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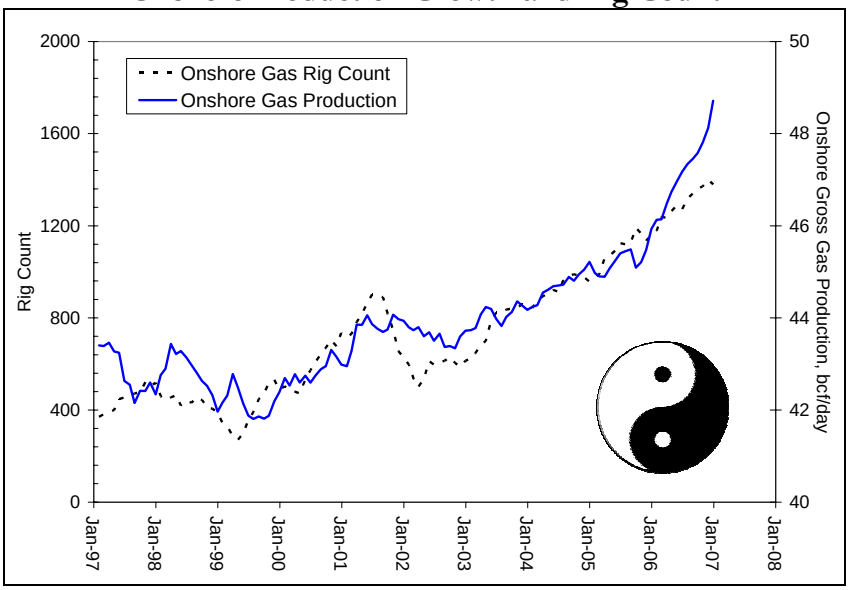
The Yin and Yang of Production Growth, Rig Count, and Gas Storage

Onshore Production Growth and Rig Count



Key Takeaways:

The Flat Earth Society?: A flat onshore rig count likely results in production growth, rather than a production decline as some have speculated. In other words, reversing the current trend of onshore production growth will require a rig count decline.

Implications: If gas storage is headed for near/above "full" during the injection season (most likely due to ongoing production growth), we project onshore rig count would have to decline by ~350 rigs to create "zero" growth of onshore gas supply.

Watching: Shoulder period injections (late-April thru May) will give us a strong signal if gas storage will "overfill" during injection season…or if gas storage levels will end up below full (~3,500bcf). We are taking the "over" at this point.

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Production in Various Rigcount/Well Quality Scenarios

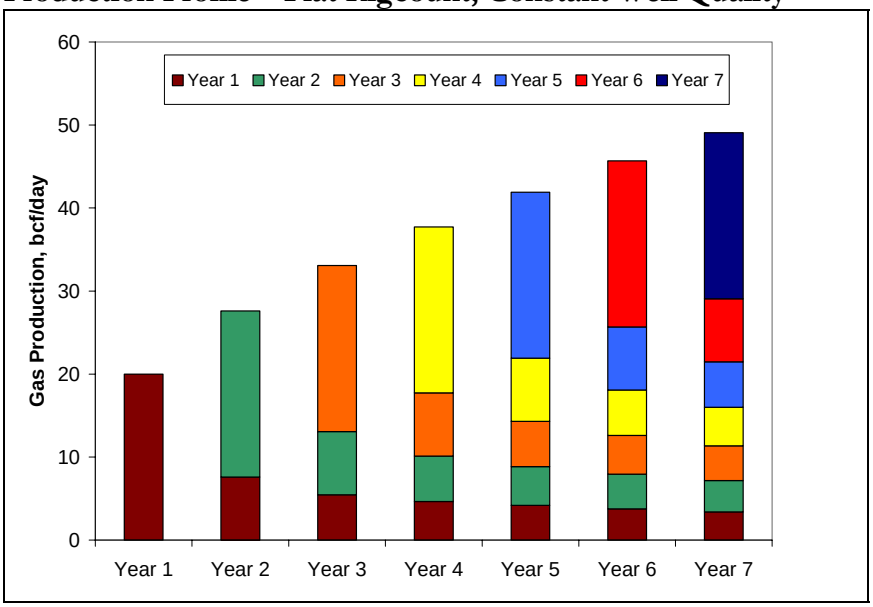
We hear a lot of folks arguing that a flat gas-directed onshore rig-count means U.S. gas production will decline. The numbers say it is not going to happen.

