

Barnett Gas Production Outlook*

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Abstract

Since the early 1990s, 16,000+ wells have been drilled in and 12.5 tcf of natural gas has been produced from the Barnett Shale. Vertical wells dominated the drilling activity in the past; today more than 98% of wells are horizontal. The Barnett Shale has dry and high Btu sections; in recent years low natural gas prices induced increased drilling activity in the high Btu parts. Fayetteville and Haynesville are dry gas plays; drilling followed a similar pattern to that of Barnett, quickly switching to horizontal. Production in these plays started in the mid- to late-2000s and expanded rapidly until the price of natural gas collapsed in early 2012. Despite this impressive history, there is considerable uncertainty about the future production potential of these three plays. The understanding of the geology and economics of unconventional resource plays is still evolving but it is commonly accepted that there is a wide distribution within a play in terms of well productivity.

In 2011, the Sloan Foundation funded a major interdisciplinary project at the Bureau of Economic Geology to assess resource potential in four major shale plays, including the Barnett, Fayetteville and Haynesville shales. This project represents the most detailed look to date at the geology, production decline and economics of shale gas production in these plays. Using data on more than 16,000 wells from the Barnett, 3,500 wells from the Fayetteville, and 2,000 wells from the Haynesville, numerous studies were undertaken in order to understand the nature of production: geologic mapping of reservoir properties, the decline analysis, analysis of spacing, inferred-refracturing and interference, well economics, and econometric analysis of drivers of production.

In this article, we present a model of future production of natural gas from these three shales under different scenarios using outputs from companion studies: acreage available for further drilling, 10 tiers of varying productivity within each play, 3 depth levels in Fayetteville, the production profile, and breakeven economics to adjust pace of new drilling in each tier in each play. Differences across the plays add considerable value in our efforts to understand shale plays.

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Browning, J., S. Ikonnikova, G. Gulen, and S. Tinker, 2013, Barnett Shale production outlook: SPE Economics & Management, v. 5/3, p. 89-104.

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Gulen, G., J. Browning, S. Ikonnikova, and S.W. Tinker, 2013, Well Economics across ten tiers in low and high Btu (British thermal unit) areas, Barnett Shale, Texas: Energy, v. 60, p. 302-315.

