The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Don’t count on natural gas to solve US energy problems

Posted by Gail the Actuary on February 18, 2011 - 11:26am

We often hear statements suggesting that by ramping up shale gas production, the US can raise total natural gas production and solve many of its energy problems, including adding quite a number of natural gas vehicles, and replacing a large share of coal fired electricity generation. While there is the possibility that shale gas will allow US natural gas supplies to increase for a few years (or even 10 or 15 years), natural gas is only about one-fourth of US fossil fuel use, so it would be very difficult to ramp it up enough to meet all of these needs.

One issue is whether a rise in shale gas will mostly offset other reductions in natural gas supply. In Annual Energy Outlook 2011, EIA forecasts that shale gas production will increase from 23% of US natural gas production in 2010 to 46% of US natural gas production by 2035, but that these increases will mostly offset decreases elsewhere. Even with this huge increase in shale gas production, the EIA only sees US natural gas production increasing by an average of 0.8% per year between 2011 and 2035, and US natural gas consumption increasing by an average of 0.6% per year per year to 2035--not enough to make a very big dent in our overall energy needs.

Figure 1. Shale gas offsets declines in other U.S. supply to meet consumption growth and lower need

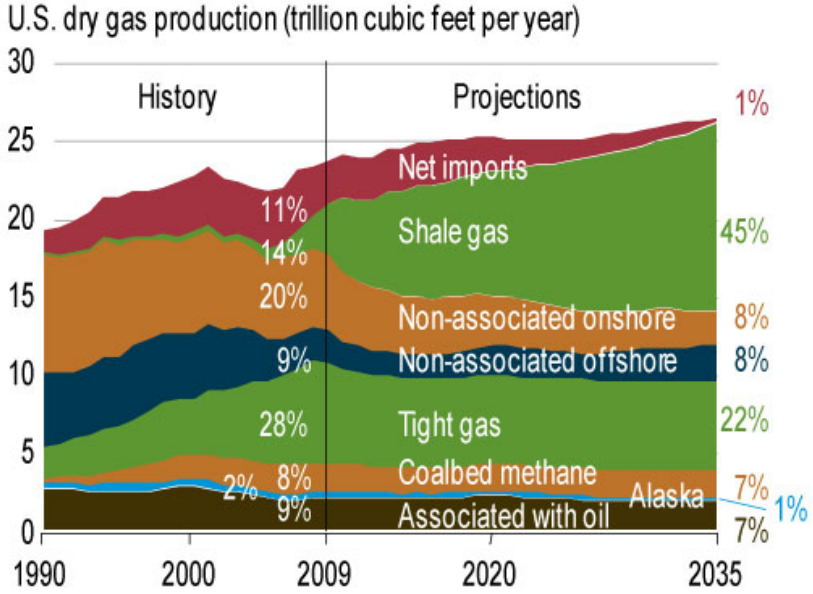

Figure 1. EIA Figure from the Early Release Overview of Annual Energy Release 2011. (Upper caption is EIA's.)

I don't know that the EIA forecast is correct, but below the fold are some related issues I see. While we may see some increase in natural gas supplies, there is significant downside risk, if shale gas cannot continue to ramp up considerably, because of cost, or fracking issues, or CO2 issues, or any number of other problems. Even if shale gas does continue to ramp up as planned, the EIA forecast suggests that the impact on total US natural gas production is likely to be modest at best.

It seems to me that steps we make to use this new supply should be made cautiously, being aware that the increased supply may not be all that much, or last all that long.

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1. The US is a natural gas importer. It does not produce as much natural gas as it consumes.