Flat Rig Count

There is a pervasive (if not persuasive) argument that U.S. onshore gas production will fall in a flat rig count rig environment. The rationale is qualitatively driven by the belief that high decline rates (like the Barnett Shale) are difficult to overcome.

Our analysis suggests the opposite. In the example gas field outlined below, we assume 10 wells are drilled annually and the production profile of each well is similar to a high quality Barnett Shale well (2mmcf/day initial production, high initial decline rate of 60% and diminishing decline rates over time). As this example shows, in a flat rig count environment, the overall growth rate will slow, but production growth is maintained.

Production Profile – Flat Rigcount, Constant Well Quality



10 wells per year – flat

Year 1 decline 60%

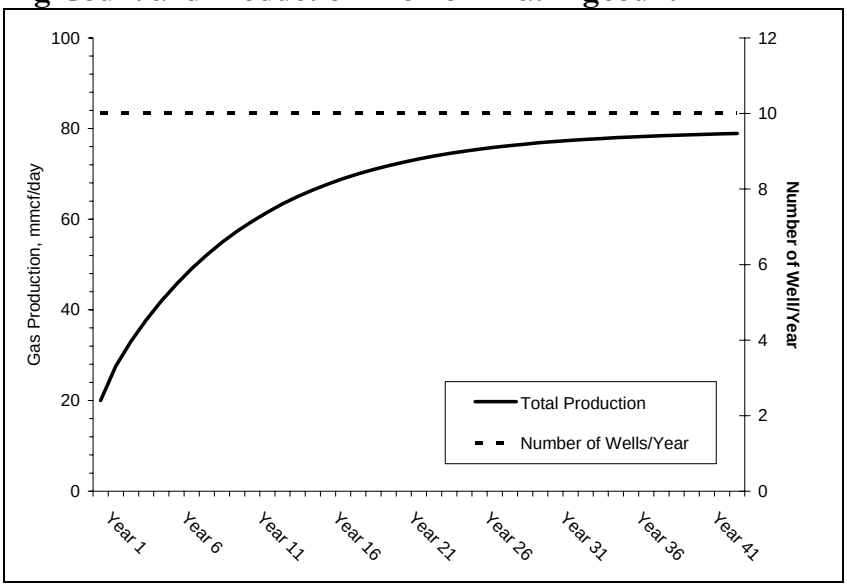
Year 2 decline 28%

Year 3 decline 15%

Terminal decline ~8%

Source: Pickering Energy Partners, Inc.

Rig Count and Production Profile – Flat Rigcount

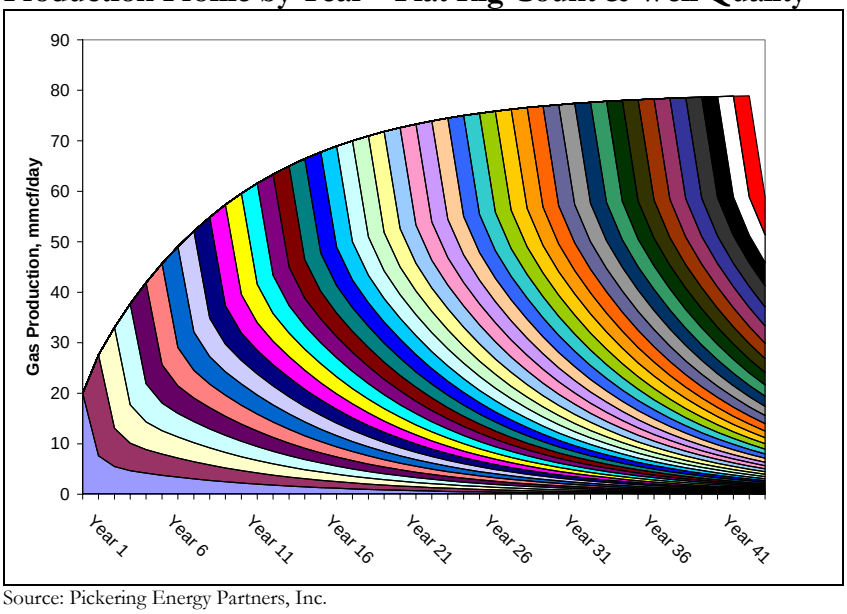


Source: Pickering Energy Partners, Inc.

In a steady rigcount environment, production grows when there is *no change* to the quality of wells drilled each year.

The following graph shows the annual production "wedges".

Production Profile by Year – Flat Rig Count & Well Quality



Source: Pickering Energy Partners, Inc.

