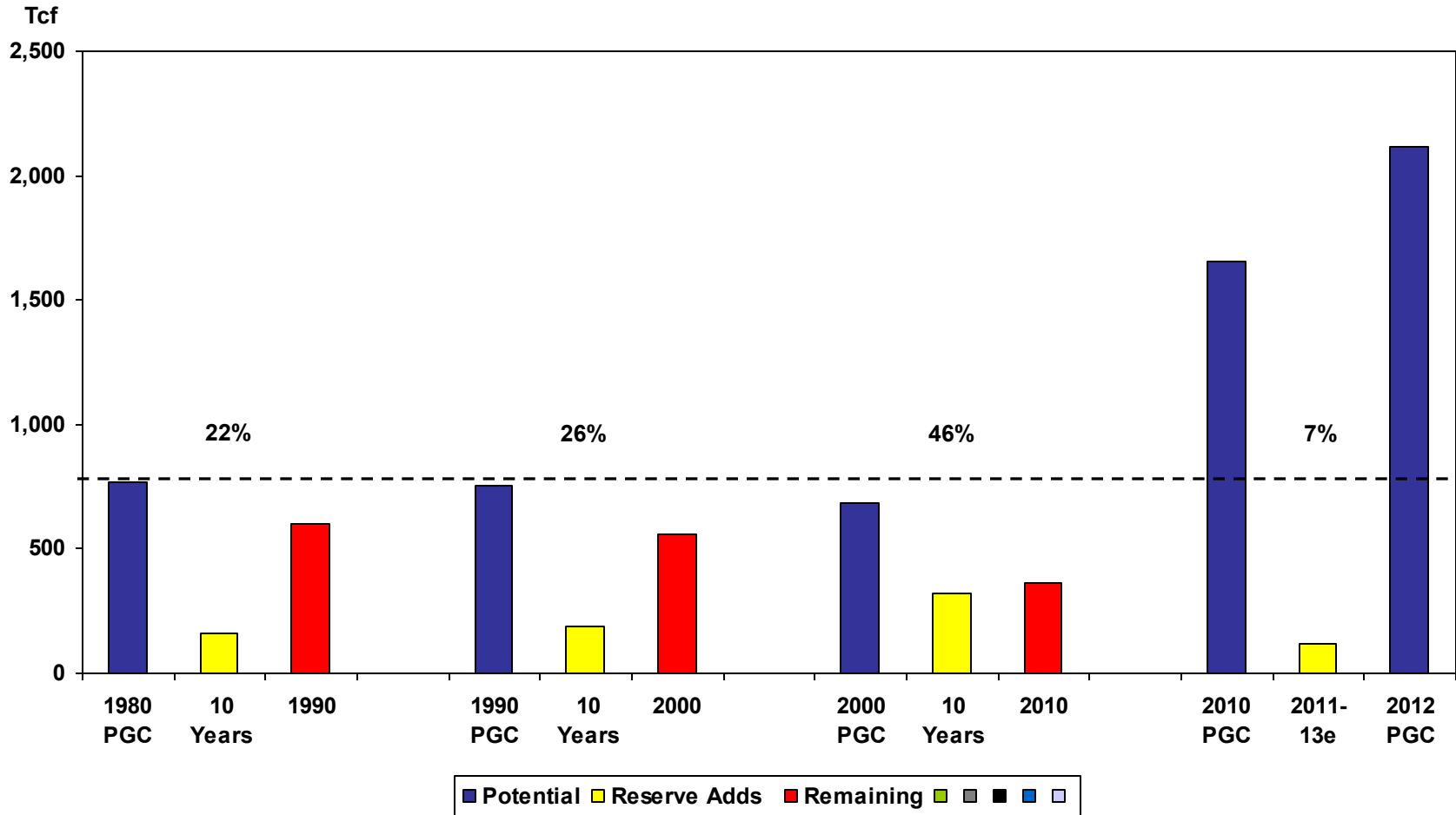
Emerging Production Model Factors

- **Growing, not Declining Production**
- **Growing Yields of Industry Activity**
- **Changing Linkages between Production and Price**
- **Diverging Oil and Gas Prices**
- **Co-Product Economics**
- **Loose Gas Supply/Demand Balance**
- **Looking for Gas Demand to Buy Gas Supply**

