

# Shale Play Assessment Methods and Implications for the Success of the Plays

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## *Shale Gas—A View from the Bottom of the Resource Pyramid*

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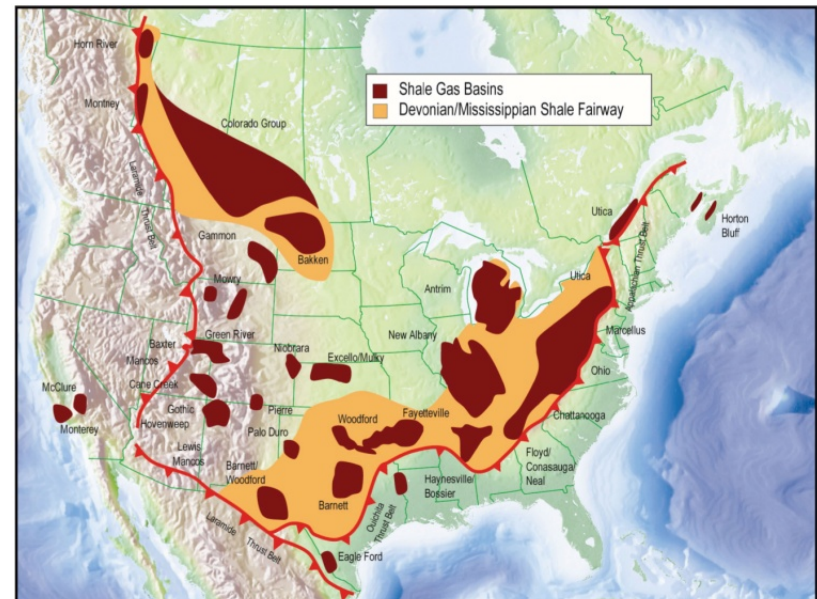
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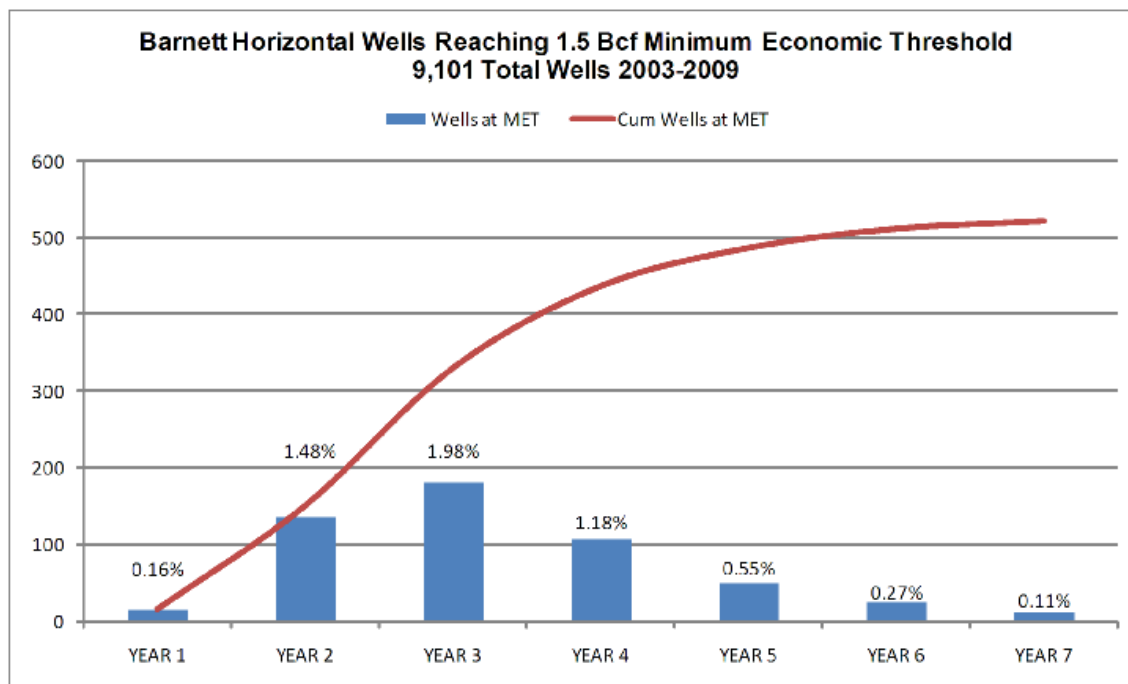
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# Why shale gas may disappoint expectations of abundance

- Shale gas is at the bottom of the resource pyramid: resource volumes are large, but costs are high and recovery efficiency is low.
- Low decline-rate hyperbolic models are not supported by empirical production history data.
- Production is impressive but most wells are not profitable.
- Claims of profitability at less than \$5.00 /mcf are based largely on point-forward economics, & are at odds with costs reported to the Securities and Exchange Commission in 10-K filings.
- All plays have contracted to core areas a fraction of the size of the play as originally advertised.
- Reserve forecasts are over-stated.

