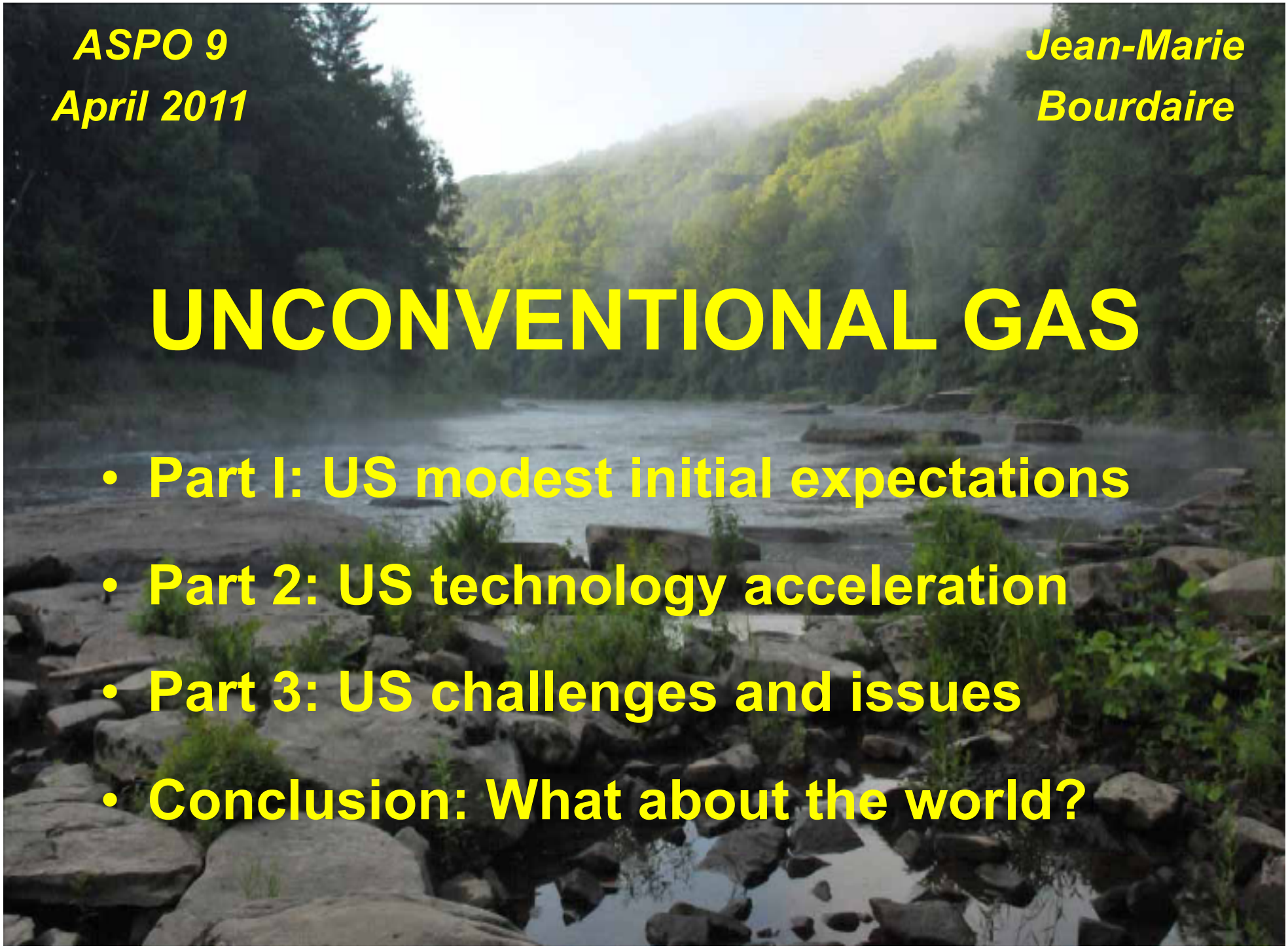


ASPO 9
April 2011

Jean-Marie Bourdaire

UNCONVENTIONAL GAS

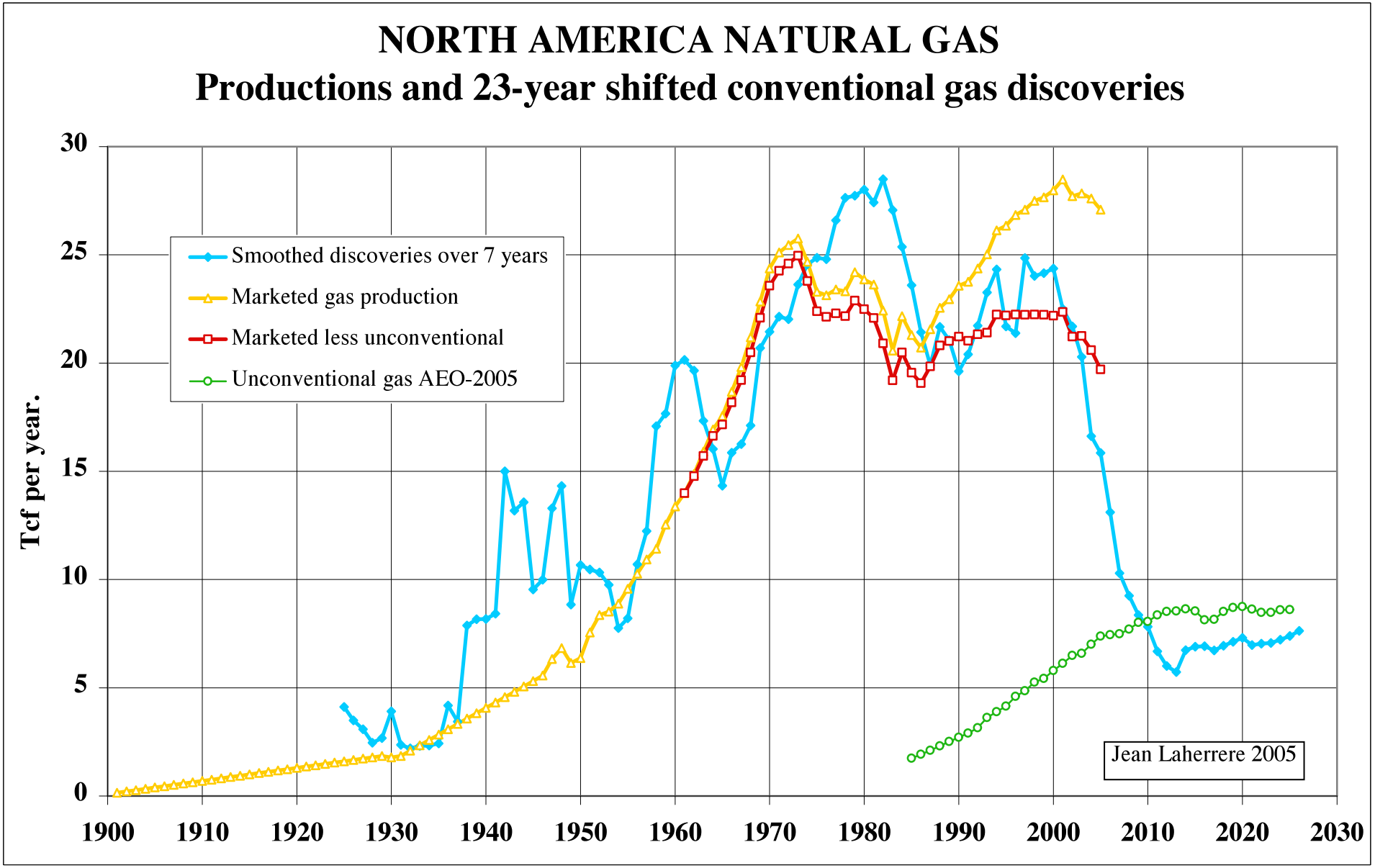
- Part I: US modest initial expectations
- Part 2: US technology acceleration
- Part 3: US challenges and issues
- Conclusion: What about the world?

PART I: US MODEST START-UP

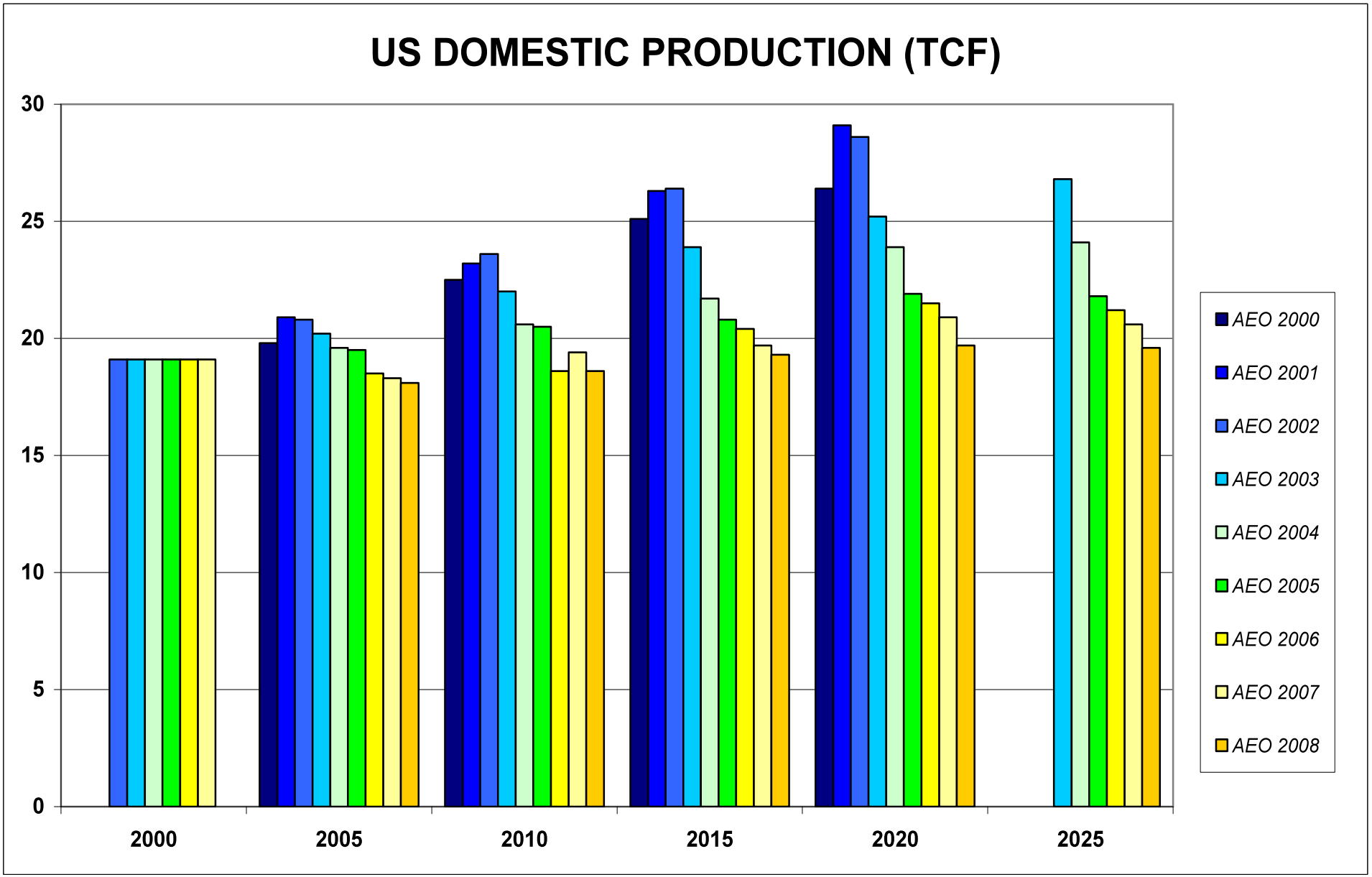
- **1970-2000**: Unconventional gas (on average 70% tight gas, 20% CBM and 10% gas shale up to 2008) has grown slowly from less than 1 Tcf/y in 1970 to ~5 Tcf/y in 2000
- **2000-2008**: Unconventional gas was foreseen to reach a 9 Tcf/y plateau in 2010-25, but the fall of conventional gas was such that much increased LNG imports were to be needed
- **2008**: Oil & natgas prices, and the US rig count, collapse. To maintain their production, operators deploy new technologies, which are at the origin of the shale boom

Because of their belief that LNG imports were set to grow, many operators have developed LNG terminals