Lower-48 "USGS" Oil Resource Potential



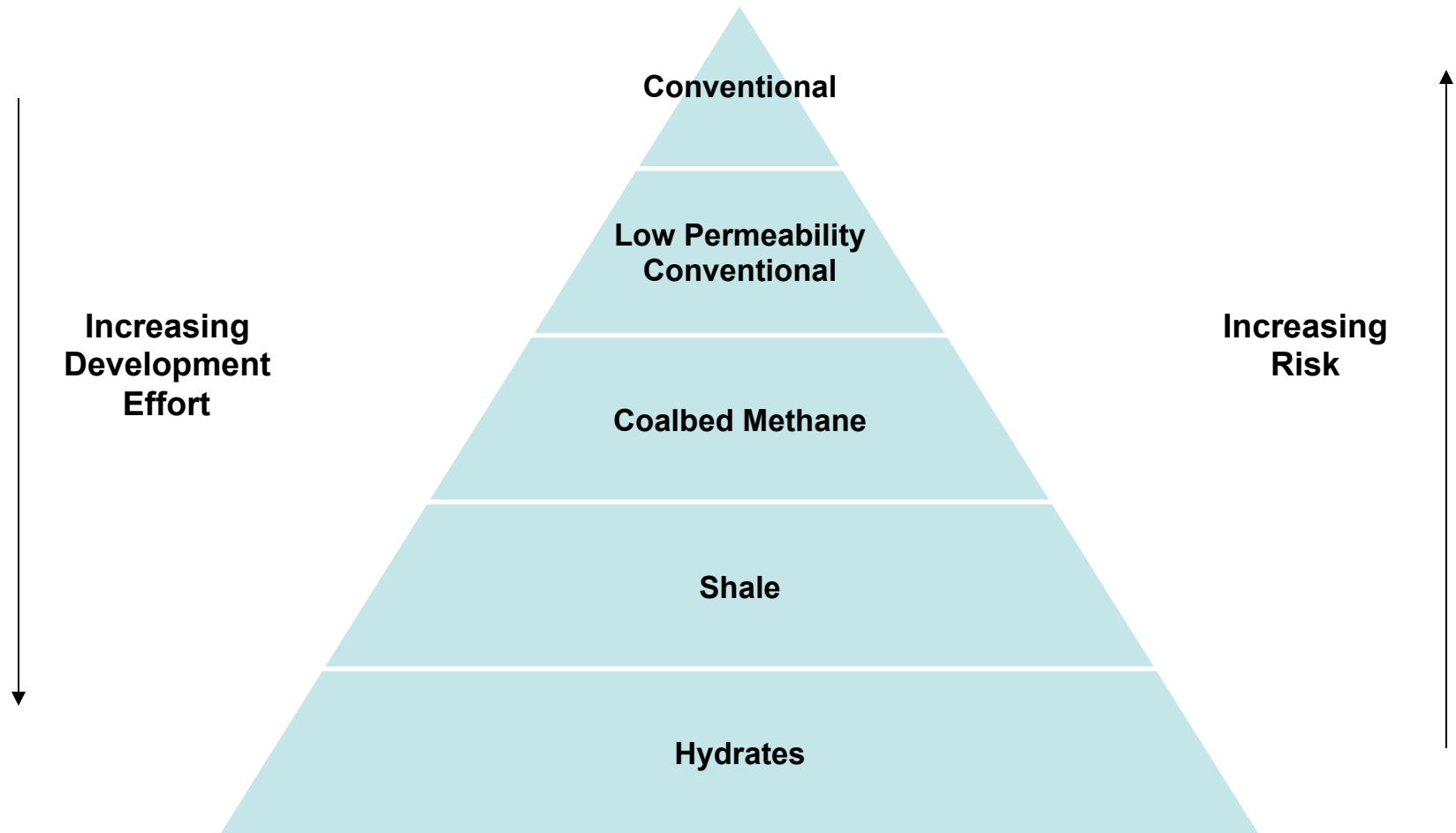
Lower-48 PGC Resource Potentials



What is a Resource Potential?

