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The Rise of Unconventional Gas

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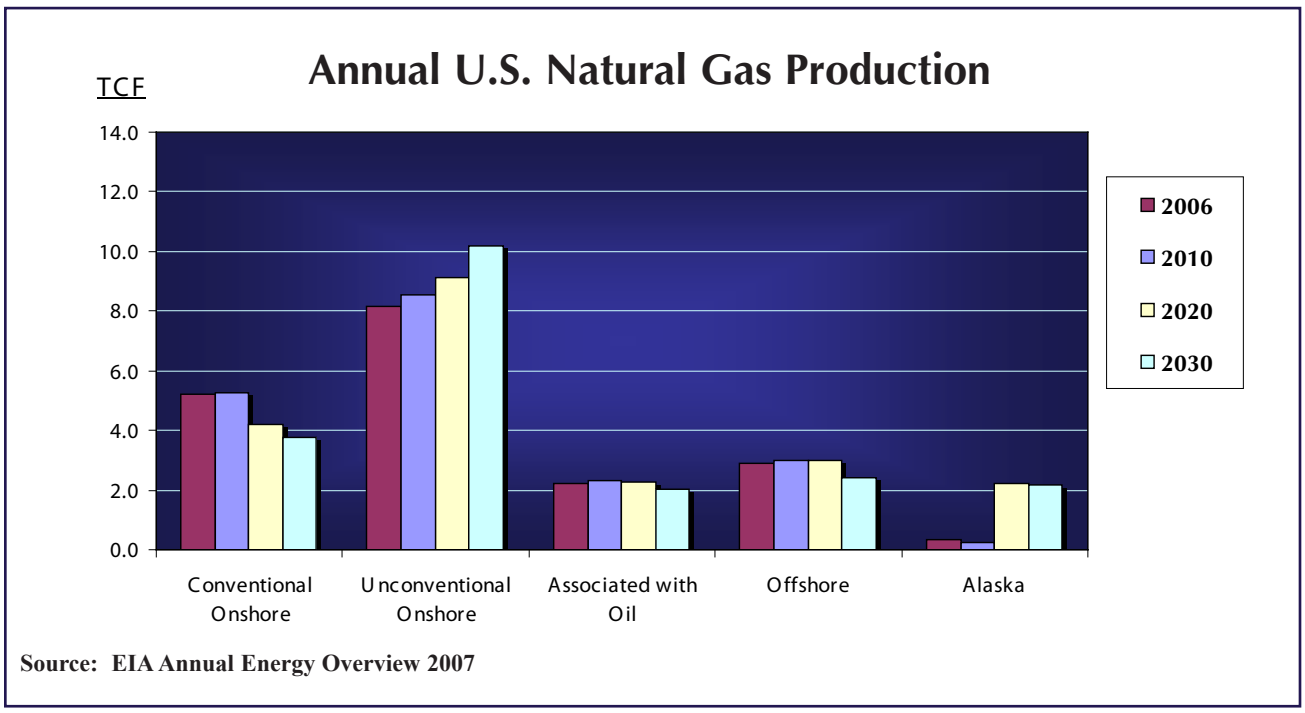
The popular belief about U.S. natural gas supplies is that they are a declining resource. In fact, most experts believe that our production of gas from traditional domestic resources has already peaked and will only continue to fall in future years. The most recent comprehensive study of U.S. gas resources, completed by the National Petroleum Council (NPC), concluded that conventional U.S. sources will decline by 5% by 2025 and will be able to supply only 75% of our long-term gas needs.[1] How then can we rationalize continuing growth in U.S. gas demand with declining traditional supply? Are we destined to a future of increasing imports with less and less control over our own energy? And are we wrong to see natural gas as the bridge fuel that will see us through until our society can be rebuilt around a sustainable fuel?

While one solution is to increase reliance on LNG imports, there is a domestic source of supply that is often overlooked – the resource called unconventional gas.[2] You may be surprised to learn that nine of the 12 largest gas fields in the U.S. produce unconventional gas, and these fields currently supply 44 % of U.S. production.[3] Annual unconventional production has grown by 2.3 Tcf since 2000, more than offsetting a decline of 2.0 Tcf from Gulf of Mexico production in the same period. What's more, the EIA projects that by 2030 the percentage of U.S. production from unconventional resources will have grown to 50%. Clearly, to understand the future of U.S. gas supply, you must understand unconventional gas. In the pages that follow we will explore what unconventional gas is, why it is likely to become a key supply source for American



Source: EIA Annual Energy Overview 2007

[1] *Balancing Natural Gas Policy – Fueling the Demands of a Growing Economy (2003)*, available at www.npc.org. [2] The actual definition of unconventional gas can be a bit nebulous. The EIA simply defines it as gas that is not conventional – with conventional defined as natural gas that is produced by a well drilled into a geologic formation in which the reservoir and fluid characteristics permit the gas to readily flow to the wellbore. Other sources use definitions that include technical difficulty in production and more expensive costs of production than conventional sources. [3] All production statistics and forecasts are from the EIA Annual Energy Outlook 2007 unless otherwise noted, the report is available at www. eia.doe.gov.

consumers, and how growth of the resource will affect gas markets.

