Shale Gas and Tight Oil:
A Panacea for the Energy Woes of America?

ASPO-USA Conference
The Next Oil Crisis: Is the Boom Just Another Bubble?
Austin, Texas
November 30, 2012

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Global Sustainability Research Inc.

Geological Survey of Canada - retired

The Optimism on Gas

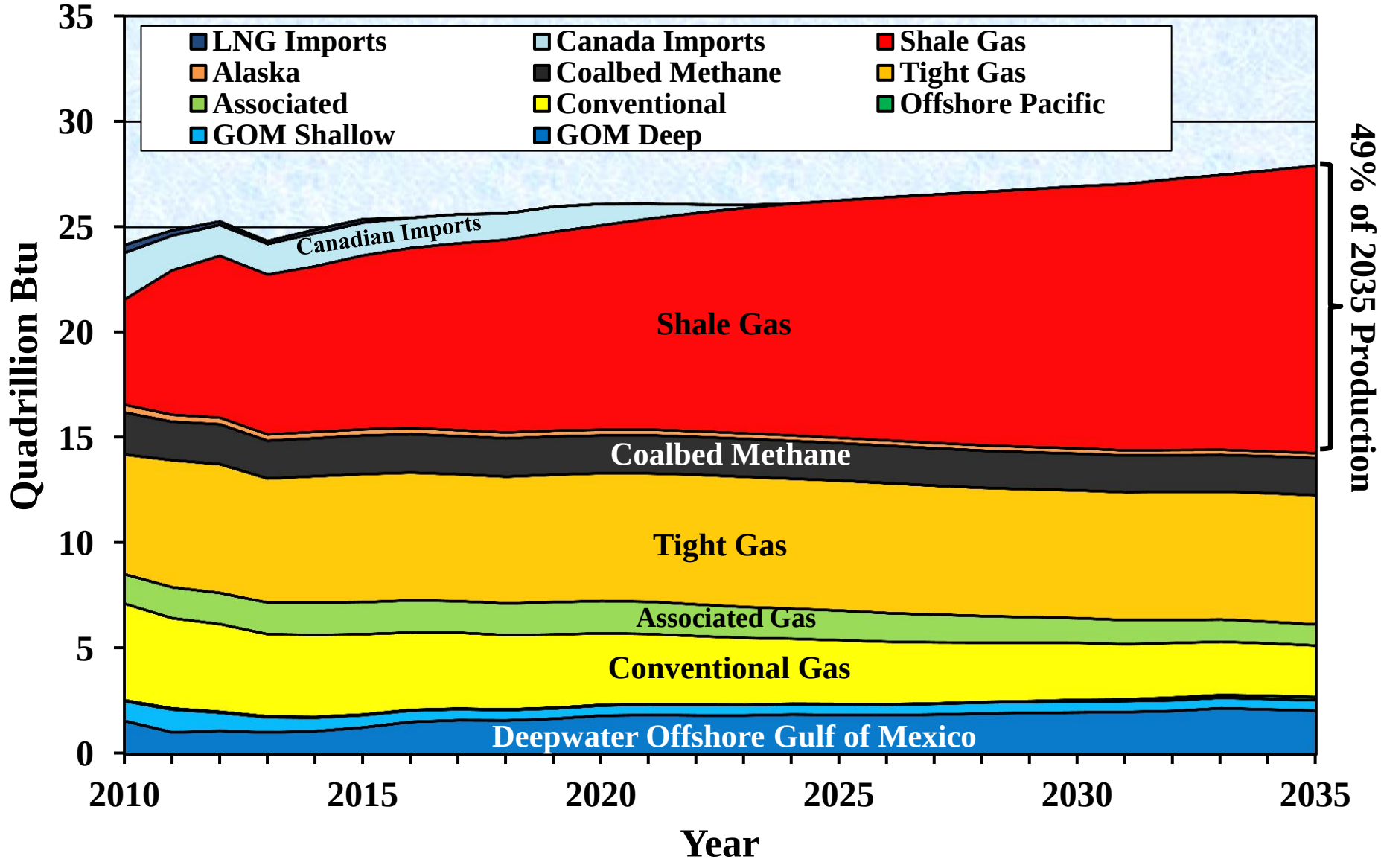
- There is so much natural gas that there is enough available to, according to one researcher, "displace half of the coal burning power plants [in the United States] by 2020" (Pickens Plan, 2012)

- "We have the domestic natural gas necessary to fuel our trucks and fleet vehicles…" (Pickens Plan, 2012)

- Studies from prestigious energy research firms and universities have affirmed that the dream of clean, abundant, home grown energy is now reality, with the help of shale gas. (ANGA, 2012).

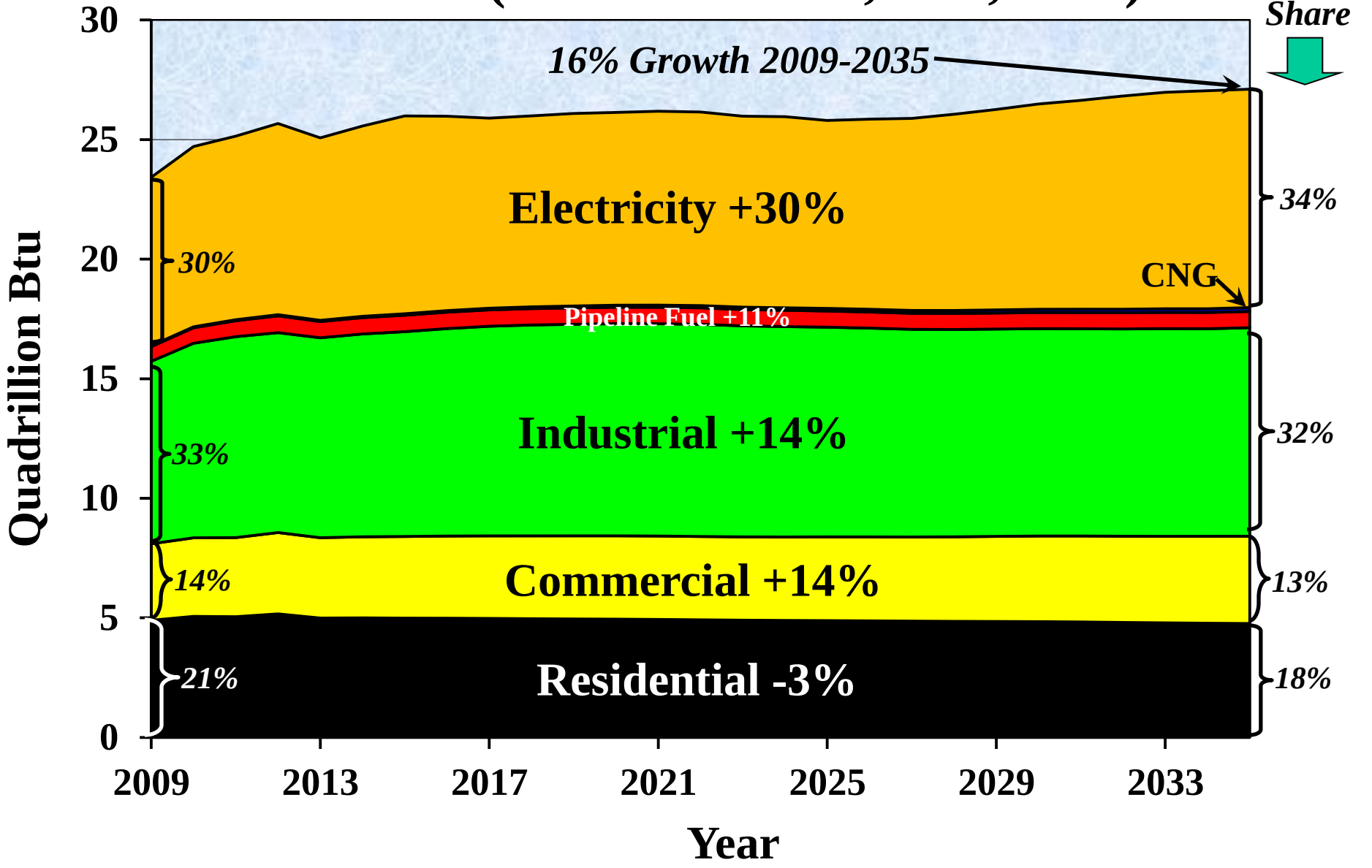
- The Utica Shale is "the biggest thing to hit Ohio since the plow" (Aubrey McClendon, Chesapeake, 2011).

U.S. Natural Gas Supply by Source, 2010-2035, EIA Reference Case 2012



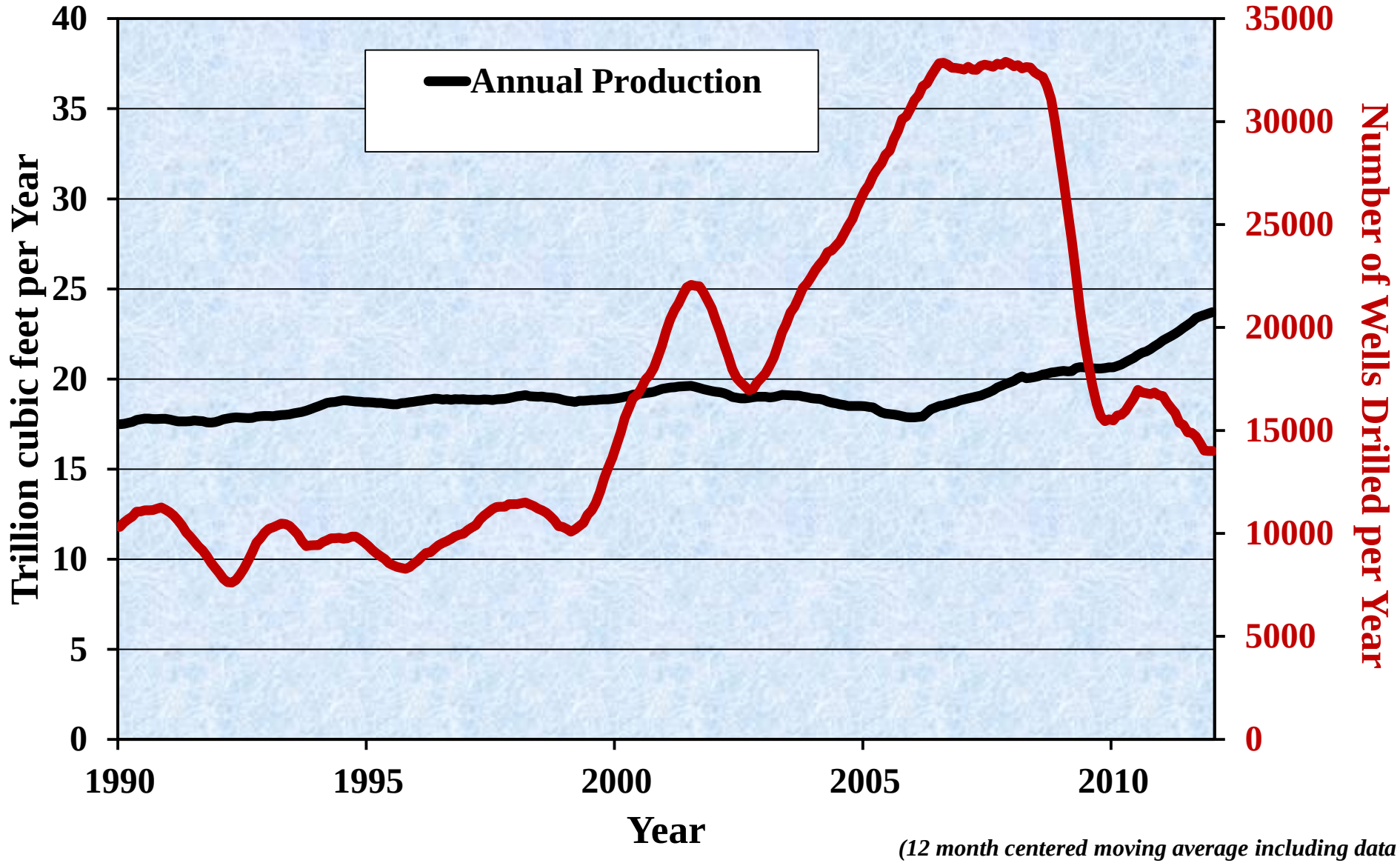
(data from EIA Annual Energy Outlook 2012)

U.S. Natural Gas Consumption by Sector 2009-2035 (Reference Case, EIA, 2012)



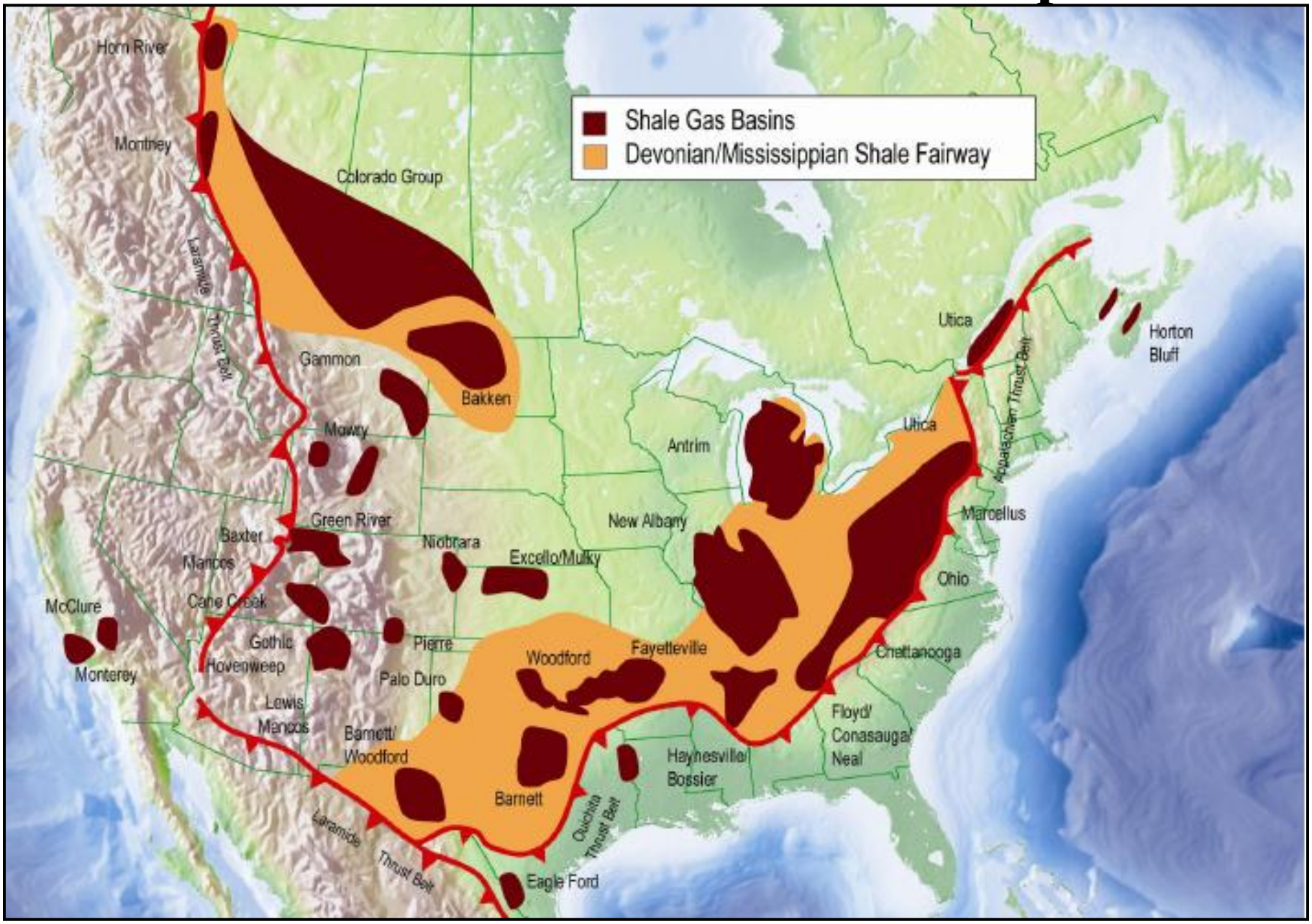
(data from Energy Information Administration Annual Energy Outlook, 2012)

U.S. Gas Production versus Gas Wells Drilled per Year, 1990-2012



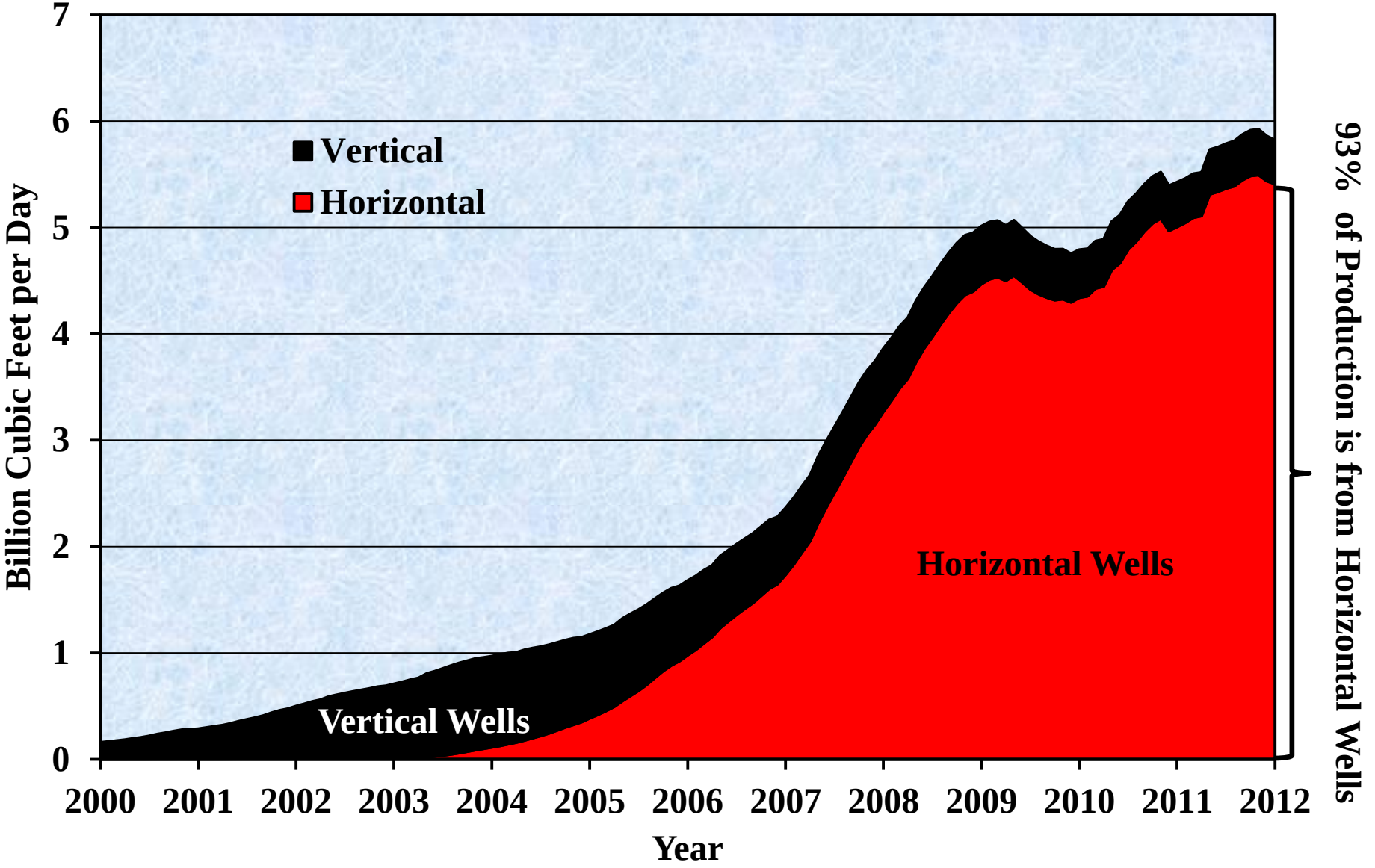
(12 month centered moving average including data to June 2012 - data for well count http://www.eia.gov/dnav/ng/ng_enr_wellend_s1_m.htm and dry gas production http://www.eia.gov/naturalgas/monthly/xls/ngm01vmall.xls)