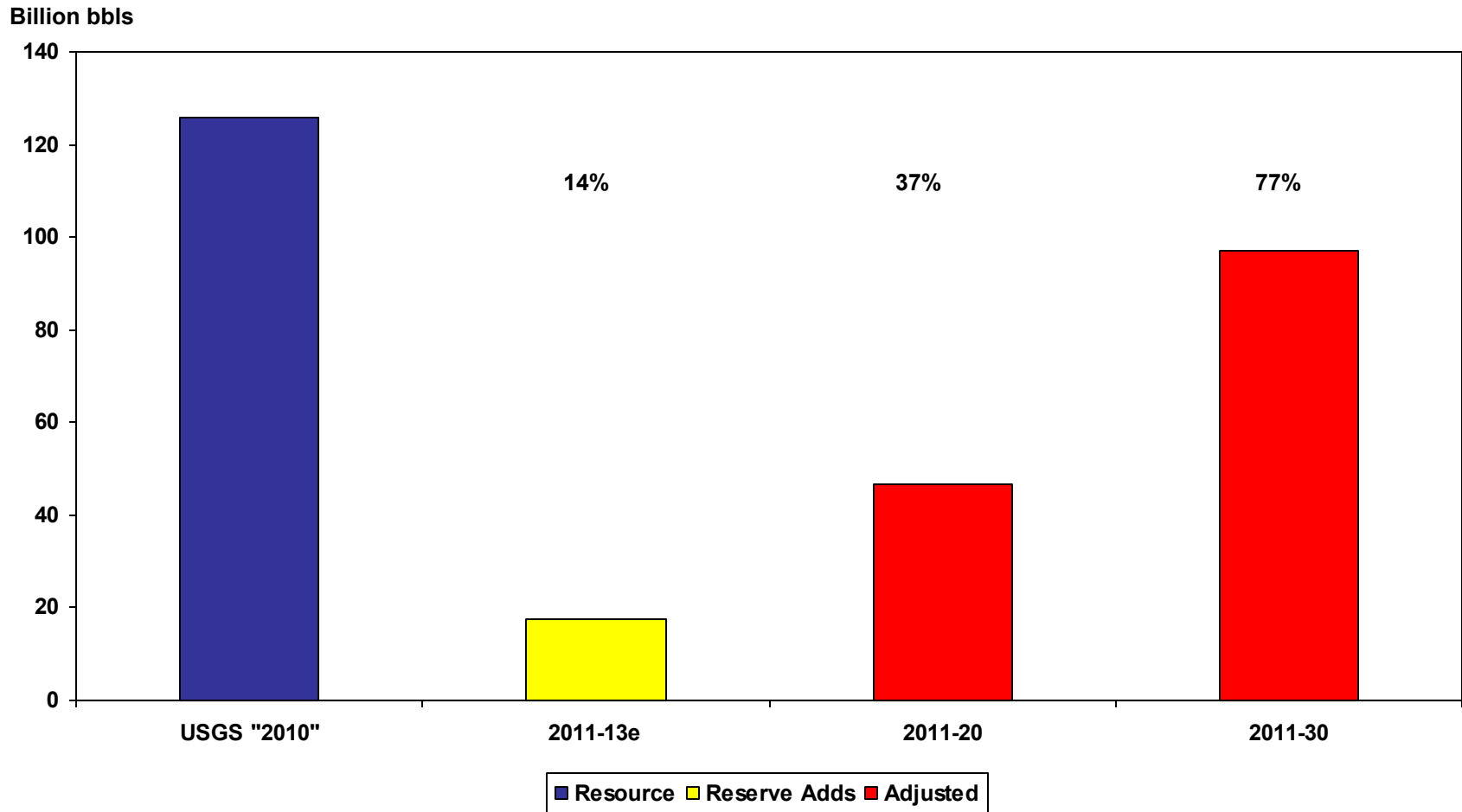
- **Ultimate Recovery or Longer-Term 3P Reserves?**
- **Indicator of Production Growth or Decline**
- **Indicator of Price Pressures**
- **Indicator of Industry/Government Perceptions**