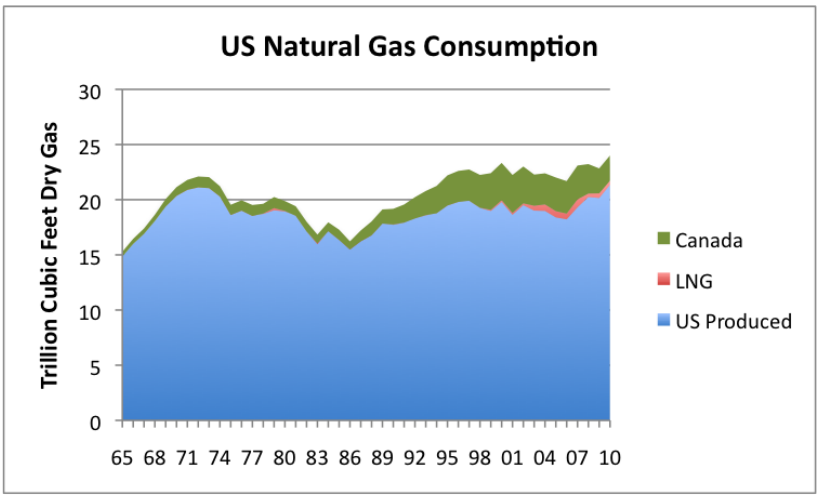
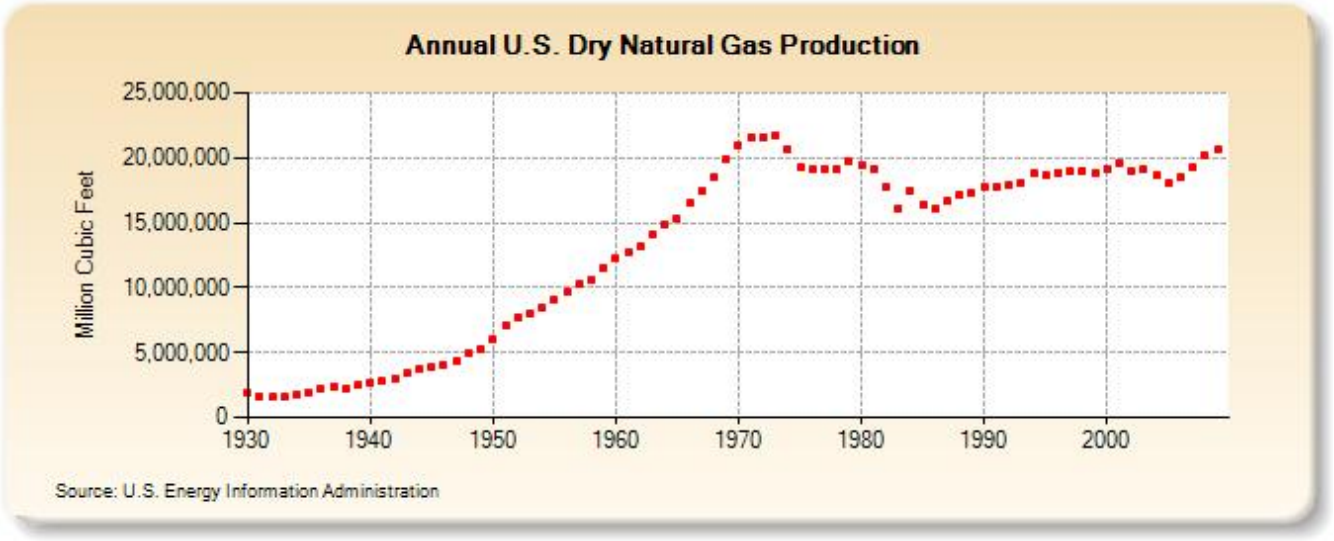


Figure 2. US natural gas consumption, separated into US produced, LNG, and Canadian imports, based on EIA data.

Figure 2 shows the US has been a natural gas importer for many years, with Canada being the major source of imports. LNG has played a more minor role. The amounts imported have not been a large percentage of the total, but even now they are essential for keeping the prices down. The import amounts shown are on "net of exports" basis. In other words, LNG imports have been reduced by LNG exports (from Alaska to Japan), and Canadian imports have been reduced by exports of natural gas to Canada.

2. The US supply pattern for natural gas has been quite irregular over the years.

A person can see how irregular the natural gas supply pattern has been in Figure 2. Figure 3, below, shows US natural gas production by itself. The irregularity of production over the years and the fact that current production is not much above 1970, makes a person wonder if the optimistic forecasts are really accurate. One factor that may have may have depressed production was price controls from 1954 until 1978, but even without price controls, there has not been much of an upward trend in production until recently.