Shale Gas – North American Prospects



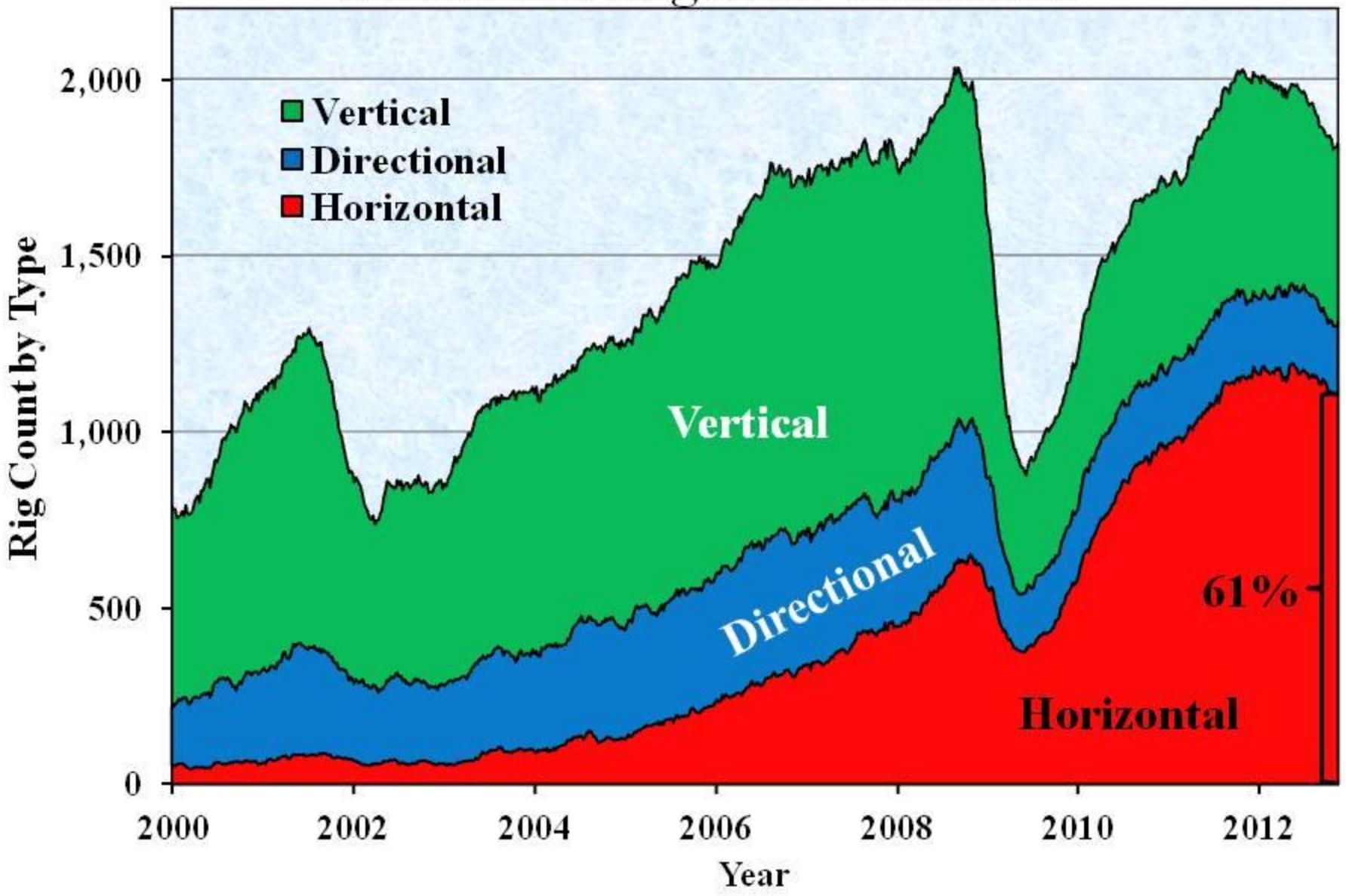
(from National Energy Board, 2009)

Barnett Shale Production by Well Type, 2000-2012, Illustrating Impact of Horizontal Drilling Technology



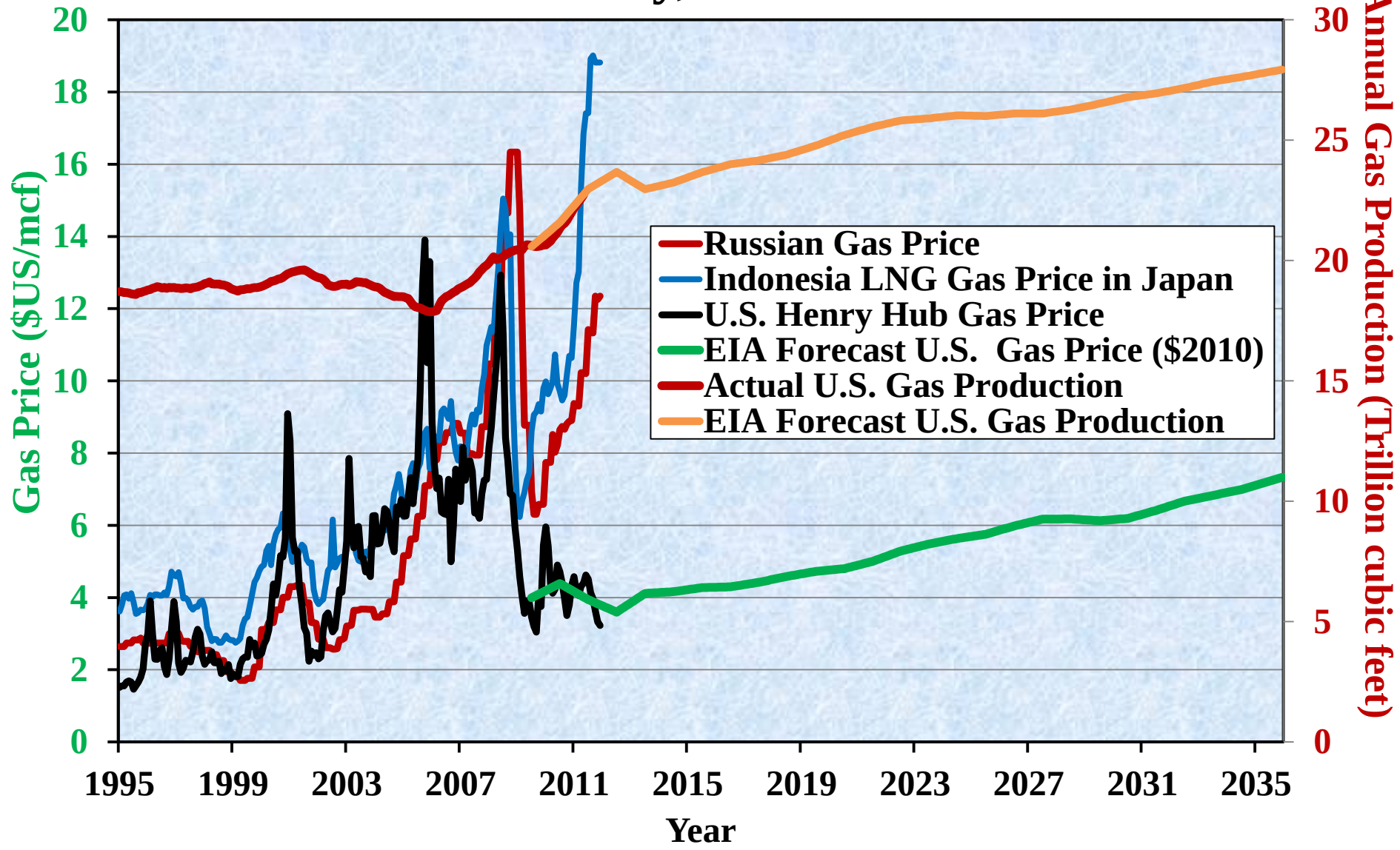
(data from DIdesktop, June, 2012, fitted with 5 month centered moving average including data up to March, 2012)

U.S. Rig Count by Type, 2000-2012
Horizontal Rigs now Dominate



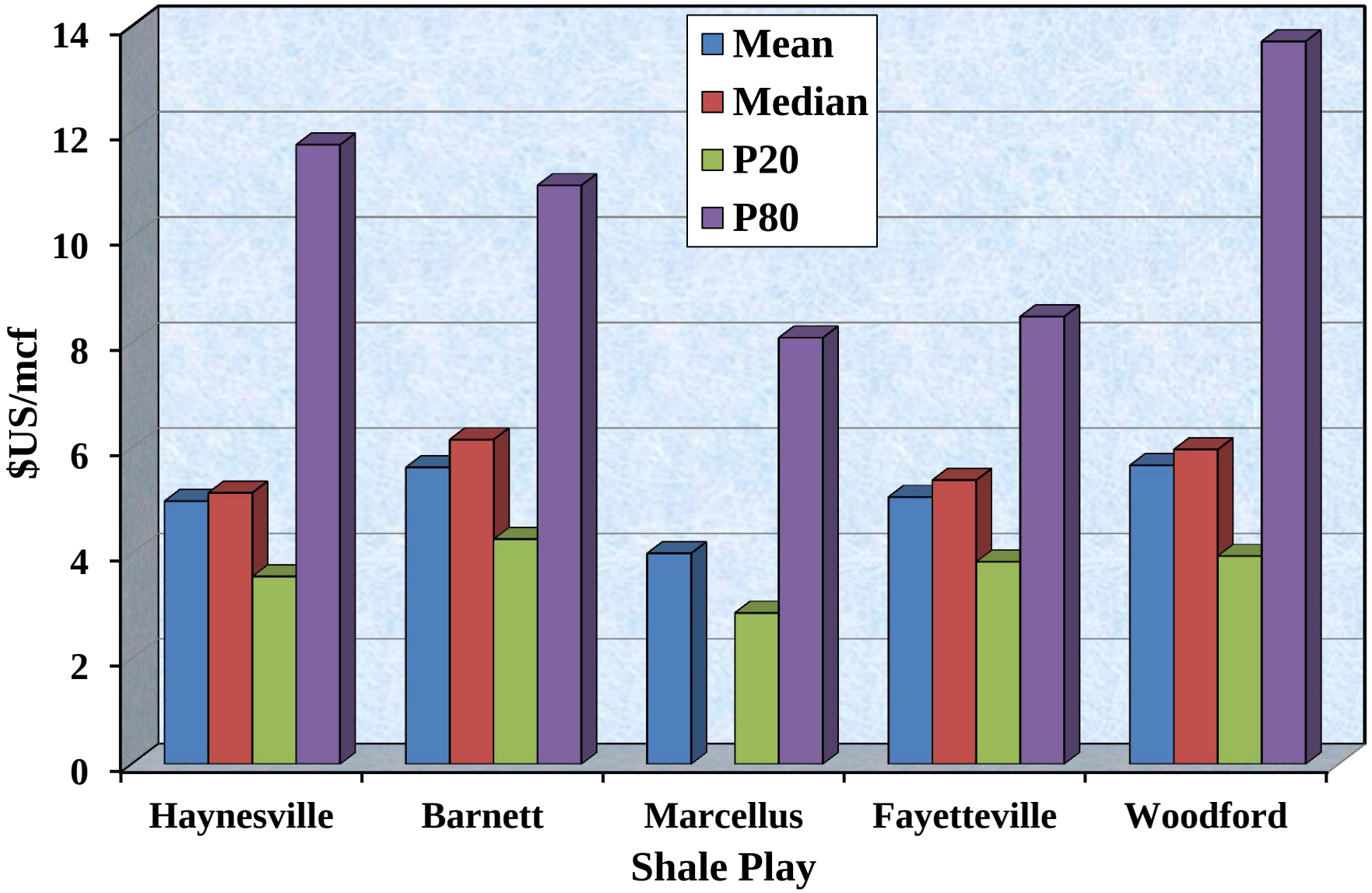
(data from Baker-Hughes, November, 2012)

EIA projections of Gas Price and Production Compared to History, 1995-2035



(data from International Monetary Fund 2012; EIA AEO 2012)

Breakeven Gas Price by Shale Play for a 10% Rate of Return



(data from Jacoby et al., Economics of Energy and Environmental Policy, vol. 1, no.1, 2012)

Arthur Berman on Shale Gas (ASPO meeting in Washington DC, October, 2010)

"Shale plays are marginally commercial at best."

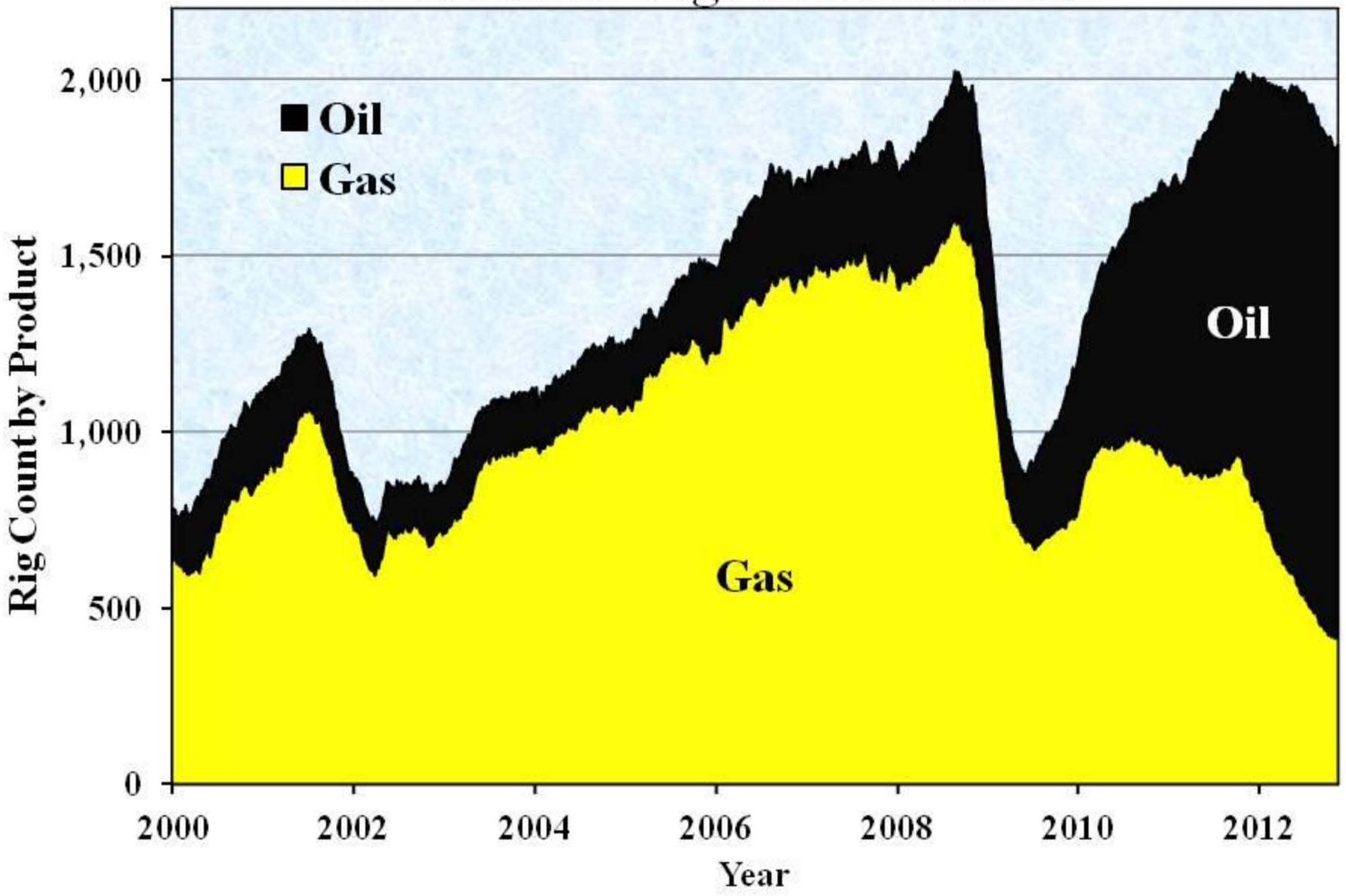
"The plays have consistently contracted to a core area that represents 10-20% of the resource that was initially claimed. The manufacturing model has failed."

"These are not low-cost plays: the marginal cost of production for most companies is $7.50/Mcf based on SEC 10-K filings over the past 5 years."

"Reserves have been greatly over-stated and 80% of booked reserves are undeveloped."

