The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Can US Natural Gas Production Be Ramped Up?

Posted by Gail the Actuary on September 4, 2008 - 10:35am
Topic: Supply/Production
Tags: barnett shale, coal bed methane, natural gas, original, shale gas, tight gas, unconventional gas [list all tags]

Navigant Consulting Inc (NCI) recently prepared a report called North American Natural Gas Supply Assessment on behalf of a natural gas organization called the American Clean Skies Foundation. In this report, NCI estimates the amounts shale gas and tight gas production can be increased in the next decade. These estimates suggest that US natural gas production can be ramped up by nearly 50% by 2020. How reasonable are these estimates? What obstacles are there to such a big ramp up?

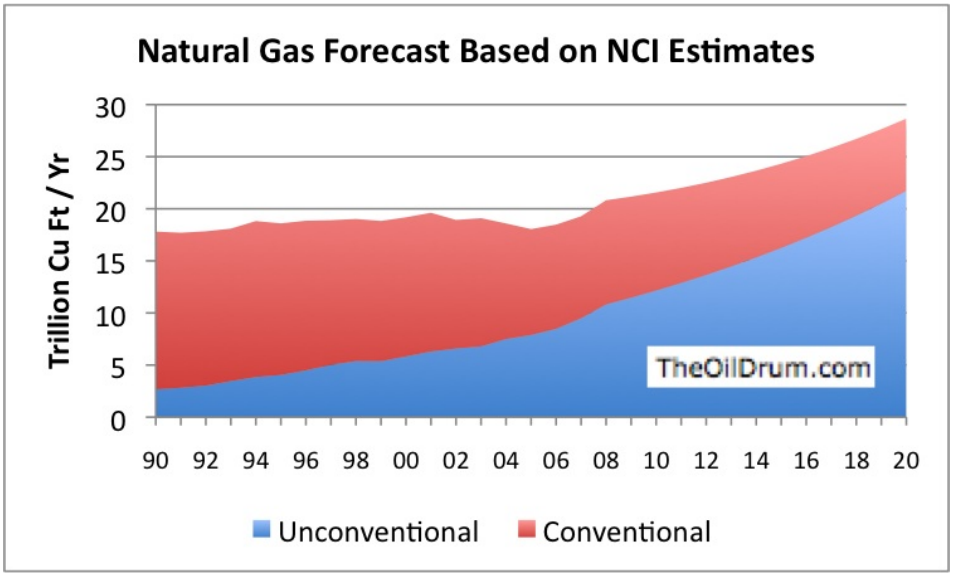

Figure 1. Approximate future US natural gas production, based on Navigant Consulting estimates of shale gas and tight gas production.

My analysis indicates that NCI is correct in some respects. There is indeed a great deal of unconventional natural gas resources in the United States, and recent improvements in technology point to the possibility of significantly greater production.

There are two major problems, however. One is that short-term demand is not very flexible. It is very easy to flood the market with more natural gas than the market can absorb. The other is that there are a number of obstacles ahead for companies selling natural gas. It is likely that these obstacles, rather than a lack of natural gas, will curtail the rise in natural gas production. As a result, the full ramp up in production is not very likely.

Recent EIA Data for Natural Gas

Let's start by looking at EIA natural gas data. EIA has recently reported a big increase in US natural gas production (8.8%, comparing the first five months of 2008 with the first five months of 2007). Some have suggested that the EIA numbers must be wrong. It seems to me that what we may be seeing is the effect of a recent technological breakthrough.

Until fairly recently, many of us had noticed a pattern of increased drilling being required to achieve the same quantity of natural gas production. Most of us interpreted this to reflect declining Energy Return on Energy Invested (EROEI).

In the last few months, there has been a sudden shift in the data. EIA data shows that recent production is rising at the same time that the drilling of new wells is leveling off. Average daily dry gas production during the first five months of 2008 is up 8.1% over the same period in 2007. (Because 2008 is a leap year, total dry gas production has increased 8.8% for the five month period.)