3. In the absence of shale gas, EIA's forecast for US natural gas production would be a decline over the next 25 years.

This is clear from Figure 1, at the top of the post. EIA is forecasting an increase in shale gas, but to a significant extent it would act to offset a decline in other production. Note that historical shale gas production on Figure 1 is very small, but the EIA is forecasting a very large increase for this sector. If declines in other production have been optimistically estimated, then it is possible that there may be a decline in total production, even if the shale gas estimate is correct.

4. The production of Canada, the US's largest source of imports, is declining as its own use is rising.

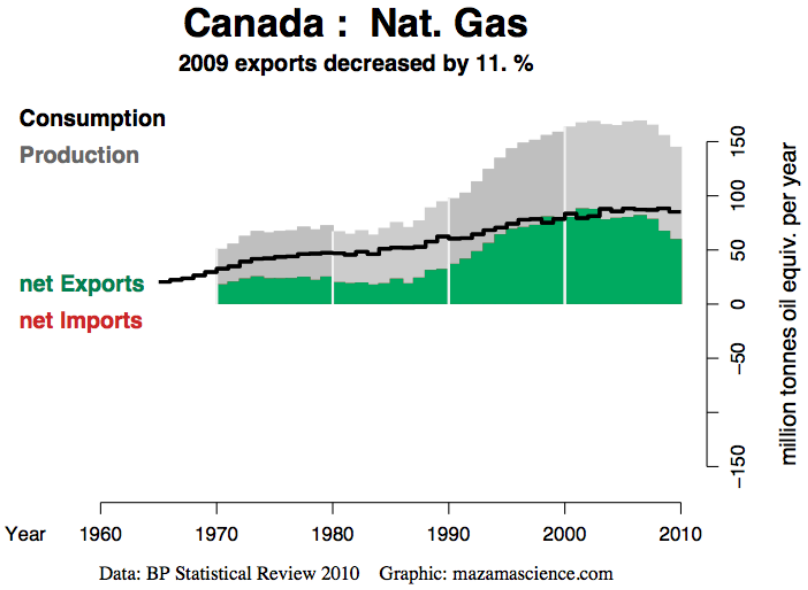


Figure 4. Canadian Natural Gas Production, Consumption, and Exports from Energy Export Databrowser.

Figure 4 suggests that at least part of the need for additional shale gas production is simply to offset declines in Canadian production. If Canada uses more natural gas in its oil operations, this could exert additional downward pressure on exports in future years.

5. The much publicized report from the Potential Gas Committee relates to

"resources". Much of these resources may prove to be too expensive, or not technically feasible, to extract.

Figure 5 is the summary exhibit from the report, showing proved reserves and resources.

Table 1.

Resources Category	(Mean Values, Tcf) 2008	2006	Change Tcf (%)
Traditional Gas Resources:			
Probable resources (current fields)	441.4	270.1	
Possible resources (new fields)	736.9	426.4	
Speculative resources (frontier)	500.7	460.7	
Subtotal Traditional Resources*	1,673.4	1,154.8	+518.6 (44.9%)
Coalbed Natural Gas:			
Probable resources	14.2	15.5	
Possible resources	49.8	50.9	
Speculative resources	98.9	98.9	
Subtotal Coalbed Gas Resources*	163.0	166.1	–3.1 (1.9%)
Total Potential Resources	**1,836.4**	**1,320.9**	+515.5 (39.0%)
Proved reserves (DOE/EIA)	237.7**	211.1	
U.S. Future Supply	**2,074.1**	**1,532.0**	+542.1 (35.4%)

Figure 5. Summary Exhibit from the Potential Gas Committee Regarding Natural Gas Reserves and Potential Resources

US current consumption is about 24 trillion cubic feet a year. If we divide the "U. S. Future Supply" of 2,074.1 TCF by 24, we get 86 years, which is the source of the statement that 100 years of natural gas supply is available. But it is not at all clear how much of this is economically extractable with technology that we have now, or will be able to develop in the future. If we exclude speculative resources, we are down to 61 years, assuming no growth in natural gas consumption. If natural gas use rises, we would exhaust those resources much sooner.

If we exclude both "Speculative Resources" and "Possible Resources," then the number of years at current consumption falls to 29 (but much shorter, if production ramps up sharply). The shale gas portion of this is about a third of the total, or approximately 10 years, at current consumption levels.