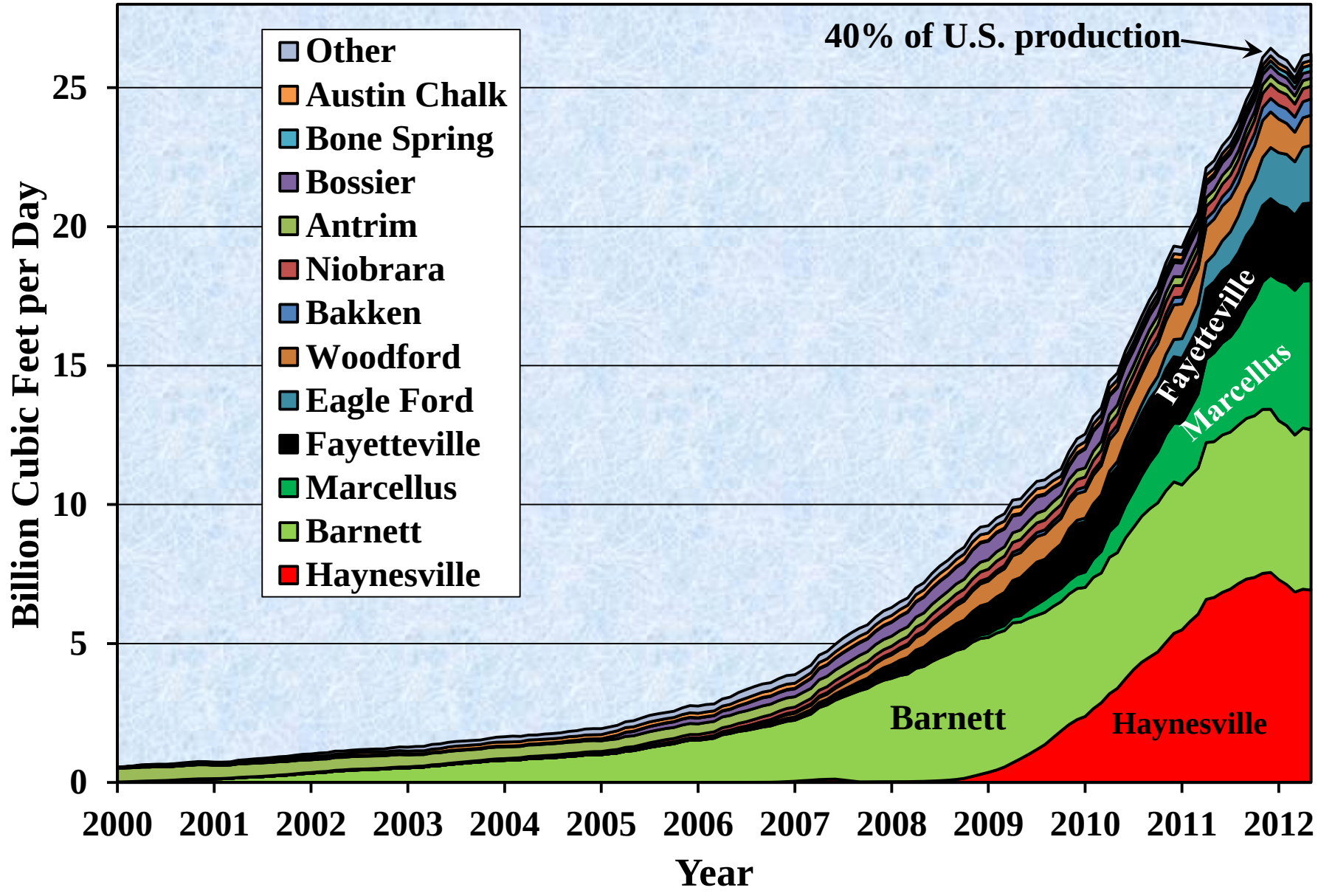
(from Art Berman's ASPO-USA presentation in October 2010)

U.S. Rig Count by Product, 2000-2012
Oil-Directed Rigs now Dominate



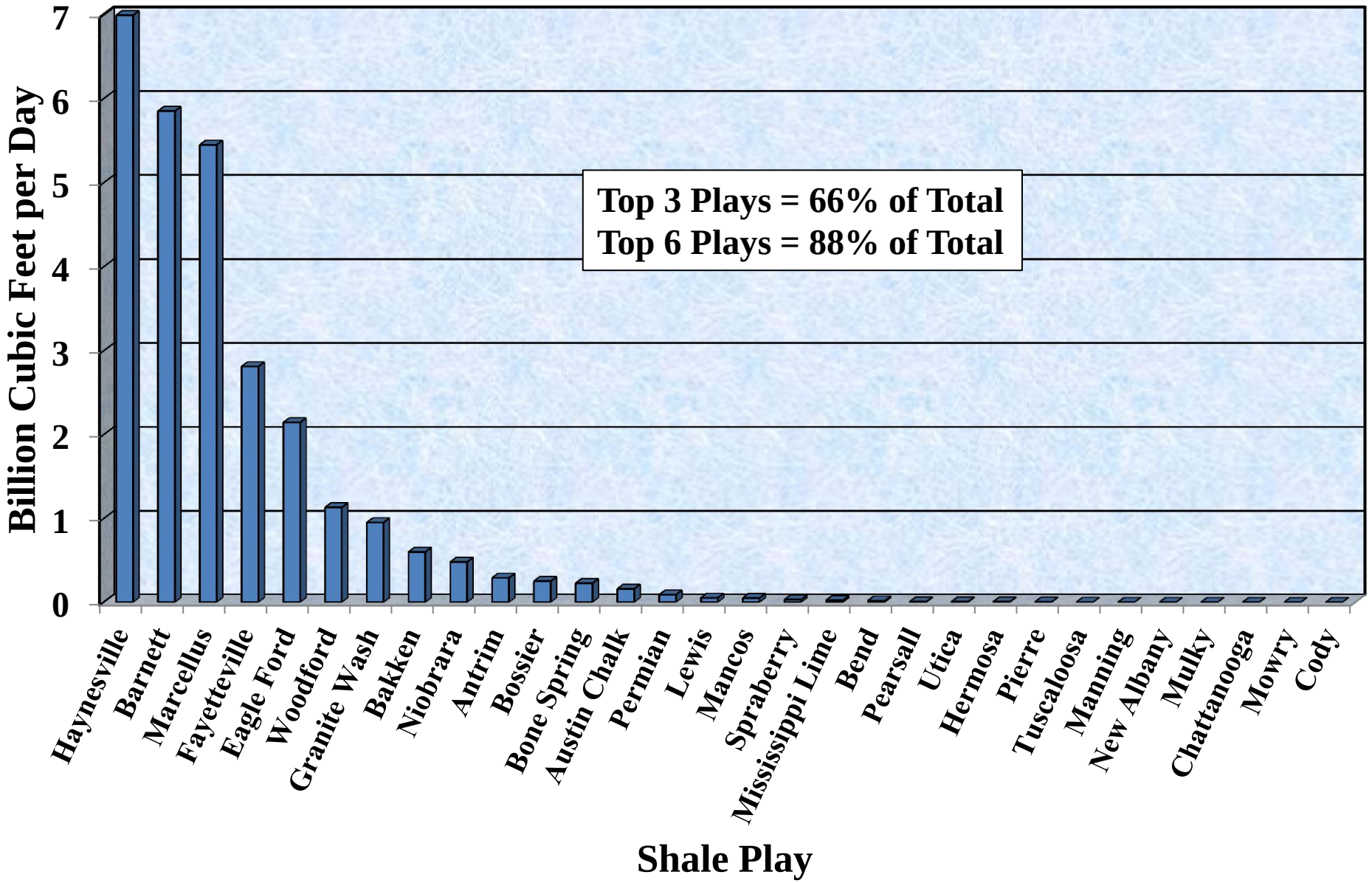
(data from Baker-Hughes, November, 2012)

Shale Gas Production by Play, 2000-2012



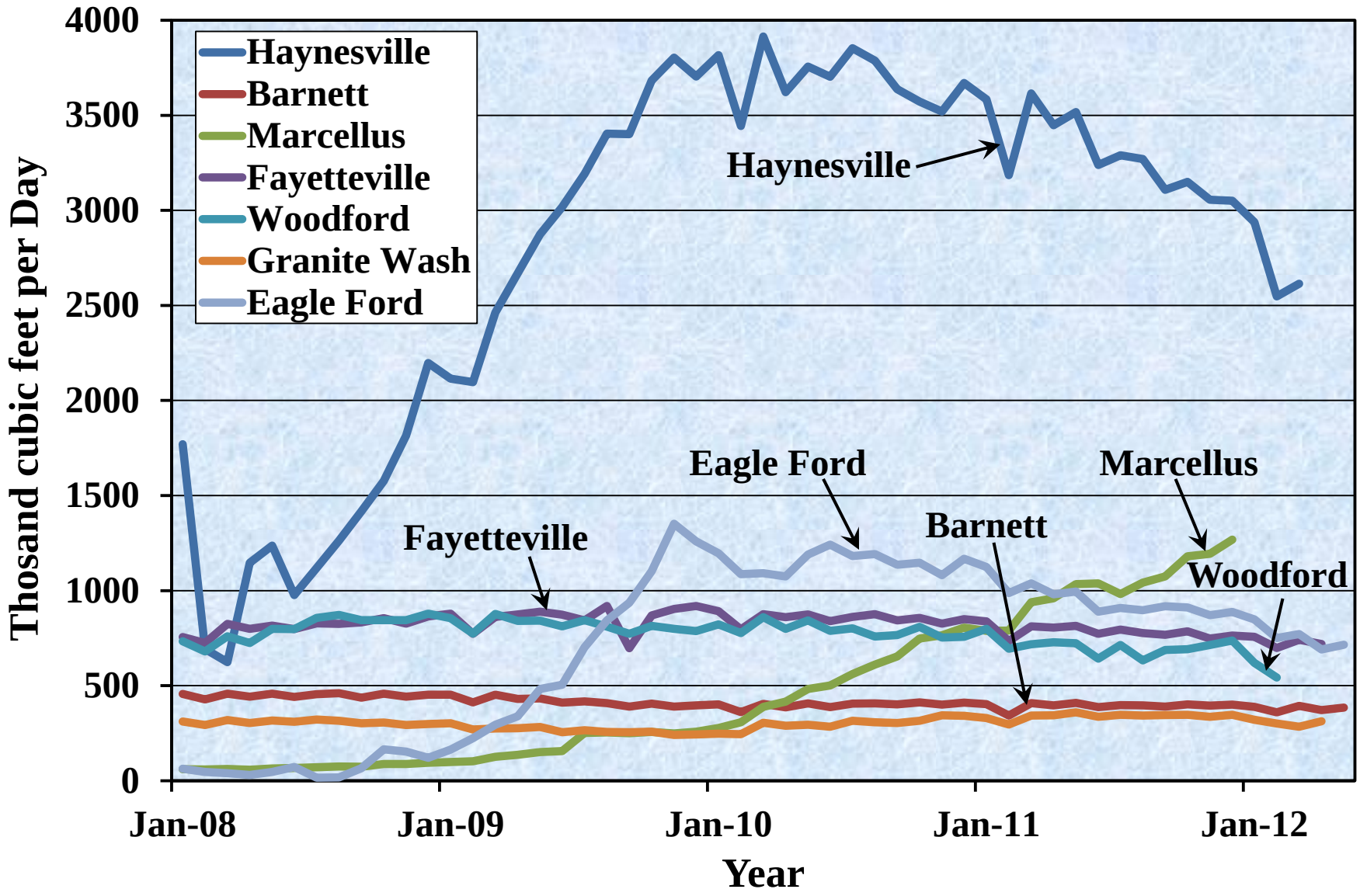
(data from DIdesktop, September, 2012, fitted with 3 month centered moving average including data up to June, 2012)

Shale Gas Production by Play



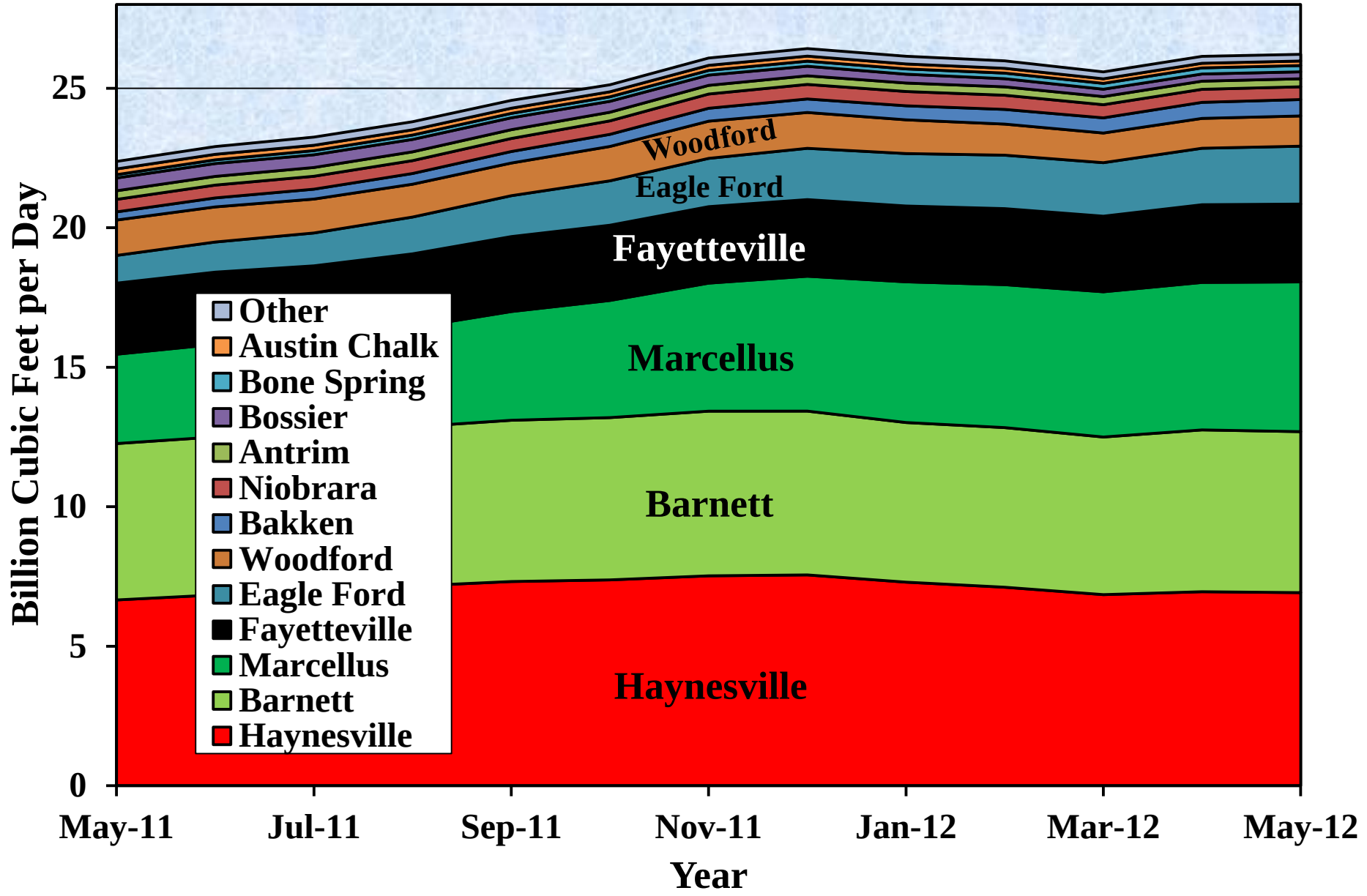
(data from DI Desktop, September, 2012, for production in most cases through May-June, 2012)

Average Well Production by Month for Top Seven Shale Gas Plays Accounting for 92.5% of Shale Gas Production



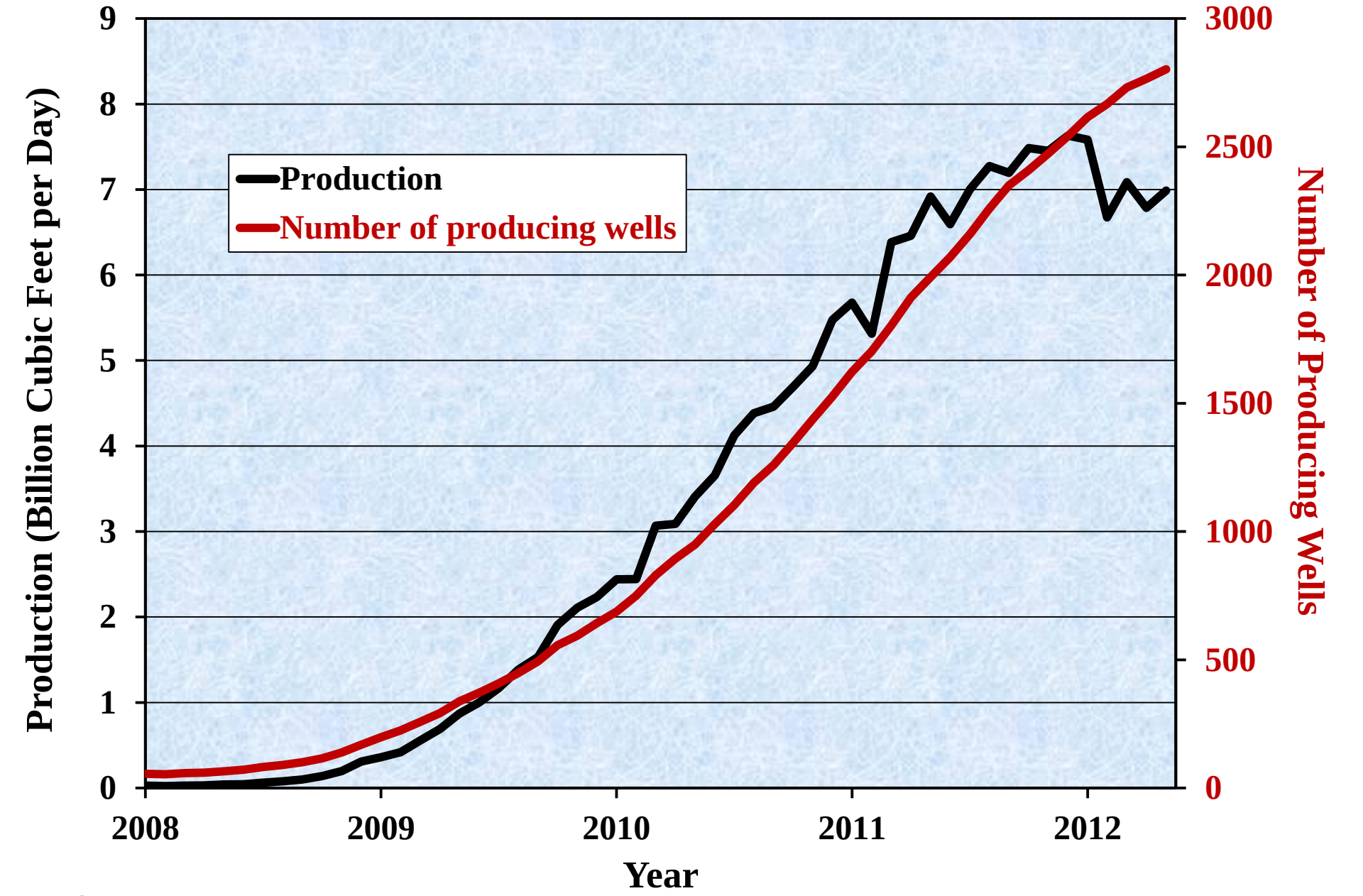
(data from DIdesktop, July and August, 2012)