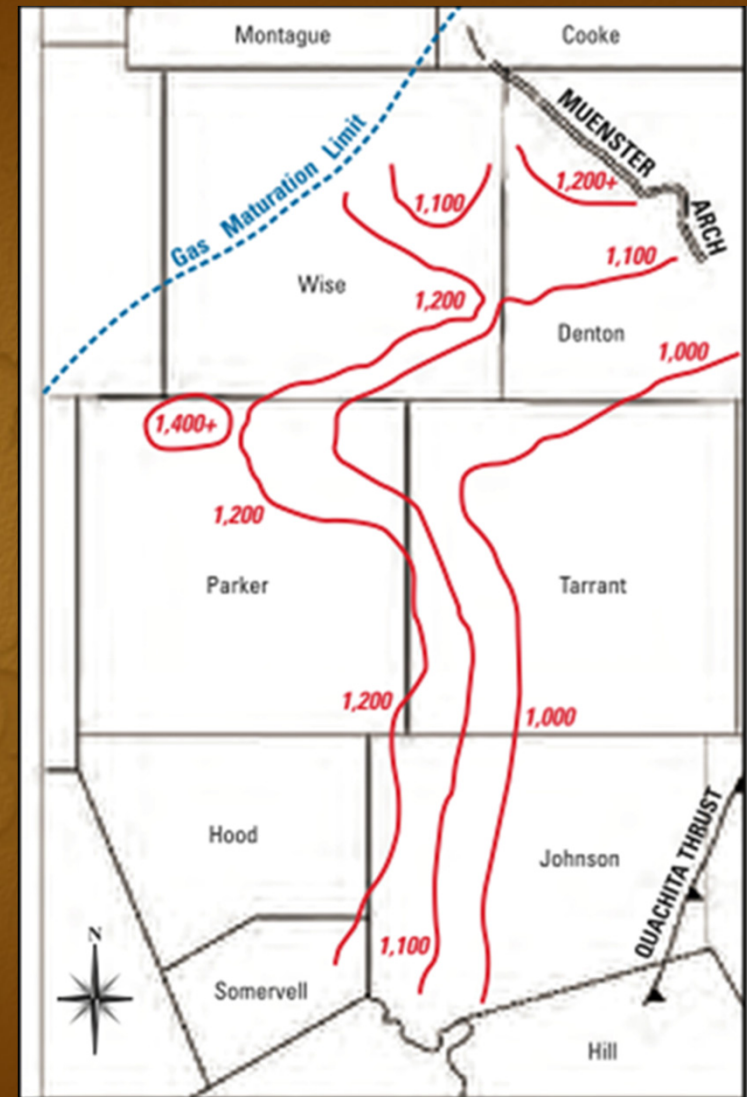
Barnett gas production outlook