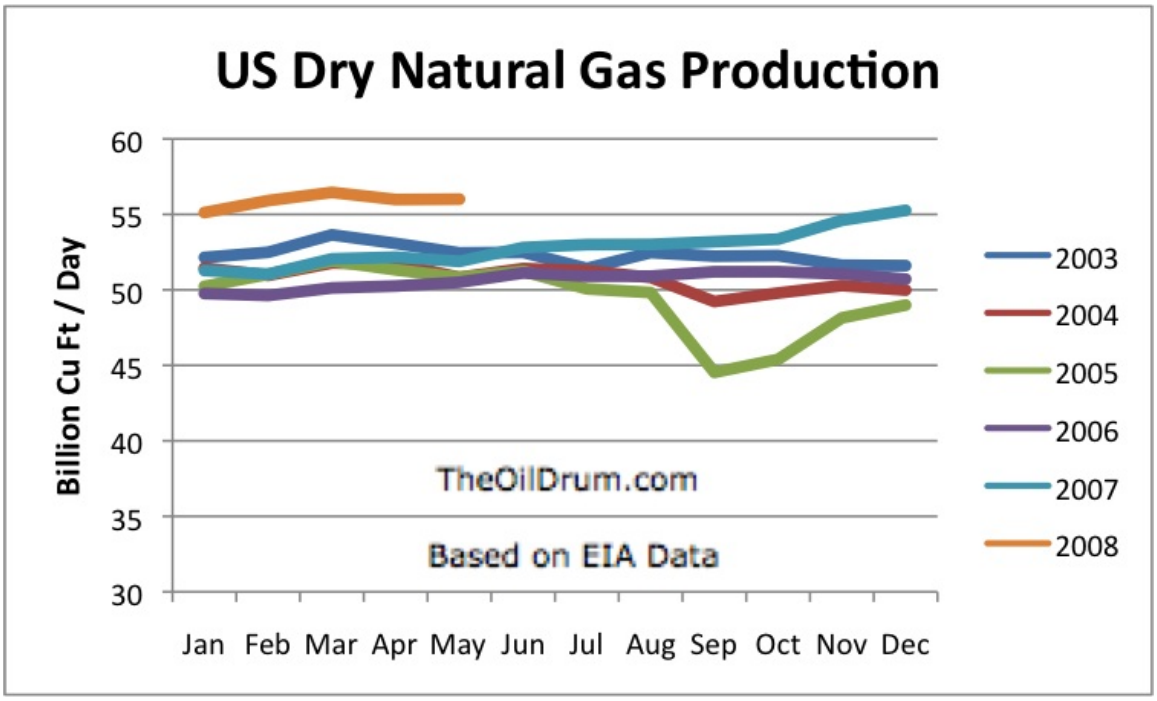

Figure 2. US dry gas production has been rising since about November 2007

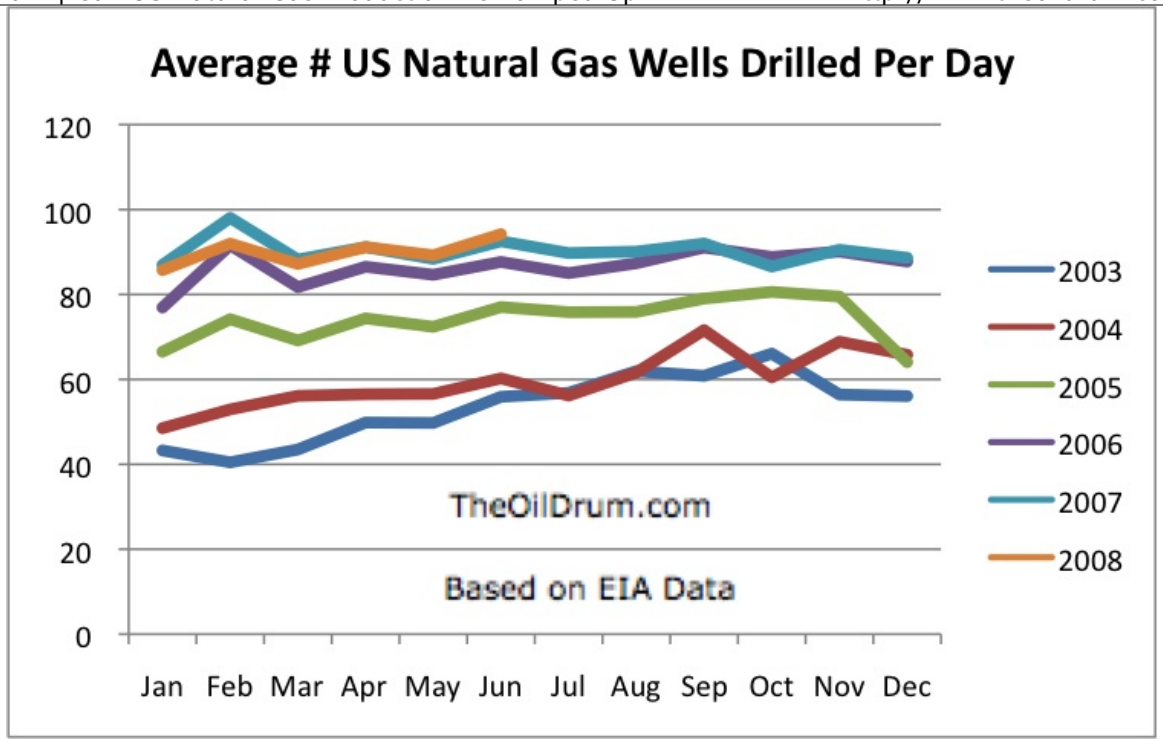

Figure 3. Number of natural gas wells drilled levels out, about the same time production begins to rise (November 2007)

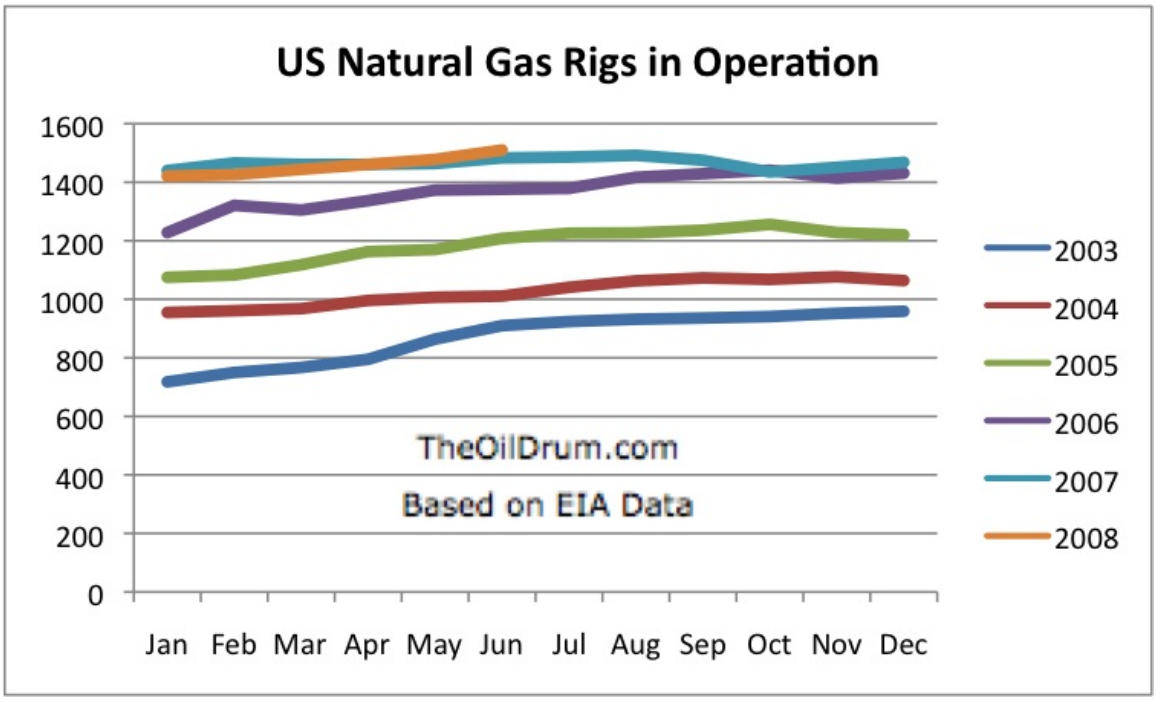

Figure 4. Number of natural gas drilling rigs levels out in late 2007

One can look at many other measures as well, and see a similar pattern. The number of well feet drilled per day levels off and even drops, in late 2007 and early 2008, at the same time natural gas production increases. My interpretation of what is happening is that there has been a technological breakthrough, probably in the area of shale gas production of natural gas. Because of this breakthrough, companies are able to produce more gas, with less drilling effort.