THE PRE-2008 VISION

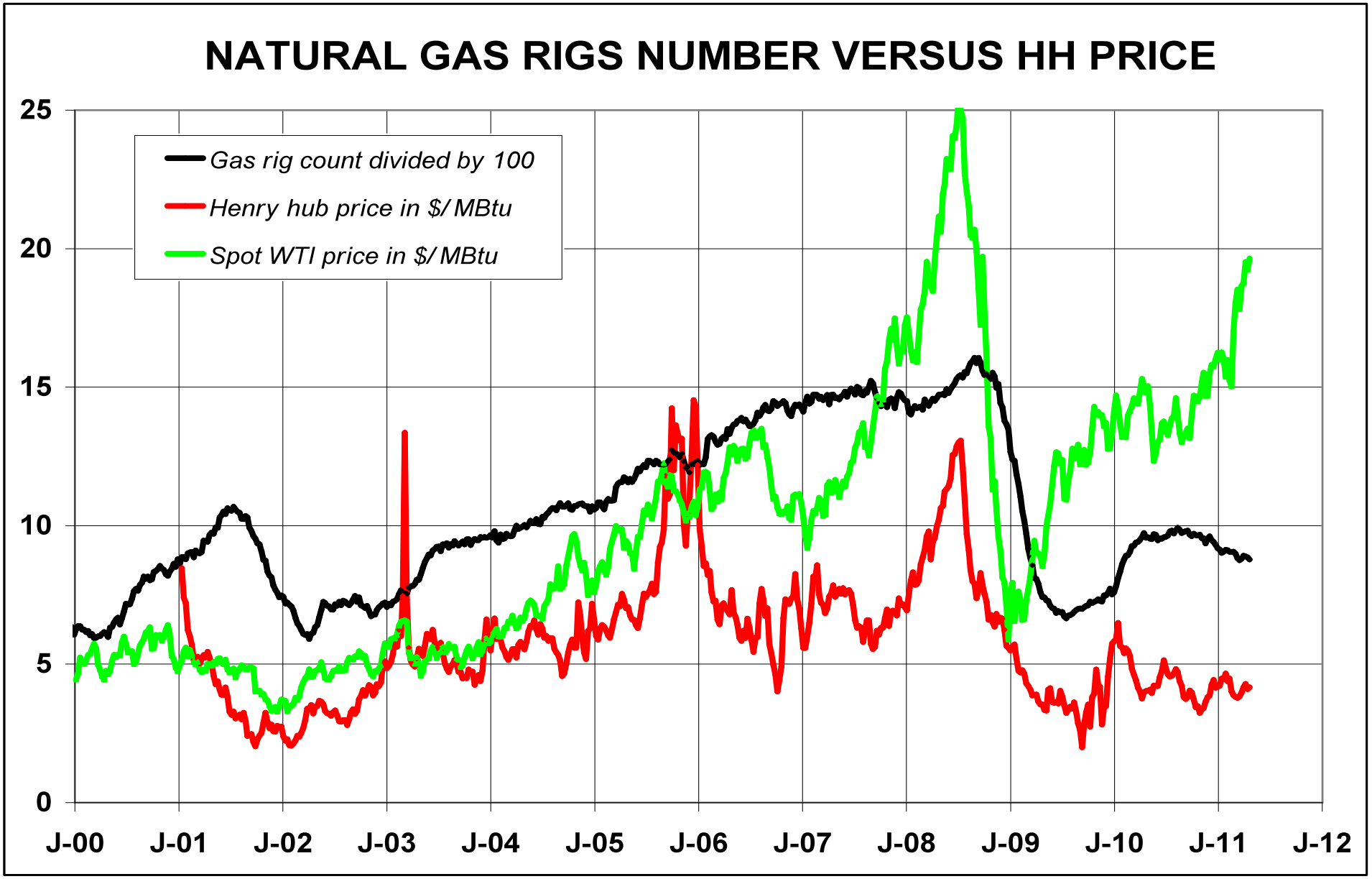


AEO FORECASTS: 2000-2008

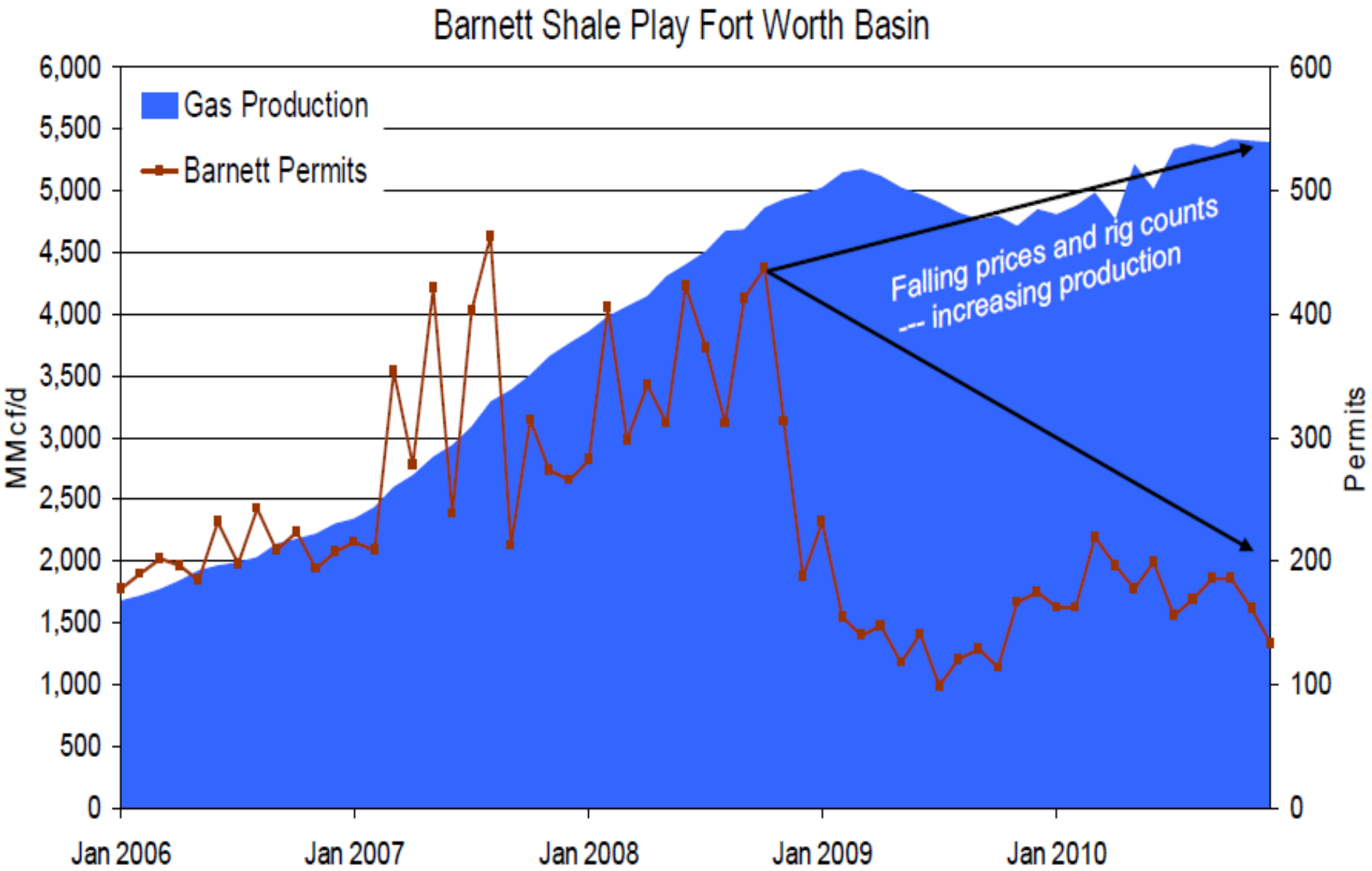


LNG SABINE PASS TERMINAL

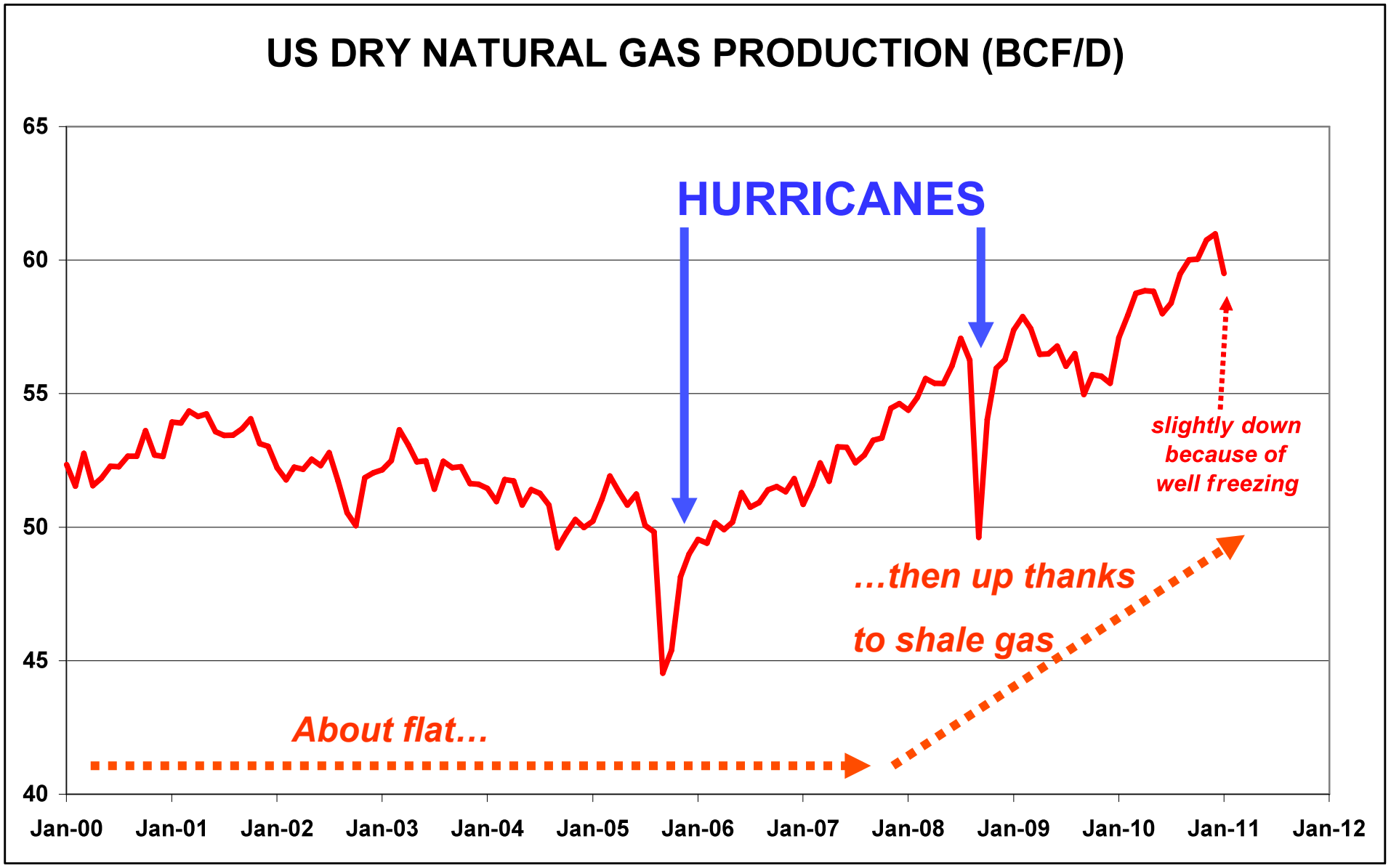
2008: THE COLLAPSE…



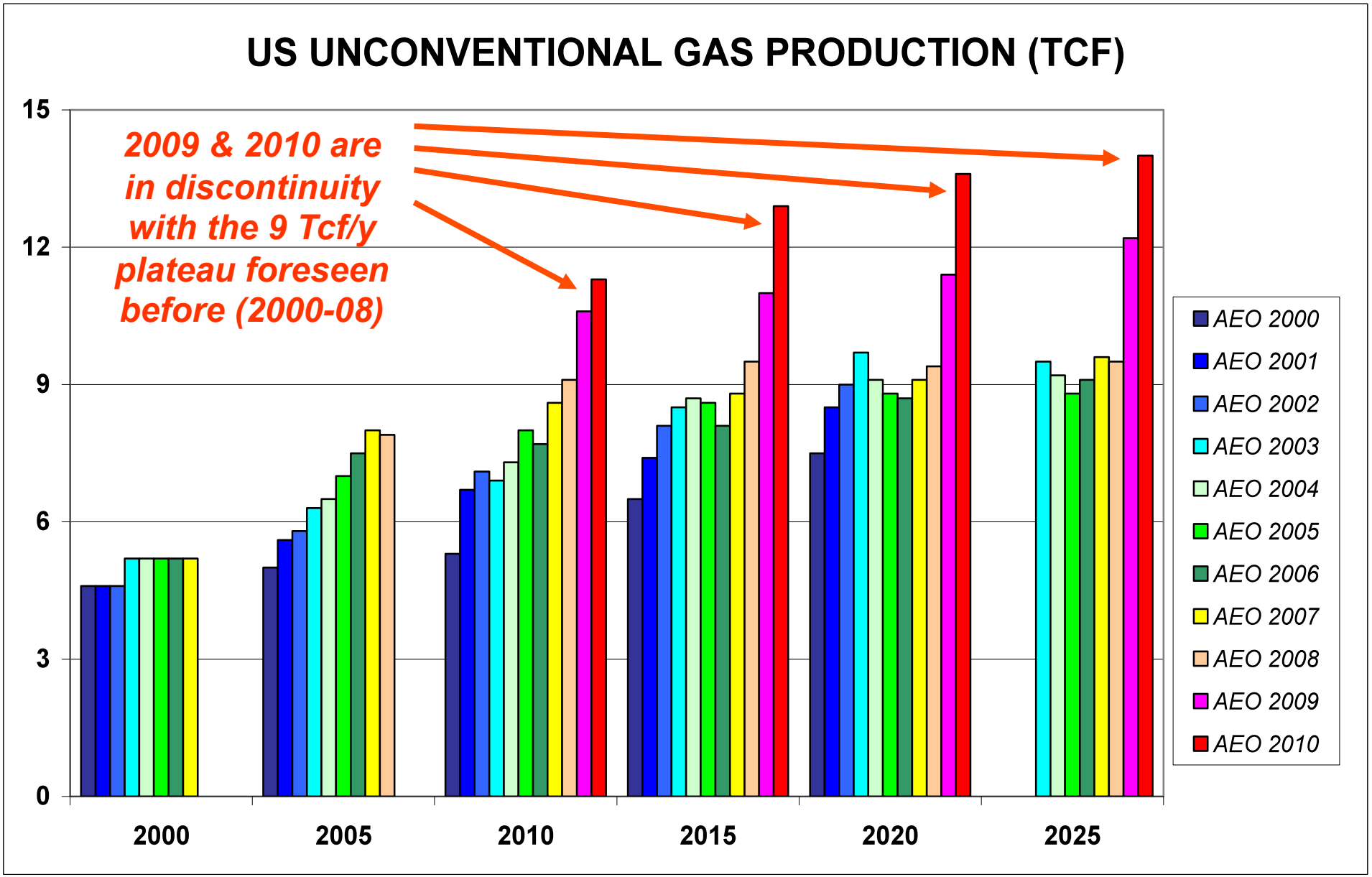
…EXCEPT FOR PRODUCTION…



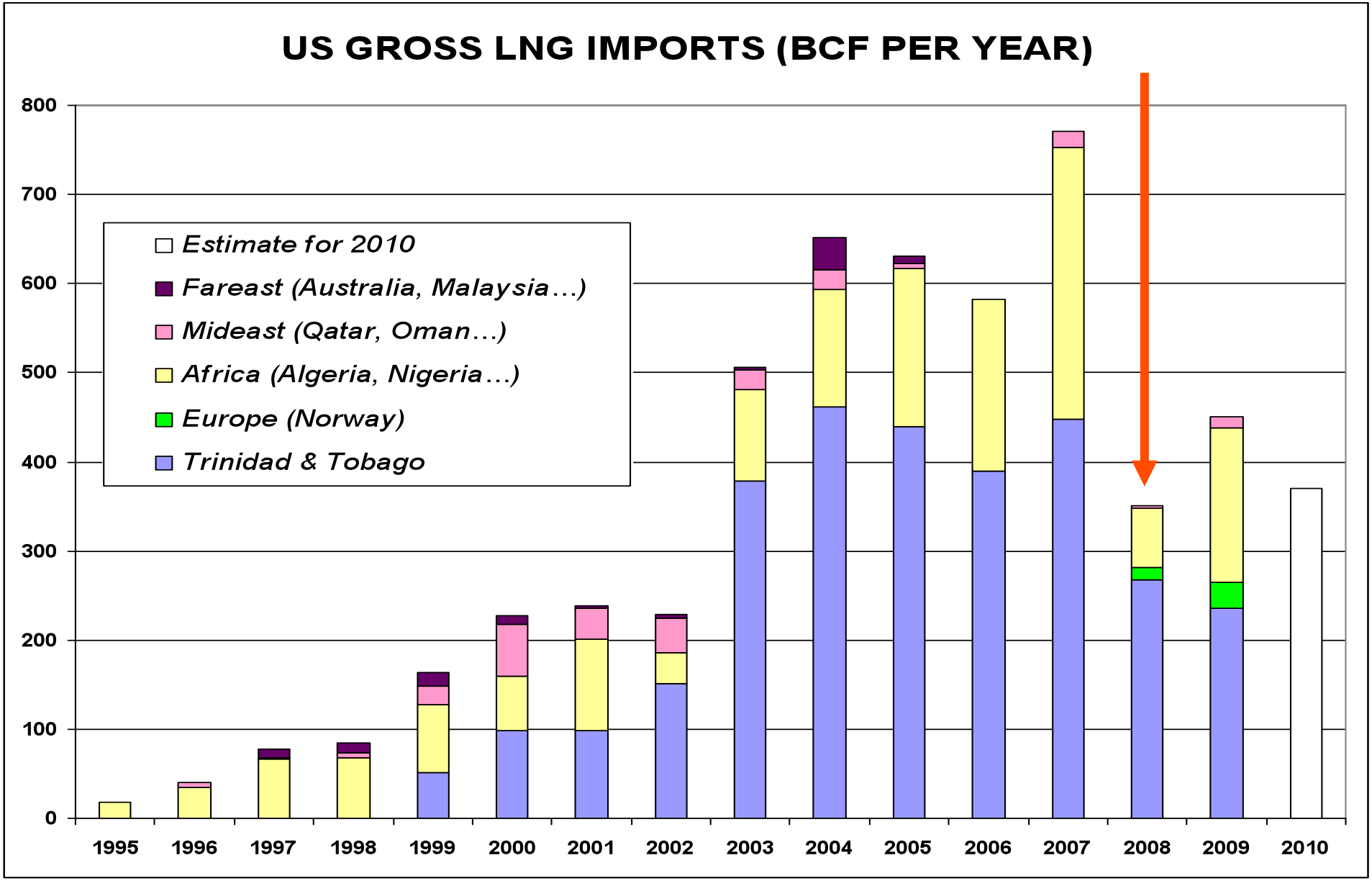
…RESILIENT AND GROWING



AEO SHOW A BREAK IN 2008…



…AS DO US LNG IMPORTS

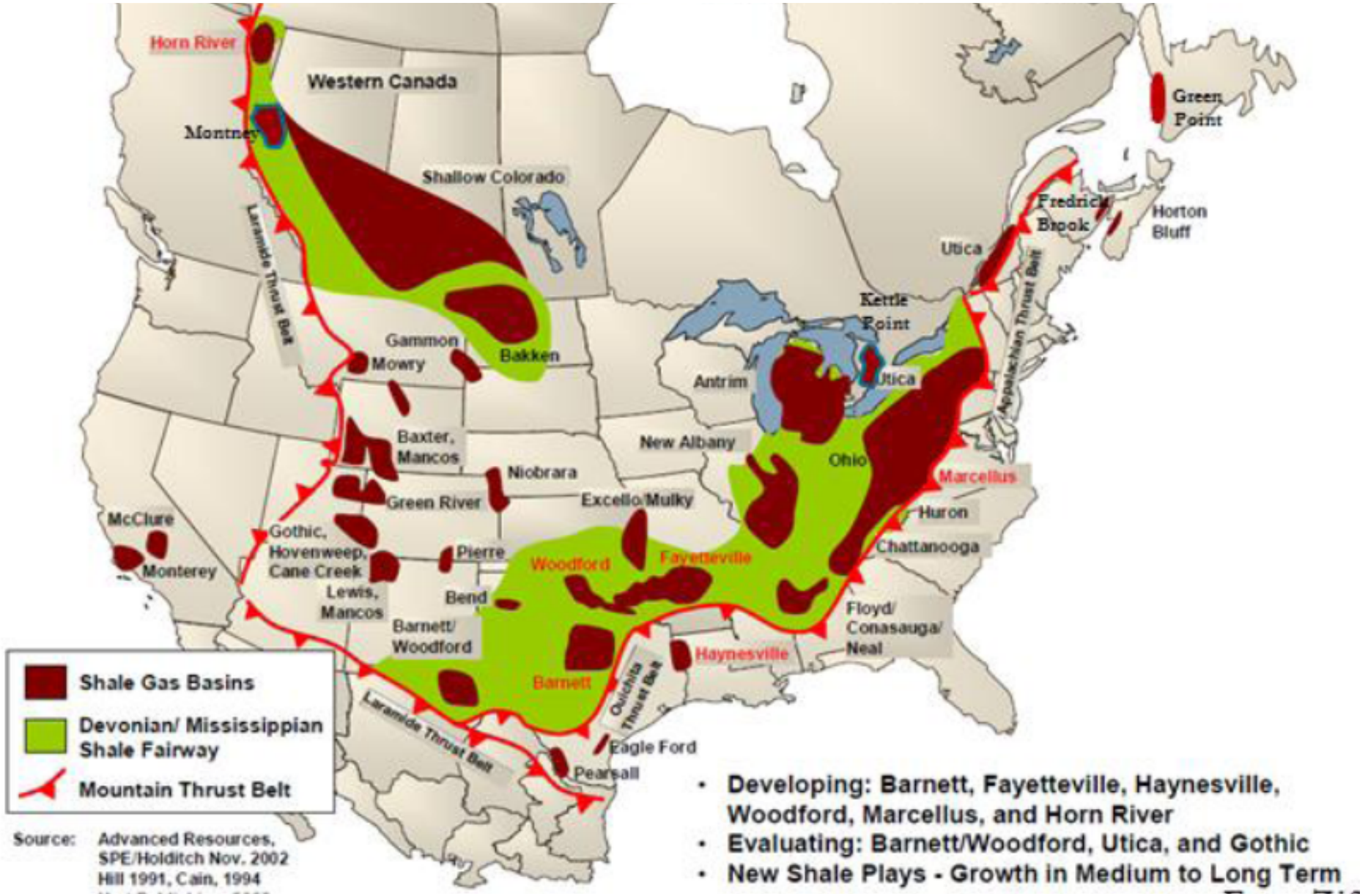


PART II: TECHNOLOGY DRIVE

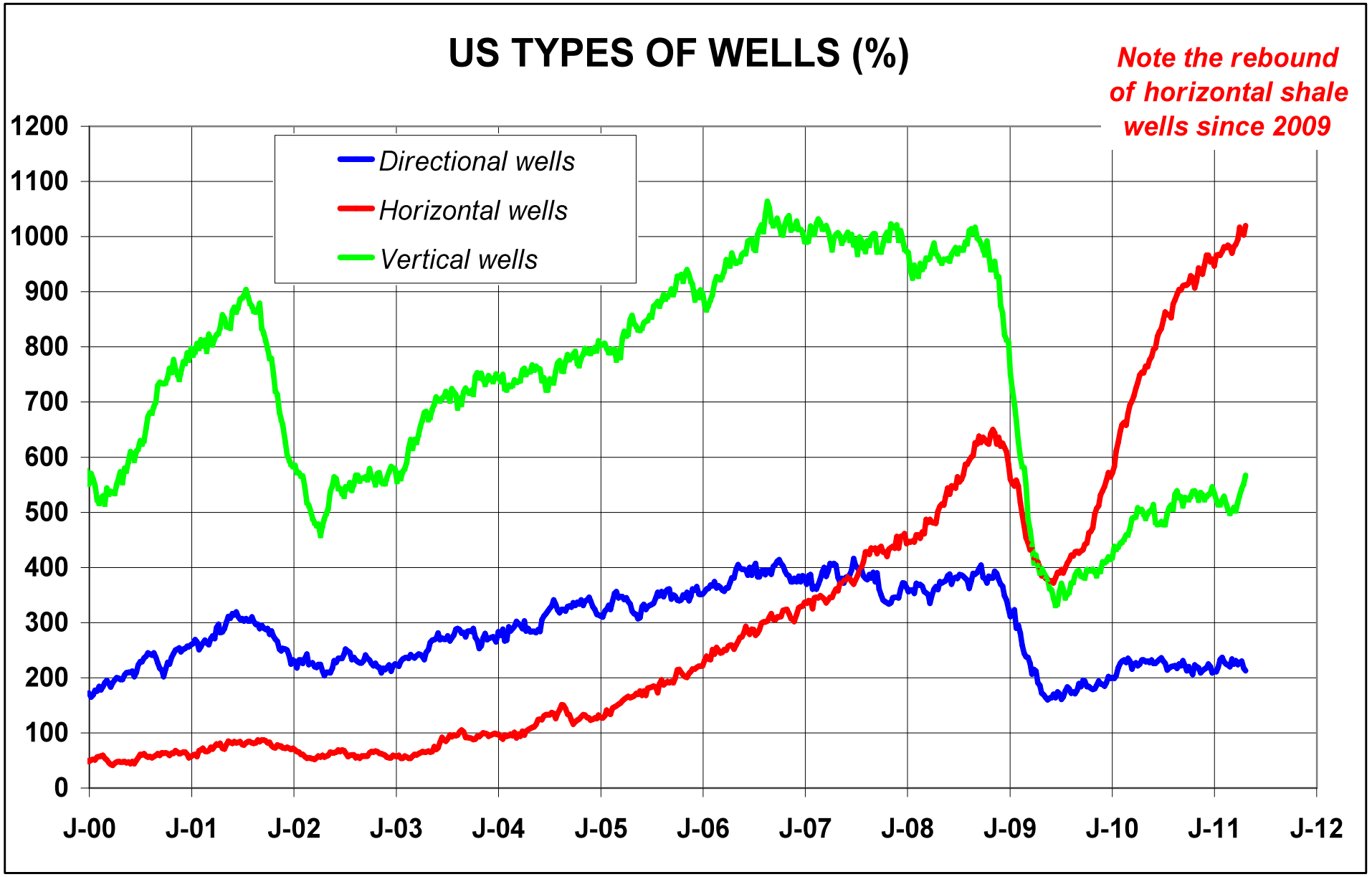
- Thanks to the hedging on high pre-2009 prices, shale gas production starts to surge making LNG imports to decline
- The “sea change” is the generalization of horizontal drilling with a focus on shales with liquids (condensates/NGL)
- Increased frack pressure, more sophisticated fracking fluids, and re-fracking of wells in production
- Better productivity and lower costs thanks to the targeting of sweet spots, learning curves, and shorter drilling times
- Restricted-choke techniques to manage underground back pressures and extend well life and production profile

