Bureau of Economic Geology's Center for Energy Economics

Barnett Shale Reserves and Production Forecast

John Browning and Gurcan Gulen

Scott Tinker, Svetlana Ikonnikova, Bill Fisher, Qilong Fu, Susan Horvath, Frank Male, Ken Medlock, Tad Patzek, Eric Potter, Forrest Robert, Likeleli Seitlheko, and Katie Smye

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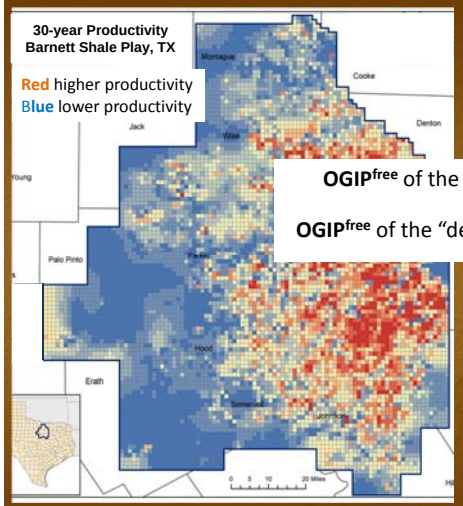
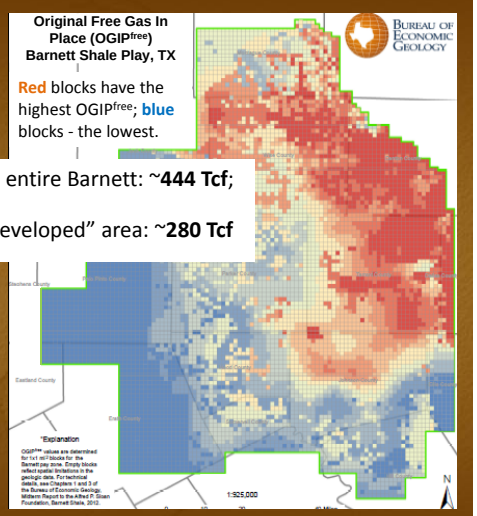
Questions

- The central questions of the study are:
  - What is the resource base in place?
  - What portion of that resource is recoverable?
  - What pace of drilling activity will be necessary to sustain production at various levels?
  - How achievable is this activity level, given advances in technology and natural gas prices?

Geologic Analysis



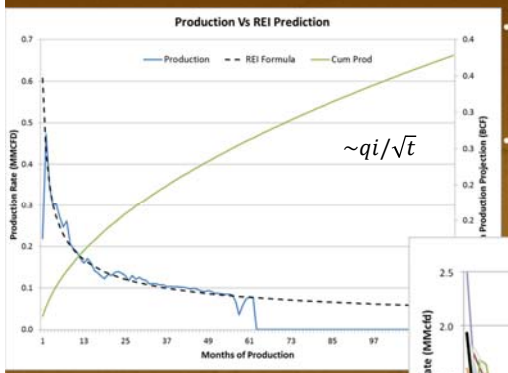


OGIP^{free} of the entire Barnett: **~444 Tcf**;

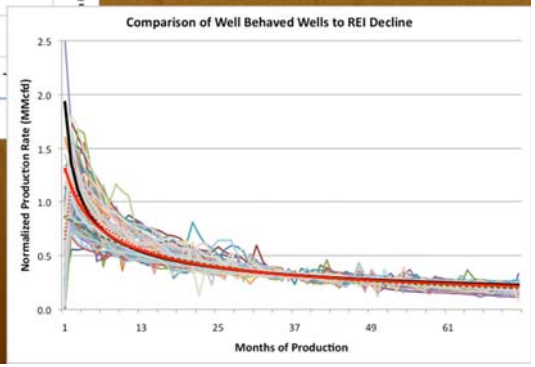
OGIP^{free} of the "developed" area: **~280 Tcf**

We estimate the content of natural gas for each 1 mi^2 of the Barnett Shale Play

Decline Analysis



- Rather than apply a standard exponential or harmonic decline approach, we derive the decline function (REI) based on physical properties.
- We confirm it to be statistically valid by testing the function against the data for more than 15,000 wells drilled in the Barnett Shale.