Overall production grows as the new wells add a consistent amount of production, which is additive to the production "tail" from the wells drilled in previous years.

Our work in this example is directly applicable to overall U.S. gas production. In a stable rig count, stable well quality environment, *production will grow*. We must therefore examine the sensitivity around the two variables in our example: rig count and well quality. It stands to reason that production will fall if :

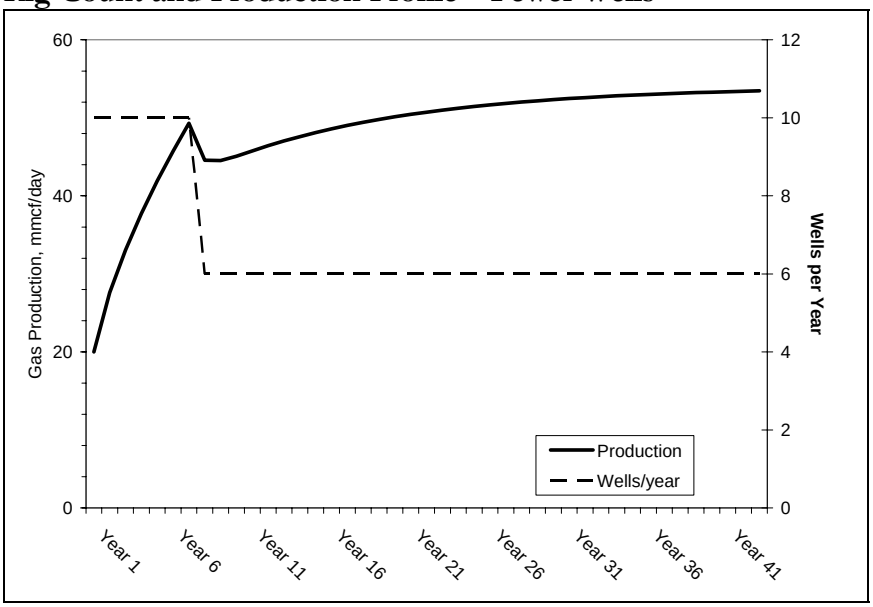
- Rig count declines and/or
- Well quality deteriorates noticeably

As such, let's examine these issues.

Declining Rig Count

The quickest and most certain method to restore equilibrium to our currently oversupplied gas market would be to see a reduction in drilling activity. In our example gas field with the same high IP and high decline rate wells, production growth rapidly becomes production decline when the number of wells drills is reduced 40% (from 10 wells annually to 6).

Rig Count and Production Profile – Fewer Wells



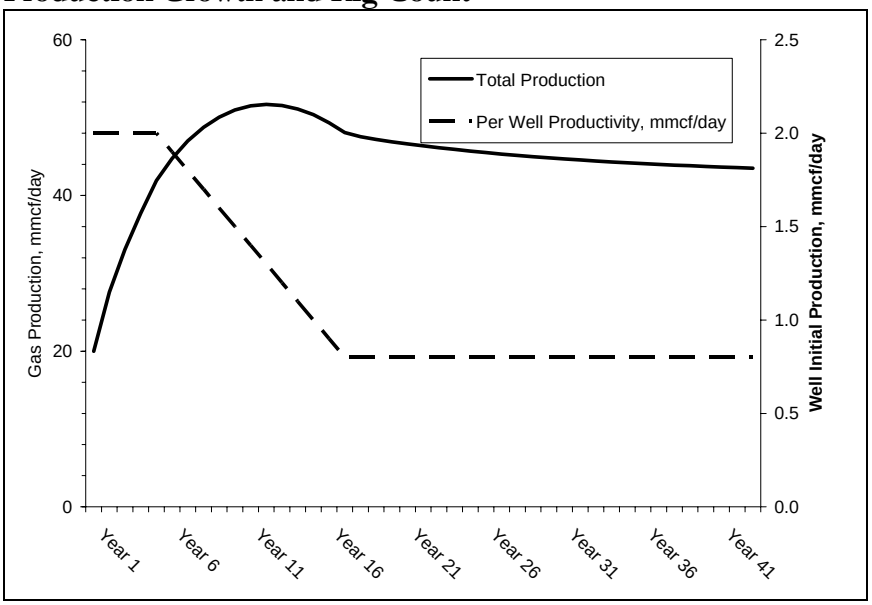
Source: Pickering Energy Partners, Inc.

Production growth is slowly reestablished at the lower activity level…although at a lower growth rate and absolute production levels.