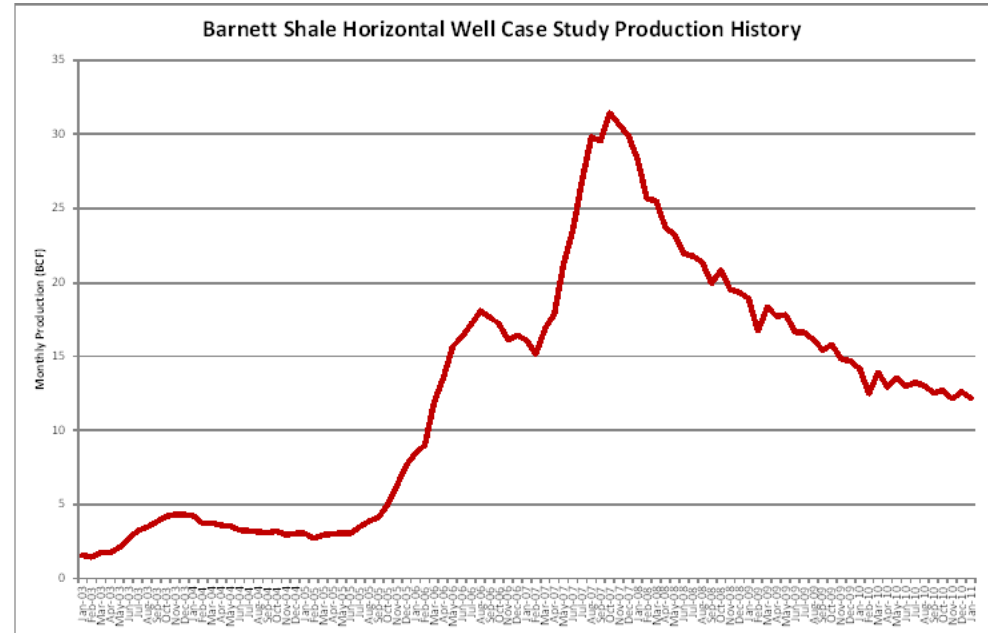
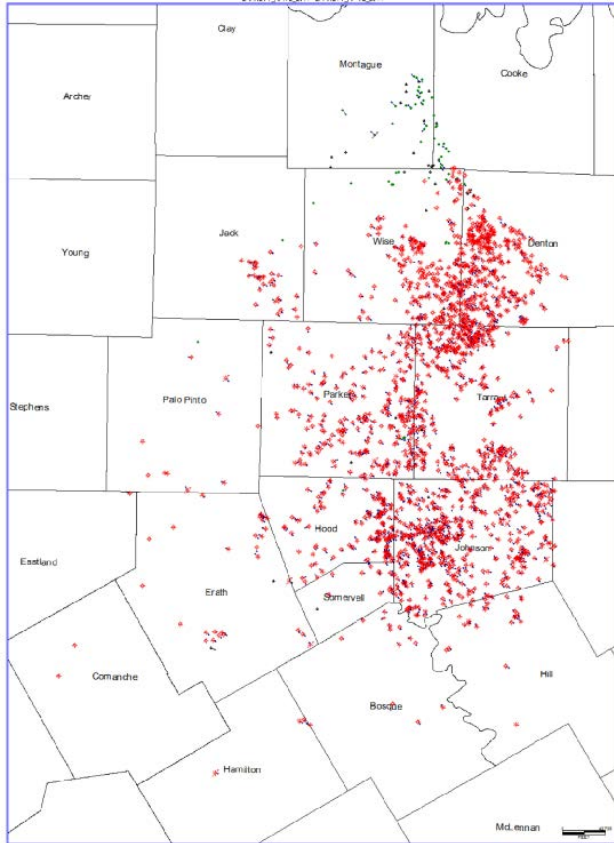