Shale Gas Production by Play, May 2011 – May 2012



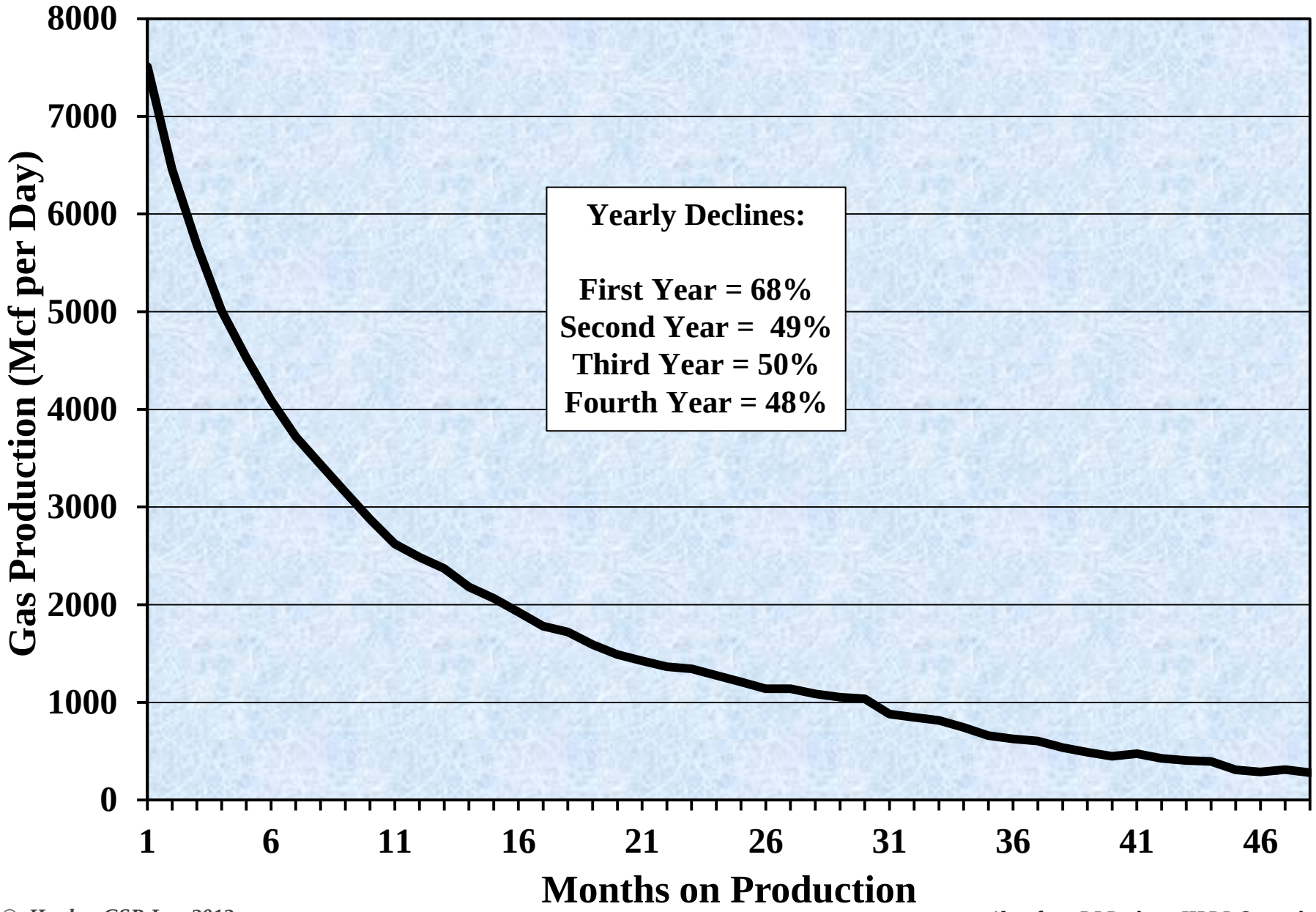
(data from DI Desktop, HPDI, September, 2012)

Haynesville Shale Gas Production vs Operating Wells



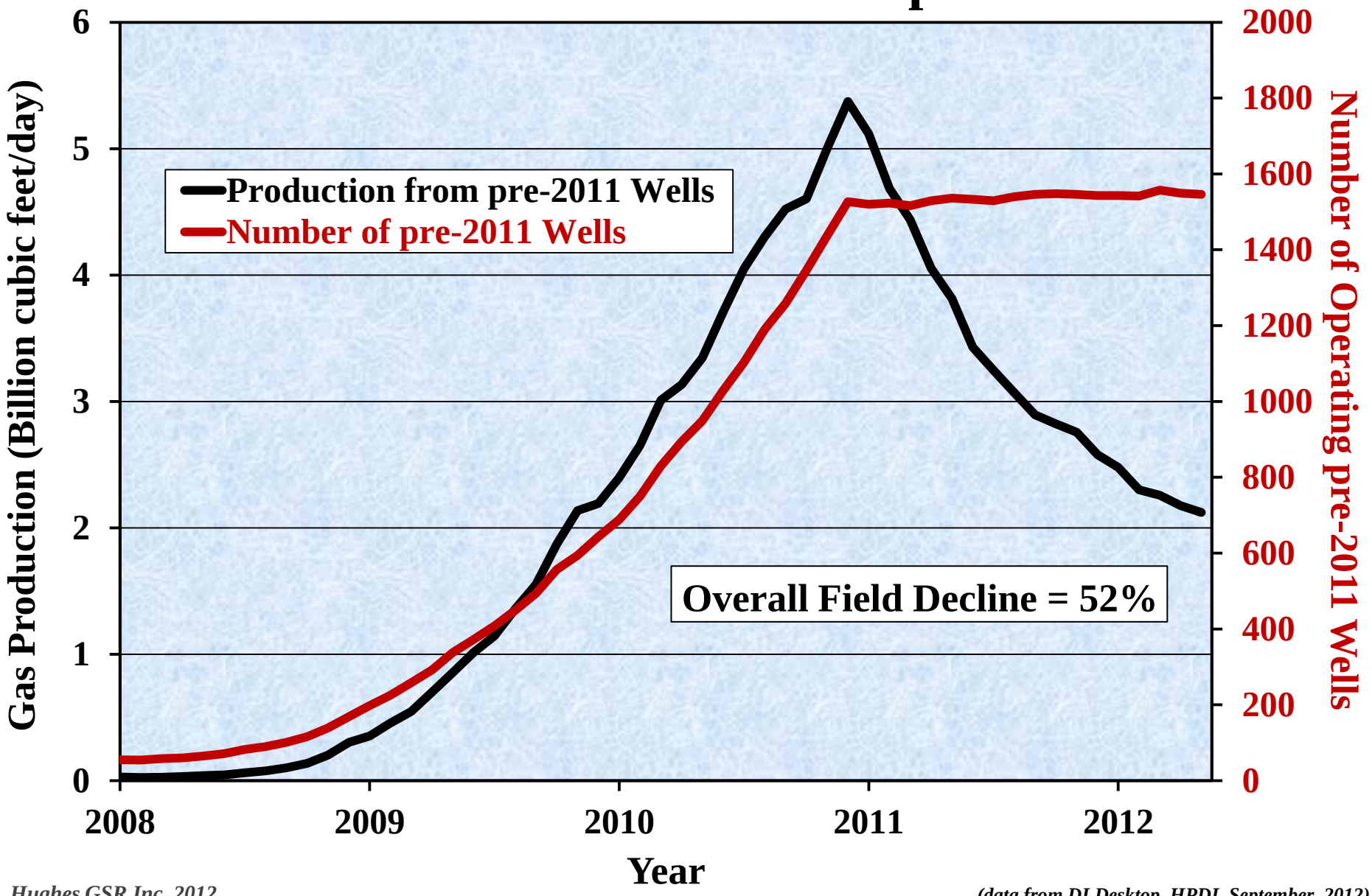
(data from DI Desktop, HPDI, September, 2012)

Type Decline Curve for Haynesville Shale Gas Wells



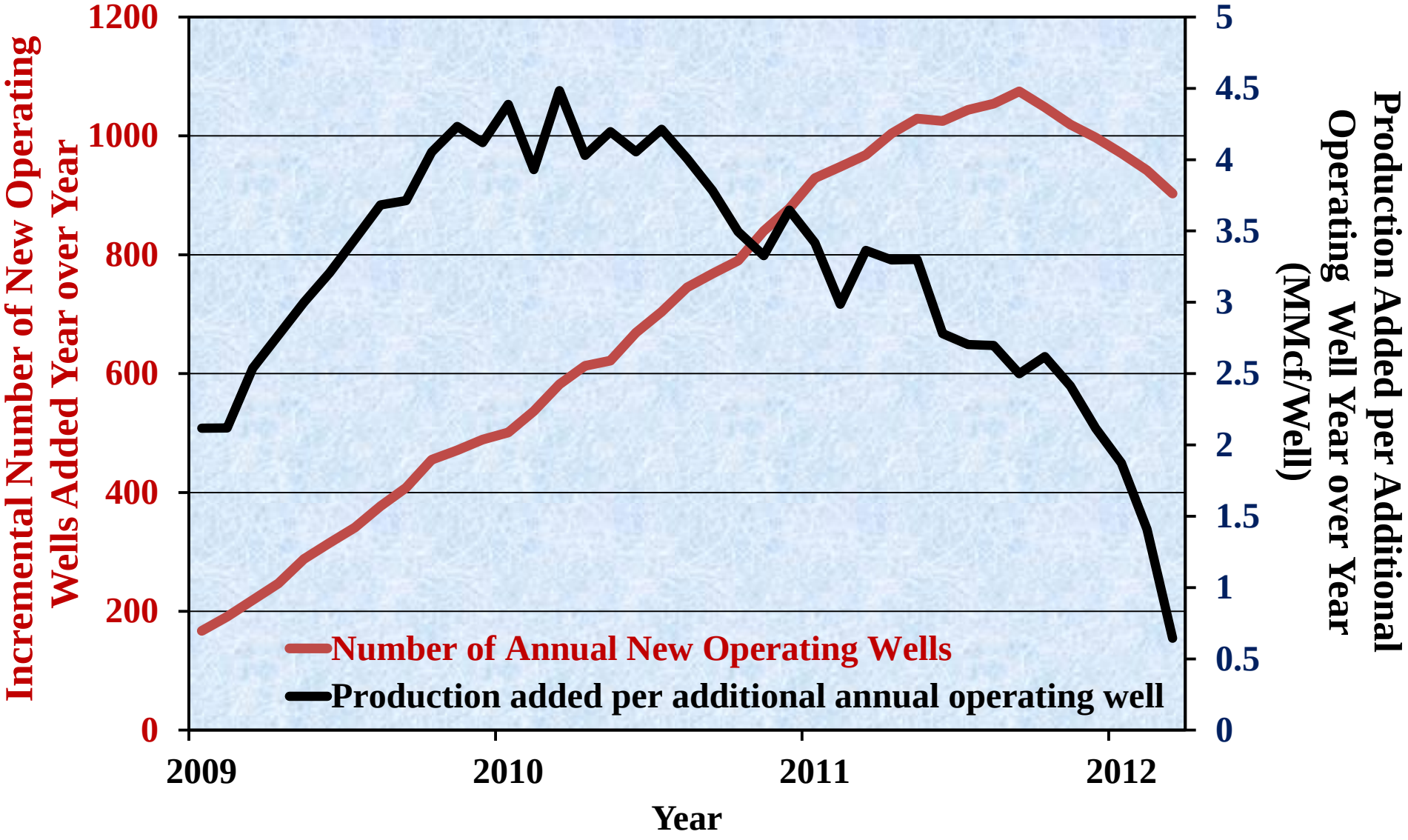
(data from DI Desktop, HPDI, September, 2012)

Overall Field Decline for Haynesville Gas Production based on Production Decline from pre-2011 Wells



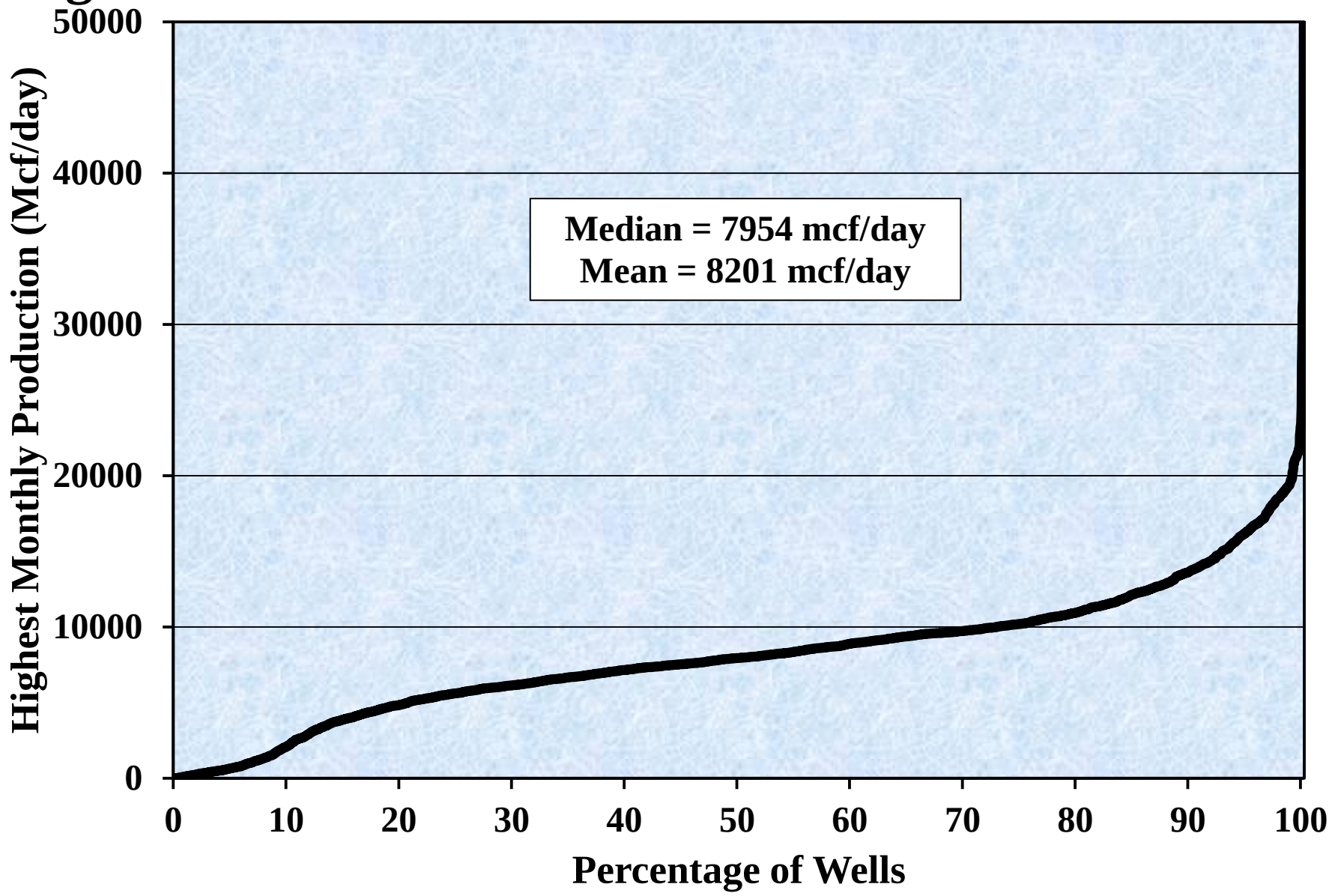
(data from DI Desktop, HPDI, September, 2012)

Haynesville Production Added From Each Additional Operating Well on a Year over Year Basis



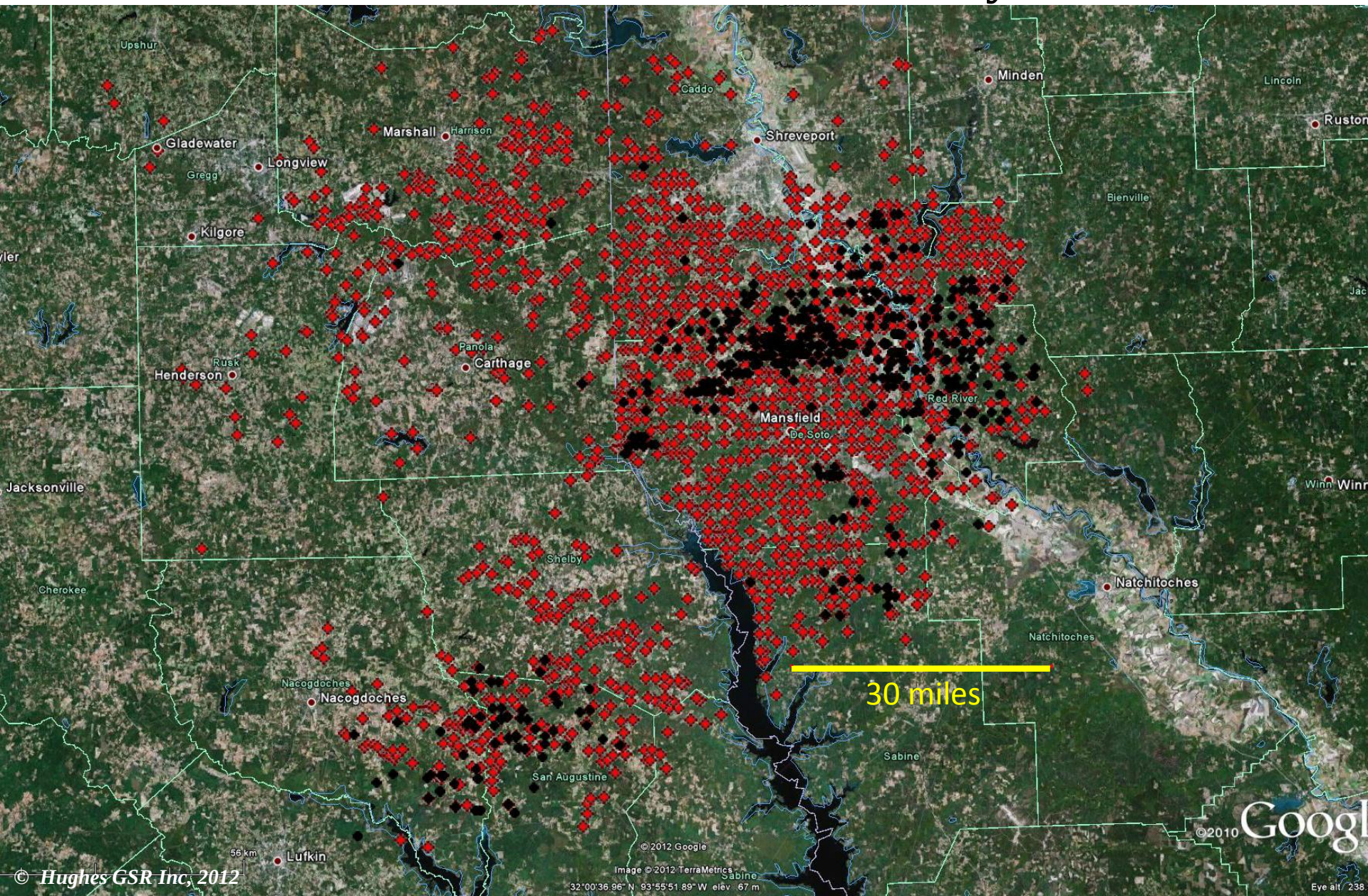
(data from DIdesktop, July and August, 2012)