Declining Well Productivity

The typical reason field production declines is the opportunity set diminishes. Said more directly…one runs out of quality well locations and drills lower quality peripheral wells and/or lower impact infill locations. Adjusting our example gas field, we maintain steady activity (10 wells/year) but adjusted initial production rates for the new wells from 2mmcf/day to 0.8mmcf/day over a 10 year time frame.

Production Growth and Rig Count



10 wells/year flat

Year 1 decline ~60%

Terminal Decline ~8%

Well quality deteriorates

Source: Pickering Energy Partners, Inc.

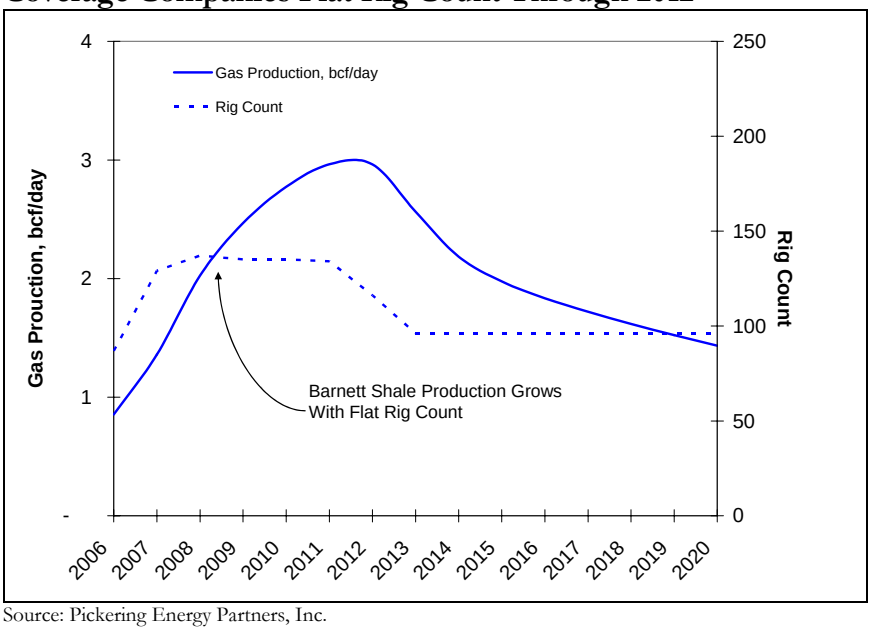
In the example above, a gradual deterioration of well quality (60% in 10 years) sees production growth continue for ~5 years after the deterioration begins. In an even more draconian scenario where well quality falls by 50% in 2 years, declines in production would be experienced almost immediately.

Bottom Line – natural gas production will fall in a flat rig count scenario *only* when prospect quality (i.e., initial production/reserves per well) deteriorates…*significantly*. In our analysis of aggregate U.S. supply on page 7, actual well productivity would have to fall 20% in 2007 to flatten production growth…which simply is too large a drop to expect in a single year.

Real Life Example…The Barnett Shale.

The Barnett Shale is a noticeable driver to U.S. onshore production growth (see our Dec 2006 report "*The Barnett Shale: Update*"). However, a flat rig count will not cause Barnett (or U.S.) production to decline. In fact, the bottoms up Barnett Shale production outlook (in the Core and Tier 1 areas) for our coverage companies shows meaningful growth through 2012 with an essentially flat rig count. Once rig count falls (i.e., when companies run out of drillable location), production will fall materially.

Barnett Shale Core/Tier I Production
Coverage Companies Flat Rig Count Through 2012



Source: Pickering Energy Partners, Inc.

Created by bottoms-up aggregation of Core and Tier 1 Barnett Shale company production forecast.

Companies are generally guiding to a flat rigcount from 2007-2011.

Production still ramps from from 1.3bcf/day to 3bcf/day.

To re-emphasize the point… just because initial decline rates are high, a flat rig count does not automatically mean that gas production will be decline.