Gas Resource Pyramid

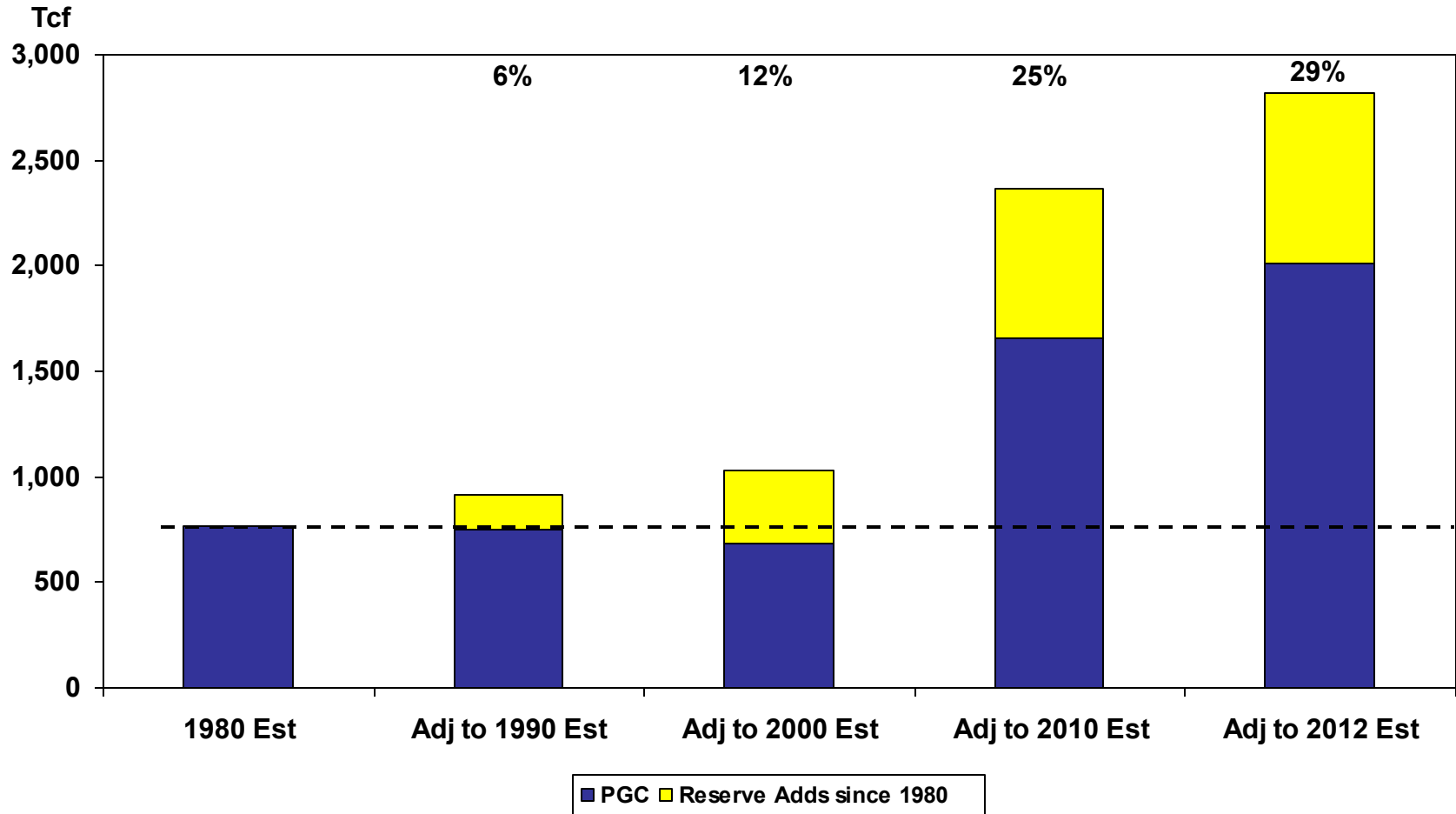


Lower-48 Crude Oil Resource Base Depletion

Production Growth past 2013



1980 PGC Lower-48 Gas Resource Base *Adjusted to 2013*



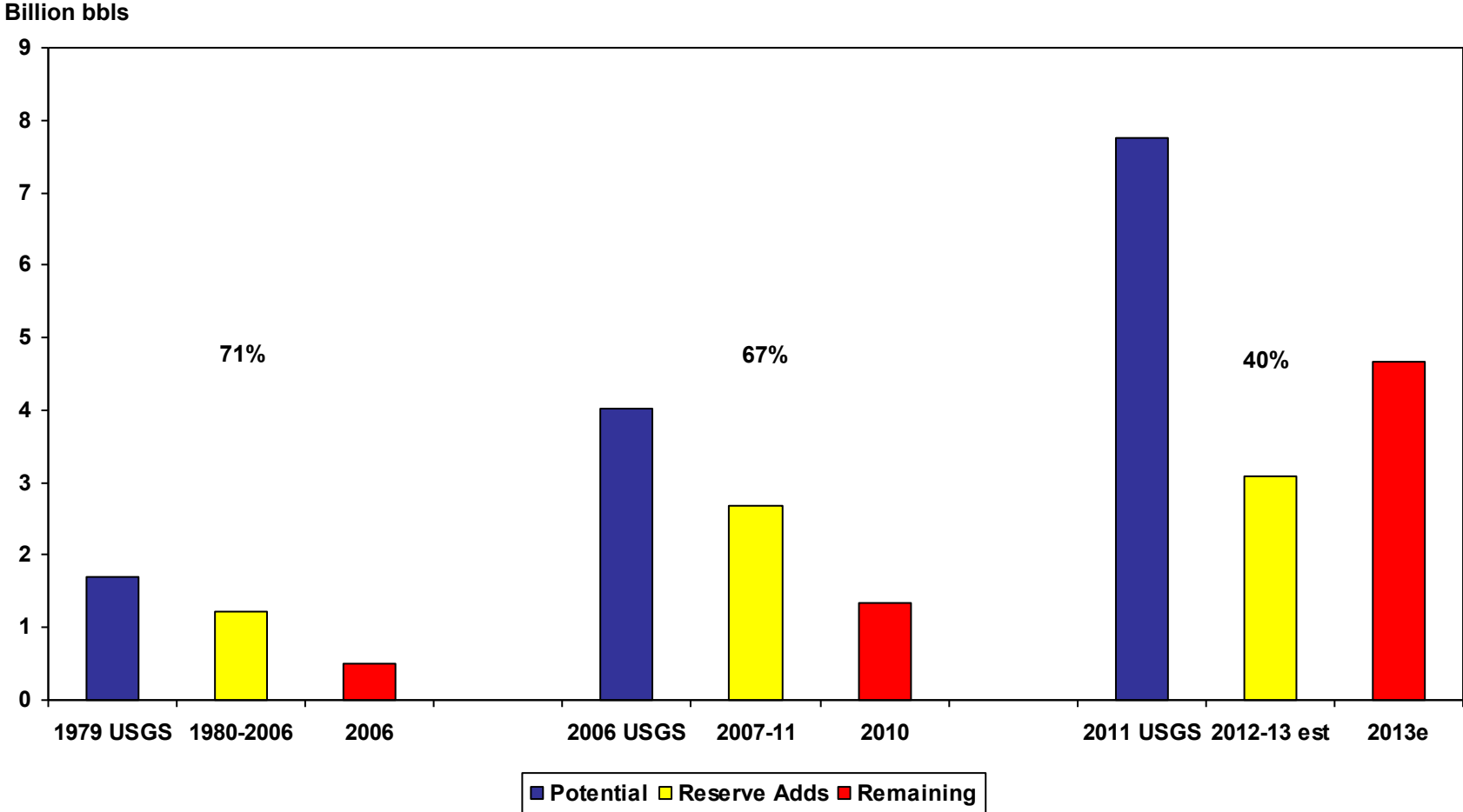
Resource Depletion Observations

- Reserve Additions Deplete **and** Expand Resource Potential
- Trade-off between Risk and “Cost”
- Higher Resource “Cost” of Less Conventional Resources: Hurdle Price or Upward Slope?
- Depletion of 20-25% of Resource Potential at start of a Decade Unlikely to Put Strong Upward Pressures on Resource “Costs” during that Decade
- Production Outlooks and Resource Potentials not That Independent