Producers better manage their IP and land-owners their leasing rates to optimize economic conditions

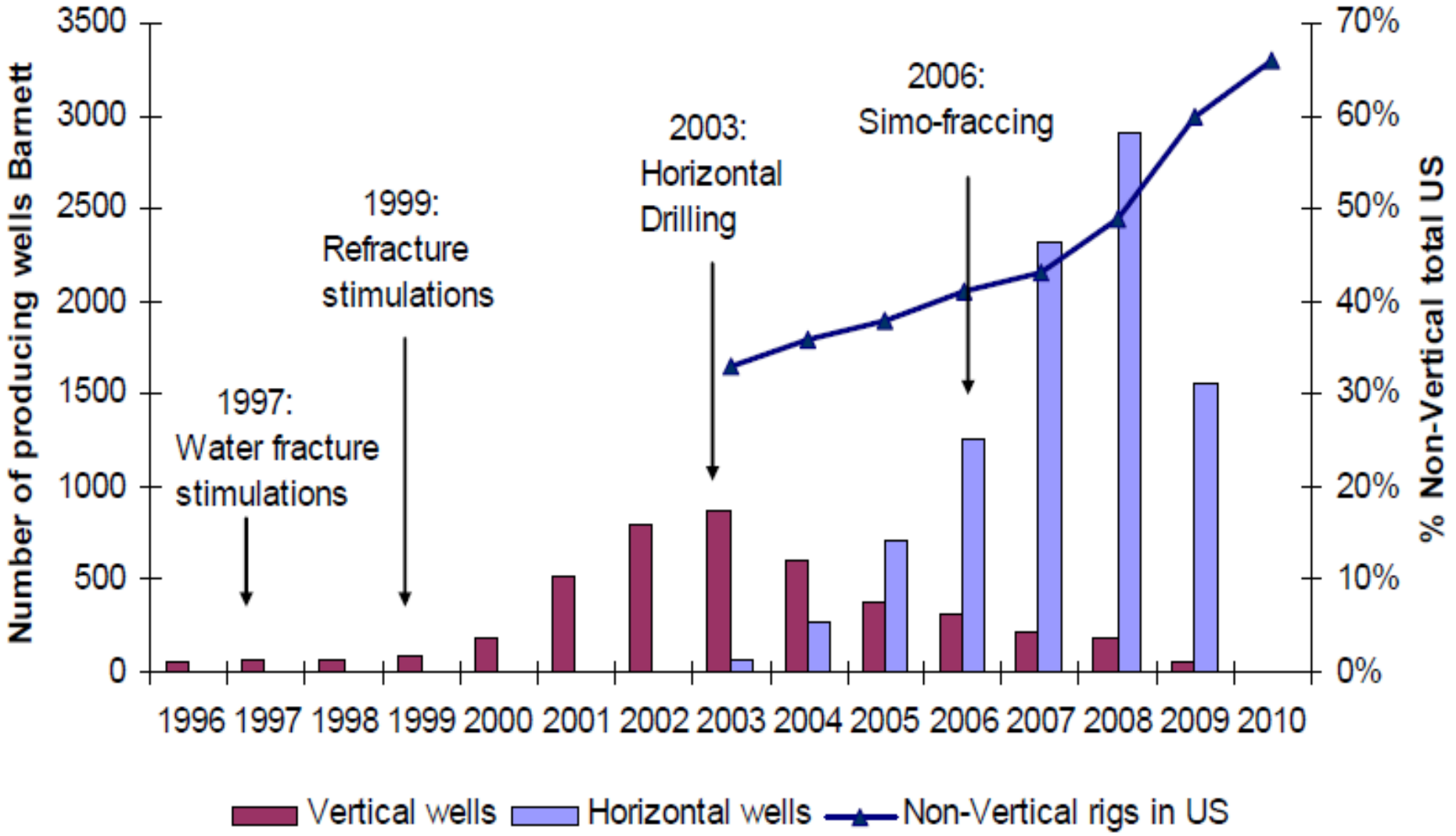
MAIN SHALE GAS DEPOSITS



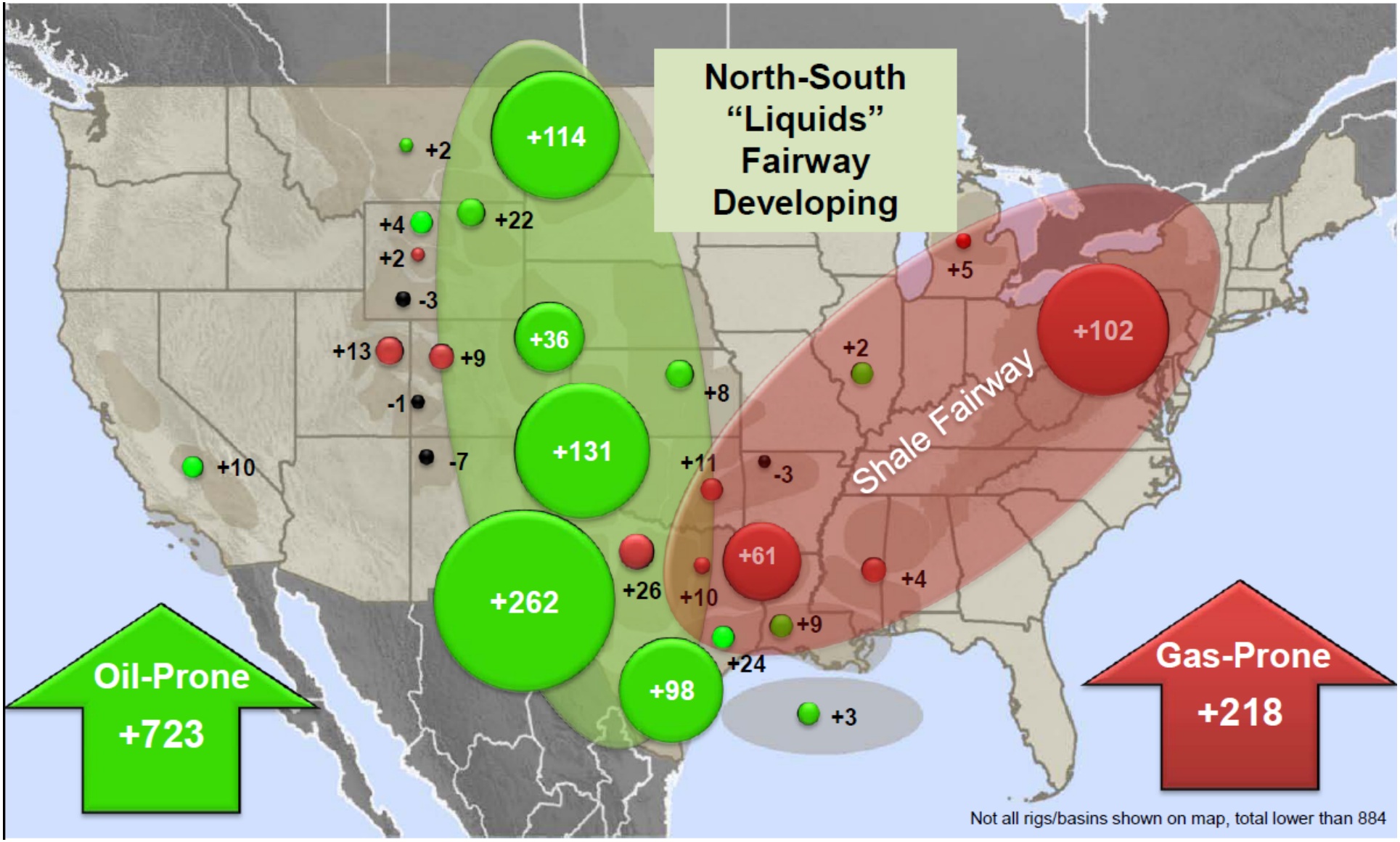
SPLIT OF US RIGS BY TYPES…



…E.G. IN BARNETT SHALE

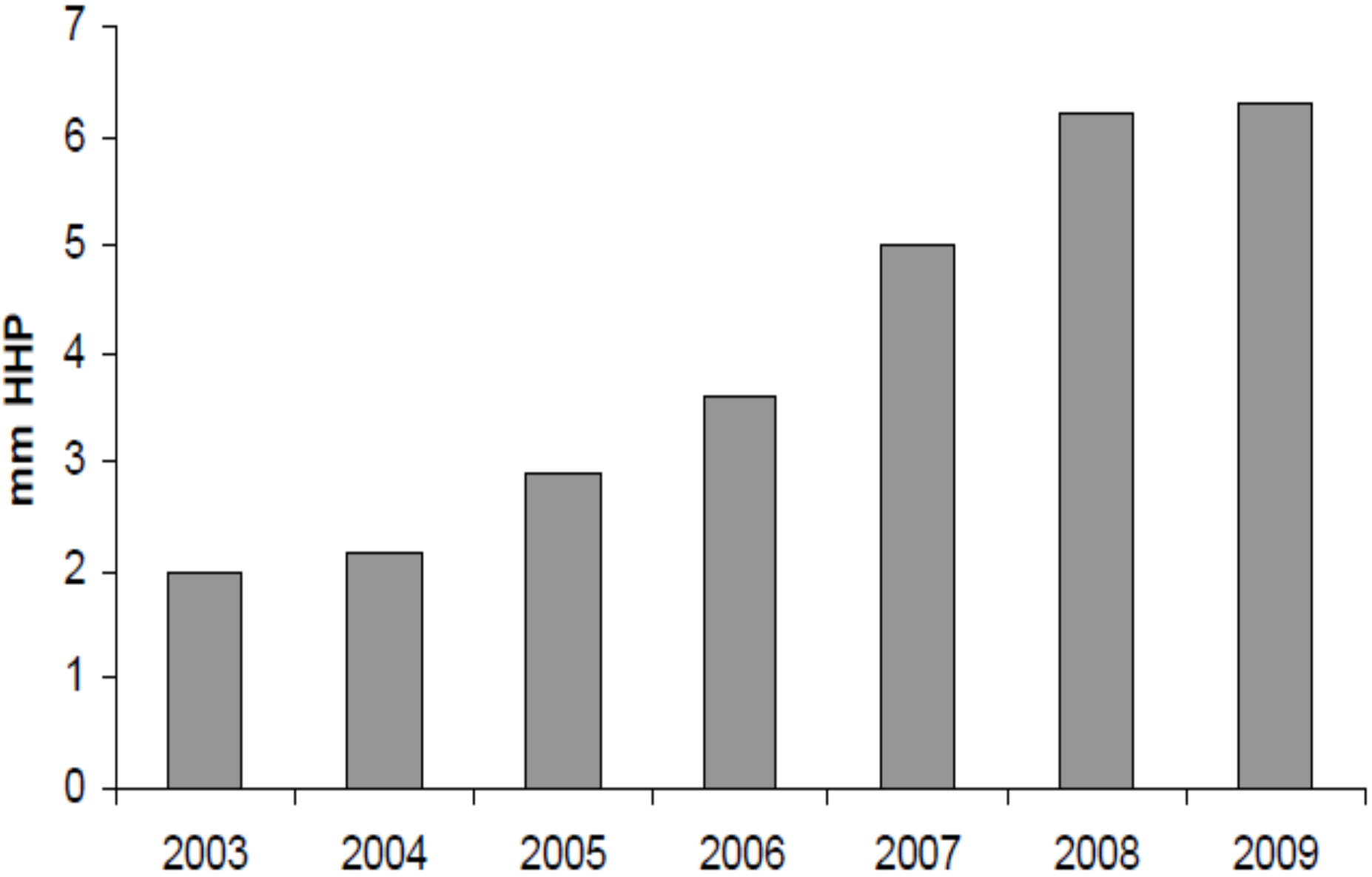


NEW RIGS SINCE MID 2009

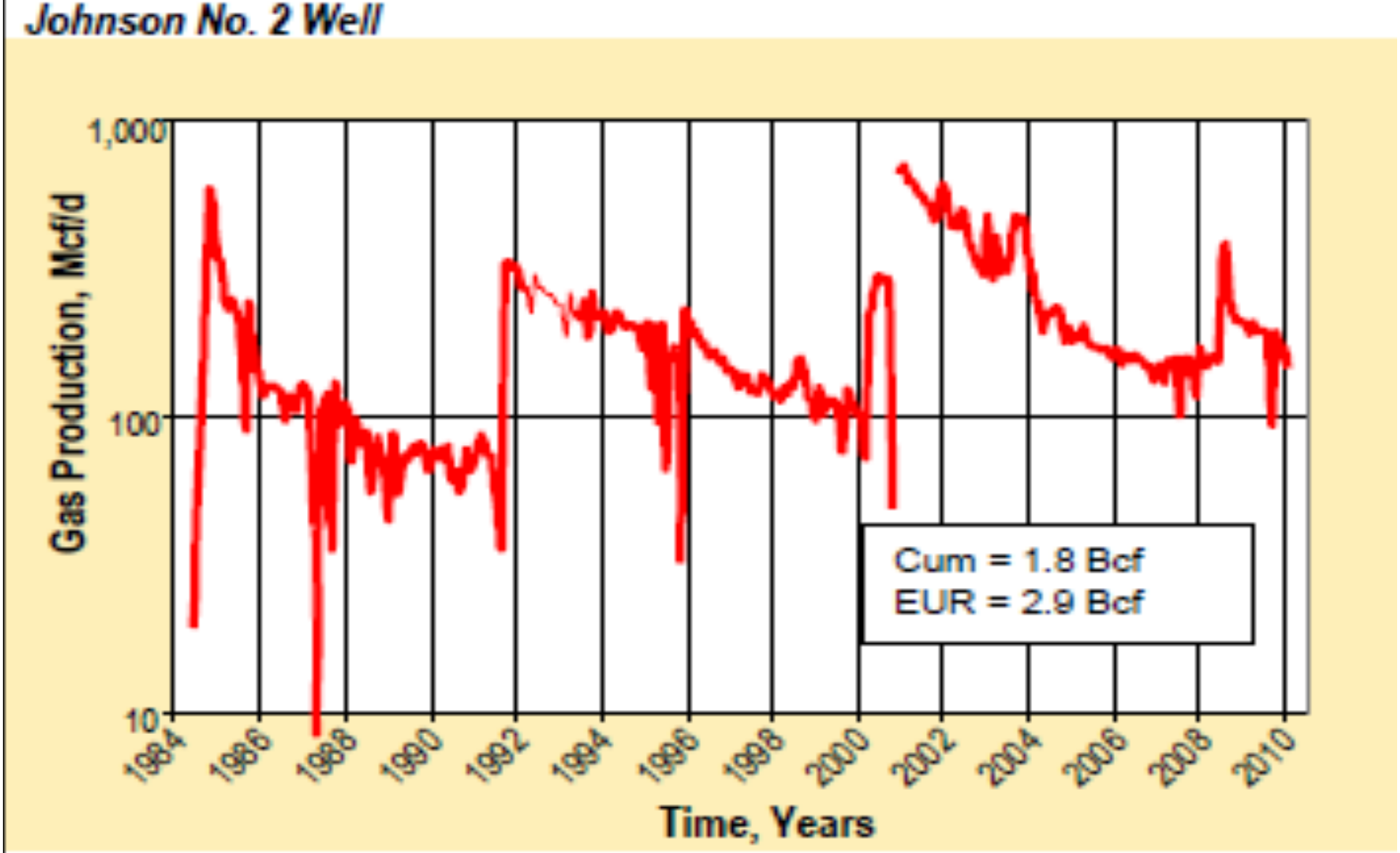


Source: Bentek Energy

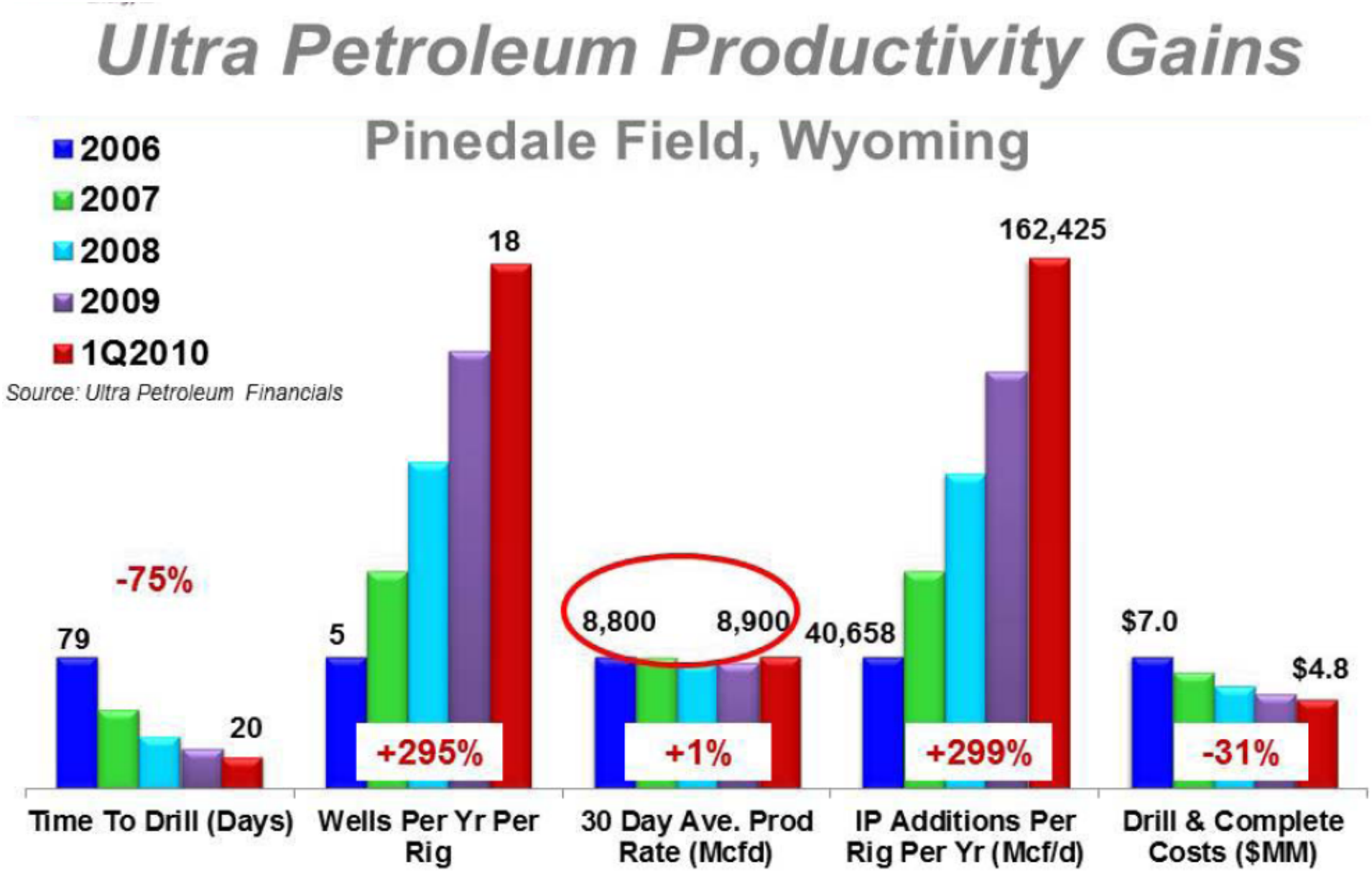
PRESSURE PUMPING CAPACITY



REFRACTURE STIMULATION