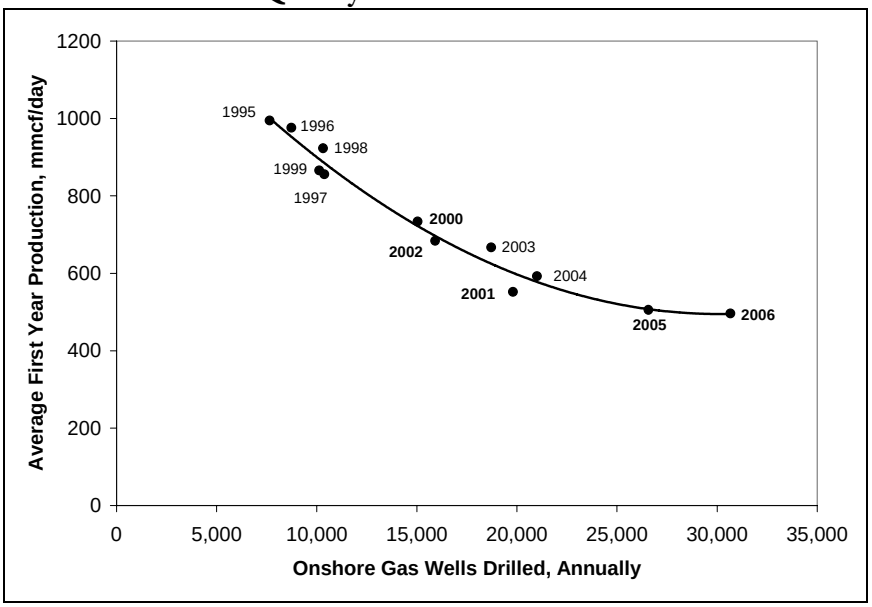
Enough Theoretical Scenarios…What About the U.S. Gas Market?

We believe U.S. onshore rig count would have to fall ~350 rigs to flatten U.S. onshore production.

Average first year production for most onshore wells shows a dramatic decline (even the best operators can not escape the "physics" of oil and gas reservoirs). This explains why the onshore gas production growth has been modest (2.5% annually) even though rig count has more than doubled in the past 5 years.

The following chart shows first year well productivity is in a declining trend over the past 12 years as the number of wells drilled has generally increased. This is why production growth did not shoot through the roof.

Onshore U.S. Well Quality Curve



Average well quality deterioration halted in 2006...could be the result of horizontal well technology.

Simply stated: As activity ramps up, the average well gets worse (driven down by lower quality incremental/marginal wells). As activity falls, the average well improves (driven by fewer lower quality marginal wells). Best projects are done first and marginal projects done last! This was seen in 2002 when drilling slowed and the average well productivity *increased* by 25%. Fewer "bad wells" were being drilled.

We know the engineers and geologists reading this are saying "Duh! We spend $$$ on the best projects first"…but it is an important point when trying to estimate the impact of falling rig count. If the last wells drilled are not very impactful to supply (which helps explain low onshore growth rates), then more rigs will need to be dropped to have a meaningful impact on supply.

Onshore Well Productivity

	Onshore Production bcf/day	Onshore Wells	Base Decline Rate	Gas Decline bcf/day	Gas Growth via Drilling bcf/day	First Year Productivity mmcf/day/well	First Year Productivity % Change
1995	42.0	7,649	19%	8.0	7.6	995	-10%
1996	42.1	8,733	20%	8.4	8.5	976	-2%
1997	42.1	10,379	21%	8.8	8.9	856	-12%
1998	42.0	10,319	23%	9.7	9.5	923	8%
1999	41.3	10,121	23%	9.5	8.8	866	-6%
2000	41.8	**15,042**	25%	10.5	11.0	**734**	**-15%**
2001	42.6	**19,803**	24%	10.2	10.9	**552**	**-25%**
2002	42.1	**15,917**	27%	11.4	10.9	**684**	**24%**
2003	42.6	18,711	28%	11.9	12.5	667	-2%
2004	43.0	21,005	28%	12.0	12.5	593	-11%
2005	43.8	26,572	29%	12.7	13.4	506	-15%
2006	45.9	30,665	29%	13.1	15.2	496	-2%

First year productivity rebound in 2002 after steady declines during the previous few years.