- We use the results, to estimate ultimate recovery (EUR) for all the existing wells and assess EUR of future wells.

Well Profiles Vary by Tier

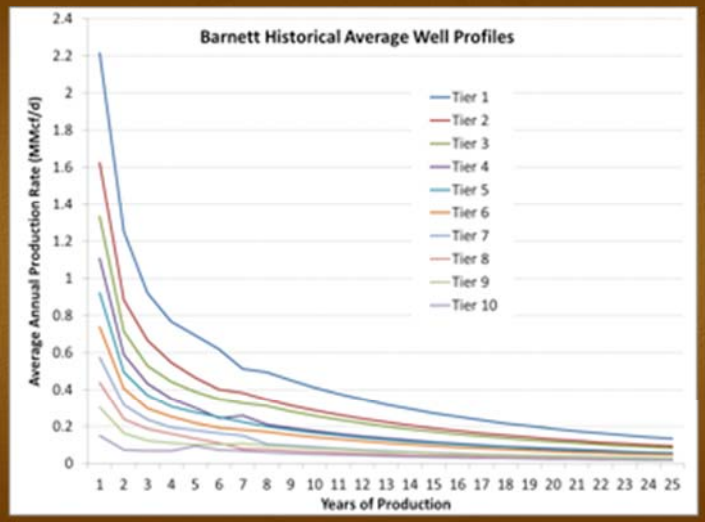
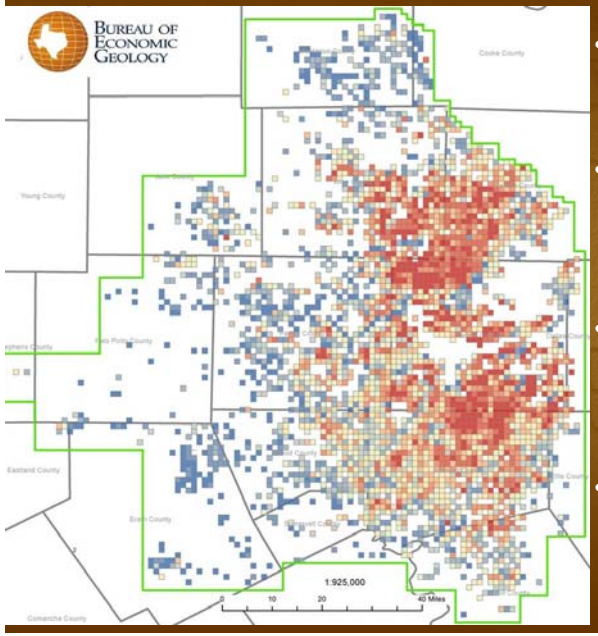
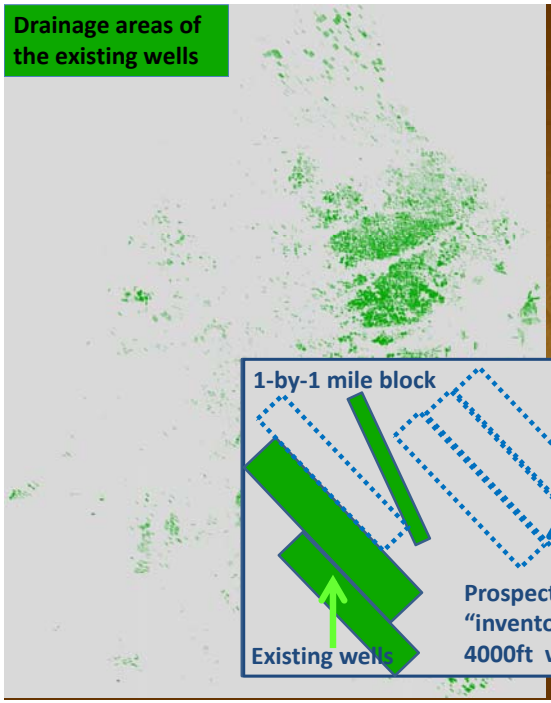


Figure 13. Average annual production profile for a 4,000-ft well (adjusted for interfracture interference).