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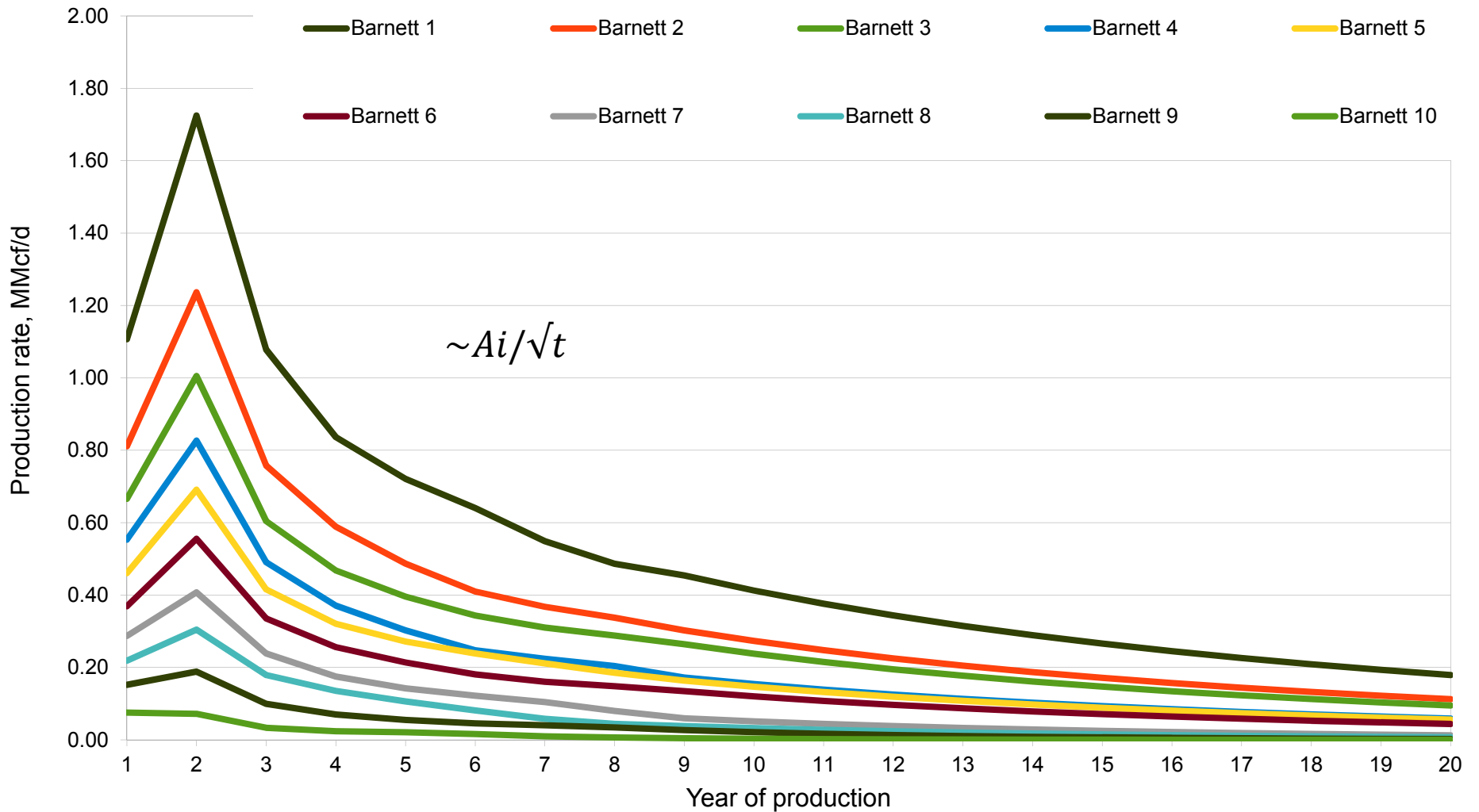
Building Blocks: Barnett