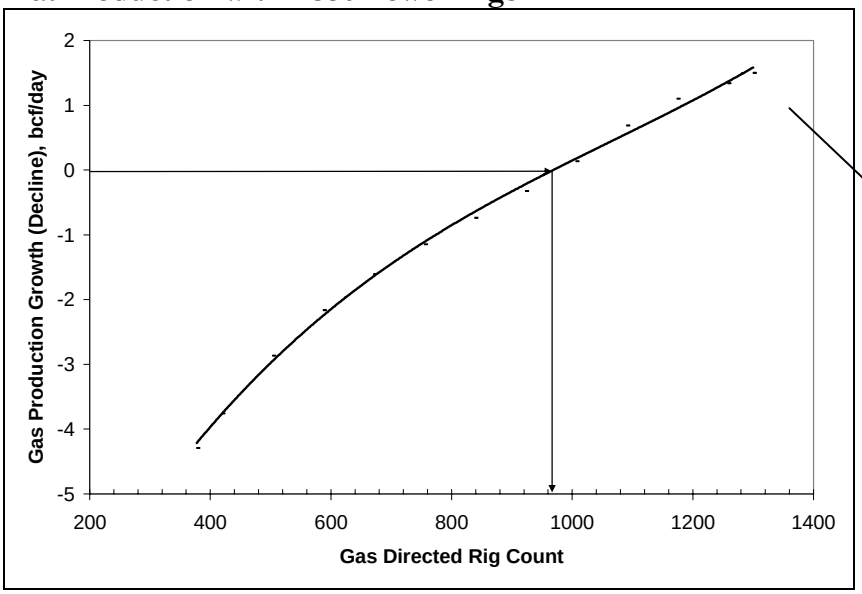
Using the above relationship and our assumption that U.S. onshore production declines 13.1bcf/day (annual decline of 29%), *we show that ~350 onshore gas-directed rigs will have to be laid down to cause 1.7bcf/day of onshore production growth to flatten* (i.e., our zero growth case). Laying more rigs down has an increasing impact to overall supply as more meaningful wells are not drilled.

Table of Onshore U.S. Rig Count and Aggregate Production

Rig Count	Change Rig Count	Wells Drilled	Average First Yr Rate mmcf/day	Added Production bcf/day	Growth/(Decline) bcf/day
1300	0%	31,000	460	14.3	1.7
1258	-3%	30,000	470	14.1	1.5
1174	-10%	28,000	495	13.9	1.3
1090	-16%	26,000	510	13.3	0.7
1006	-23%	24,000	533	12.8	0.2
923	-29%	22,000	564	12.4	(0.2)
839	-35%	20,000	601	12.0	(0.5)
755	-42%	18,000	647	11.6	(0.9)
671	-48%	16,000	699	11.2	(1.4)
587	-55%	14,000	759	10.6	(1.9)
503	-61%	12,000	826	9.9	(2.6)
419	-68%	10,000	900	9.0	(3.6)
377	-71%	9,000	940	8.5	(4.1)

This assumes ~24 wells per rig year

Onshore Production Growth and Rig Count
Flat Production with ~350 Fewer Rigs



We model current onshore growth of 1.7 bcf/day given our expectation of ~1350 gas rigs drilling in 2007.

Source: Pickering Energy Partners, Inc.

Some investors believe U.S. onshore decline rates are as high as 35% and not the 29% we use in our analysis. The magnitude of the decline rate merely changes the average first year productivity…it does not change the conclusions of the work.

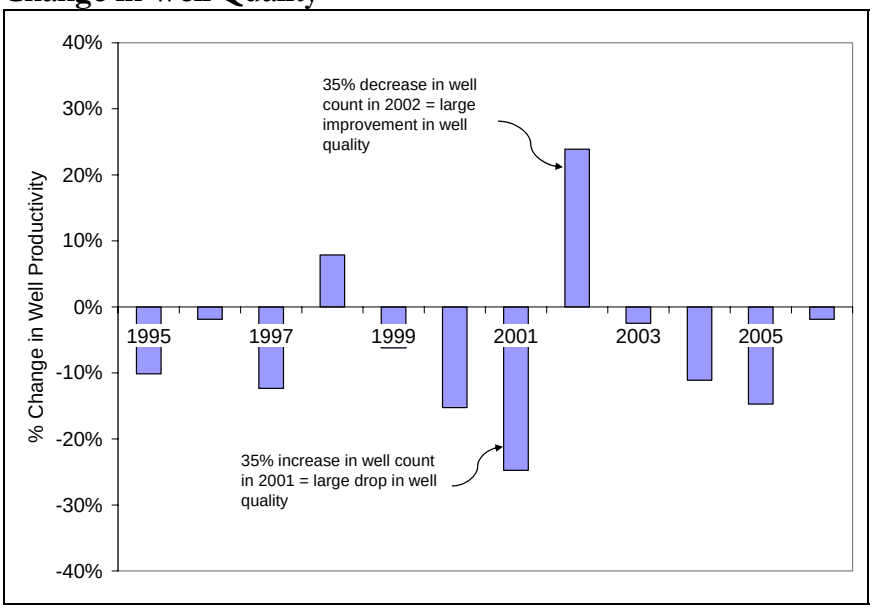
In lieu of a rig count decline…there are a few other factors that can drive productivity.