Tiering



- We overlaid the entire Barnett shale play with a 1-by-1 mile grid.
- We calculate the average horizontal well productivity for each partly drained block
- We tier the partly drained blocks (~4000 blocks): each Tier is 10% of all the blocks.
- Tier 1 (red) - areas with the highest well productivity, and Tier 10 (blue) - the lowest well recovery.



Spacing Study: Well Recovery, Drainage Areas, and Infill Drilling Potential

Future Drilling Locations Limited in Better Tiers

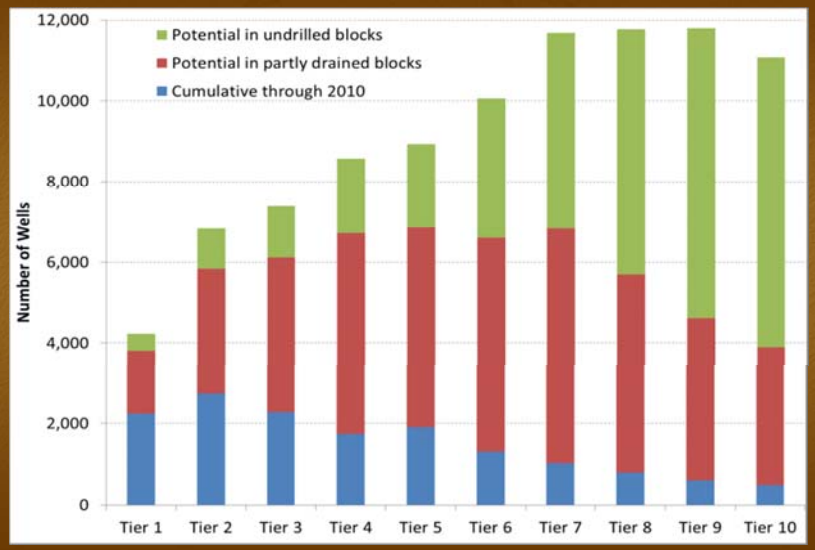


Figure 12. Drillwell potential by tier and wells drilled through 2010.

Estimated-Recovery Findings

- Existing wells are estimated to ultimately extract 8% of $OGIP^{free}$ — 19 out of 280 Tcf (drained blocks ~4000mi^2).
- Individual well recovery factor in best tiers, free gas only, averages 55% for horizontal wells (45% vertical wells).
- Of the entire Barnett, ~8,000 mi^2, only 10% of the acreage is drained and 8% of $OGIP^{free}$ extracted:
  - in Tier 1-3 (drained blocks) ~42% of acreage is already drained
  - in Tier 1 ~58% of acreage is drained
  - 28% of all the area drained is in Tier 1.
- Assuming 4000ft wells and estimated RFs, $TRFG^{remain}$ is **87 Tcf** (25 years+attrition+interfrac.interference) out of **444Tcf**

NGL Substantially Impacts Well Economics

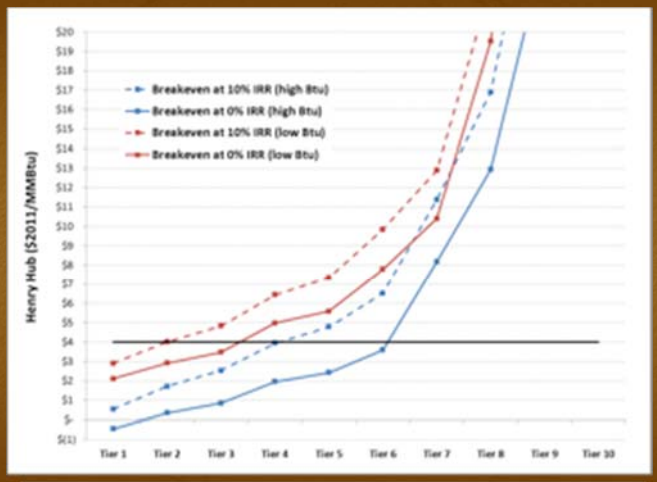


Figure 14. *Break-even natural gas price on Henry Hub equivalent required to generate 0% and 10% IRR in each tier for dry-gas and wet-gas areas.*