The EIA had access to the Potential Gas Committee report when they put out the "early release overview" version of Annual Energy Outlook 2011. They show an average annual growth rate of US dry gas production to 2035 of 0.8%, and an annual growth rate of US dry gas consumption to 2035 of 0.6%. (The latter would reflect lower expected imports over the time period.) So evidently, their expectations are quite modest overall.

6. If Texas experience serves as an example, shale production starts dropping fairly quickly after it starts.

Texas is the home of Barnett Shale, the first of the big shale resource plays. Data for the state of Texas indicates that 2009 production was down from the 2008 level, and an estimate I made for 2010 using data through November suggests it will be down even further in 2010.

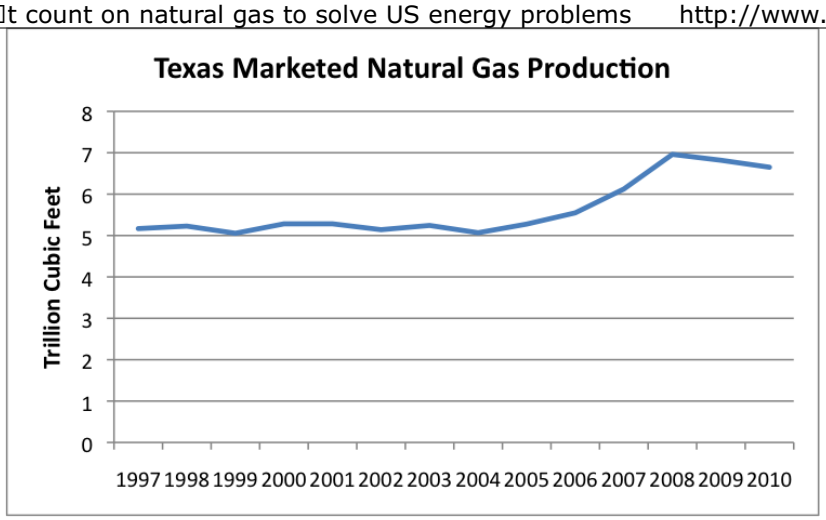


Figure 6. Texas natural gas marketed production based on EIA data. 2010 estimated based on Jan-Nov actual data.

Based on Figure 6, It appears that Barnett Shale production reached a peak (of approximately 2 trillion cubic feet per year) in 2008, and has been declining since. According to Art Berman, initial plans were based on the assumption that the quality of reserves was uniformly excellent throughout the area, but as drilling proceeded, it became increasingly clear that there were only two sweet spots, and drilling contracted into those areas.

7. Shale gas drillers appear to need higher prices than are currently available to make production of shale gas profitable.

A big reason why natural gas looks so attractive now is its low price, but it is doubtful these low prices can last. Art Berman has shown that a well head price of over $7 per thousand cubic feet is needed for shale gas drillers to make a profit. He has also pointed out that estimates of well profitability are based on optimistic views of how long individual wells will be economic. If wells are taken offline more quickly than assumed, this will further raise the needed price. (I came to a similar conclusion using a different approach here also).

In the recent past, prices have been more in the $4 per thousand cubic price range, but over the long term, prices have been very volatile.

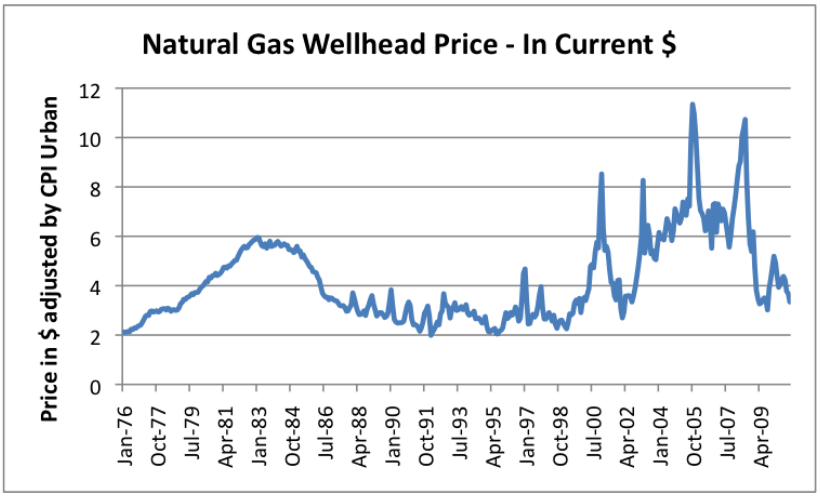


Figure 7. Monthly average wellhead natural gas prices based on EIA data, adjusted to current cost level using US Urban CPI.