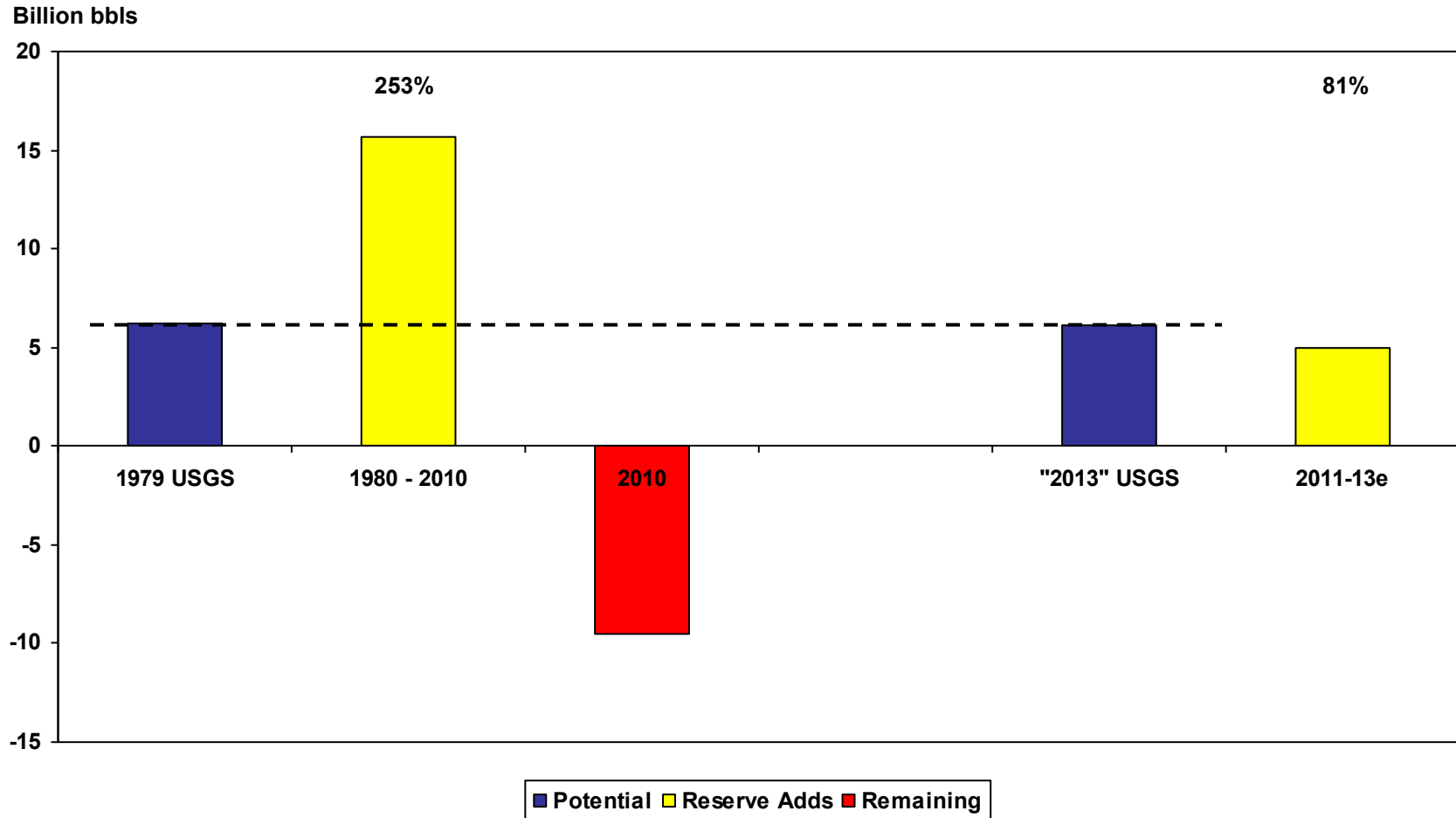
Regional Resource Trends

- **Northern Great Plains (Bakken Shale)**
- **Onshore Gulf Coast (Eagle Ford Shale)**
- **Permian Basin**