Production Outlook Indicates Barnett is peaking

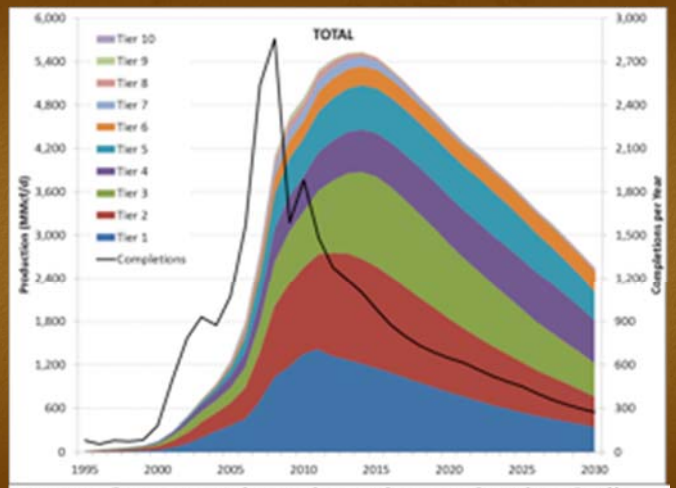


Figure 15. *Base-case production forecast by tier and number of wells completed by year.*

EUR Impacted By Future HH Price

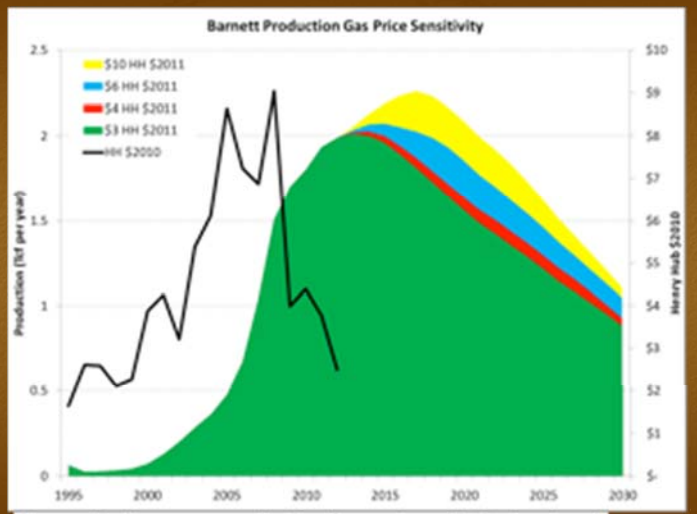


Figure 16. *Base-case production forecast sensitivity to natural gas price.*

EUR Distribution Centers on 44 Tcf

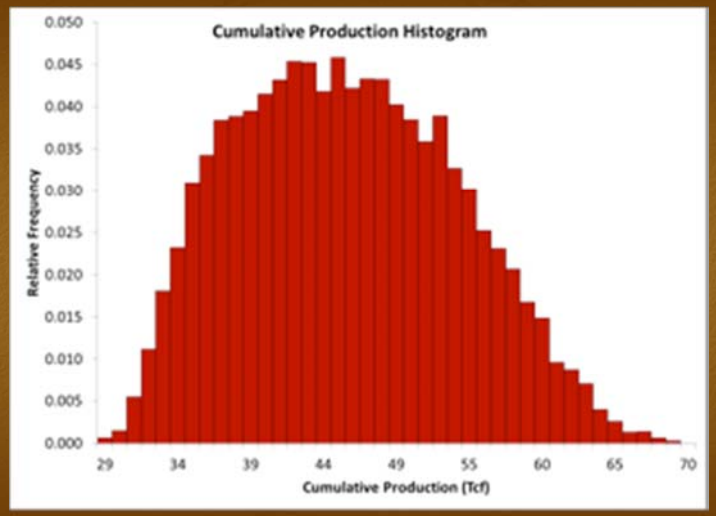


Figure 17. Simulation results for Barnett cumulative production.