## Production is impressive but most wells are not profitable



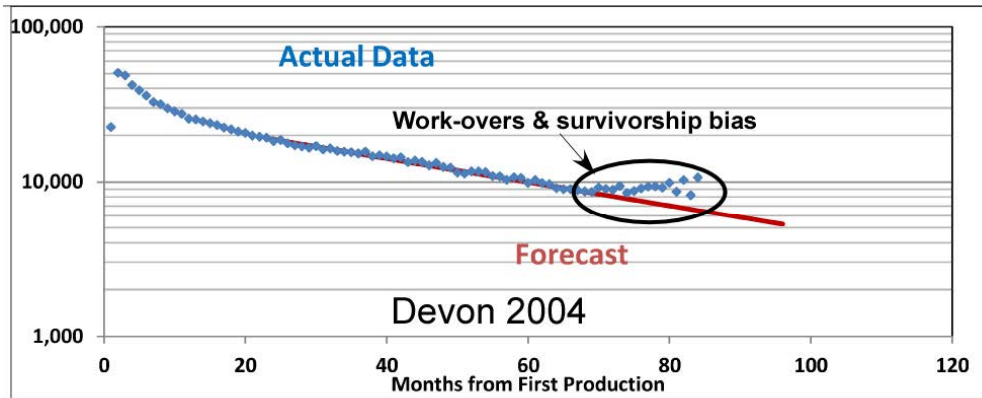
- After more than 7 years of horizontal drilling, less than 6% of Barnett Shale wells have reached or exceeded break-even production volumes.
- This is based on a minimum economic threshold (MET) of 1.5 bcf at \$6.25/mcf netback gas price, nominal land costs, \$3 million D&C cost, \$1.20 LOE & G&A cost, and a 10% discount factor.
- Most of my oil and gas clients require payout in 2-3 years at most.
- Hedging saved most companies through 2009 and some of 2010—this opportunity has been ruined by over-production & resulting low futures prices.

# Low decline-rate hyperbolic models not supported by empirical production history data: World Oil Barnett Study

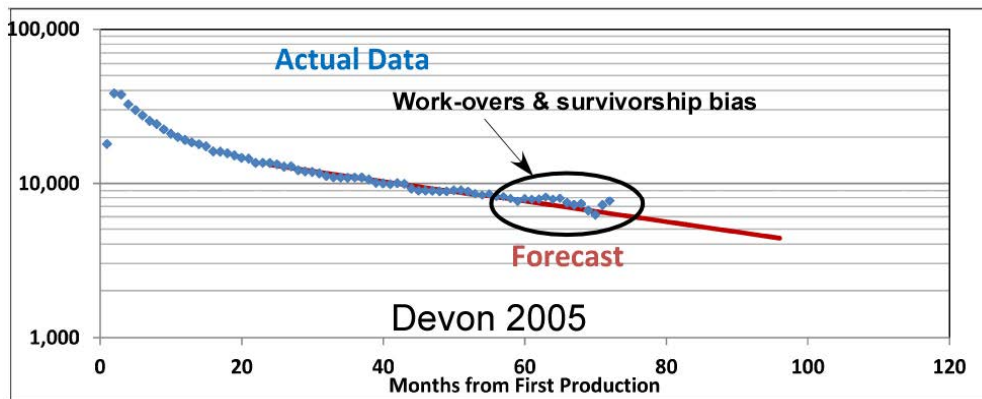


- 1977 horizontal wells declined individually first in 2007 & again in 2009.
- EUR decreased in second study because additional production data did not allow b-exponents as high as in the first study.
- We suggested decline rates of 12-15%.
- Actual production data shows average annual decline rate of 20%.