Haynesville Well Quality
Highest One Month Gas Production from Individual Wells

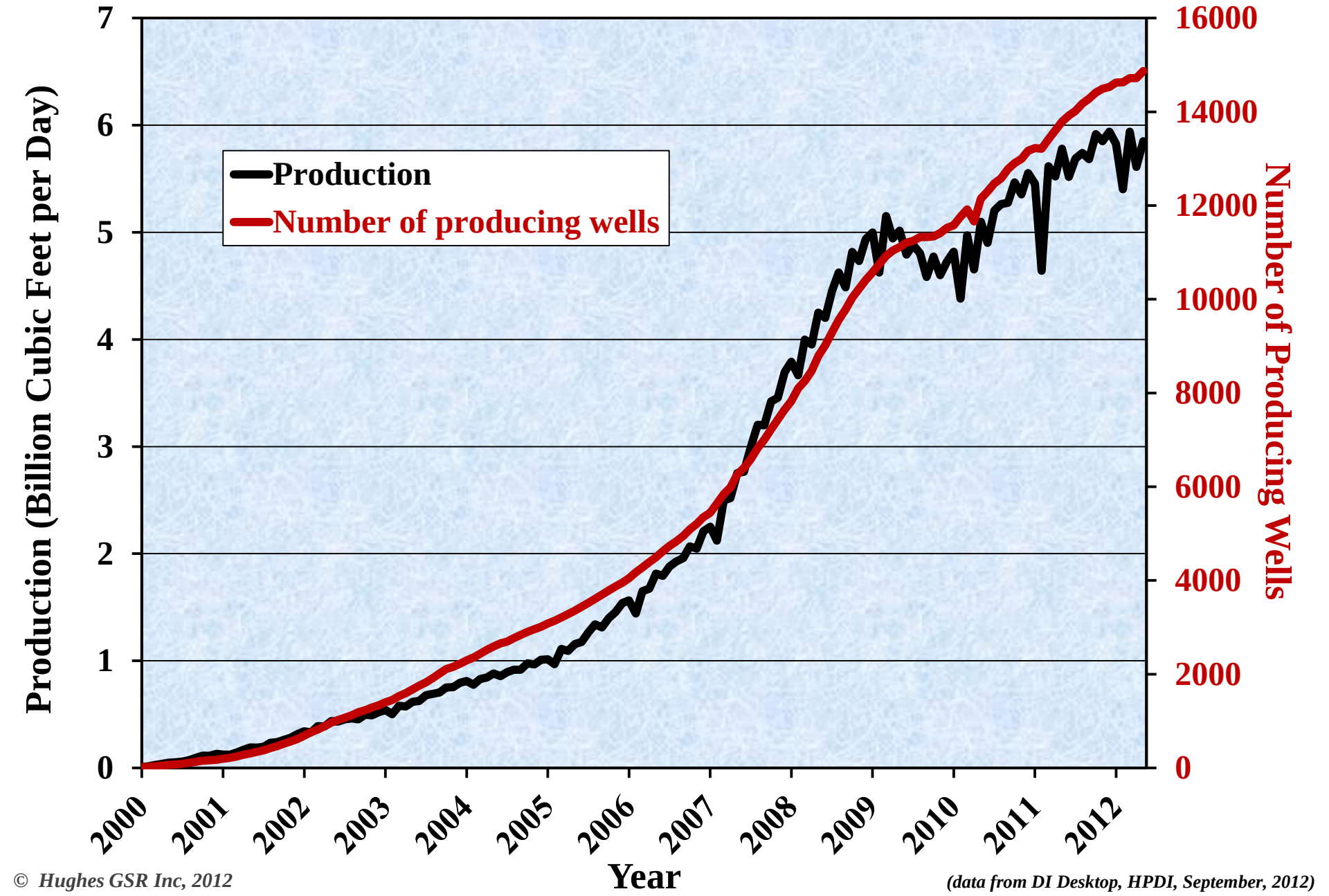


(data from DI Desktop, HPDI, September, 2012)

Haynesville Well Quality - Top 20% with Highest One Month Production of >10989 mcf/day in black

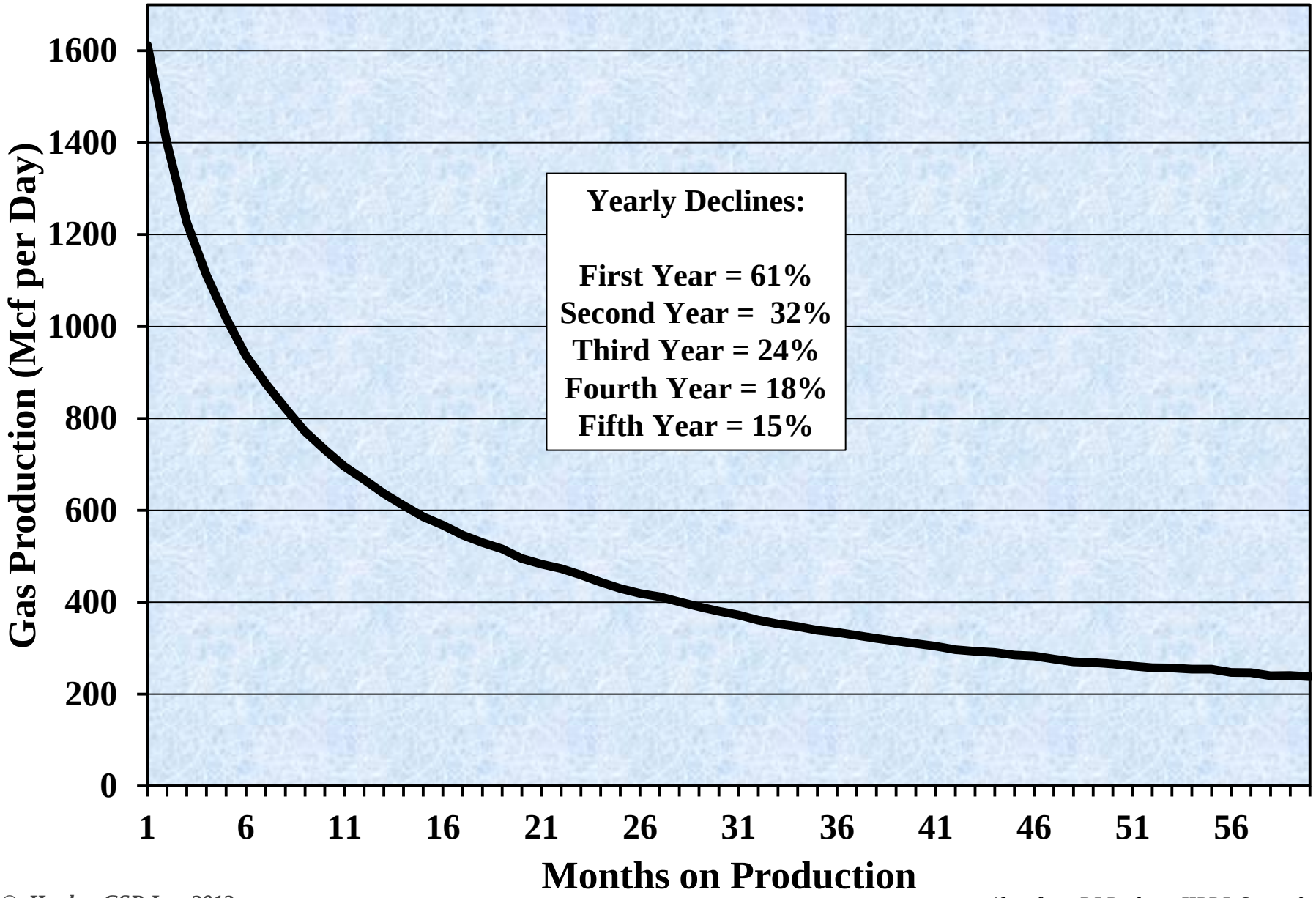


Barnett Shale Gas Production versus Operating Wells



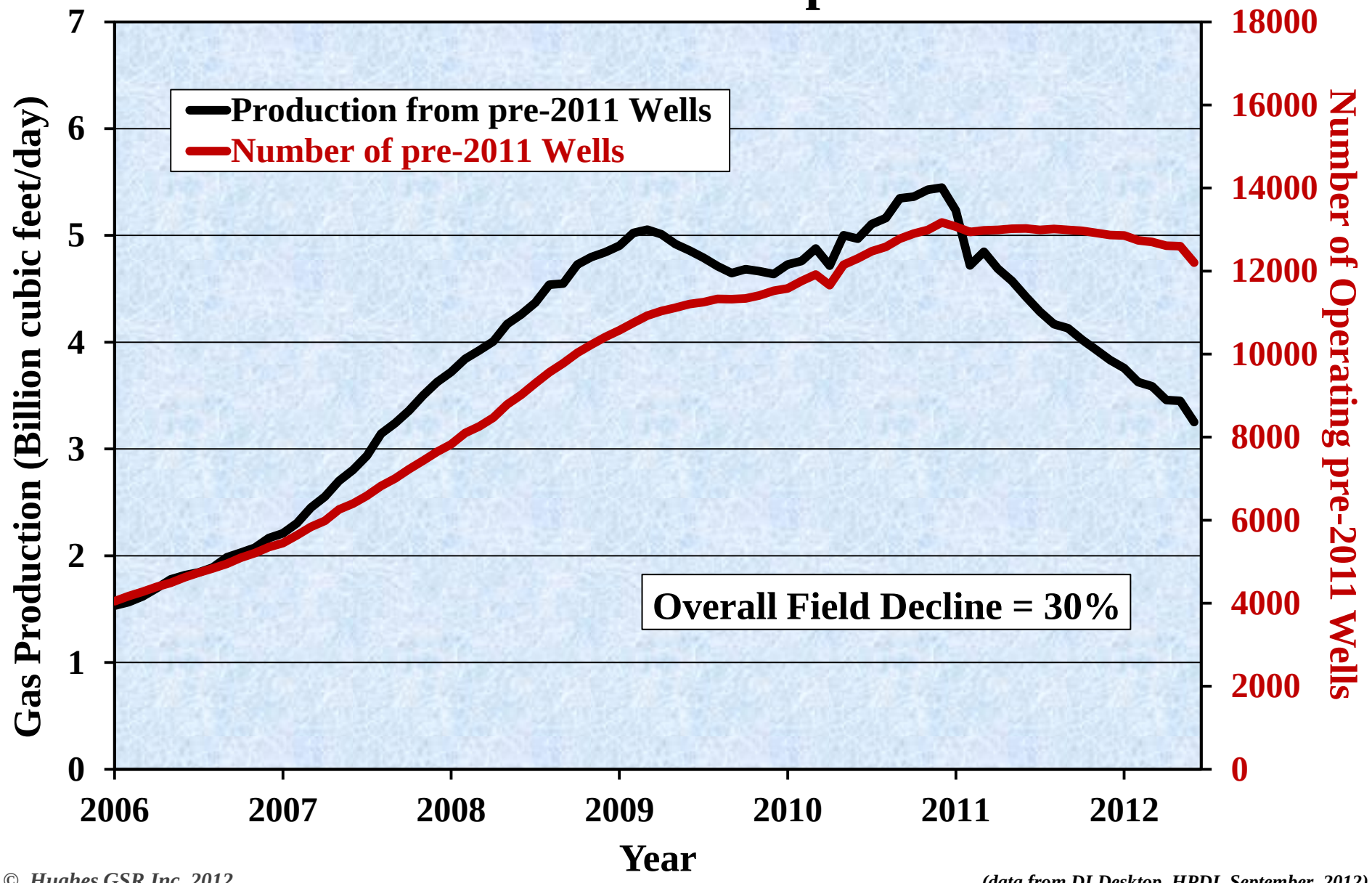
(data from DI Desktop, HPDI, September, 2012)

Type Decline Curve for Barnett Shale Gas Wells



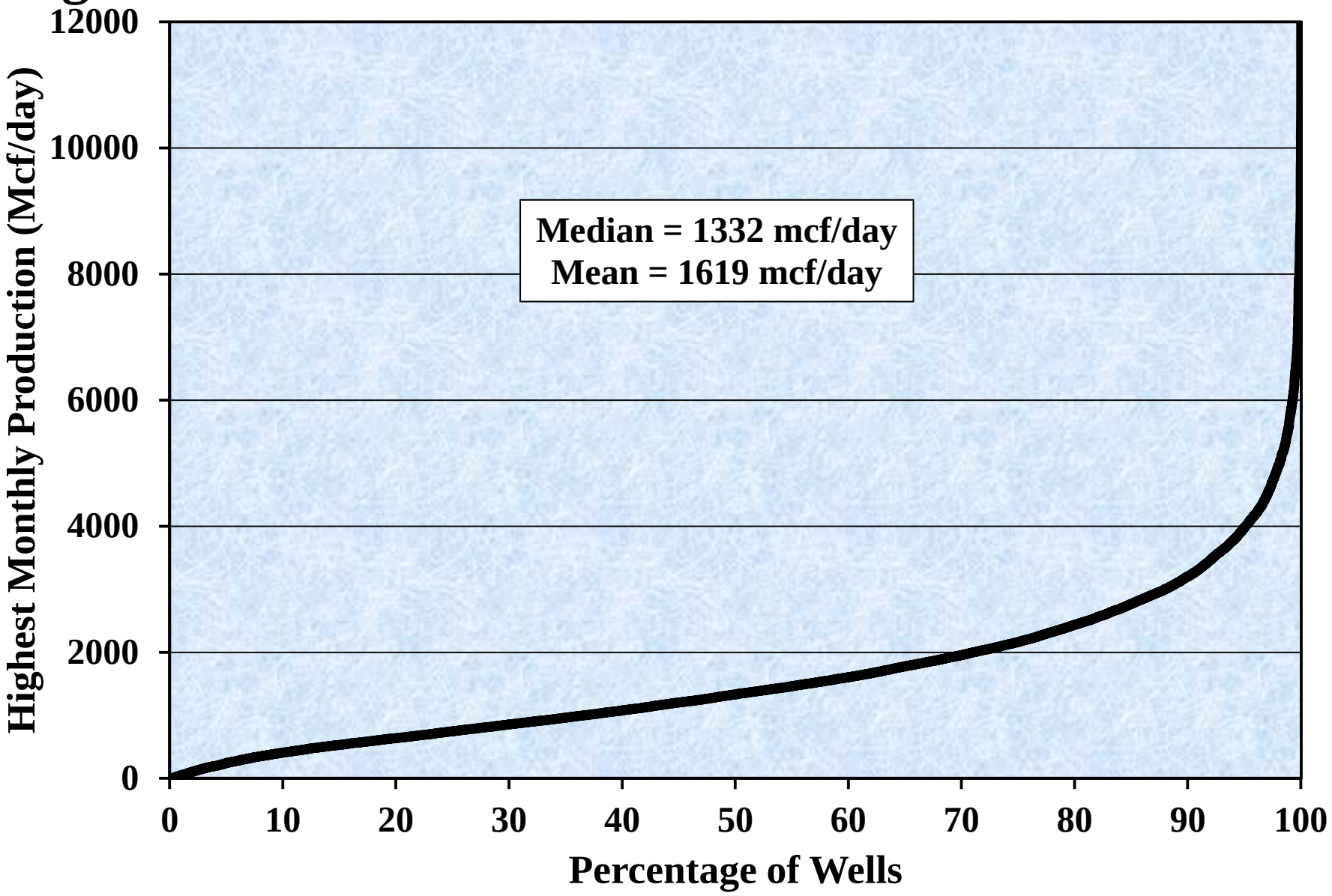
(data from DI Desktop, HPDI, September, 2012)

Overall Field Decline for Barnett Gas Production based on Production Decline from pre-2011 Wells



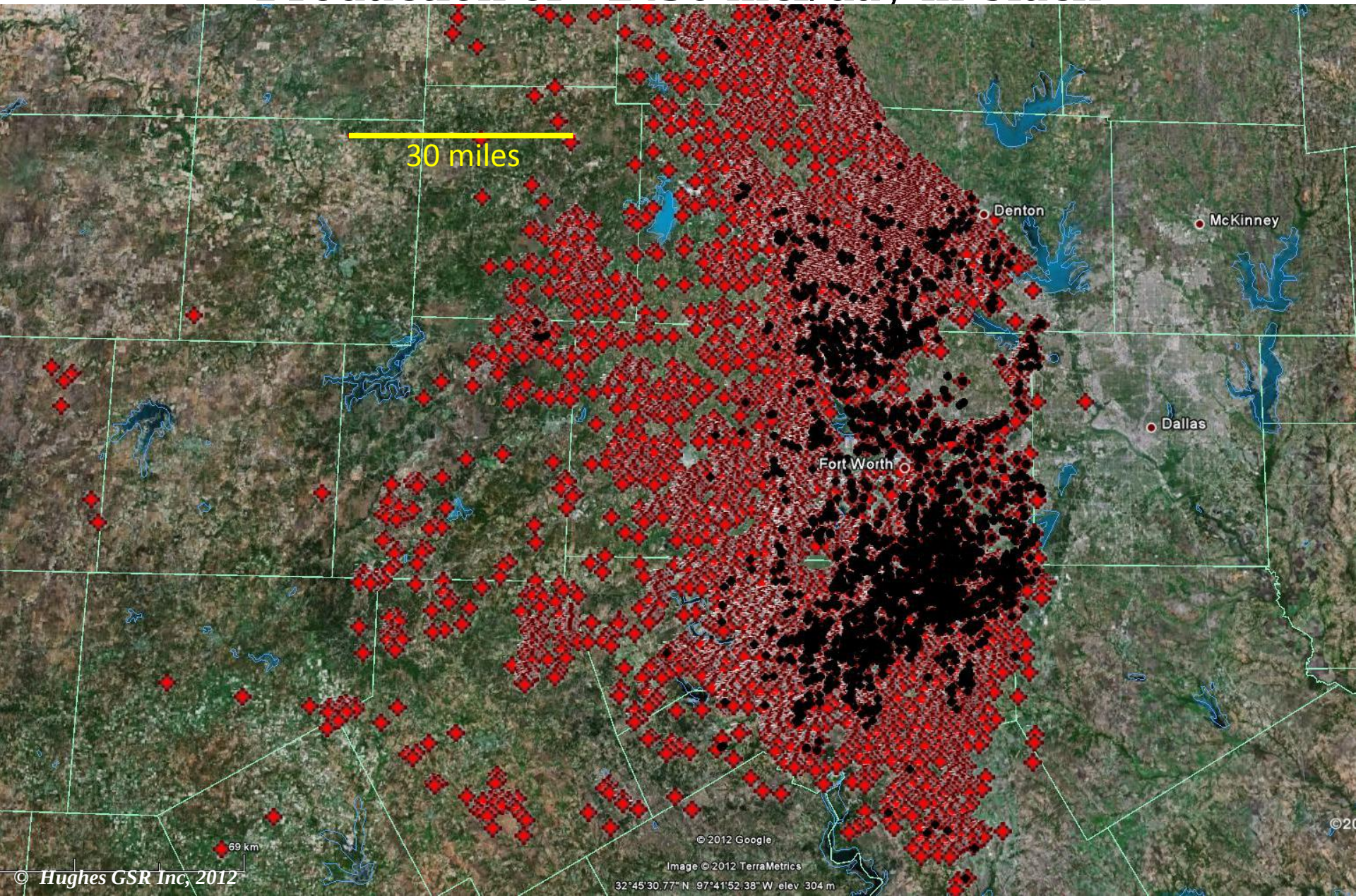
(data from DI Desktop, HPDI, September, 2012)