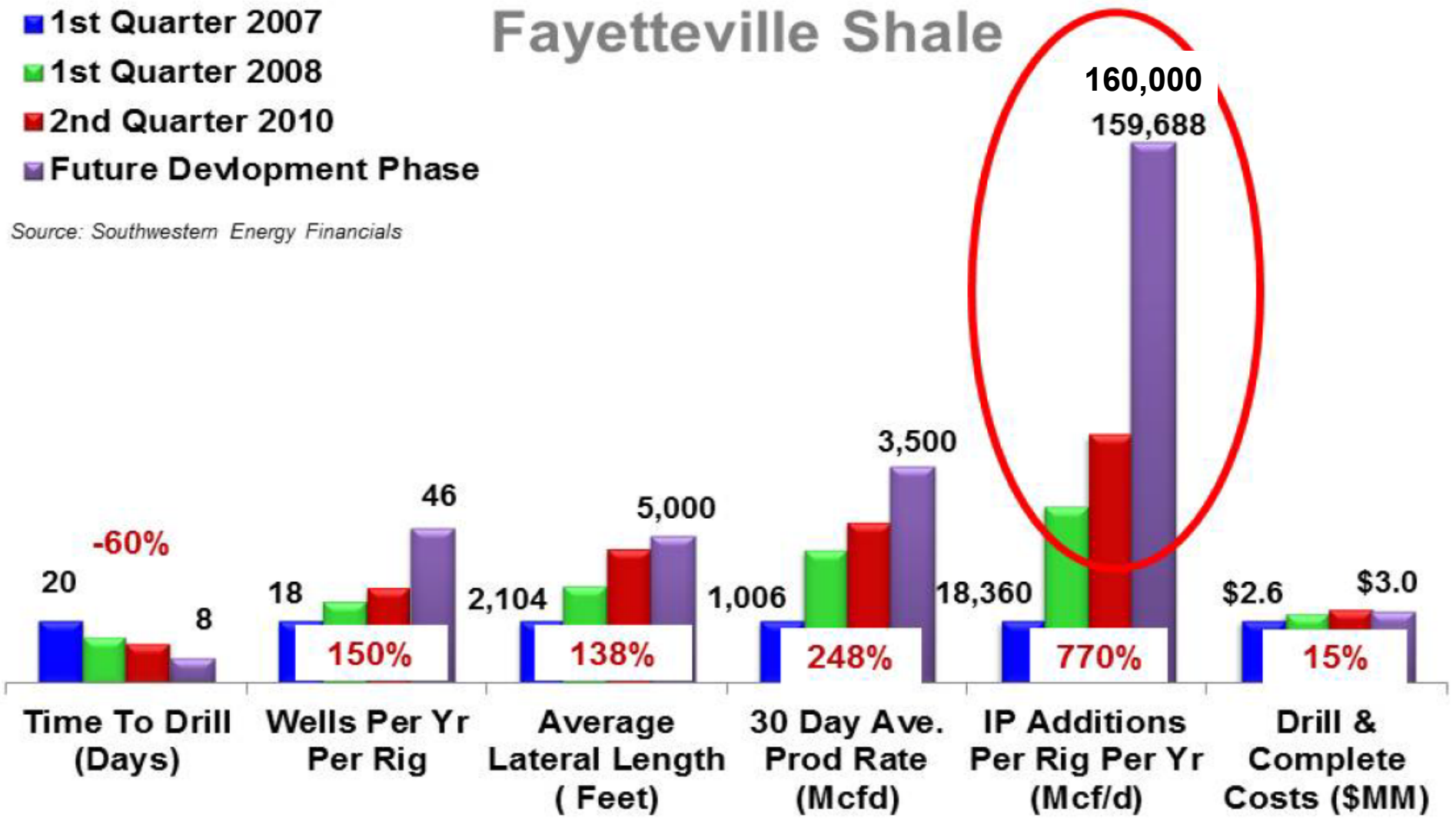


2006-10 PRODUCTIVITY GAINS

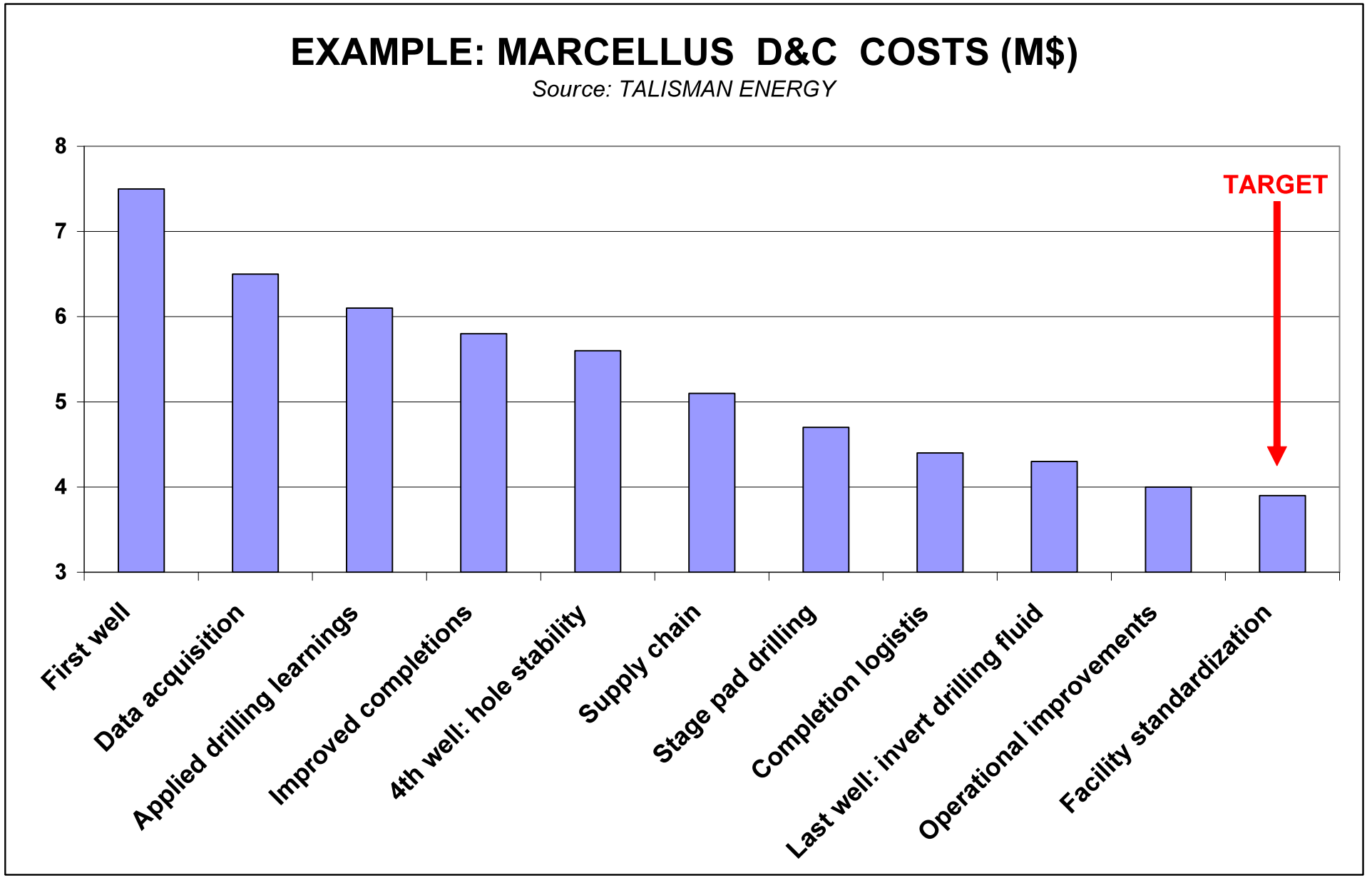


2007-10 PRODUCTIVITY GAINS

Southwestern productivity gains



WELL COST REDUCTIONS



PART III: CHALLENGES & ISSUES

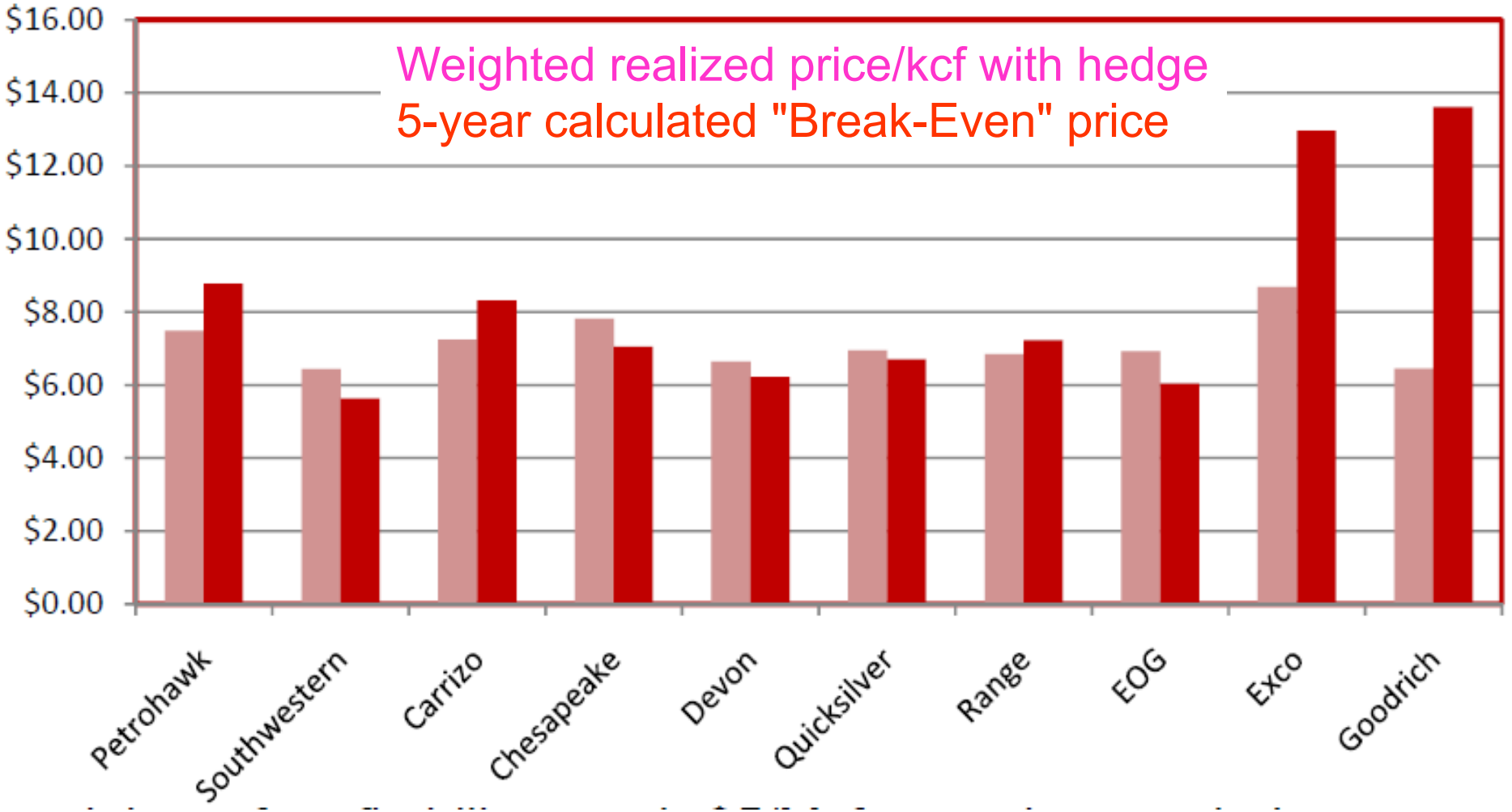
Is the development of shale gas like a Ponzi scheme, and are US gas majors behaving like Madoff? Art. Berman sees major limitations such as:

- High costs, poor economics and destruction of capital
- Infrastructure limitations (pipelines and NGL-stripping plants)