Potential Impact of Well Quality

What deterioration in overall well productivity results in flat onshore production growth if rig count does not fall?

- Average well productivity would have to decline 20%...in out view a highly unlikely event in a short (1 year) time frame with a flattish rig count.

Change in Well Quality



Source: Pickering Energy Partners, Inc.

Potential Impact of Decline Rates

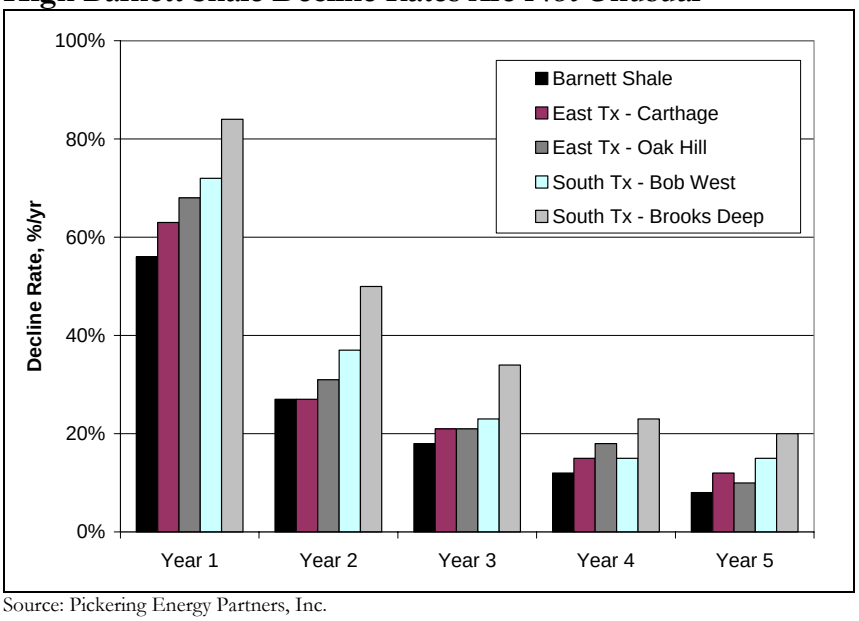
How much would aggregate decline have to accelerate to cause flat onshore production with flat rig count?

- A 400bps increase in base decline rate would be required to offset the 1.7bcf/day onshore supply growth…base decline would have to accelerate from 29% to 33%. A very unlikely scenario.

High Decline Rates Are Not New

There is some confusion that Barnett Shale wells exhibit uncharacteristically high decline rates when in fact they are typical of onshore tight/unconventional gas reservoirs. The following table shows typical annual decline rates for each of the first five years in typical tight gas fields/regions. The Barnett Shale decline profile is actually more favorable than other more well known onshore basins.

High Barnett Shale Decline Rates Are *Not Unusual*



Source: Pickering Energy Partners, Inc.

Risks To Our Analysis

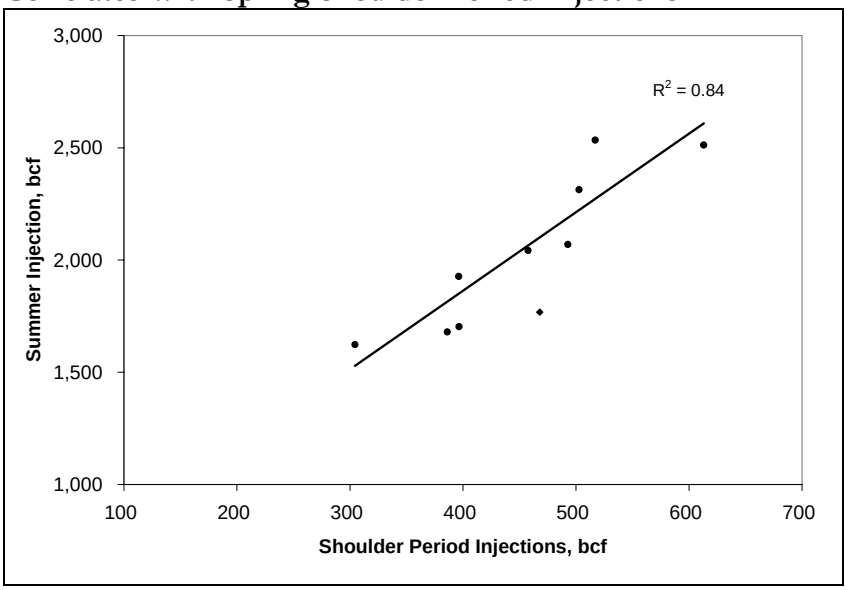
What are the risks to this analysis (or where could we be wrong)? We strongly believe the marginal well thesis explains historical behavior and our analysis is based on 10 years of data. The recent increase in horizontal drilling could change the overall well quality/economic mix that results in a faster response to supply (i.e., the zero growth case might occur with only a decrease in 200 rigs if higher impact wells are shelved). Also, the new "higher efficiency" rigs being introduced to the market have not been taken into account in this analysis.