There are several reasons I believe that the data reflects a technological breakthrough, rather than, say, an error in EIA data. First, when I look at individual company reports, the ones that show drilling activity seem to show the same kind of pattern--more success with fewer wells drilled. Also, even where there is not information on the number of wells drilled, the company reports talk about increased productivity of wells, due to the increased use of horizontal drilling and better fracturing techniques. Finally, the increased natural gas in the system is having the expected impact on storage and prices, as I will discuss later in this post.

EIA does not break out recent production into unconventional vs. conventional. In fact, the most recent break out of unconventional is for 2006, given in the backup data to Figure 80 of the Annual Energy Outlook:

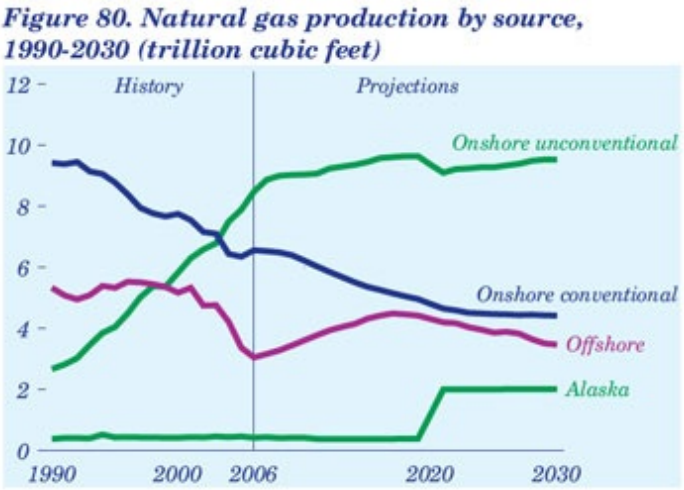

Figure 5. EIA History of Forecast of Natural Gas by Source

It is clear from looking at this figure that unconventional gas has been rising rapidly. EIA's forecast for the future looks unreasonably pessimistic alongside its production history. The other two major categories (onshore conventional and offshore conventional) are both declining rapidly (but miraculously are forecast to rise in the future).

The EIA graph in Figure 5 shows that there is the potential for an increase in gas production from Alaska, once a pipeline is built. The EIA forecasts that this will happen in 2020. The amount of the increase appears to be about 10% of current US natural gas production. If this in fact takes place, on my Figure 1, there will be a small bump up in production in 2020, bringing the 2020 production total from 29 trillion cubic feet to 31 trillion cubic feet.

If there is an increase in overall natural gas production, one might reasonably assume that the increase in unconventional natural gas is finally overpowering the decline in conventional production. EIA data by state and information from company financial reports both point to success with shale gas, particularly Barnett shale in Texas. If the recent increase in production in fact relates to shale gas, this would tend to tie what is happening now to what the Navicgant Consulting, Inc.(NCI) analysis is forecasting for the years ahead.

Navigant Estimates

NCI in its report does not make an estimate of total US natural gas production. Instead, it makes estimates of shale gas and tight gas production, in very general terms. In Figure 1, I put these estimates together with some rough estimates of the remaining pieces to get an estimate of

expected future natural gas production. (I used a 3% annual decline rate for conventional natural gas.)

NCI's forecast of shale gas production is in terms of how much sustainable production might be expected from the various shale formations:

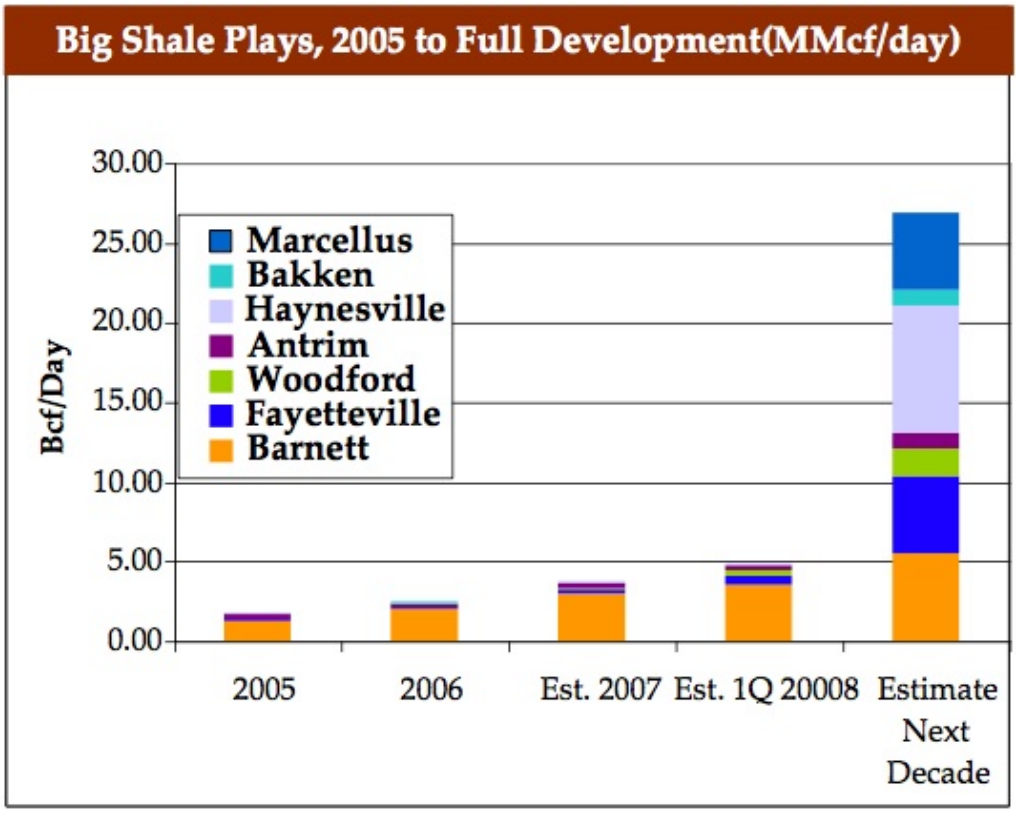

Figure 6. Navigant Consulting Inc (NCI) forecast of future shale gas production

The timing is not given very precisely, just "next decade". In Figure 1, I assume that this higher level of production will not be reached until 2020. Because of the imprecision of the wording, a person could argue that production might reach this higher level as early as 2015.

With my interpretation of the NCI report, indications are that shale gas is now the big source of growth, and will continue to be in the future. Tight gas production will also continue to grow.