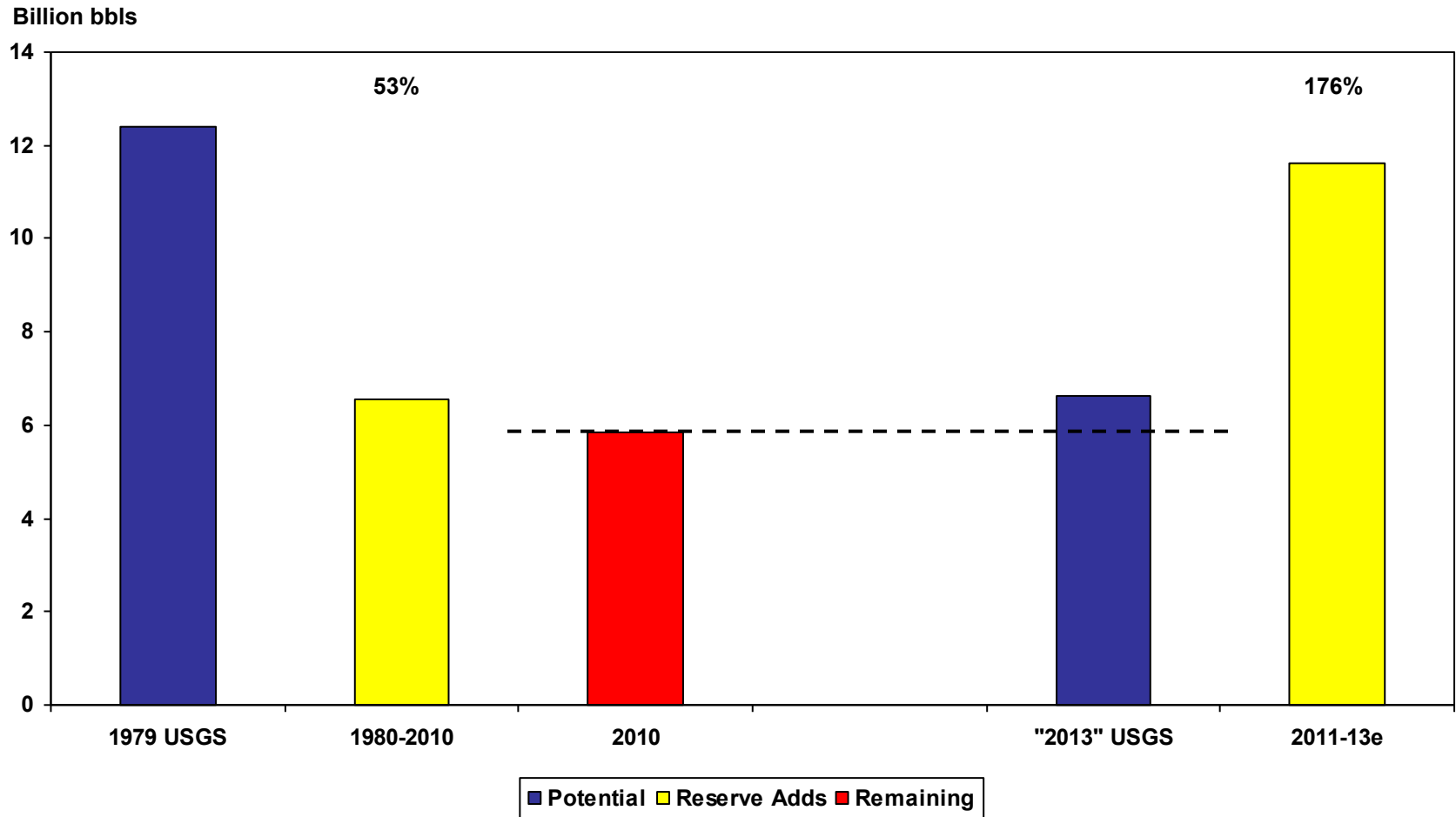
Williston Basin Crude Oil Resource Potentials