# Reserve forecasts are over-stated & hyperbolic decline weakly supported: Barnett example

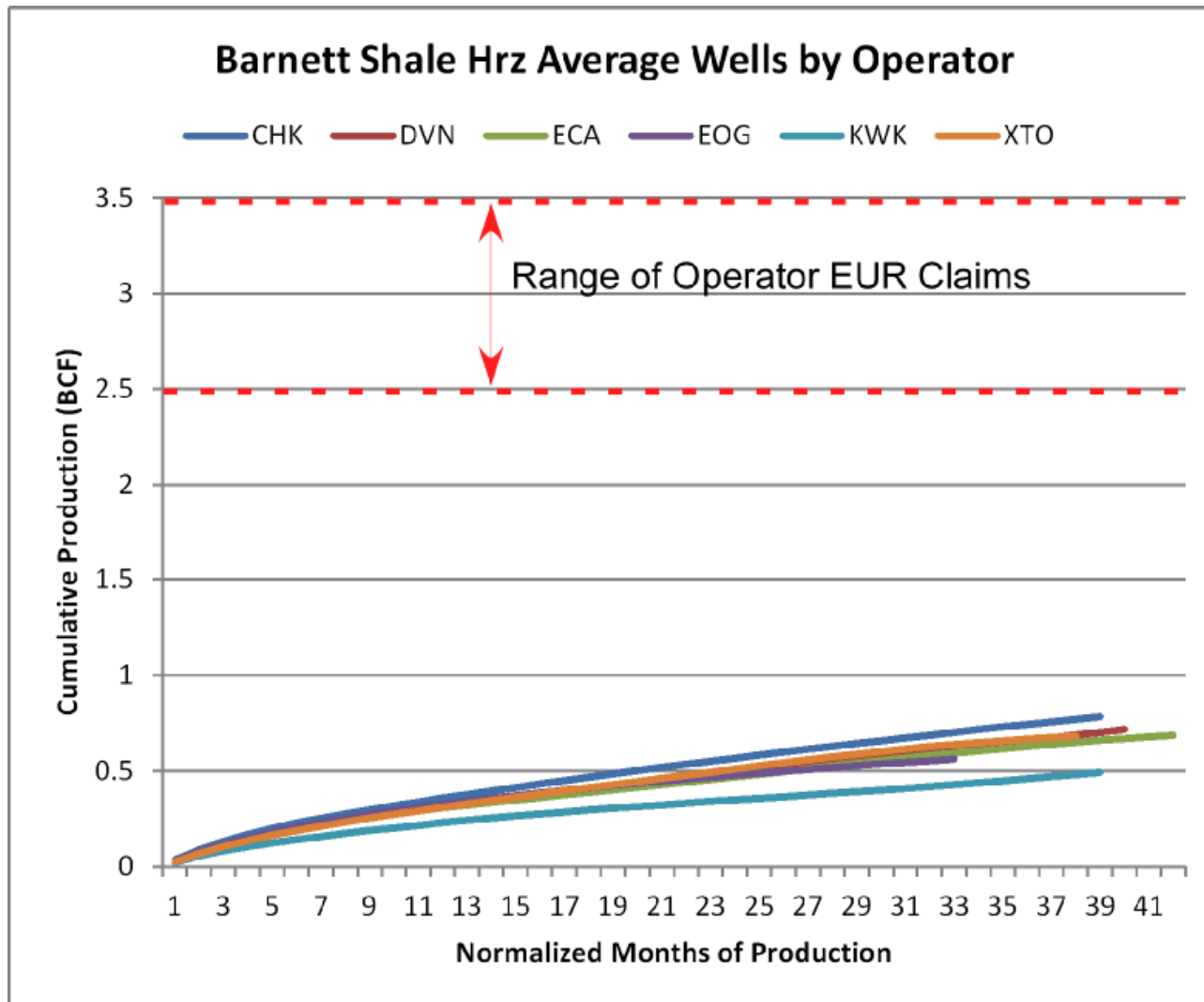


Index	WELL VINTAGE	EUR	NUMBER OF WELLS
1	DVN 2004	1,555,508	91
2	DVN 2005	1,172,450	160
3	DVN 2006	1,034,726	289
4	DVN 2007	1,139,035	459
5	DVN 2008	1,358,715	573
6	DVN 2009	1,156,912	287
7	DVN 2010	1,074,705	431
	DVN WTD AVG	1,189,856	2290