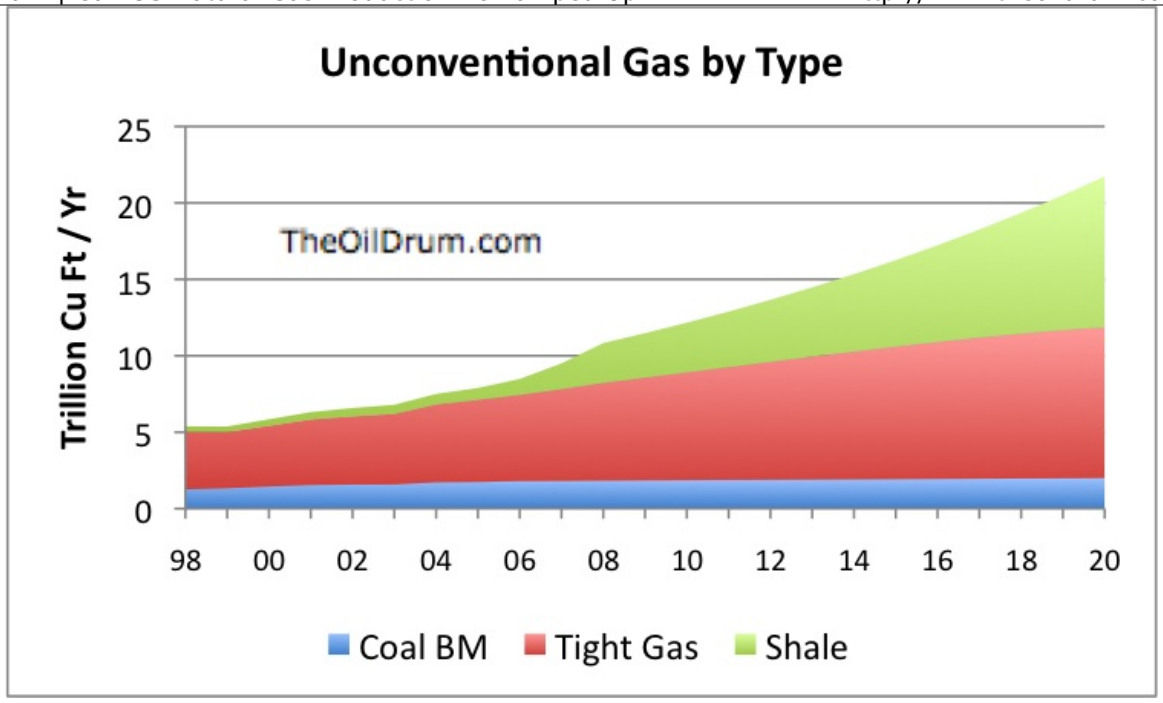

Figure 7. Breakdown of Figure 1 forecast of unconventional gas into tight gas, shale gas, and coal bed methane

Previous unconventional gas posts

Many readers will remember that I have written previously about unconventional natural gas:

US Natural Gas: The Role of Unconventional Gas

US Natural Gas: Lessons from BP's Tight Gas Facility in Wamsutter WY

In these posts, I talk about how widespread shale gas and tight gas are. I also talk about the advances BP has been making in its Wamsutter, Wyoming tight gas facility. With this as a background, it is easy for me to believe that if all of the resources are there, there is a reasonable possibility that US unconventional production can be ramped up further. I think there are obstacles that may get in the way of this, however.

Short term problem: overwhelming the system with too much gas, and causing price to drop

What happens when one increases natural gas production by 8% per day? There are a few places this can go--a little to offset a decline in imports from Canada, a little to use as exports to Canada and Mexico, and a little to meet the growing demand of electric utilities. Liquefied natural gas (LNG) imports can be reduced to their contractual minimum. On the industrial side, some factories with spare capacity can use some additional natural gas. It is difficult for these uses to absorb the 8% growth in production, however.

How could you individually increase your own natural gas use? You could turn up the thermostat to heat your house more in the winter, or you could use more electric appliances if you have electricity from natural gas. There really isn't much else you could do, without purchasing something new (for example, a clothes dryer that runs on natural gas, or a car that runs on natural gas). It is not a whole lot different for business users of natural gas.

Once demand is satisfied, the remainder is added to natural gas underground storage. This past week, 102 billion cubic feet were added to storage; the week before 88 billion cubic feet were added to storage. The US is currently producing about 56 billion cubic feet of natural gas a day, so over the past two weeks we have put about 20% of production into storage.