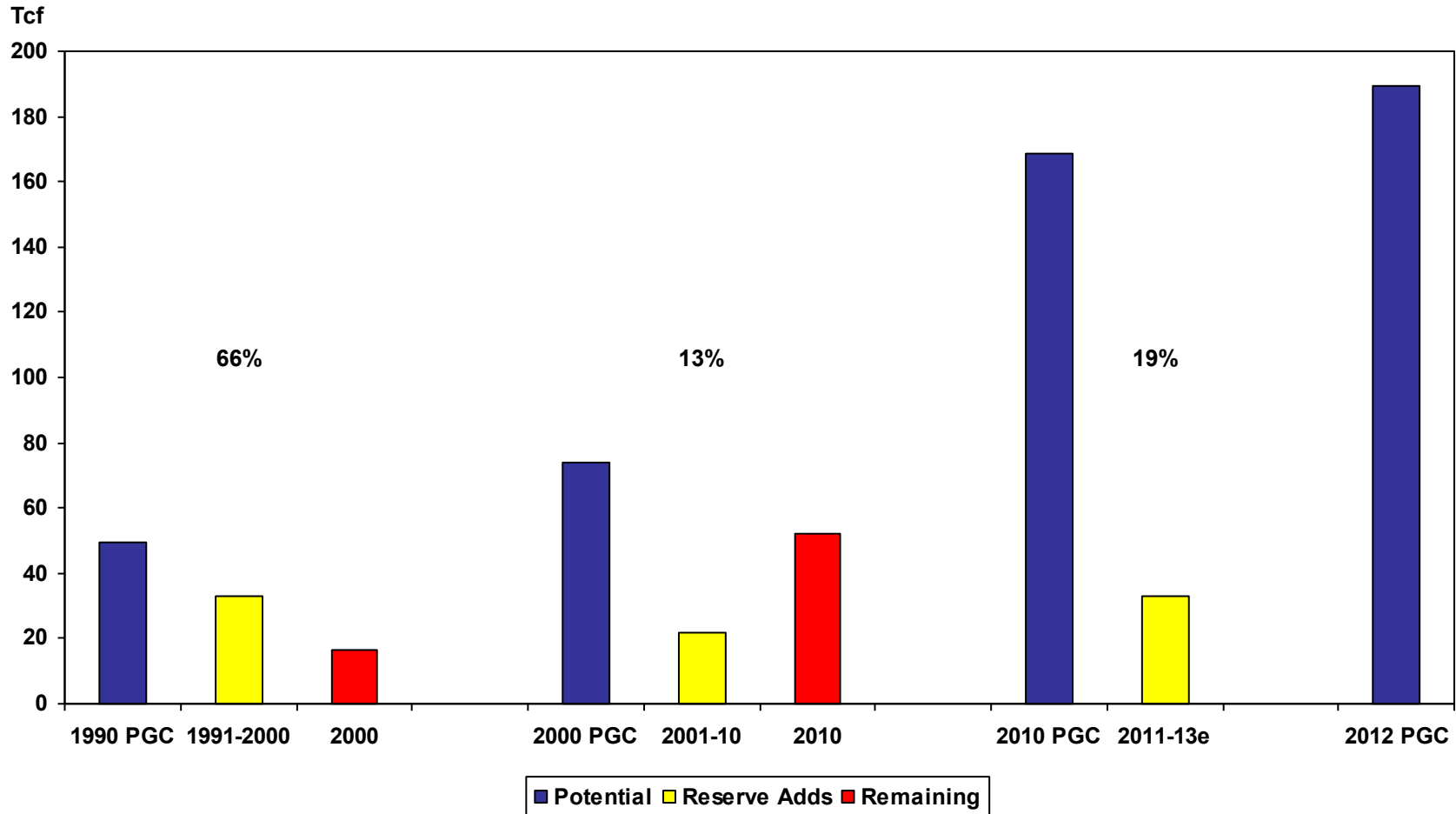
Permian Basin Oil Resource Potentials



USGS Gulf Coast Oil Resource Potential



West Onshore Gulf (LA and TX) Gas Resource Potential



Final Observations

- **Current Resource Estimates Generally Conservative and Likely to Increase in Future, Especially Crude Oil**
- **With Current Estimates, Recent Production Growths and Price “Stability” Likely to be Short-Lived**
- **“Ultimate” Resource Recovery Estimates not Fixed**
- **Price/Production Outlooks and “Ultimate” Resource Recovery not Independent Variables**
- **Growing Production Indicator of Growing Resource Estimates in Future**

21st Century Production Model Issues

- **Risk Factors (e.g., success rates, average versus median yields)**
- **Transition from Growing to Declining Production**
- **Transition from Growing to Declining Yields**
- **Limited Availability of Long-Term Regressions**
- **Linkages between Oil and Gas Prices**
- **Co-Product Economics and “Costs”**
- **Market and Deliverability Effects on Gas Production**
- **Linkages between Price/Production Outlooks and Resource Estimates**

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