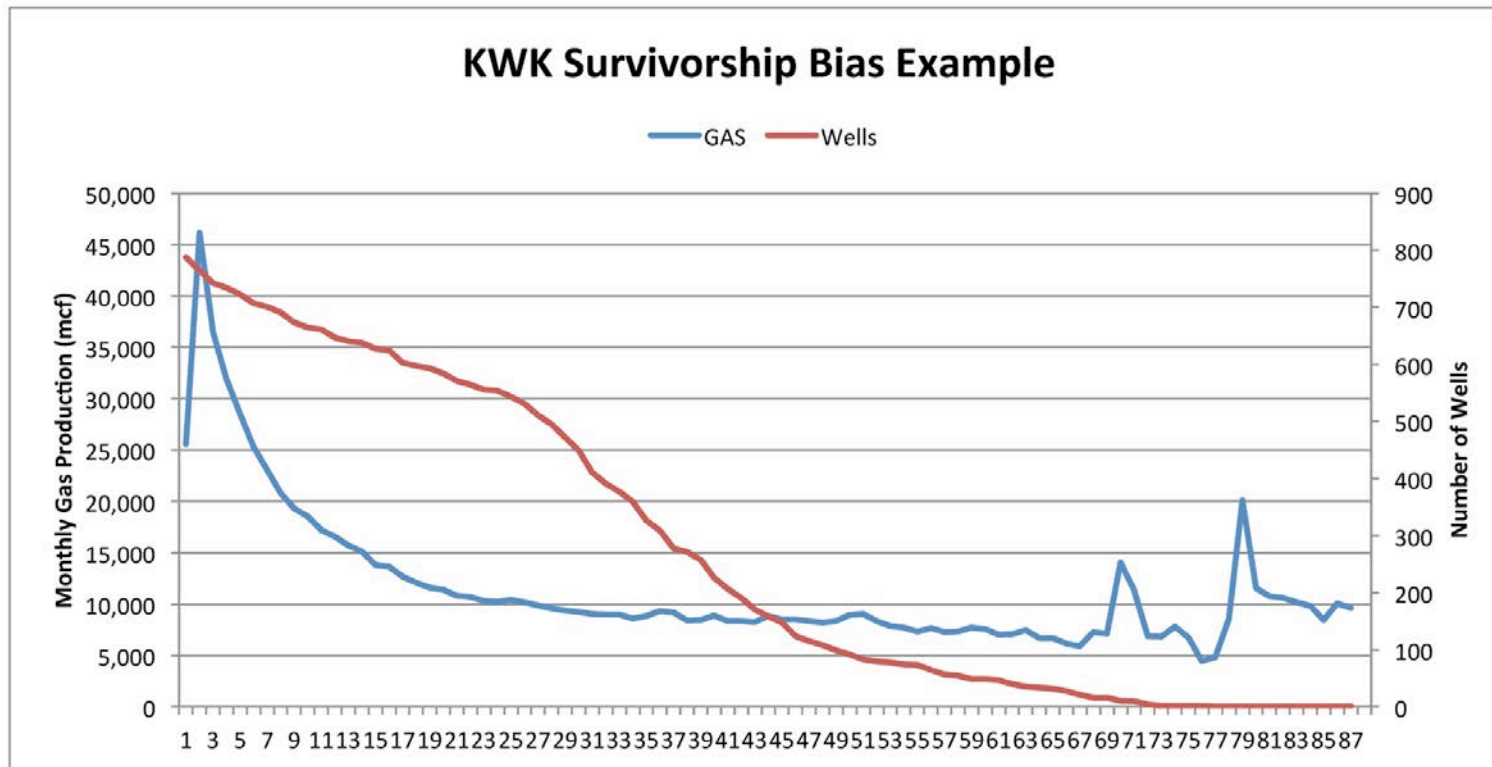
- Devon claims their average well EUR will be 2.2 bcf.
- Reserves are approximately 50% of operator claims.
- Group decline is optimistic.
- Now too much production data to invoke strong hyperbolic flattening.
- B-exponents average  $< 0.5$ .
- Survivorship bias & work-overs make our forecasts optimistic.

# Barnett Shale Example: The heart our view



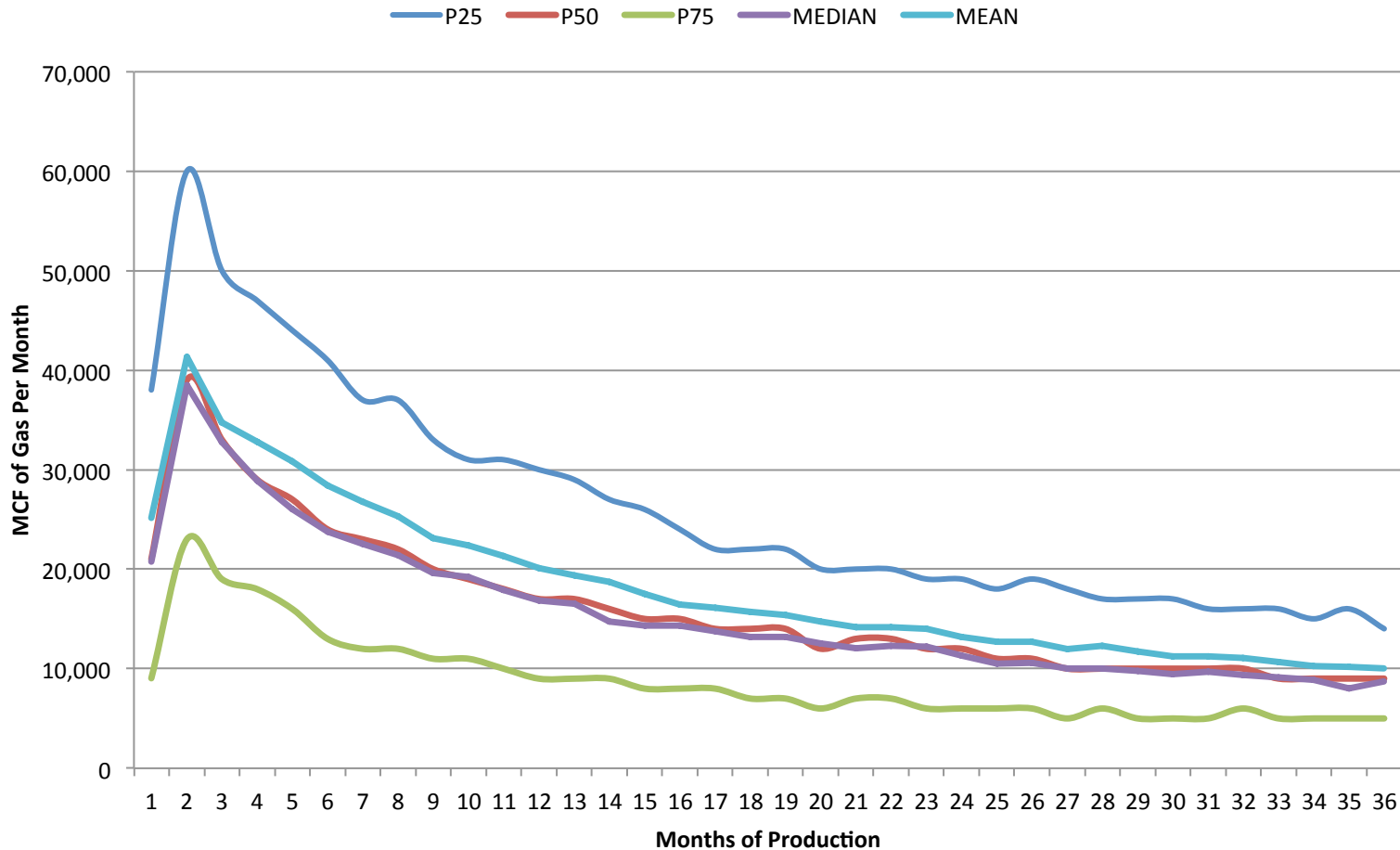
# Survivorship Bias: A Critical Perspective