Barnett Well Quality
Highest One Month Gas Production from Individual Wells

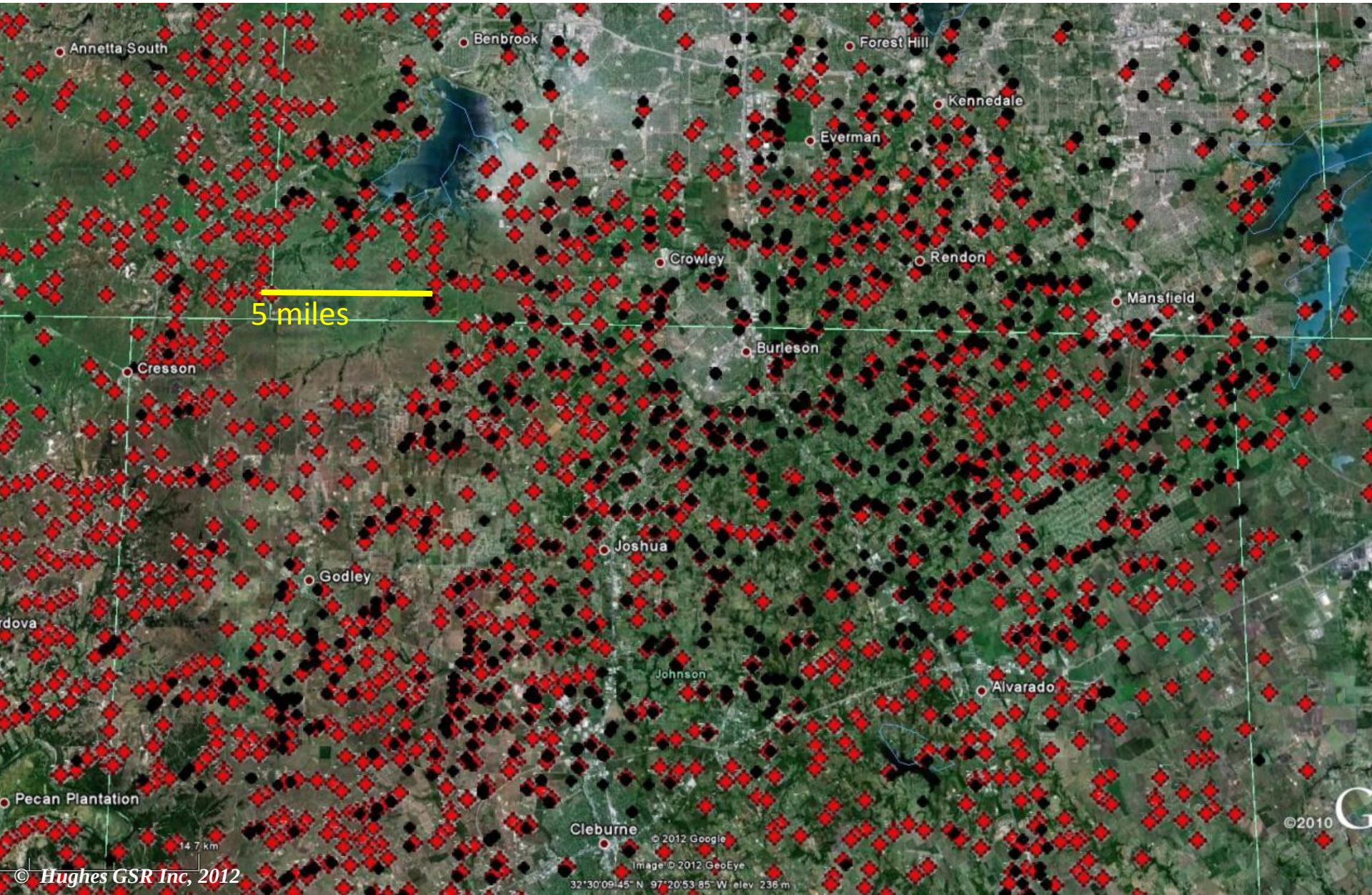


(data from DI Desktop, HPDI, September, 2012)

Barnett Well Quality - Top 20% with Highest One Month Production of >2436 mcf/day in black



Barnett Well Quality - Top 20% with Highest One Month Production of >2436 mcf/day in black



Prognosis for Future Production based on Latest Rig Count

Field	Rank	Number of Wells needed annually to offset decline	Wells Added for most recent Year	October 2012 Rig Count	Prognosis
Haynesville	1	774	810	20	Decline
Barnett	2	1507	1112	42	Decline
Marcellus	3	561	1244	110	Growth
Fayetteville	4	707	679	15	Decline
Eagle Ford	5	945	1983	274	Growth
Woodford	6	222	170	61	Decline
Granite Wash	7	239	205	N/A	Decline
Bakken	8	699	1500	186	Growth
Niobrara	9	1111	1178	~60	Flat

Annual Capex Required to Offset Overall Annual Decline by Shale Play

Field	Rank	Number of Wells needed annually to offset decline	Approximate Well Cost (million $US)	Annual Well Cost to Offset Decline (million $US)
Haynesville	1	774	9.0	6966
Barnett	2	1507	3.5	5275
Marcellus	3	561	4.5	2525
Fayetteville	4	707	2.8	1980
Eagle Ford	5	945	8.0	7558
Woodford	6	222	8.0	1776
Granite Wash	7	239	6.0	1434
Bakken	8	699	10.0	6990
Niobrara	9	1111	4.0	4444
Antrim	10	~400	0.5	200
Bossier	11	21	9.0	189
Bone Spring	12	206	3.7	762
Austin Chalk	13	127	7.0	889
Permian Delaware Midland	14	122	6.9	842
Total		**7641**		**41829**

(well cost data from various sources and is approximate)

The Reality Check

"We are all losing our shirts today." Rex Tillerson [CEO of Exxon Mobil] said "We're making no money. It's all in the red.“
(Wall Street Journal, June, 2012)

CHESAPEAKE SHAREHOLDERS DELIVER REBUKE
(Globe and Mail, June, 2012)

- Aubrey McClendon resigns as Chairman of Chesapeake (May, 2012).

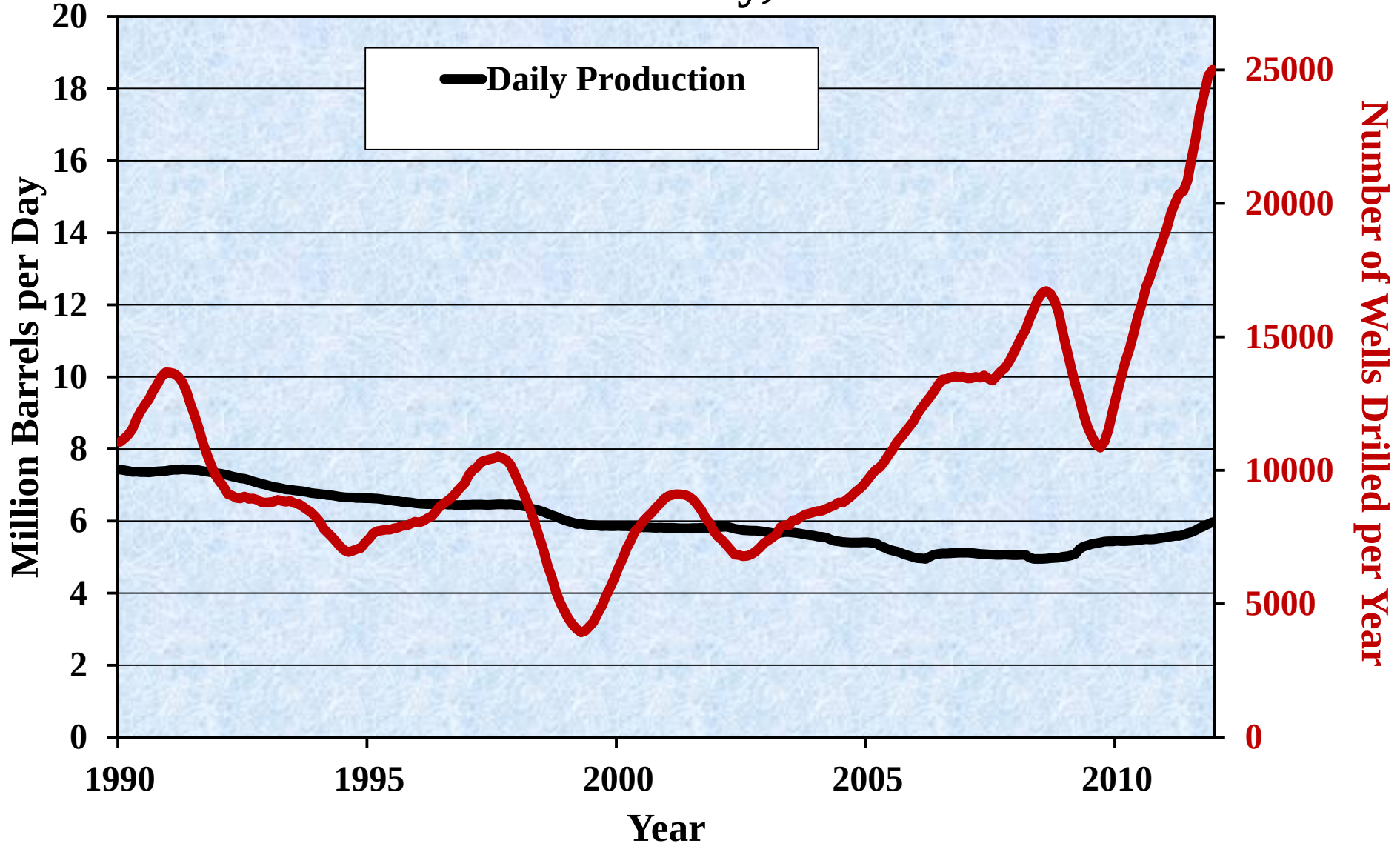
- Some Directors replaced at the behest of shareholders.

- Sale of $4 billion+ pipeline and related assets to Global Infrastructure Partners announced (June, 2012).

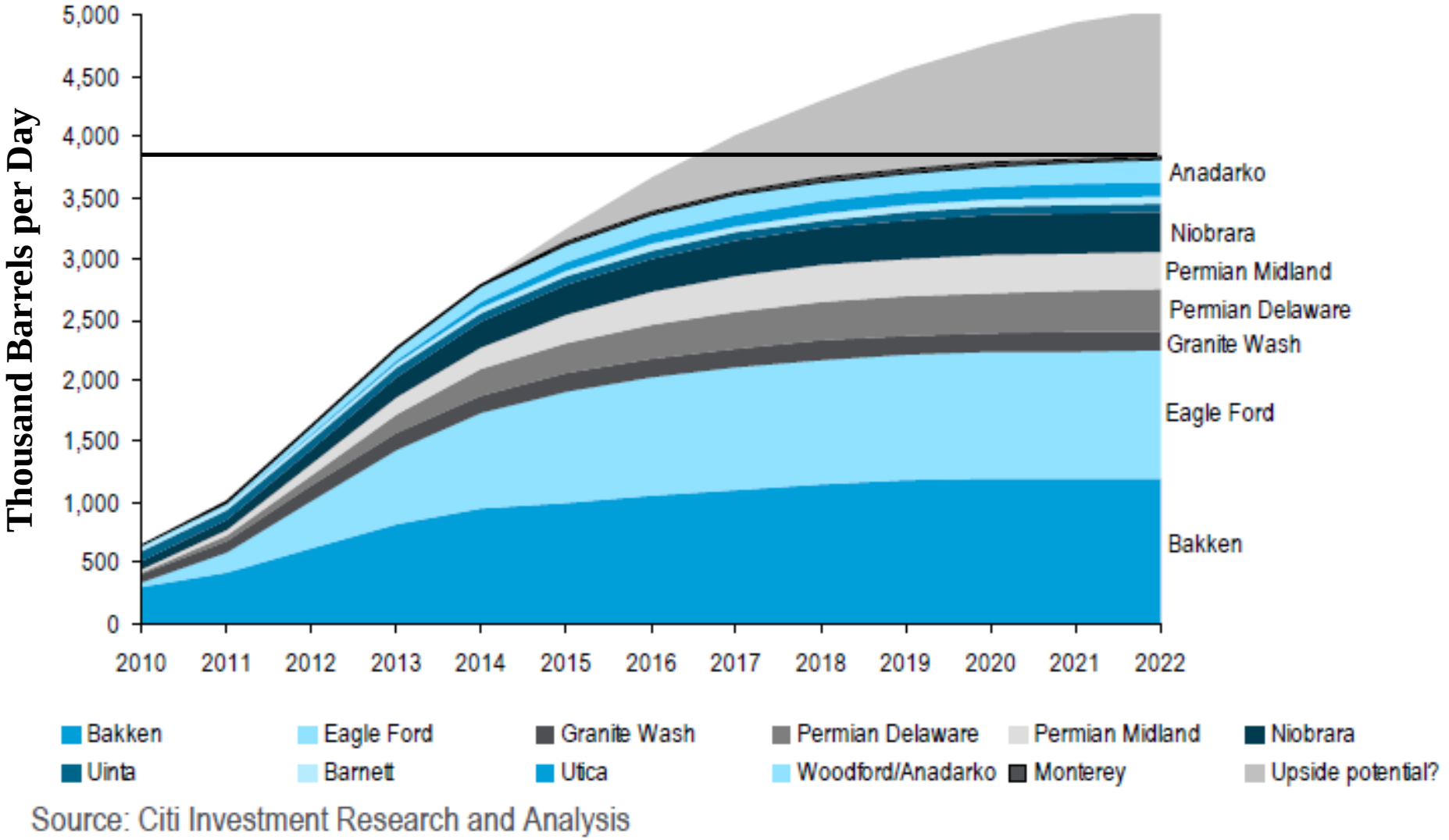
- $10 billion shortfall forecast for Chesapeake in remainder of 2012.

What About Shale (Tight) Oil and *Saudi America*?

U.S. Oil Production and Number of Oil Wells Drilled Annually, 1990-2012

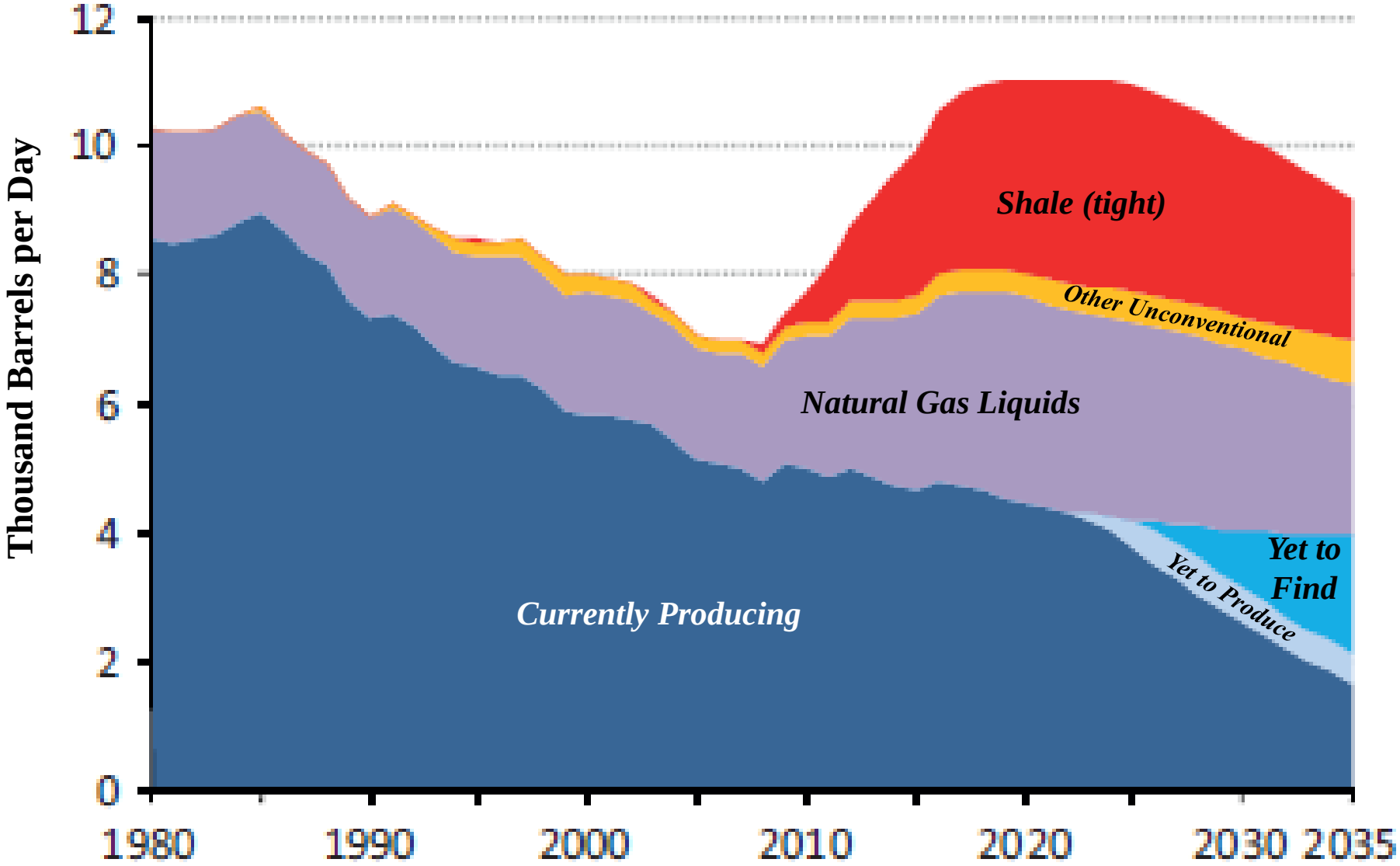


Citigroup 2012 Projection of U.S. Shale Oil, 2010-2022 (limitless well locations and no declines)