Many who are expecting that natural gas use to grow are assuming that prices will stay low. It is doubtful this can happen. Prices will need to be much higher for shale gas production to grow greatly.

8. High (and volatile) prices tend to depress natural gas consumption for industrial use and for heating buildings.

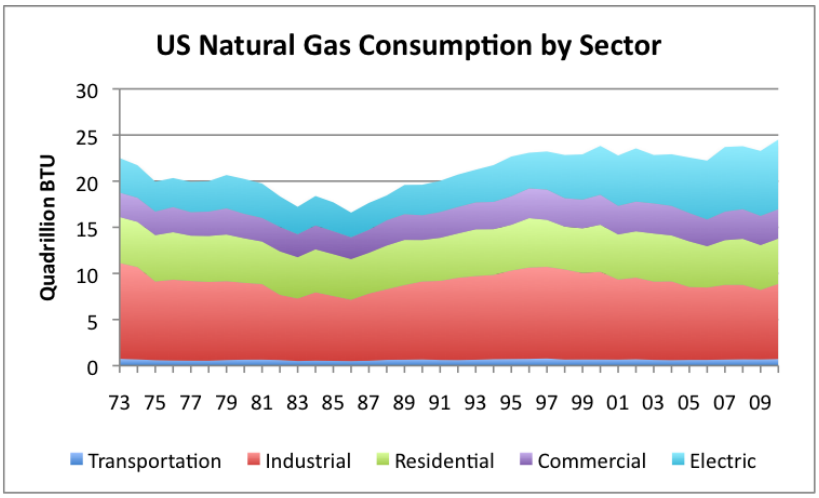


Figure 8. US Natural Gas Consumption by Sector, based on EIA data.

Industrial use of natural gas has not been rising over the long term; it was higher in 1973 than it is currently. Industrial use rose to a peak in 1997, but when prices started becoming volatile, it dropped again. Natural gas for residential and commercial use is primarily for heating, hot water, and cooking. Its use has remained quite level over the years, reflecting increased efficiency of furnaces, better insulation, and growth in electrical substitutes (such as heat pumps). The only area of natural gas consumption showing real growth has been electrical use of natural gas.

Much of the enthusiasm for new uses for natural gas seems to be driven by its current low price. When this price starts rising again, past history suggests that enthusiasm may wane. Higher use for electrical consumption may continue regardless of price, but a low price makes it more attractive for this use too.

At some point, even electrical use may decline with high price. There is considerable evidence that high oil prices send the economy into recession. There is good reason to believe that very high natural gas prices might have a similar effect.

9. The amount of oil and coal consumption that needs to be replaced is huge in relationship to natural gas consumption.

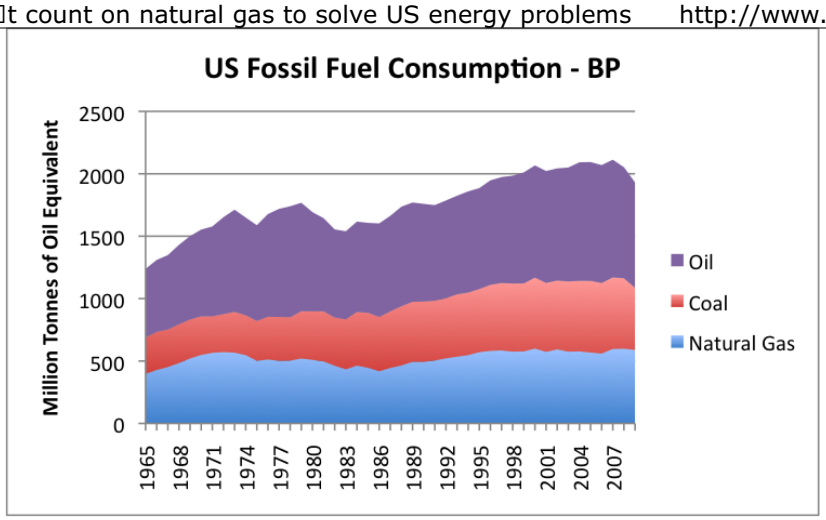


Figure 9. US historical fossil fuel consumption, based on BP data.