OPERATOR	AVG WELL CUMULATIVE PRODUCTION	NORMALIZED AVG CUMULATIVE PRODUCTION	OVER-PREDICTION
CHESAPEAKE OPERATING, INC.	784,610	1,186,740	151%
DEVON ENERGY CORPORATION	629,422	1,243,758	198%
XTO ENERGY, INC.	677,192	1,376,106	203%
EOG RESOURCES, INC.	554,346	1,087,392	161%
QUICKSILVER RESOURCES, INC.	435,782	1,002,115	181%
ENCANA OIL & GAS(USA) INC.	682,009	1,217,549	180%



# Type curves are overly optimistic: probabilistic approach acknowledges uncertainty

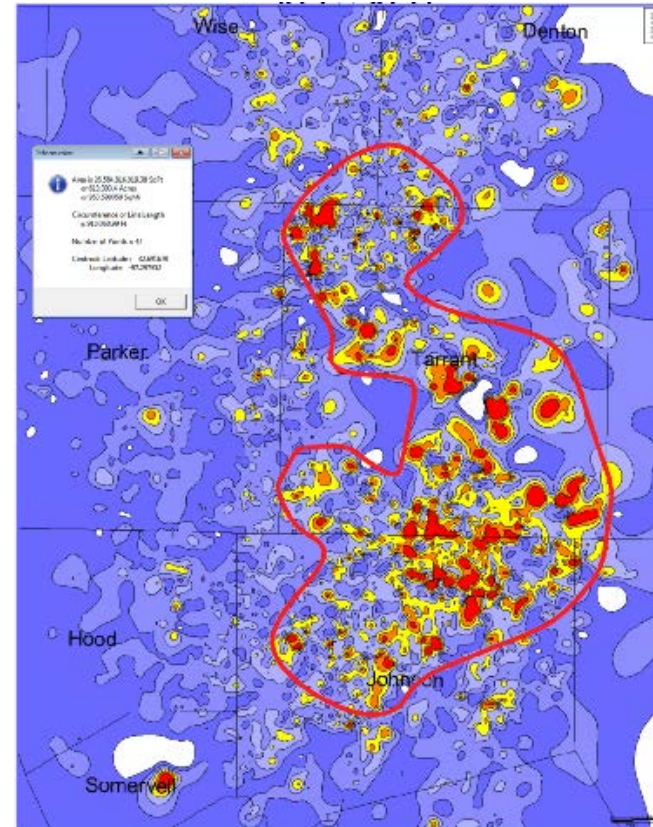
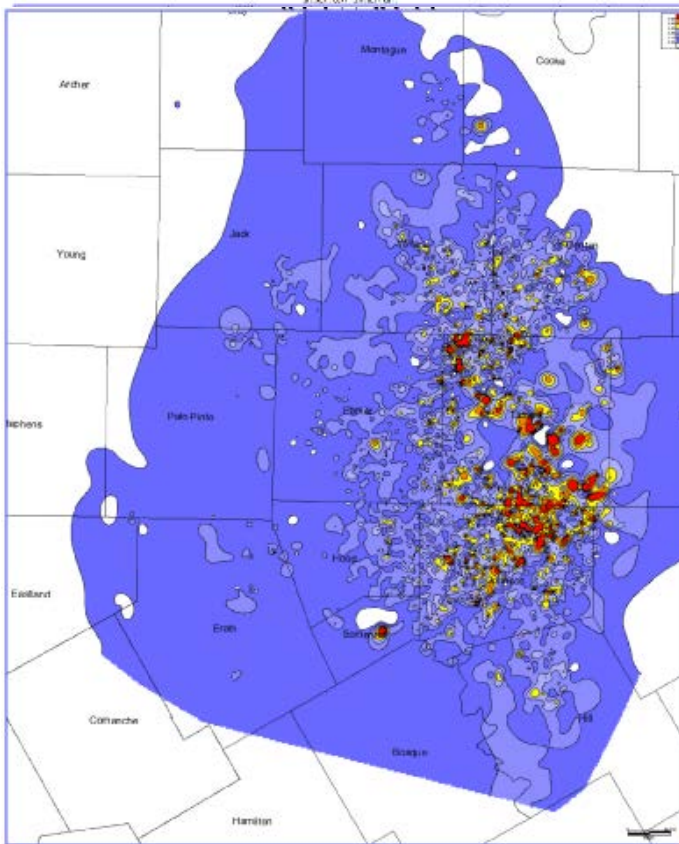
## EnCana Horizontal Barnett Wells Decline Data