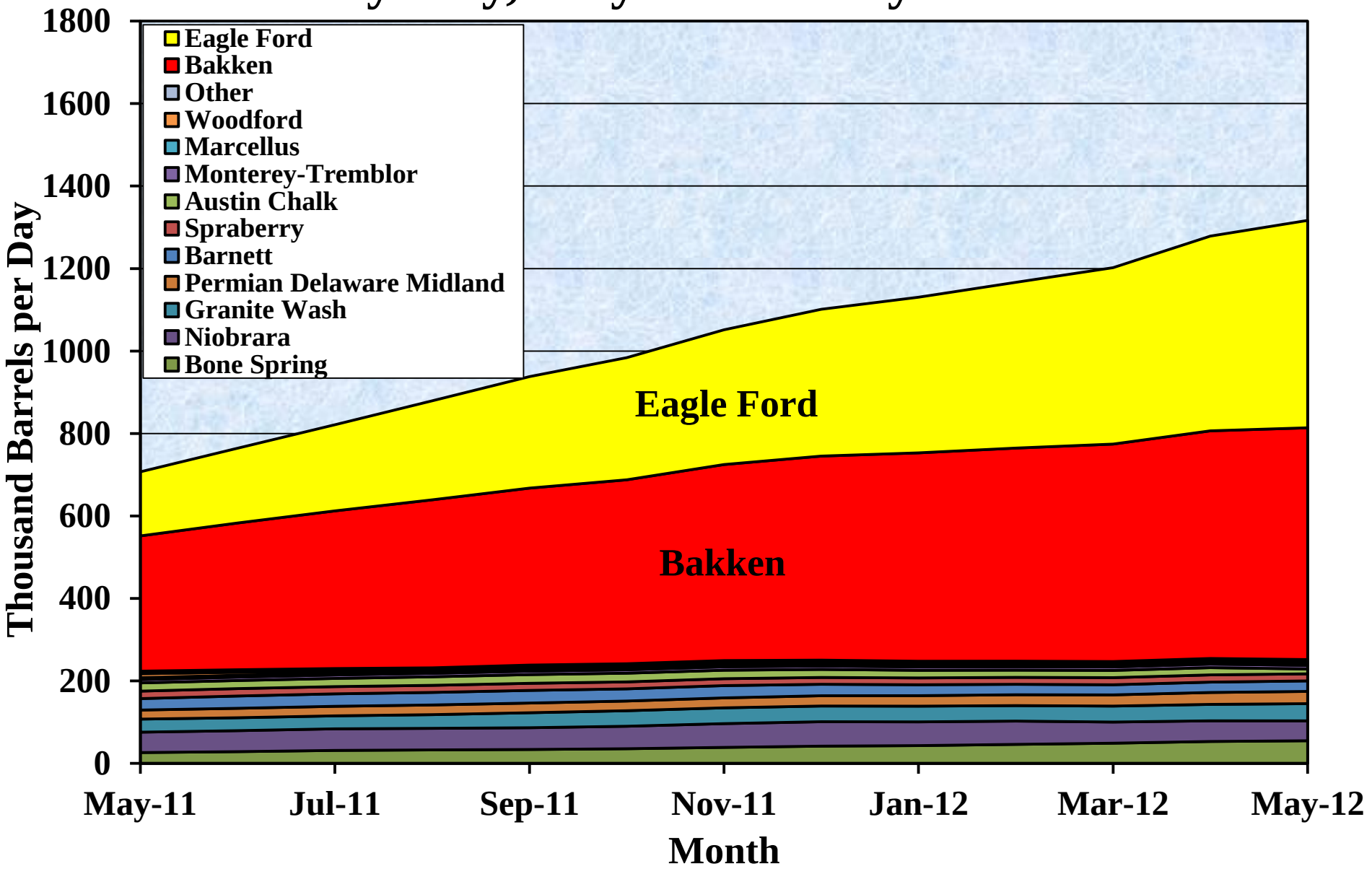


Source: Citi Investment Research and Analysis

EIA 2012 Projection of U.S. Petroleum Liquids Production, 2010-2035
(3.1 mb/d of shale oil by 2022 vs 3.7-5.0 by Citigroup)

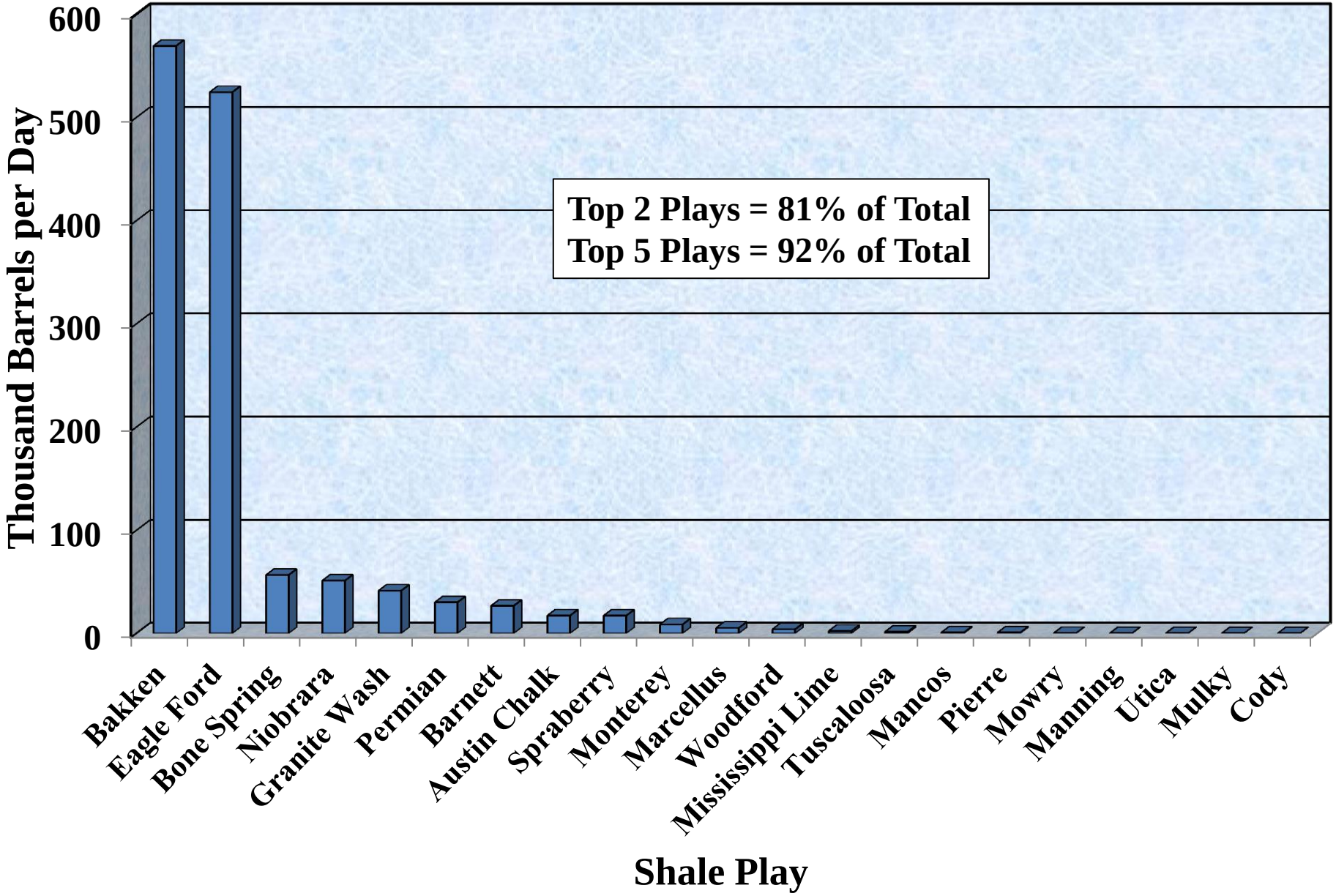


Shale/Tight Oil Production including Natural Gas Liquids by Play, May 2011 – May 2012



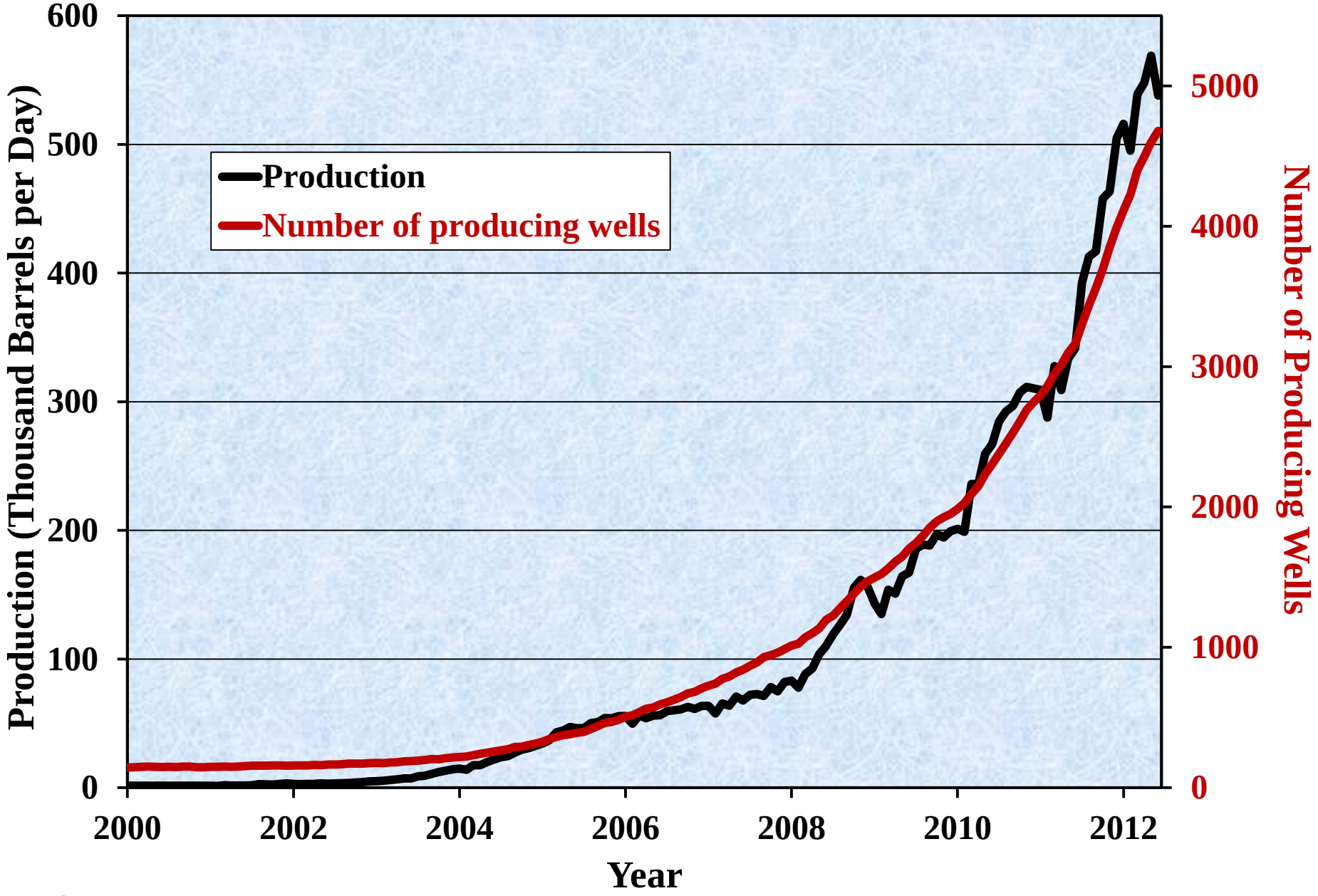
(data from HPDI, September, 2012, fitted with 3 month centered moving average including data up to June, 2012)

Crude Oil and Other Liquids Production by Shale Play



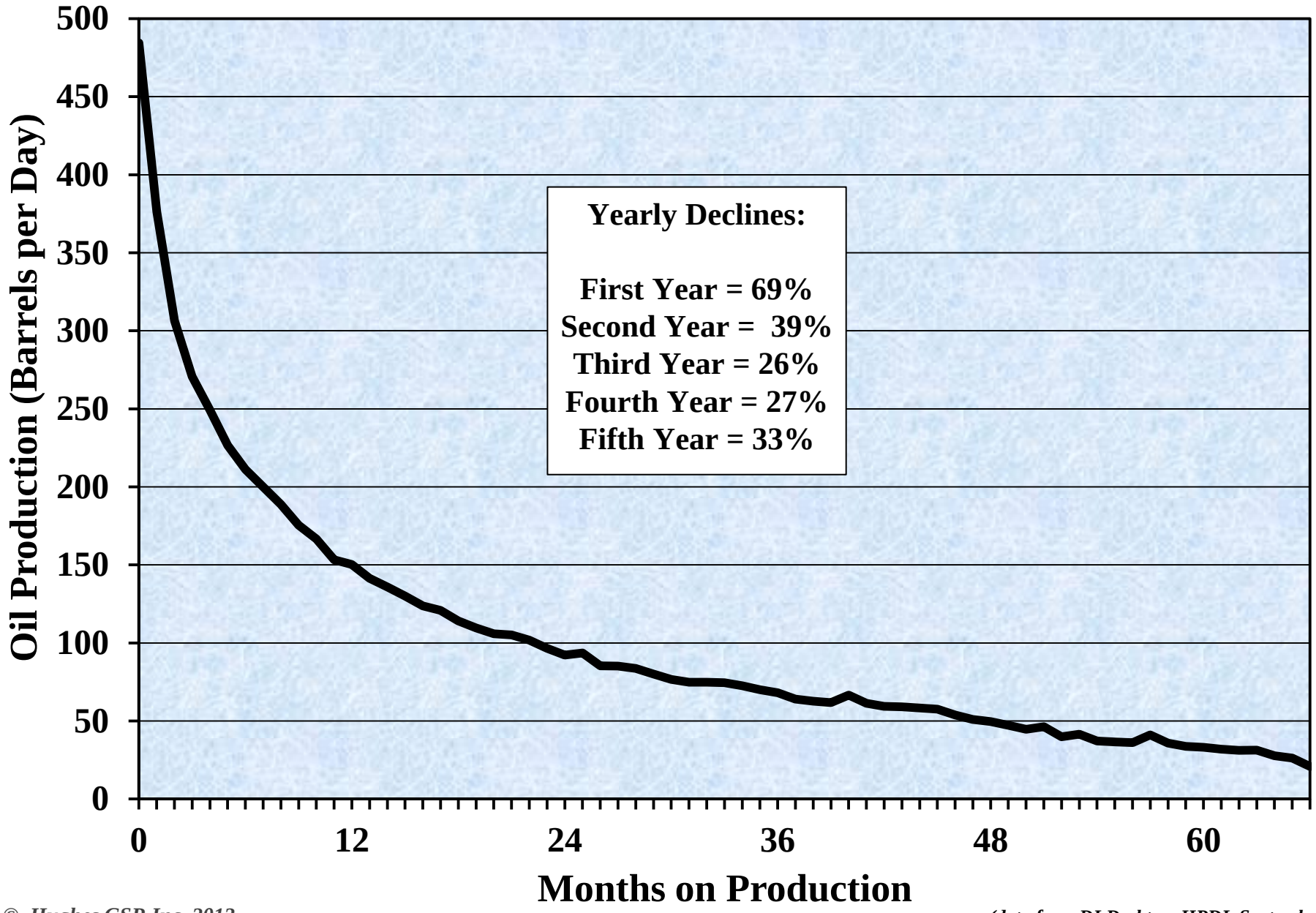
(data from HPDI, September, 2012, for production in most cases through May-June, 2012)

Bakken Shale Oil Production vs Operating Wells



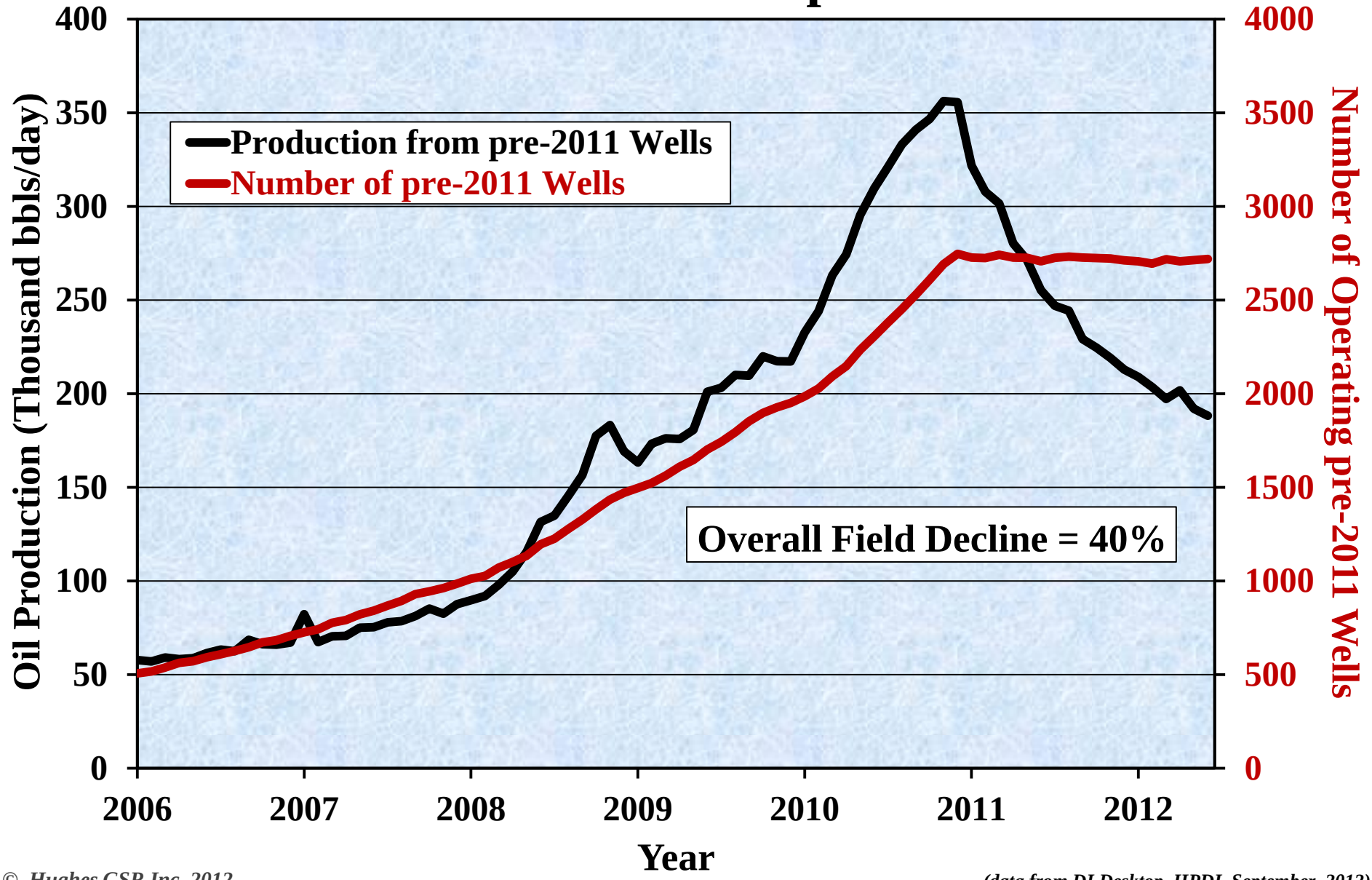
(data from DI Desktop, HPDI, September, 2012)