- Physical fundamentals (small core areas, fast decline rates)
- Average break-even prices higher than current prices

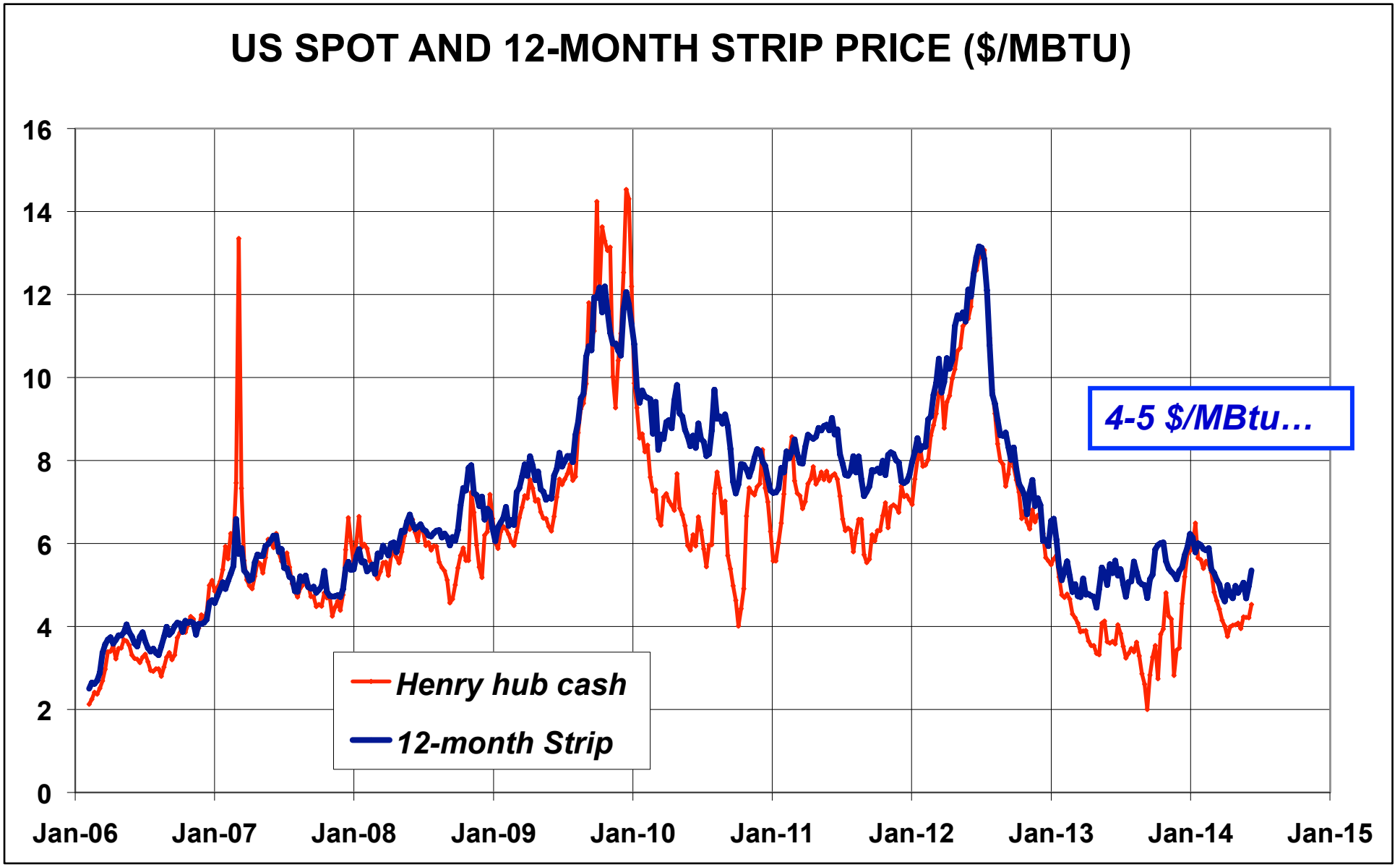
But, if some operators may fool some analysts for a while…
…the entire industry cannot be wrong for ever

LOW OR HIGH COST PLAYS?

Berman's selected 5-y production costs per kcf are misleading given the rapid productivity gains and cost reductions since 2004, and especially after 2009



ARE HH PRICES TOO LOW?



OR GOOD WITH NGL-LIQUIDS?