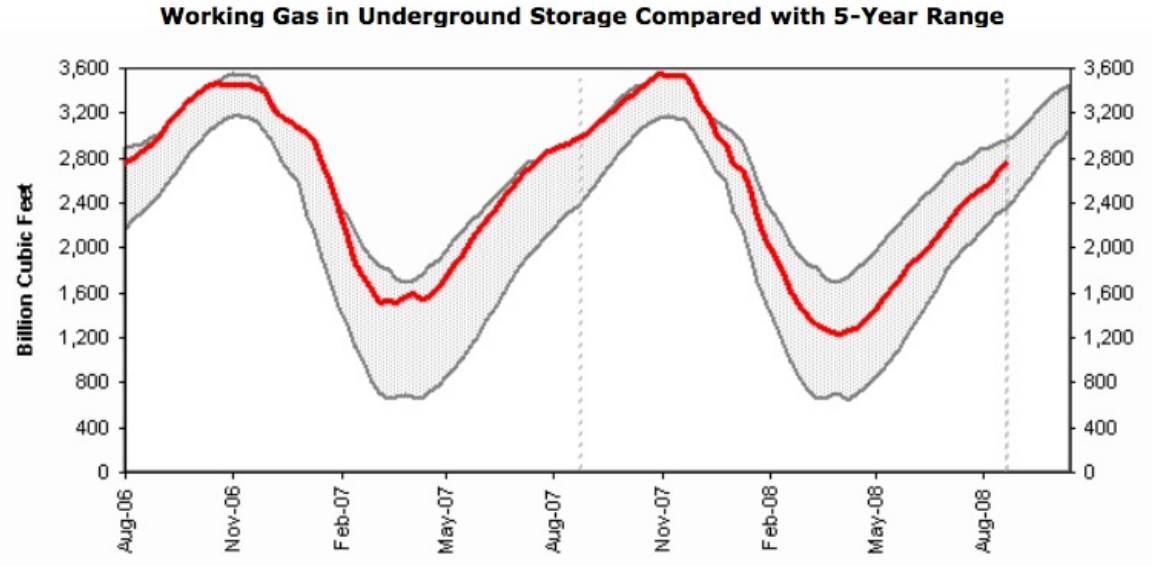

Figure 8. Recent EIA Natural Gas Underground Storage Graphic

The problem is that natural gas underground storage is not terribly large, and it hasn't been increased recently in size to accommodate the new larger natural gas production. Historical data suggests that the practical limit of working storage is 3,600 billion cubic feet. This is a bit over two months' production. As of August 22, 2008, the amount of natural gas in working storage was 2,757 billion cubic feet, leaving only 843 (= 3,600 - 2,757) billion cubic feet of "space" available.

Once storage fills up, there is no other place for the natural gas to go. To make matters worse, it is very difficult for producers to shut production in, if there is no space available for storage, so producers will mostly continue to produce, whether or not there is space available.

Once traders realize that there is a significant chance that natural gas production will exceed storage space, prices start to drop. It seems to me that this is part of what has happened with natural gas prices recently. One consideration in deciding whether the supply will exceed the storage space is the long range weather forecast. The forecast is for a warm fall, meaning that little heat will be needed. We are also in the midst of an economic slowdown, and this is also likely to reduce natural gas use.

All of this makes for a bad situation for natural gas producers--lots of supply, but not enough demand, and prices dropping disproportionately to the prices of other fuels. In another post in the next few days, I will talk various approaches that have been proposed to increase demand, so as prevent this problem. I will also talk about the quantity of gas that might be available.

Other obstacles to growth

It seems to me that the main issue is not whether there is enough natural gas in the ground. It is whether we will be able to get it out and transport it to users. It seems likely to me that one or more of the following will reduce growth to significantly below what theoretical studies would suggest:

Not enough distribution pipeline and underground storage

Every company adding new production will realize that it needs pipeline to connect its gas to an appropriate processing center. It may not be as obvious that the distribution system as a whole is likely to need to be expanded, if significantly more natural gas is produced. For example, if natural gas is to be used to replace heating oil in the Northeast, it is likely that both more underground storage and more distribution pipeline will be needed. (See this post by Heading Out.) Expanding the distribution system is likely to be expensive and take several years.

Worn out pipelines

Matt Simmons has repeatedly stated that pipeline infrastructure is nearing the end of its useful life. If this is true for natural gas, this could be a problem.

Not enough of the right kind of drilling rigs

If everyone wants new horizontal drilling rigs, this will be a bottleneck to growth, until enough new rigs of the correct type can be built.

Not enough pipe

There have been articles in the press about steel for drilling pipe and casing being in short supply.

Not enough trained manpower

This is a problem in any industry that tries to ramp up quickly.

Reduced credit availability

Banks have cut back on their lending. Natural gas companies that have depended on a lot of leverage in the past will find this business model very difficult to maintain. I expect them to either slow down their rates of growth, or partner with an oil major who is in a better position financially.

Counter-party risk

Quite a few of the natural gas companies are major participants in the derivative markets. We know that many banks are in financial difficulty. If banks in financial difficulty are counter-parties on transactions, their defaults may cause financial problems for the natural gas companies.

Issues with water re-injection or disposal

Unconventional gas production requires re-fracturing of wells from time to time. The fluid used in re-fracturing must be disposed of properly. There was recently considerable opposition to shale gas drilling in New York because of water issues.

Declining profitability

This is closely tied to EROEI. If there continue to be advances in technology, I would not expect this to be a problem. Some of the sites may prove to be more difficult to extract than the NCI forecasts, and this could be a problem. There is also the possibility of external impacts, such as higher taxes.

Peak oil

Peak oil will reduce the availability of oil for every use. It is hard to think of an allocation scheme that would fully protect the unconventional natural gas industry. The workers all need cars to get to work; food needs to be transported to the location where there workers are working; and drilling rigs often diesel powered. Any oil disruption could interfere with natural gas drilling.