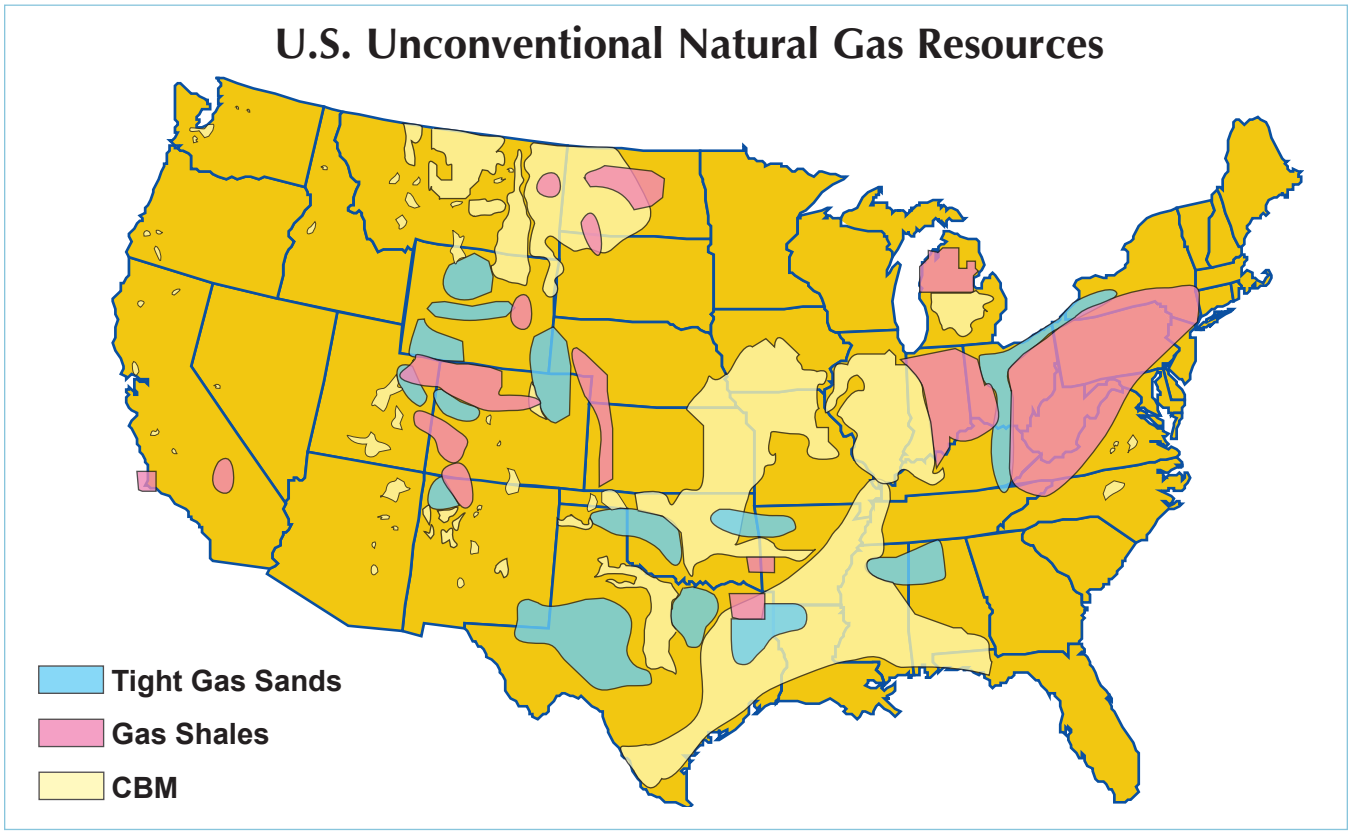
What is Unconventional Gas?

Natural gas is formed over thousands of years by the combination of pressure and heat on organic material trapped in rock. After natural gas is formed, the earth's pressure often pushes the gas upward through small holes and cracks in rock until it reaches a layer of impermeable rock where the gas becomes trapped. It sits there in a "pool" until it is released from the ground by a drill bit providing a path to the surface. This is what we call conventional gas, the resource upon which our gas industry was built. But not all gas is found in these formations. In fact, there are a number of forms of unconventional gas that were created in formations without the permeability necessary to allow migration. These include:

- Tight Sands Gas – formed in sandstone or carbonate (called tight gas sands) with low permeability which prevents the gas from flowing naturally.
- Coalbed Methane (CBM) – formed in coal deposits and adsorbed[4] by coal particles.
- Shale Gas – formed in fine-grained shale rock (called gas shales) with low permeability in which gas has been adsorbed by clay particles or is held within minute pores and microfractures.
- Methane Hydrates – a crystalline combination of natural gas and water, formed at low temperature and high pressure in places such as under the oceans and permafrost.