- Linear transient flow type curve with interfracture interference
- Breakeven well economics by **10** tiers
- Evaluated at **low and high Btu** regions
- Partly drained and undrilled acreage in each tier determined across entire field
- Drilling pace is adjusted to breakeven economics & logistical constraints; and stops when economic limit is reached.



Bruner & Smosna (2011)

Production Profiles by Tier



Barnett Well Economics – Assumptions

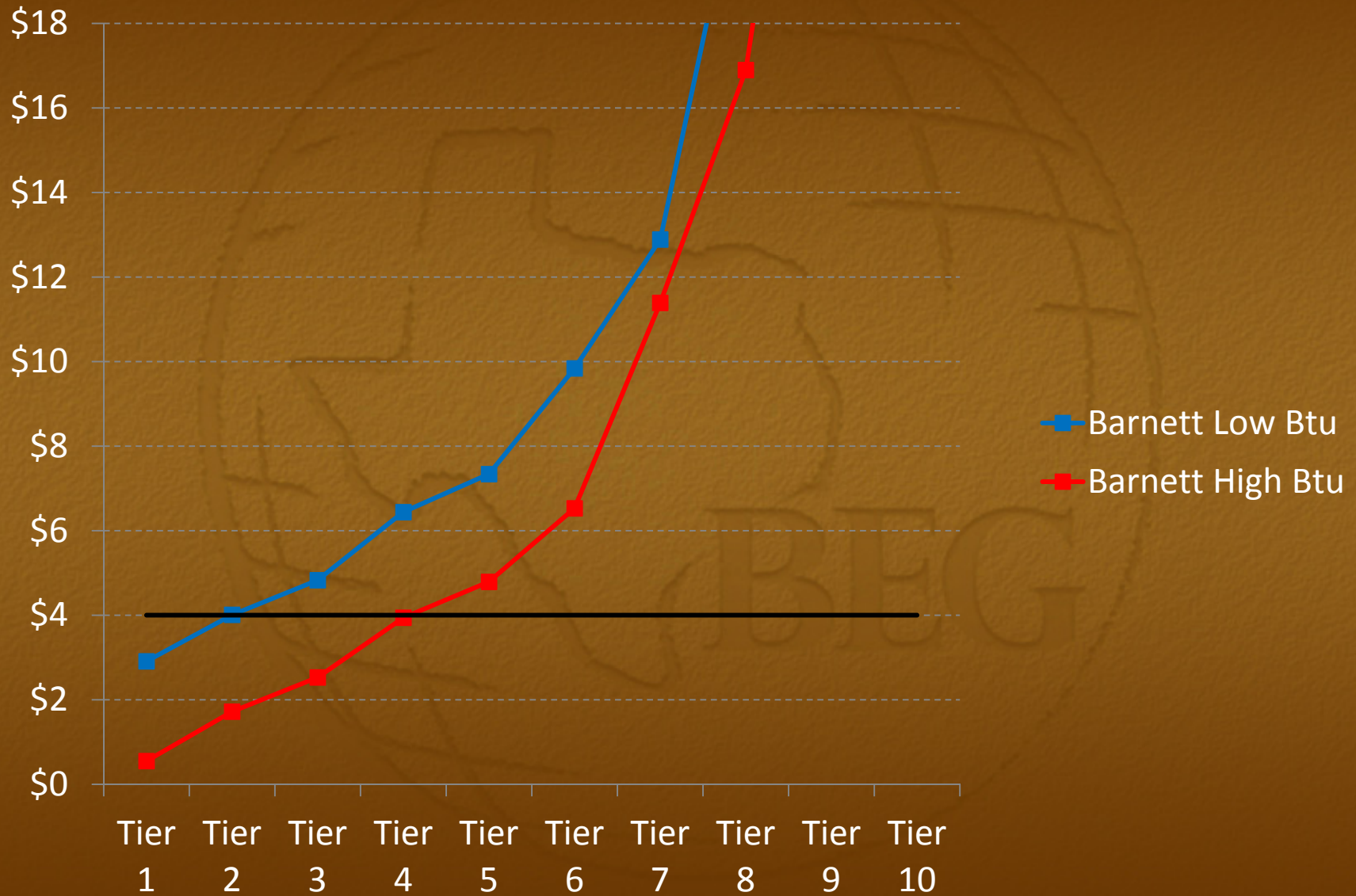
Additional assumptions for high Btu wells