- 420 Barnett Shale wells suggest considerable variance in type-curve methodology.
- Mean over-predicts EUR by 10-15%.

## All plays have contracted to core areas a fraction of the size of the play as originally advertised: Barnett Shale example

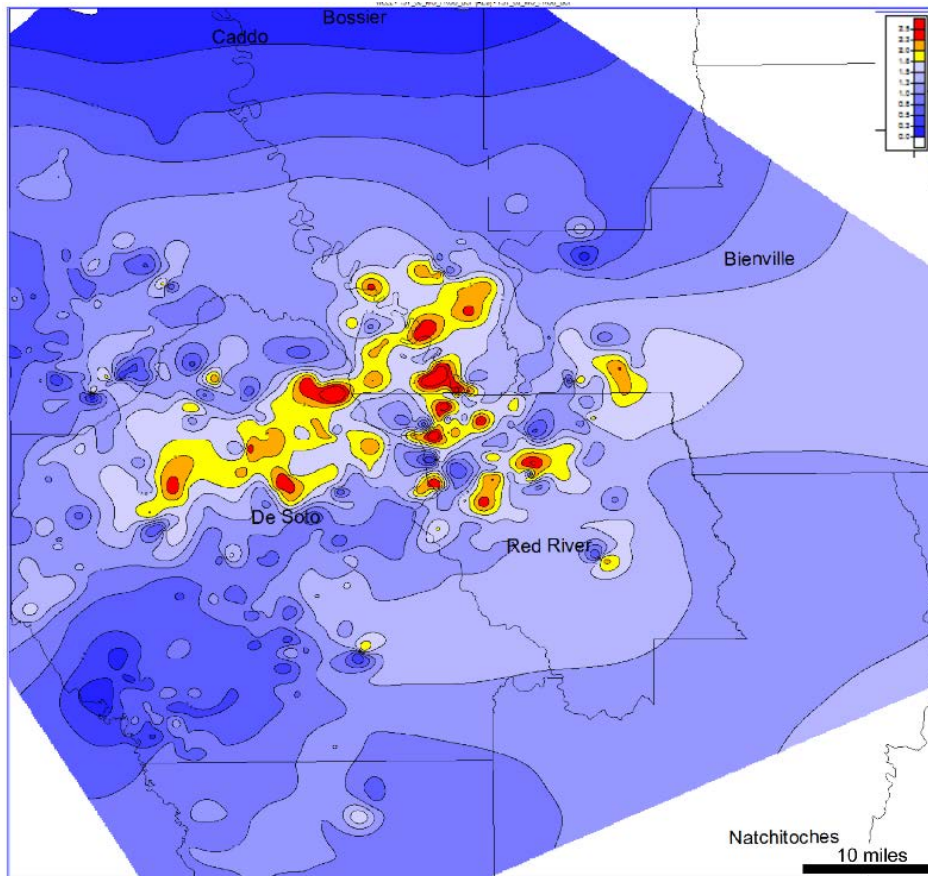
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- 14,500 wells producing wells.
- The core areas (red and yellow) are the only part of the play with the potential to be commercial.
- Approximately 7-15% is “core” area (610,000 acres of 3.9-8.6 million acres).
- Well performance within the core areas is uneven.