Type Decline Curve for Bakken Shale Oil Wells



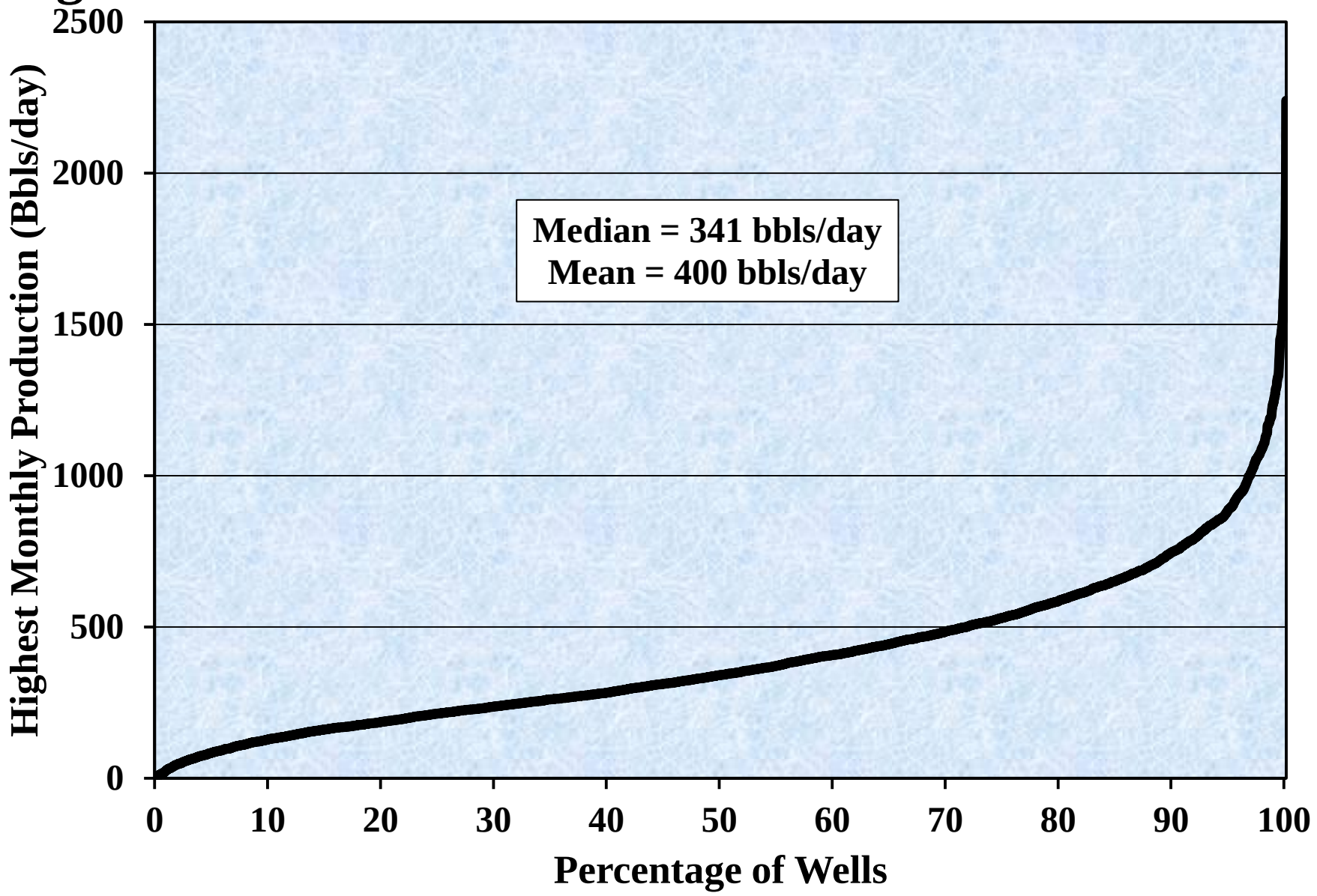
(data from DI Desktop, HPDI, September, 2012)

Overall Field Decline for Bakken Oil Production based on Production Decline from pre-2011 Wells



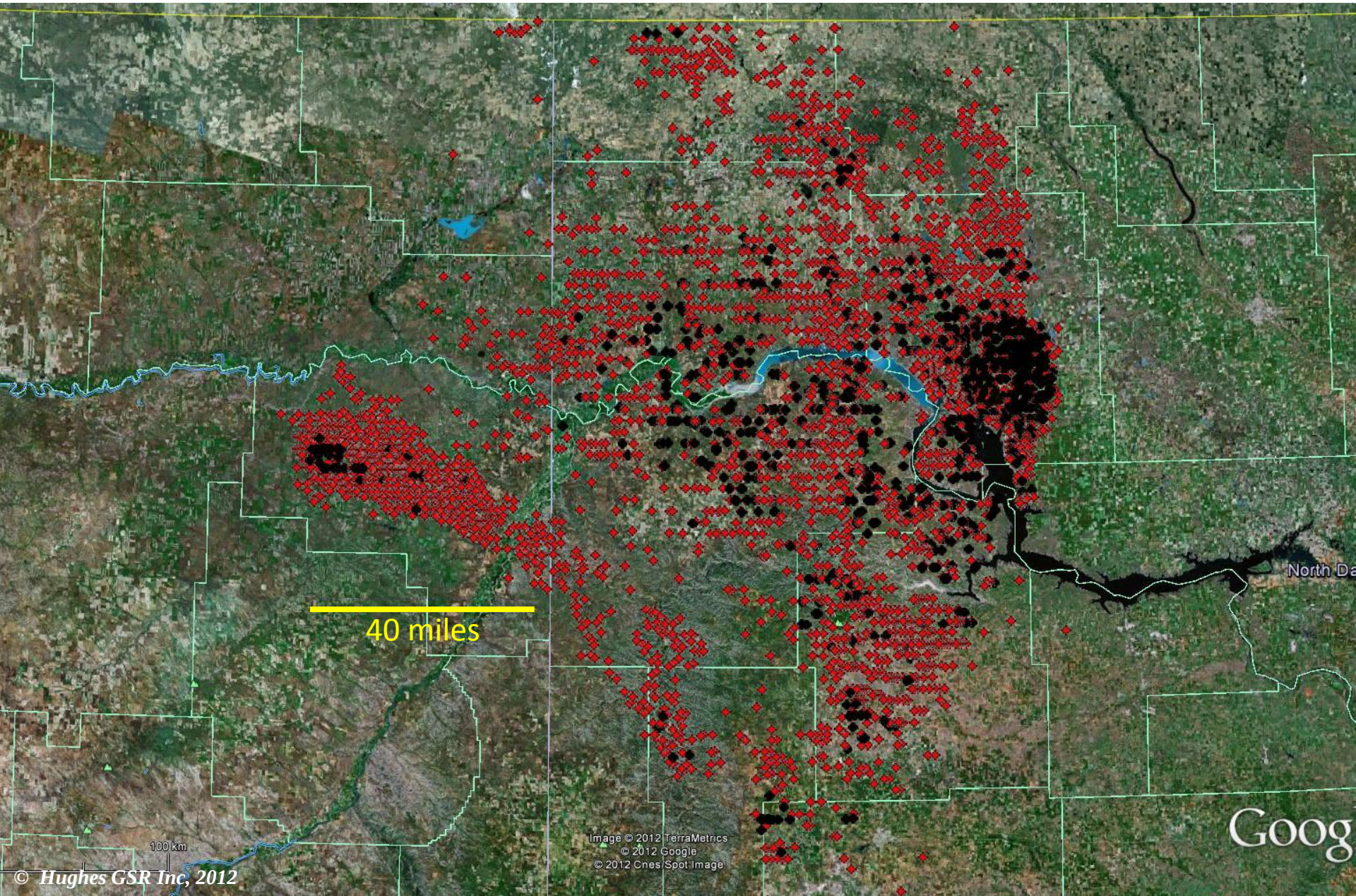
(data from DI Desktop, HPDI, September, 2012)

Bakken Well Quality
Highest One Month Oil Production from Individual Wells

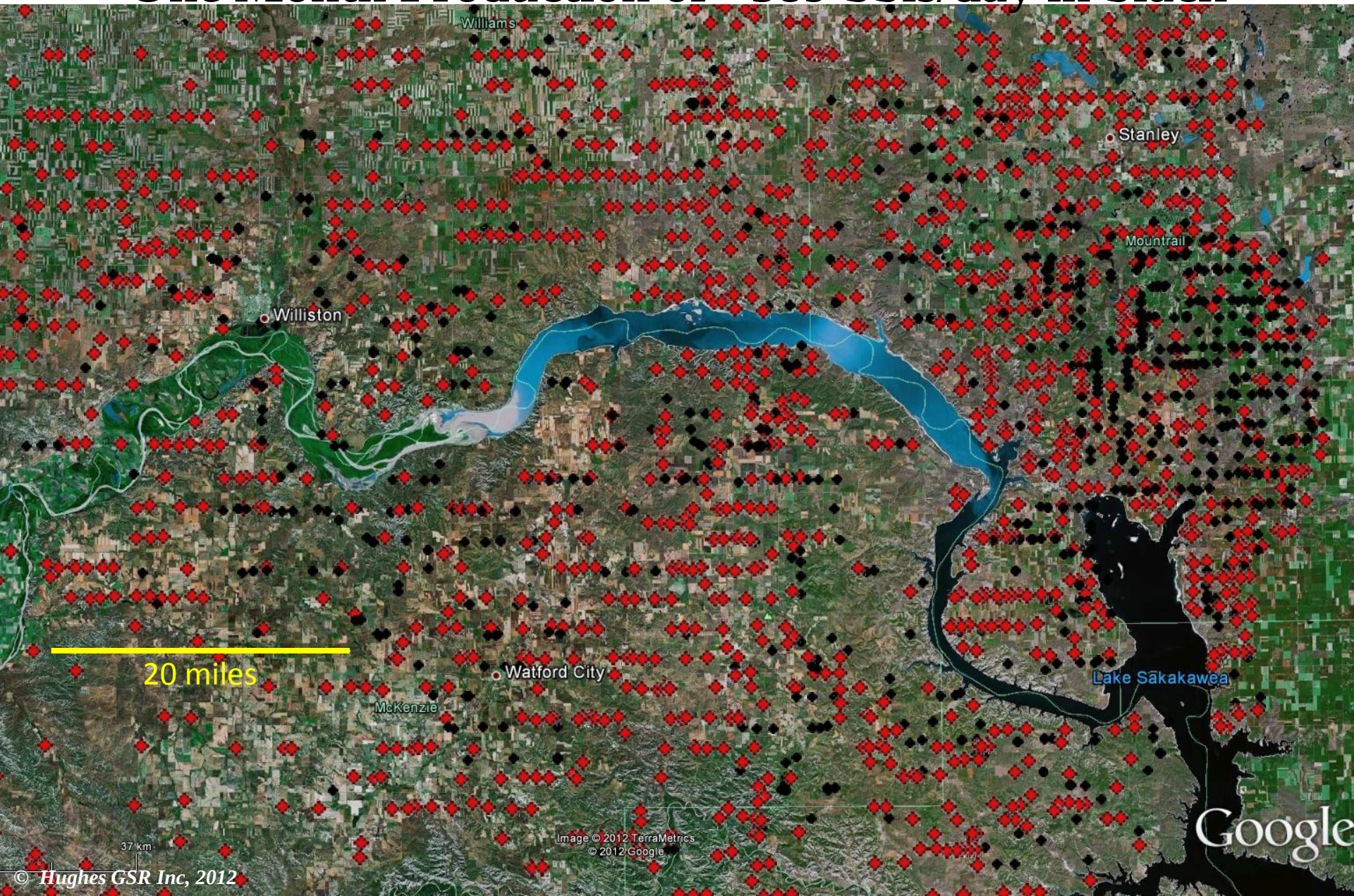


(data from DI Desktop, HPDI, September, 2012)

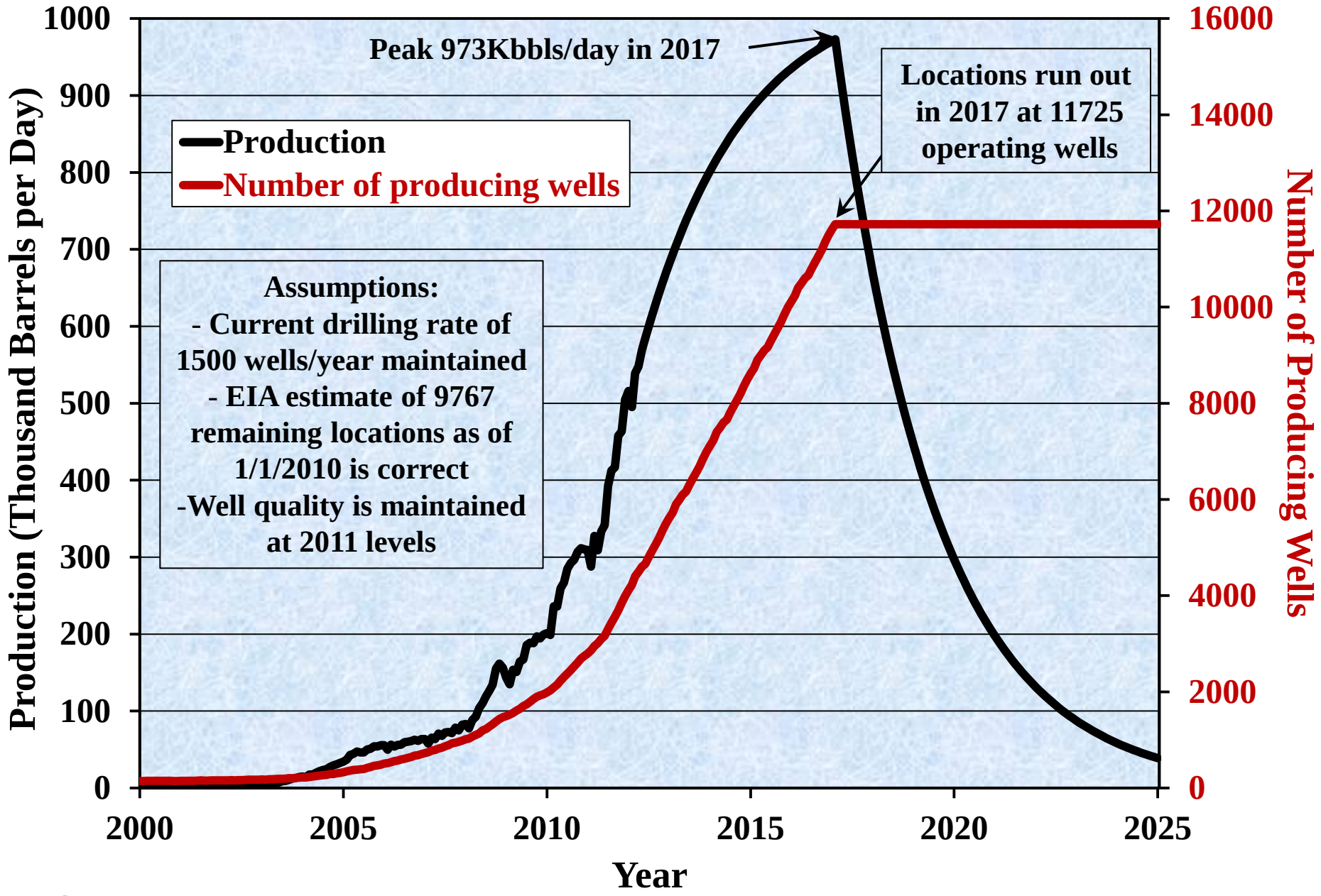
Bakken Well Quality - Top 20% with Highest One Month Production of >589 bbls/day in black



Bakken Well Quality – Sweet Spot - Top 20% with Highest One Month Production of >589 bbls/day in black



Bakken Shale Oil Production vs Operating Wells



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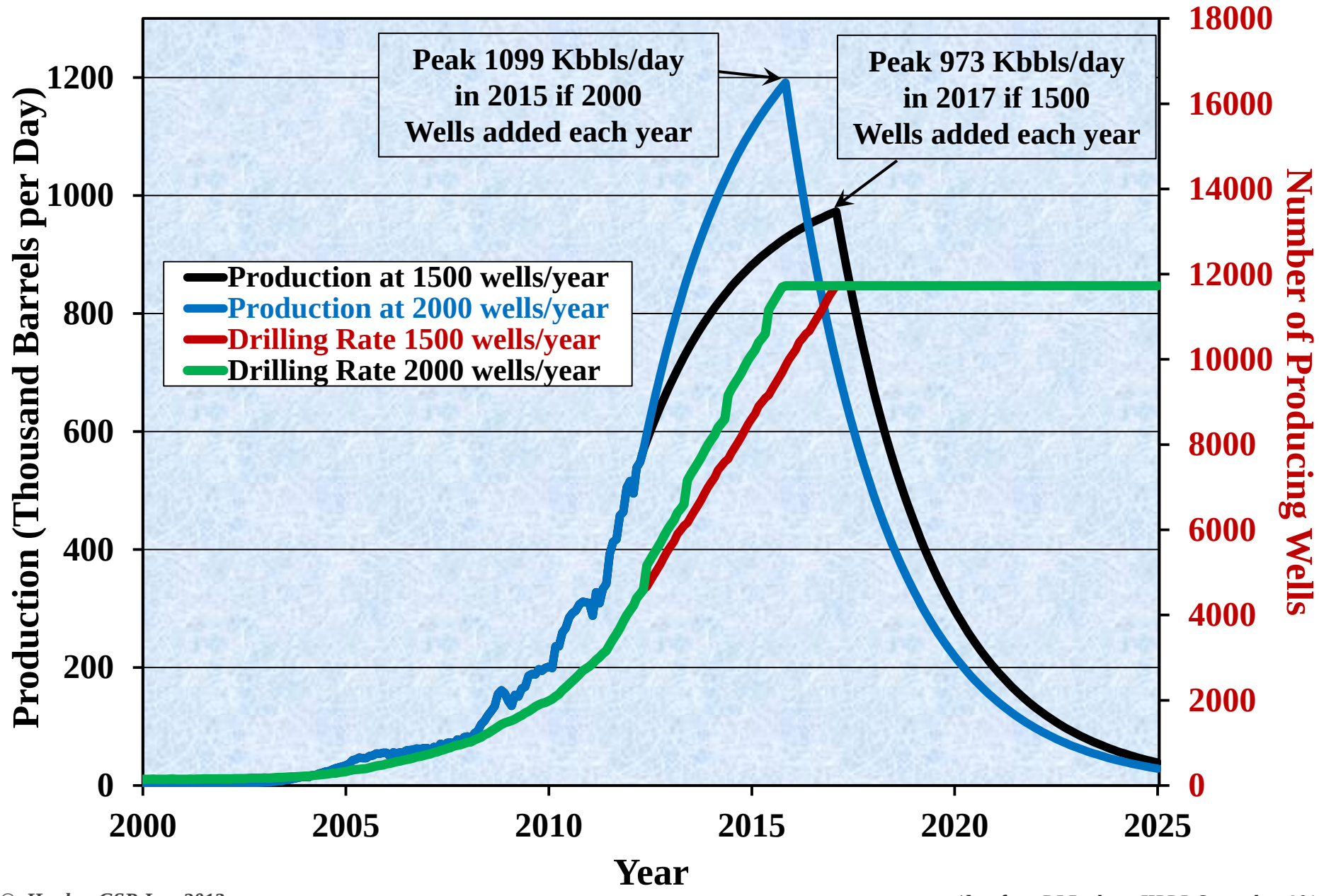
Bakken Shale Oil Production vs Operating Wells



(data from DI Desktop, HPDI, September, 2012)

And there is no such thing as a *FREE LUNCH*

There has been a great deal of pushback by many in the general public and in State and National governments to environmental issues surrounding hydraulic fracturing

- Methane contamination of groundwater

- Disposal of produced fracture fluid contaminating groundwater and inducing earthquakes

-Industrial footprint – truck traffic, air emissions etc.

-Full cycle greenhouse gas emissions which may be worse than coal

Summary and Implications

- **Shale gas has been a "game-changer" in that it has averted a terminal decline in supplies from conventional sources, but requires continuous high levels of capital input for drilling and infrastructure.**
- **Almost all eggs are in the shale gas basket as a hope in meeting supply growth projections.**
- **There are significant geological, environmental and economic challenges in continuing to grow shale gas supply. I expect significantly higher prices going forward over the next 12-24 months.**
- **The hope that shale gas can make more than modest inroads on oil for transportation and coal for electricity is unwarranted, even if the EIA's supply projections can be met.**
- **Shale (tight) oil similarly has been an important new source of oil but suffers high decline rates and highly productive fields are not ubiquitous, as the hype would have us believe. It is limited by available locations which will impose a bubble shaped production profile when they are exhausted.**