How Do Unconventional Resources Contribute to U.S. Gas Supply?

Tight sands gas currently provides the largest amount of unconventional production in the U.S. at 5.7 Tcf/year or about 30% of production. Although all gas basins contain some tight sands gas, it is currently economical to produce only in certain areas. Production requires stimulation, typically through pumping hydraulic flu-



[4] Conventional gas typically occupies pores in rocks in a gaseous state. Adsorbed gas, however, attaches itself to solid particles and is held within the solid matter.

ids into the rock to create or expand fractures through which the gas can flow. The dominant basins for production of tight sands gas include the South Texas, East Texas, Permian (in Texas and New Mexico), San Juan (in New Mexico and Colorado), and Green River (in Wyoming). Ongoing drilling suggests that production of this unconventional resource will continue to grow.

The next largest unconventional source is CBM, with 1.8 Tcf/year or 9% of U.S. production. Production of CBM requires a combination of de-pressurization and de-watering. Pressure in the coalbed is typically reduced by pumping out water that is trapped in seams. As the pressure is reduced, gas is desorbed from the coal particles and can then flow freely. The three largest basins for CBM production are the Powder River (in Wyoming), the Uinta (in Utah) and the Raton (in New Mexico and Colorado). Known untapped CBM resources suggest that this resource will also continue to grow in importance.

The third largest unconventional production source is shale gas, with 1.1 Tcf/year or 6% of U.S. production. Shale gas is typically produced by horizontal drilling and by using hydraulic fluids to create fractures that allow the gas to flow. Production comes from five geographically diverse basins including the Appalachian (in Ohio, Pennsylvania, and West Virginia), Michigan, Illinois, Fort Worth (in Texas), and San Juan. Future growth in shale gas is expected, but growth rates are less predictable than for tight sands gas and CBM due to technical and economic factors.

Gas from methane hydrates is currently not in commercial production. A few test wells have been drilled and research is underway to develop procedures that would allow the methane to be extracted in economically viable ways. It is expected that this will take a minimum of ten to fifteen years; but the potential resource is huge. In fact, some studies have suggested the total U.S. methane hydrate resource may be as large as 200,000 Tcf.[5] This is nearly 9,000 times current U.S. gas consumption!

How Will This Affect Gas Markets?

Growth of unconventional gas production was stimulated by federal tax credits and by research funded by the Department of Energy and the Gas Research Institute in the 1980s and 1990s. This led to development of new techniques to access unconventional resources and provided economic support during low-price gas years. Although tax credits have expired and research programs have been reduced, recent high market prices for natural gas, coupled with production advances, have led to the commercial viability of unconventional resources. And given the decline of conventional resources, it appears that the future is bright for continued growth. But what does this mean for energy markets?

First, an investment in infrastructure will be crucial. Many unconventional resources are located in different regions than conventional sources, leading to a need to develop new pipeline and storage infrastructure to bring these supplies to market. This has already begun. Indeed, the largest current pipeline projects in the U.S. are designed to deliver unconventional supplies. These include the $4.4 billion Rockies Express pipeline which will bring 1.8 Bcf/day of supply from Wyoming to the Midwest and Northeast and the recently completed

[5] Report to Congress: Bringing Gas Hydrate – a Potential New Source of Natural Gas – to Market, available at www.mms.gov.

$425 million Centerpoint Energy Carthage Expansion designed to move 1.2 Bcf/day of supply from the East Texas Barnett Shale fields. And more development in infrastructure will certainly be required. More infrastructure provides profit opportunities for pipeline and storage companies, but also means more costs which must be absorbed in the price of gas.

Further supporting future higher prices is the fact that the production cost of unconventional supplies can be significantly higher than the cost of producing conventional supplies. While production costs vary for unconventional gas, the amount of supply that is economic is significantly higher at higher prices. For instance, the economically recoverable CBM gas in the Powder River Basin doubles when the wellhead price is raised from $3 to $7.[6] Given competitive markets where the marginal source of supply sets the market price, this would suggest that we can expect that natural gas prices will remain significantly higher than the good old days of the 1990s unless demand unexpectedly drops. The EIA projects that U.S. gas prices will be in the order of $6/MMBtu through 2020, while others have suggested that prices will range between $7 and $9/MMBtu. Either scenario is significantly higher than historic prices.

The Bottom Line

Despite what you may have heard, worldwide gas resources are plentiful and significant resources are still available in the U.S. But, continued development of unconventional resources will require significant investment in both infrastructure and technology, and is only feasible if long-term gas prices are higher than historic levels. This may push some industrial customers to increase efficiency or to shift to electric technologies and may discourage some gas-fired electric generation demand. But it appears that the attractiveness of natural gas is too great to affect demand much, even at high prices. As a result, the size and increasing availability of unconventional resources is likely to secure natural gas' position as a key energy source for the U.S. far into the future – but at a price higher than in the past.

[6] The Economics of Powder River Basin Coalbed Methane Development, prepared by Advanced Resources International for the U.S. Department of Energy, available at www.adv-res.com