## Shale plays have contracted to a fairway or core area: Haynesville Shale example

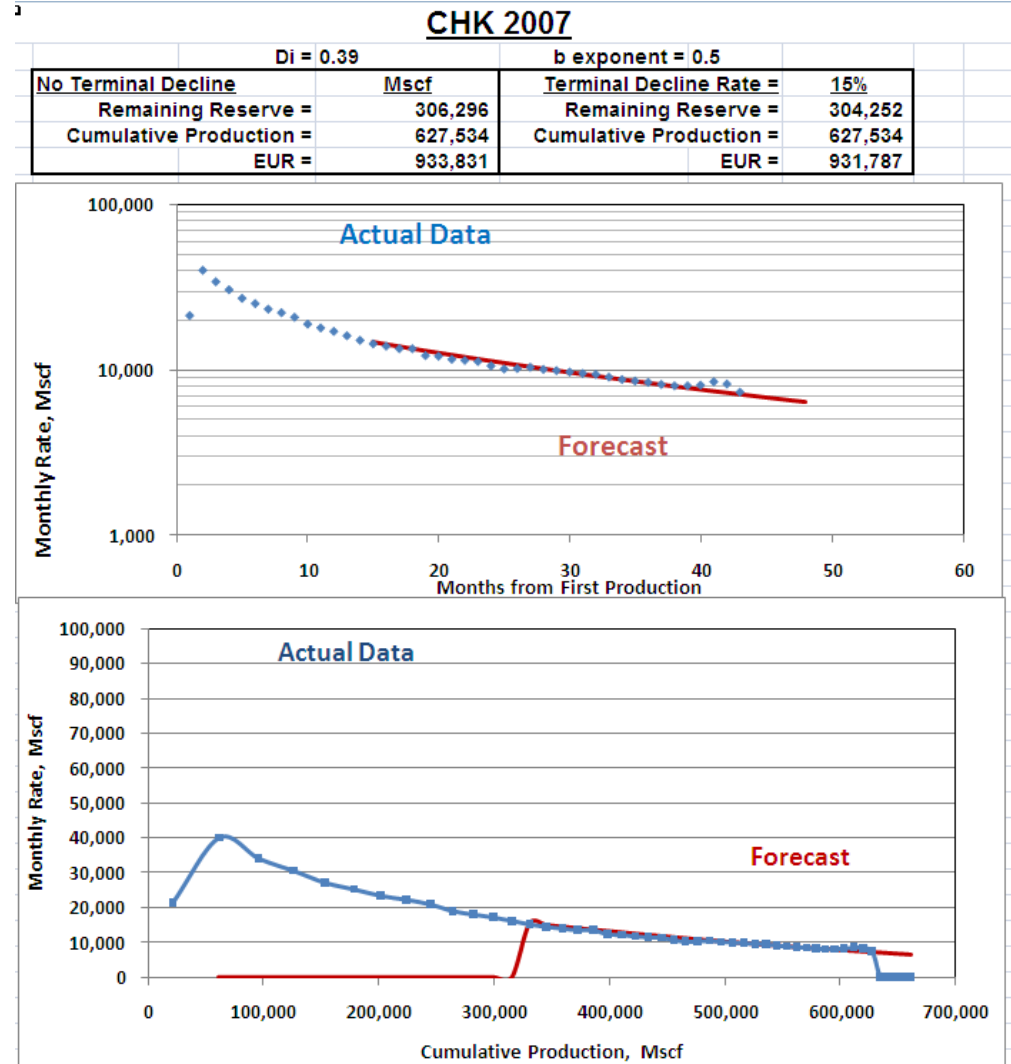
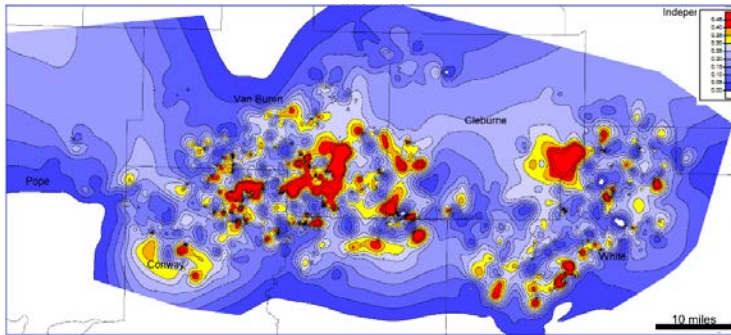
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First 6-month cumulative production for Haynesville Shale horizontal wells (with contours). Data source: HPDI

- The emerging core area includes ~110,000 acres or about 5 Townships.
- This represents approximately 10% of the play area in Louisiana defined by limits of drilling (1.5 million acres or 65 Townships).
- A few years ago, this was promoted as the 4<sup>th</sup> largest gas field in the world, and the largest in North America.
- Core areas are structurally influenced.

# There is now too much production history data to perpetuate the myth of strong hyperbolic decline: Fayetteville Shale example 2007



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