$4.00 NYMEX equates to $6.34 per one mcf

$4.00 NYMEX Henry Hub
$85.00 NYMEX WTI
Based on 12/10 Gas Quality (1)
Assumes 1130 Btu

Wellhead Production
1 mcf of Natural Gas

	Natural Gas & Ethanes	NGLs	Condensate
Production by product	.91 mcf	2.25 gallons/mcf	.012 bbls/mcf
Gross realized by product	$3.98 net	$1.61 net (2)	$0.75 net
		$6.34 per one mcf	
Gathering, compression and transportation (deducted from gas price)		$0.75 to $1.25(3)	...or 6+ /MBtu
Operating expenses		$0.25 to $0.40(3)	

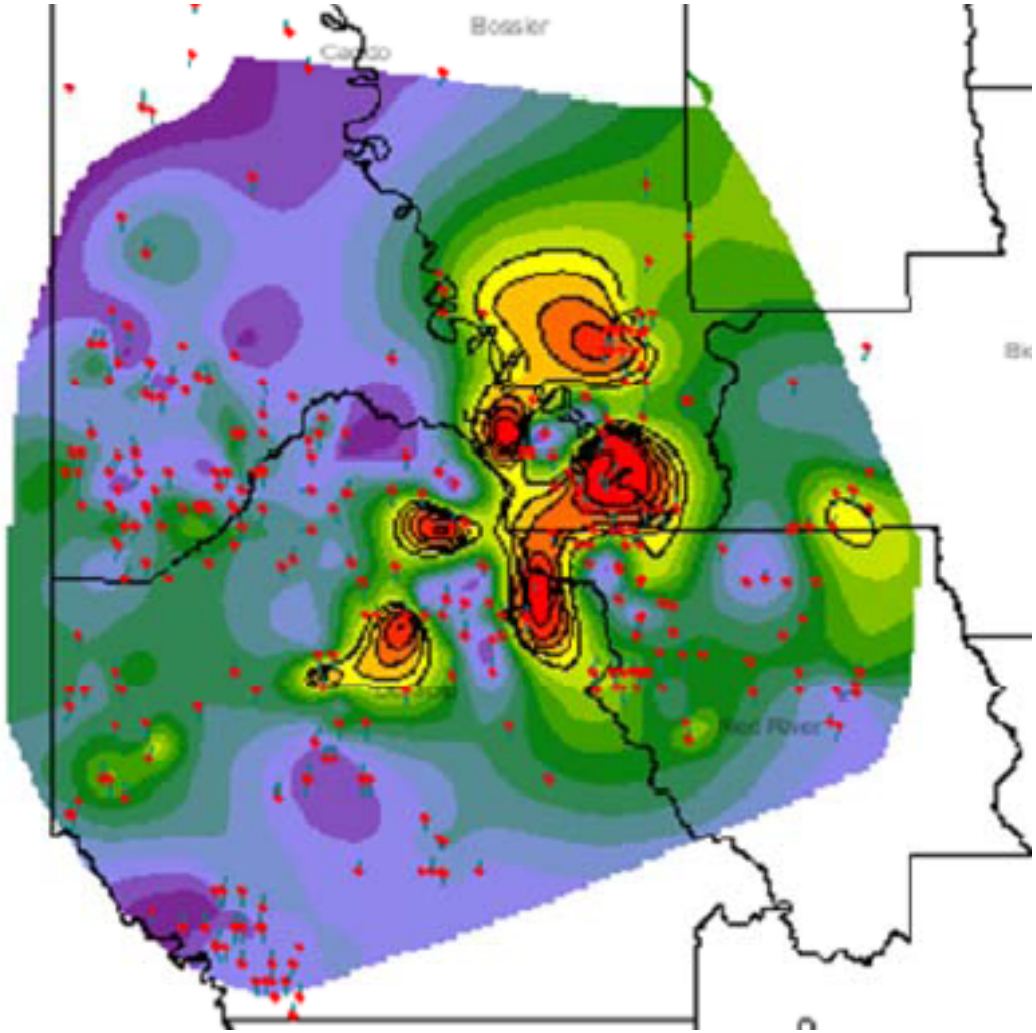
(1) Realization will change as gas quality changes

(2) Uses 2 years correlation factor of WTI to Marcellus realized of .5123 and net realized price of $36.80 after deductions

(3) Will decline over time as volumes decrease

HAYNESVILLE CORE AREA

But 1 section (640 acres) can hold reserves up to 500 Bcf!

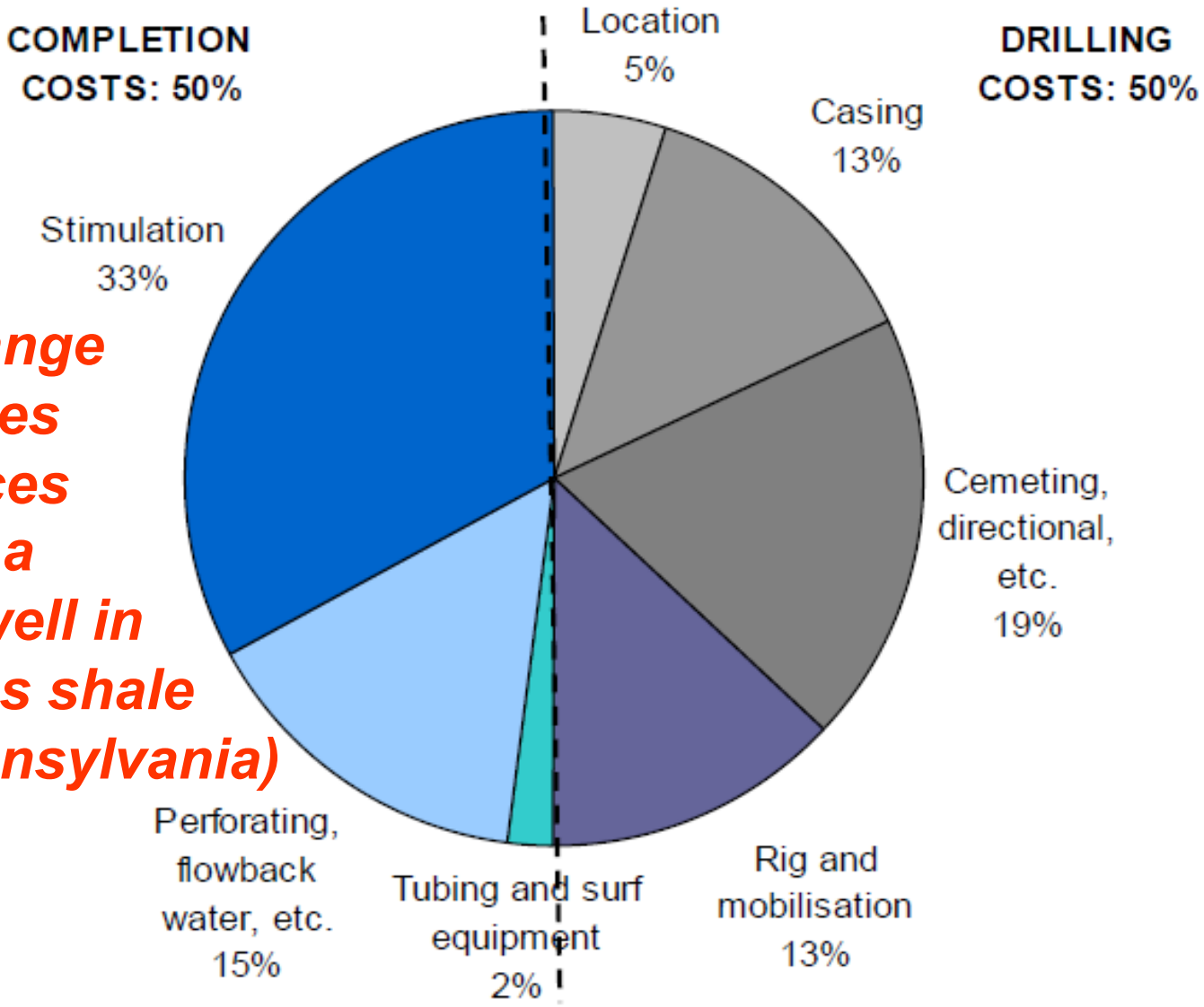


- In Haynesville shale the emerging core area includes ~110 000 acres or about 5 townships.
- i.e. ~**8%** of the 1.5 M-acres play area in Louisiana within the drilling limits.
- It was recently ranked the 4th largest gas field in the world, and the largest in North America.
- Operators claim 6.5-7.5 Bcf per well. How can HK and EXCO wells be twice better than those of CHK or EOG?

A. E. BERMAN, Dec 2, 2010

ARE COSTS TOO HIGH?

Total Haynesville well said to cost 9 M$...



…but Range Resources announces 4 M$ for a similar well in Marcellus shale (SW Pennsylvania)

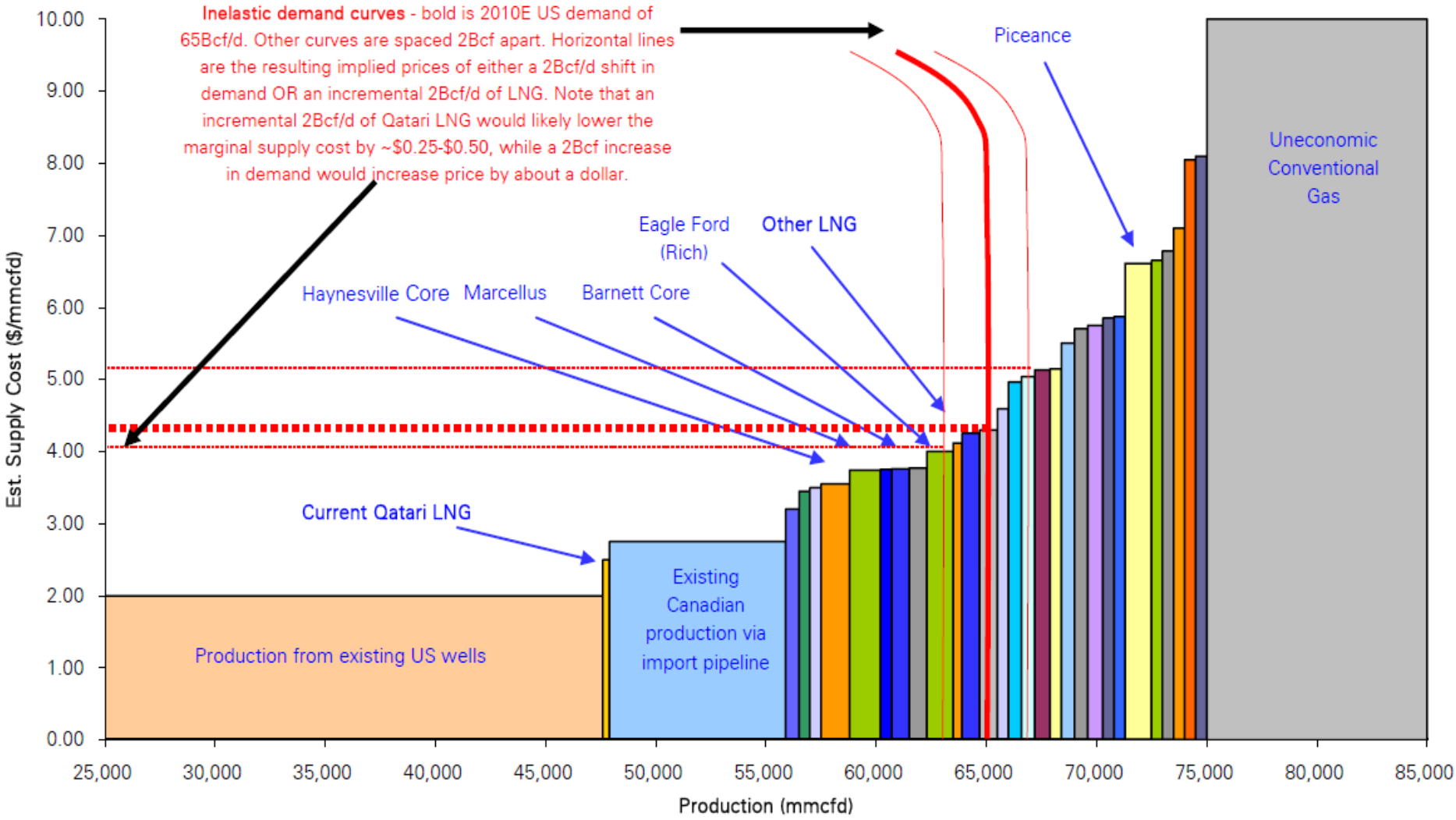
YES SAYS ART. BERMAN…*

He doubts that shale plays can be commercial and says…

- "…Most operators maintain the illusion of success…
- …Growth is subsidized by debt and sales of assets…
- …High decline rates call for continuously drilling…
- …Mostly high-cost plays: $7 based on SEC 10-K…
- …Overstated booked reserves (80% are undeveloped)…
- …Undeveloped reserves must be drilled within 5 years…
- …Destruction of shareholder equity (write-downs & sales)…
- …And falling strips that do not allow hedging…"

Source: "Shale Gas, Abundance or Mirage?" presentation in Quebec, Dec. 2010

NO SAYS WOODMAC*



Source: Deutsche Bank/Woodmac supply cost curve estimates Sept. 2010

EXAMPLES OF ECONOMICS

Source: Enterprise Products Partners L.P.