Oil yield	1.2 bbl/MMcf	Drilling cost (CAPEX)	\$3,500,000 (20% tangible)
GPL yield	3,500 Gal/MMcf	Related CAPEX factor	13%
Shrinkage of gas	17%	Expense/well/yr	\$25,000 (+13% overhead)
Economic limit	0.05 / 0.029 MMcf/d	Processing fee	\$0.35/Mcf
Basis to Henry Hub	-\$0.20/MMBtu	Gathering cost	\$0.42/Mcf
WTI price	\$80/bbl	NGL transport	\$5/bbl
GPL/WTI price	45%	Water cut	20 (bbl/Mcf)
Royalty rate	20%	Water disposal	1.2 \$/bbl
Severance tax rate	7.5% (after 5 years)	Lease cost/acre	\$3,000
Marginal tax rate	35%	Spacing	40 acres
Inflation rate	2.5%	Abandonment	\$75,000

Gulen et al (2013) “Well economics across ten tiers in low and high Btu (British thermal unit) areas, Barnett Shale, Texas”. *Energy*, in press.

<http://www.sciencedirect.com/science/article/pii/S0360544213006464>

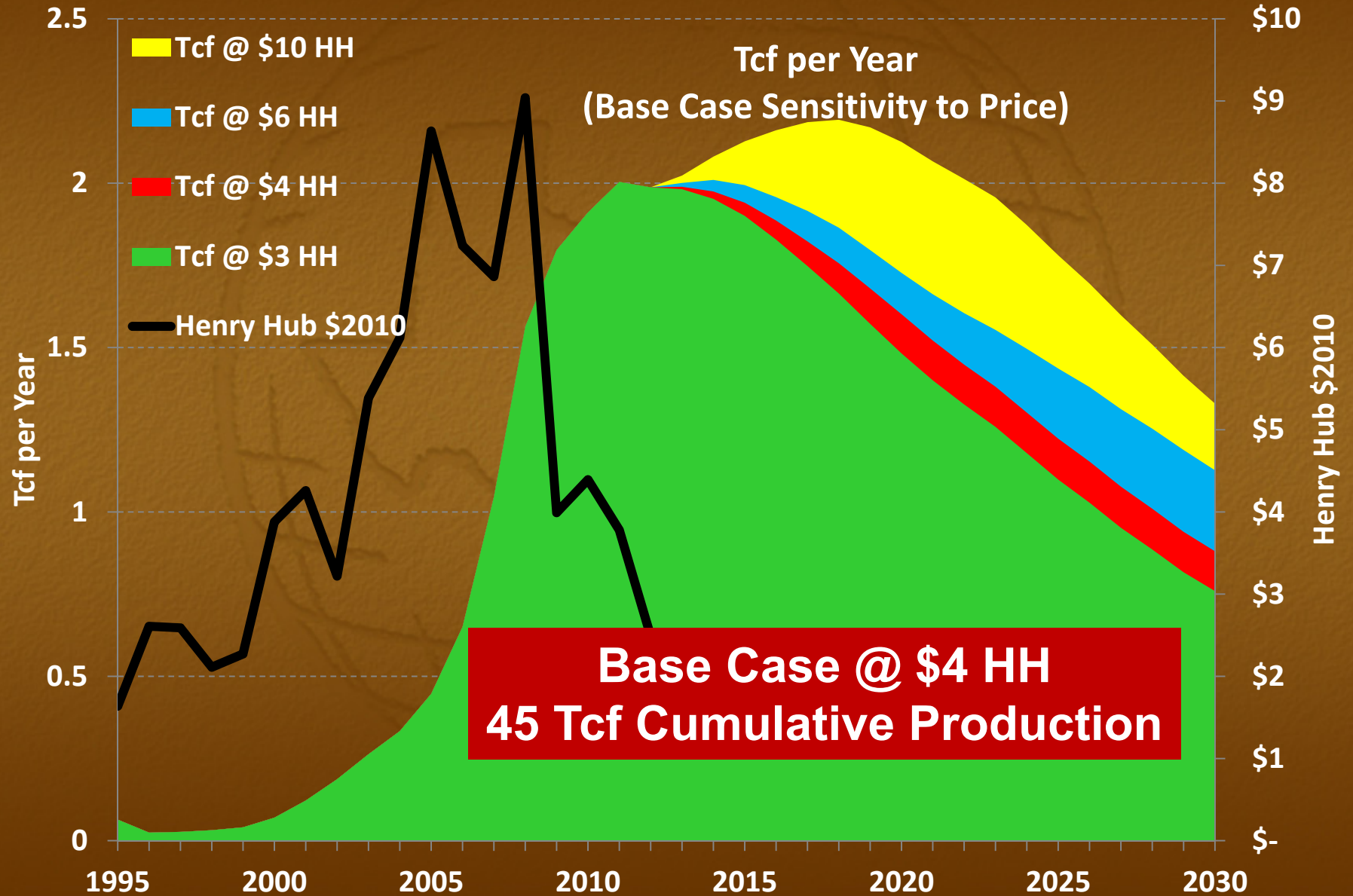
Breakeven Well Economics – 10% IRR



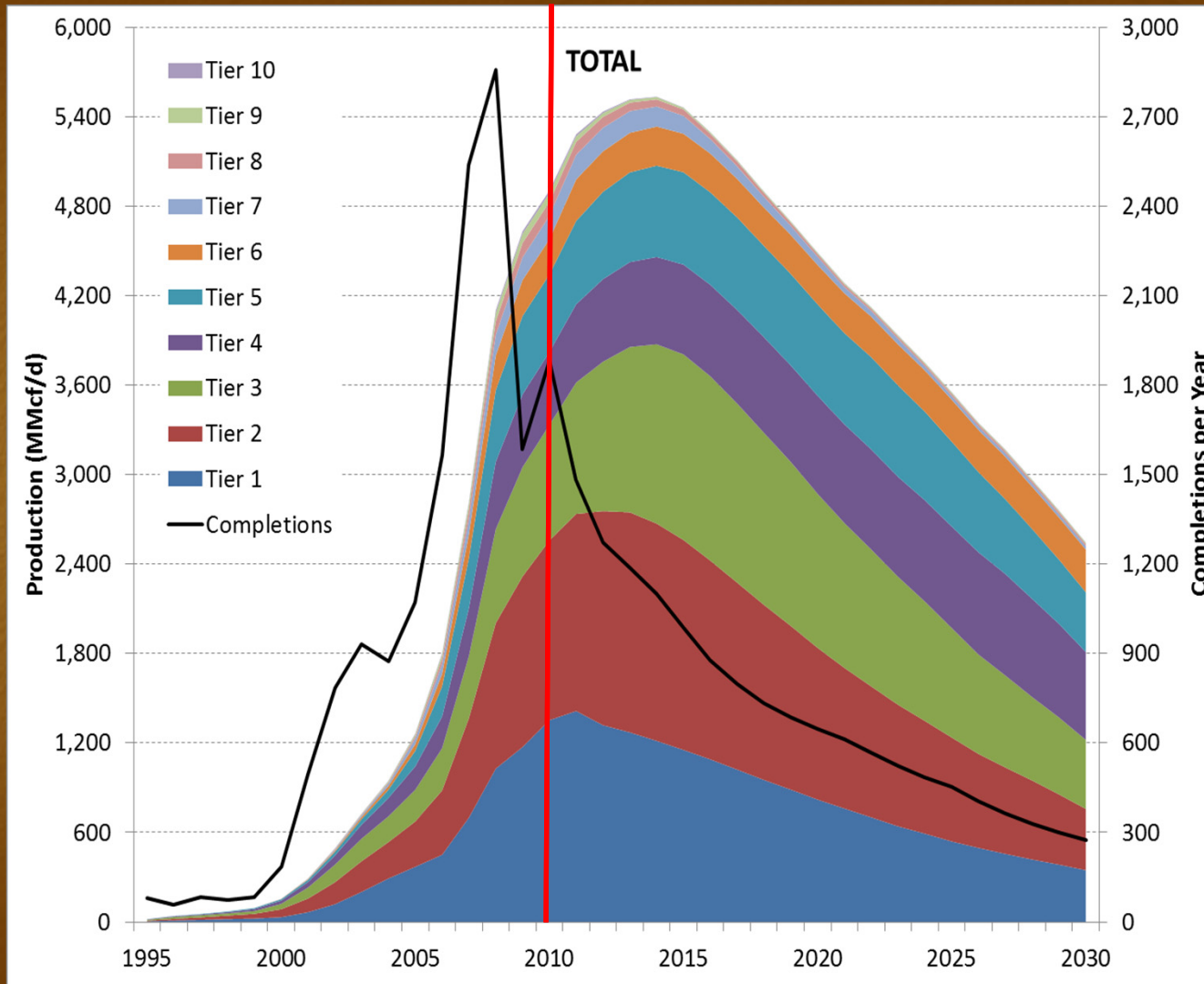
Barnett Shale: Base Case

Assumption	Base case
- Henry Hub price for natural gas	\$4.00/MMBtu
- Partly drained acreage developable ceiling	80%
- Undrilled acreage developable ceiling	15%
- WTI price	\$80/bbl
- GPL/WTI price ratio	45%
- Annual technology improvement	0.39%
- Annual well-cost improvement	0.24%
- Economic limit for shutting-in a well (low Btu)	0.05 MMcf/d
- Economic limit for shutting-in a well (high Btu)	0.029 MMcf/d
- Minimum completions in a year (low Btu)	20 (Tiers 1–4) 2 (Tiers 5–10)
- Minimum completions in a year (high Btu)	25 (Tiers 2–5) 10 (Tiers 1, 6–10)