What are we watching?

Shoulder period injections will be a good near term indicator of expected total injections…and if storage is likely to fill/over-fill.

If natural gas production is growing as the DOE monthly production data suggests (Pickering Energy Jan 07 report "*U.S. Natural Gas Production Growth Drives Soft Outlook*"), this production growth should "show up" in the weekly gas storage numbers. The spring shoulder period can provide some insight as these are often the largest injections due to little weather impact…because summer has not yet arrived and winter is in the rear view mirror.

Overall Injection Period
Correlates With Spring Shoulder Period Injections



Recent history shows that total summer injections correlate well with shoulder period injections (the six week period from late April thru May yields the best results). This April and May, we will closely monitor gas storage injections:

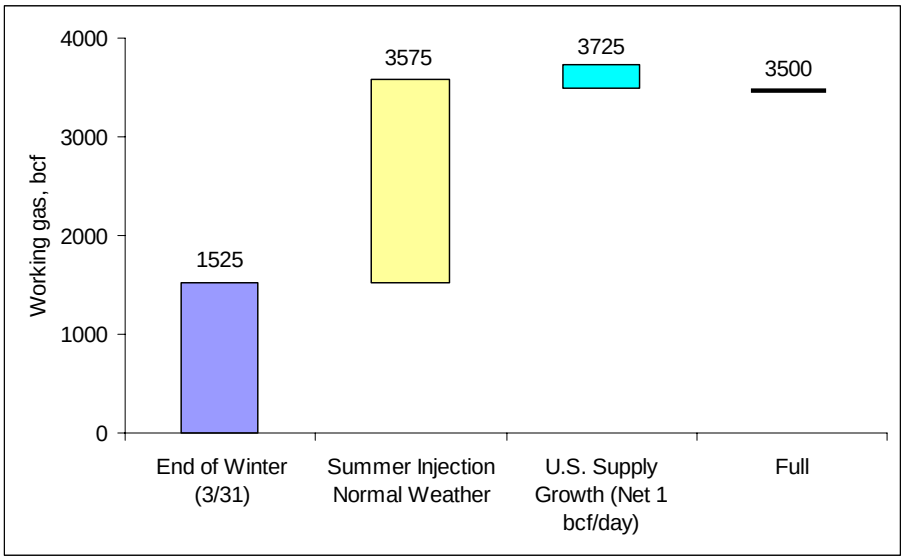
- If injections are large, then gas production is likely the culprit and storage levels will be heading back toward full (>3,500bcf).
- If injections are small, the risk of over-filling storage is significantly reduced. Potential explanations would include less gas production growth than we model or U.S. economic expansion is driving more gas-fired power demand than we currently model.

Bottom Line: April showers and May flowers will provide critical insights into summer gas storage injections, fall storage levels, gas prices and (theoretically) rig count through the summer.

Our current base case is that gas storage will end the injection season slightly above "full" (>3,500 bcf). This rests largely on a normal weather prediction and a belief that onshore supply growth will continue. In addition to storage fills, we will continue to watch:

- Monthly U.S. supply growth and rig count
- Canadian imports and rig count
- LNG imports
- And weather!

Storage Fill Waterfall Chart



The bottom line, it will take a hot summer and/or an active GOM hurricane to prevent storage from filling /over-filling…or a dramatically lower rig count.

Conclusions

Flat (steady) rig count is not sufficient to cause onshore production to fall. Over time, the pace of growth will moderate…but it will not result in declining onshore production.

If a storage "over-fill" becomes the likely scenario, deterioration in onshore rig count will cause onshore production growth to flatten…exposing storage and gas prices to offshore production declines.

Shoulder period injections are important. If they are low, then total summer injections will likely not test system capacity and gas prices/activity levels will remain strong.

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