Company	Play	Break Even ($/kcf)
Ultra	Pinedale Lance Sands	2.8
Williams	San Juan Conventional	4.7
Talisman	Eagle Ford Rich gas	4.0
Goodrich	Haynesville	3.3 - 4.6
Newfield	Arkoma Woodford	3.0 - 4.6
Chesapeake	Fayetteville	4.0 - 4.7
Range	Marcellus rich shale	2.4

TRUE SHALE GAS REALITIES

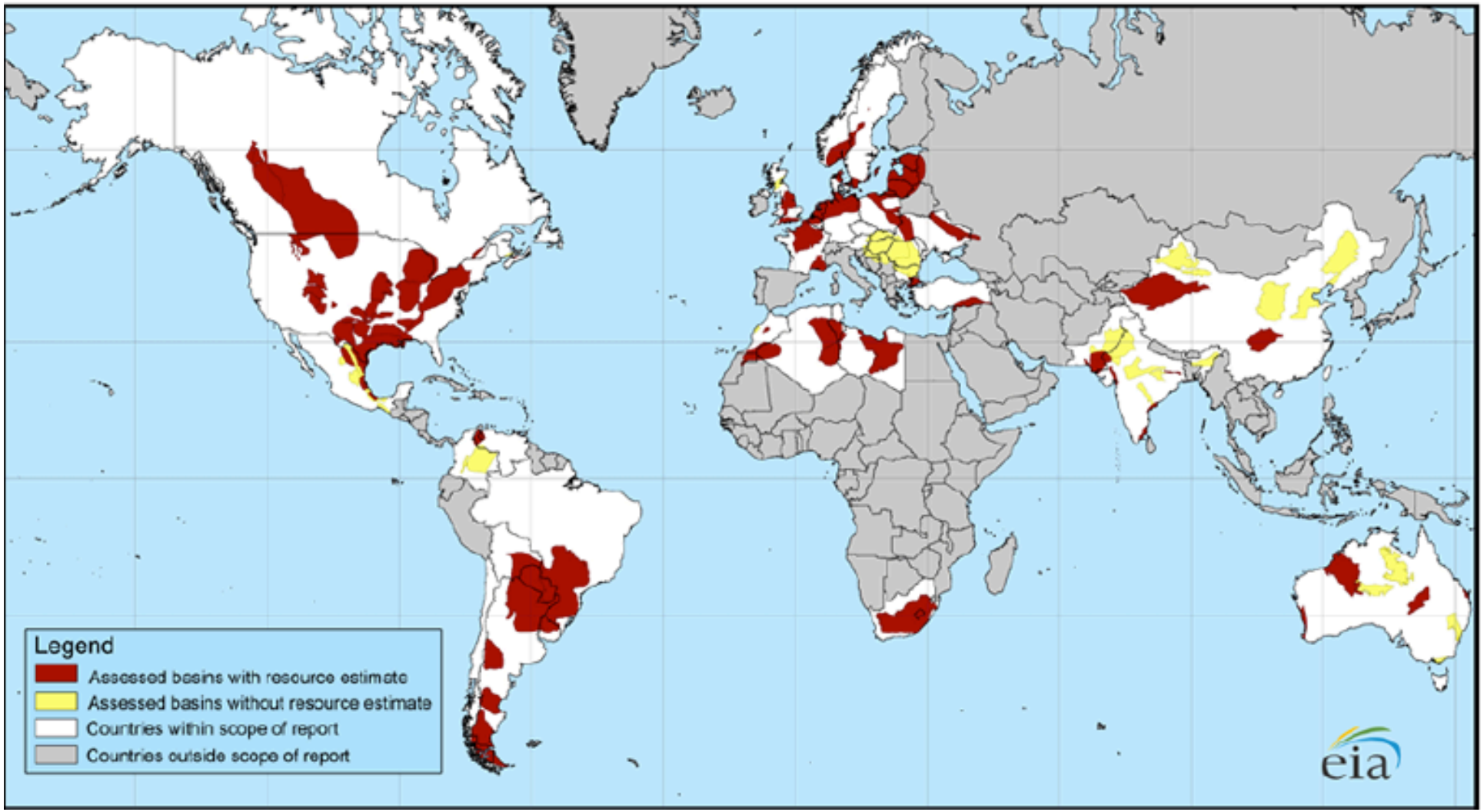
- Shales are the last unconventional gas in development, and still are at the beginning of the learning curve. The pace of technological improvement will continue
- EUR (expected ultimate reserves) critically depend on the type of decline (exponential or hyperbolic) but economics become irrelevant after 10-20 years
- High costs plays: NGL make part of the economic value; Core areas with good IP are small (a few %), but overall reserves may be very large (a “game-changer”)
- Good operators will manage environmental concerns but infrastructure (NGL plants and pipelines) is critical

CONCLUSION: WHAT FUTURE?

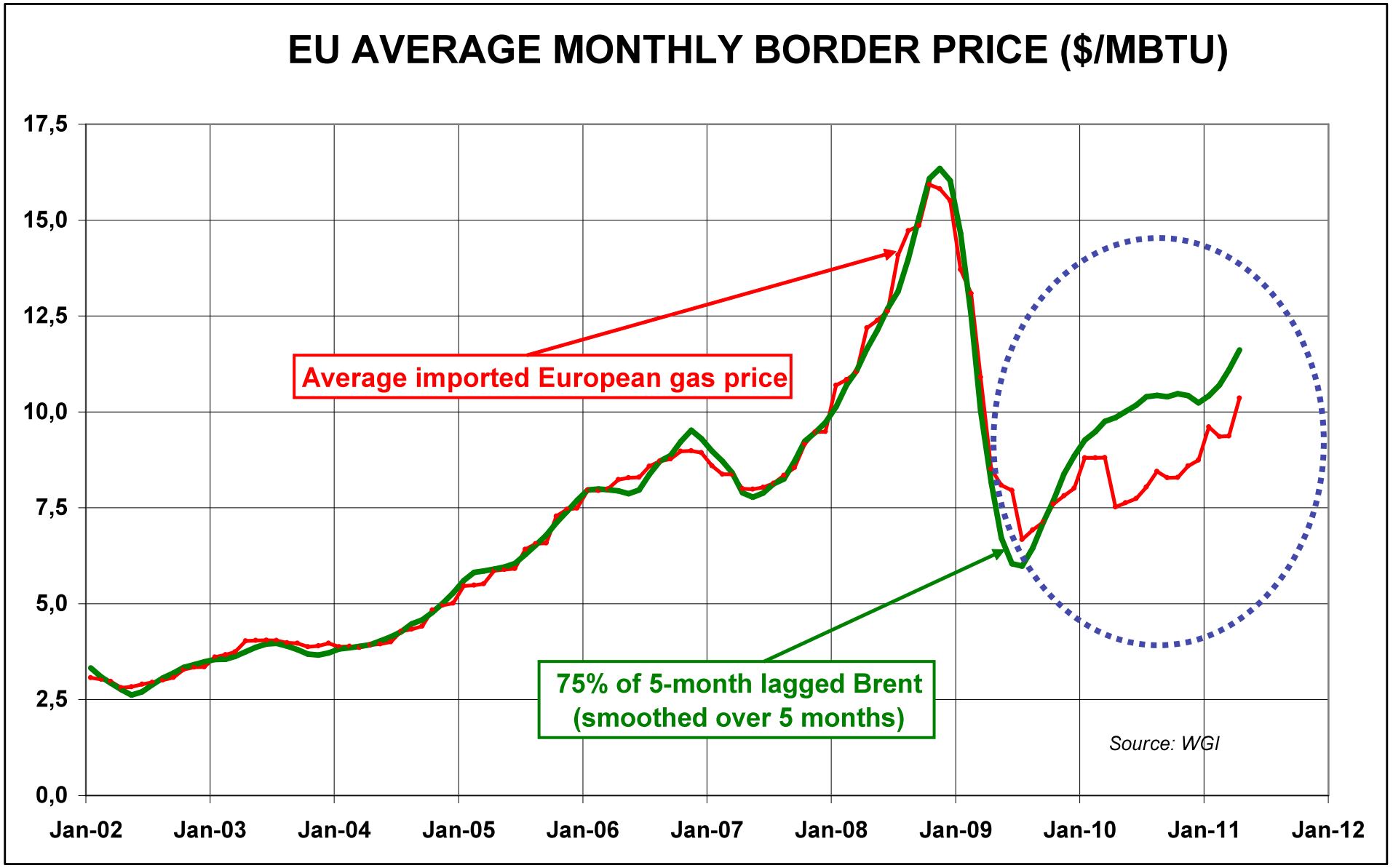
- **In North America**: Exports of a few % of production as LNG will sustain a balanced price level (5-6 $/kcf) which, in turn, will allow production to grow evenly.
- **In Europe**: Unconventional gas prospects are remote: not only spot LNG imports push prices down but the EU E&P legislation needs to be deeply redrafted
- **In Asia-Pacific**: Neither China unconventional (still far away), nor Australian CBM-to-LNG (2-3 Bcf/d) will be game changers and decouple LNG from oil soon.

WORLD SHALE RESOURCES

6 622 Tcf of which 20-30% may be recoverable



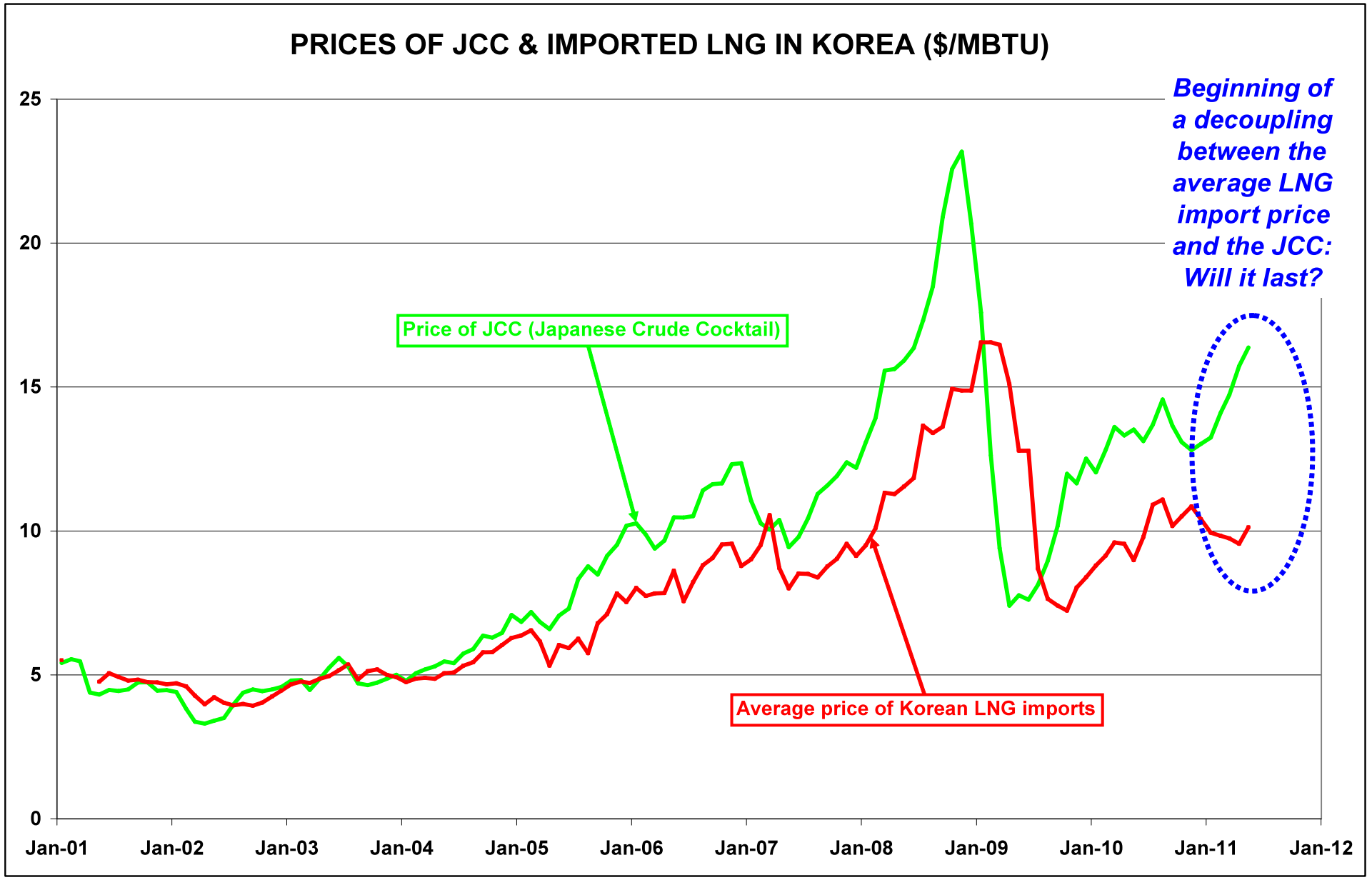
EU OIL-NATGAS DECOUPLING



ASIA-PACIFIC

- Some countries like Korea did succeed to lower their LNG supply cost but oil-indexation will likely remain, especially in the post-Fukushima context
- The nuclear crisis will add new LNG requirements in Japan (+7 Mt/y?), Asia-Pacific (China? India?) and Western Europe (?), and push LNG prices up
- High LNG prices make unconventional attractive but controlled domestic prices reduce the incentives as well as the lack of liquids in “dry” gas such as CBM

KOREAN LNG DECOUPLING




MARCELLUS LANDSCAPE
THANK YOU