Barnett Shale: Base Case



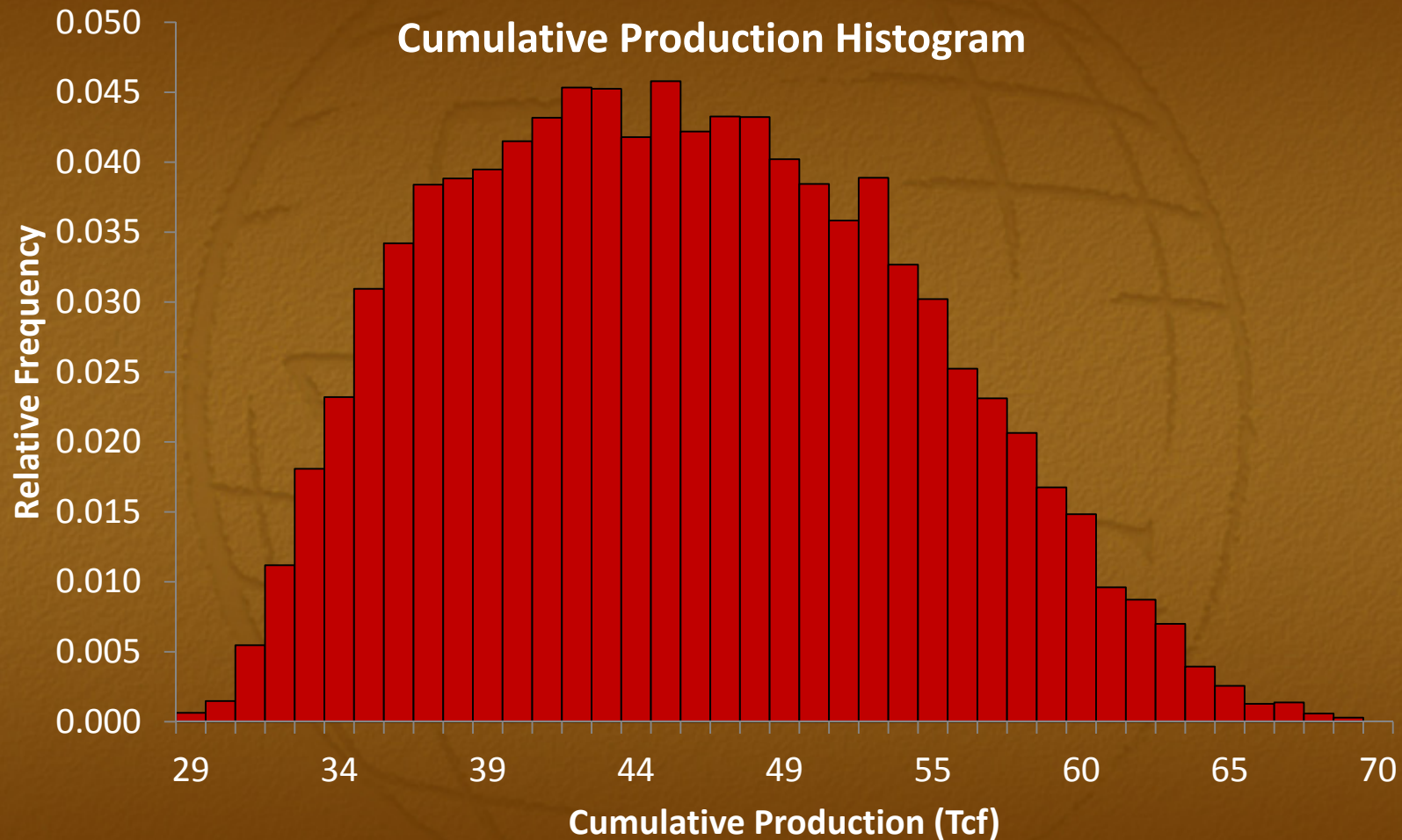
Barnett Production by Tier – \$4 HH



New wells after 2010	Average EUR/well
842	3.9
2,018	2.7
2,731	2.2
2,963	1.7
2,513	1.6
1,703	1.3
485	0.7
291	0.4
252	0.2
276	0.1
14,073	

~16,000 wells by the end of 2010 with 10.5 Tcf of cumulative production

Barnett Production Distribution



Browning et al. 2013. Barnett Shale Production Outlook. SPE Econ & Mgmt 5 (3): 89-104.
<http://www.spe.org/ejournals/jsp/journalapp.jsp?pageType=Preview&jid=EFM&mid=SP E-165585-PA&pdfChronicleId=0901476280298206>