Figure 9 shows that natural gas amounts to only a little more than a quarter of total US fossil fuel consumption. Trying to ramp its production up to replace coal, and to offset declines in oil availability would seem to be an extra-ordinarily difficult task. Natural gas production would need to be more than doubled–something no one is expecting.

10. There are a number of outstanding environmental questions.

With traditional gas drilling, most drilling seems to be in relatively unpopulated areas. Shale gas operations include more populated areas, leading to more chance of water pollution. Many people are concerned about the possibility of harmful environmental effects from fracking, especially if it is done close to the source of New York City water supplies. At this point, there is a six month ban on fracking of horizontal wells in New York. The EPA is also doing an analysis of the safety of fracking. It is not expected to be completed until 2012, however.

There is also an issue of whether fracking permits significant fugitive emissions of methane that could result in shale gas's overall global warming potential being far higher than that of natural gas from conventional sources. The EPA has a technical support document on its website, suggesting that this might be the case. This is a summary graphic from that paper:

Table 1: Comparison of Emissions Factors from Four Updated Emissions Sources

Emissions Source Name	EPA/GRI Emissions Factor	Revised Emissions Factor	Units
1) Well venting for liquids unloading	1.02	11	CH_4 – metric tons/year-well
2) Gas well venting during completions			
Conventional well completions	0.02	0.71	CH_4 – metric tons/year-completion
Unconventional well completions	0.02	177	CH_4 – metric tons/year-completion
3) Gas well venting during well workovers			
Conventional well workovers	0.05	0.05	CH_4 – metric tons/year-workover
Unconventional well workovers	0.05	177	CH_4 – metric tons/year-workover
4) Centrifugal compressor wet seal degassing venting	0	233	CH_4 – metric tons/year-compressor

1. Conversion factor: 0.01926 metric tons = 1 Mcf

Figure 10. Summary Emissions factors from EPA Technical Paper.

According to David Lewis's calculations, these high emissions would bring the global warming gas potential of shale gas at least to that of coal. Professor Robert Howarth of Cornell University has come to a similar conclusion, analyzing data directly. His article has been submitted for publication in a peer-reviewed journal, but has not yet been published.

These findings are obviously preliminary. It may also be that even if the findings are true, there are changes to production techniques that can bring emissions down to an acceptable level, but these are things we don't know. If this issue starts receiving much attention, it would seem to have the potential to reduce interest in shale gas production.

Summary

In summary, a review of information related to US natural gas production (and in particular shale gas production) does not give much confidence that it can ramp up by more than a small percentage over the next 25 years before it runs into some obstacle. The most likely obstacle is affordability, but there are others obstacles including the need to keep drilling (at high cost) to keep shale gas production up, or production will decline as it has done in Texas. Even if production can ramp up more, there is a chance that global warming gases associated with shale gas will suddenly become an EPA concern, and production will need to be scaled back.

There is little evidence that shale gas producers can make money at current low prices. At higher price levels, coal becomes a cheaper alternative, and substitution becomes more difficult. Coal and petroleum consumption are so large in relationship to natural gas consumption that trying to ramp up natural gas to replace more than a very small percentage of these fuels would seem to be impossible.

Shale gas is needed to offset declines in conventional production and a drop in Canadian imports,

so one cannot assume that an increase in shale gas production corresponds to an increase in the amount of natural gas available for consumption.

I have not tried to look at LNG imports. To date, they have played a minor role. Based on EIA data, in 2008, LNG exports corresponded to about 7.5% of world consumption, and from Figure 2, it is clear they have only played a small role in US consumption. I would not expect this situation to change greatly. LNG terminals are expensive, and have to be financed whether they are actively used or not.

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