Natural Gas: A Bridge and a Destination

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Abstract

Clean burning natural gas is uniquely positioned to serve not only as a low carbon bridge to a new clean and sustainable energy future but to also be a part of that sustainable future. With production from new and abundant domestic resources, broad use diversity, unequaled efficiency potential, all enhanced by its low carbon intensity and minimal criteria pollutants, domestic natural gas is a viable component of a long term clean energy portfolio at scale. Continued development of both technology and intellectual capital is critical to perpetuate this practical and environmentally friendly energy source which currently provides approximately 20% of U.S. energy supply.

Natural Gas

Among energy sources, clean burning natural gas is uniquely positioned to serve not only as a low carbon bridge to a new clean and sustainable energy future but to also be a part of that sustainable future. With production from abundant domestic resources such as newly developing gas shales, to distribution and consumption where natural gas is the most diverse fuel available today, to unequaled upstream and downstream efficiency potential in areas such as combined cycle generation, distributed generation, combined heat and power (CHP) and co-generation, all enhanced by low carbon intensity and minimal criteria pollutants, domestic natural gas is a viable component of any long term clean energy portfolio at scale. Continued development of both technology and intellectual capital is critical to perpetuate this practical and environmentally friendly energy source which currently provides over 20% of U.S. energy supply.

Among the national issues of the economy, security, healthcare, immigration, and war, maybe the most important issue of all is energy. Its impact on productivity, standard of living, the economy, the environment, and national and global security are indisputable. Energy plays a primary role in virtually every major challenge the U.S. faces today, and if the energy problem is adequately addressed all other problems become more manageable. Effective energy policy must address many issues and consider many options and there is no single solution. What must occur is the development of a diverse yet integrated portfolio of next generation renewable and sustainable technologies and policies that are clean, affordable, secure, and at scale. One component of that portfolio is natural gas, and its importance in the short, medium, and long term, especially in a carbon constrained world, makes it not only a practical bridge to a clean and sustainable energy future but also a destination.

Several unique attributes of natural gas differentiate it from other energy sources, including its efficiency potential, low carbon intensity, cleanliness, and abundant and secure domestic supplies. The end use energy efficiency of natural gas is a critical complement to the supply side of the equation as supply cannot be decoupled from consumption. Driven by effective public policy and appropriate market incentives, end use efficiency leverages all forms of supply, and this especially holds true for natural gas with its over one fifth of the nation's energy consumption. The low 1:4 carbon to hydrogen molecular ratio gives it the lowest carbon intensity of all fossil fuels. Natural gas in primary combustion has one half the carbon intensity of coal, but when combined with the efficiency potential of combined cycle generation, point of use siting options for distributed generation and CHP, and high efficiency end use applications, the carbon intensity per unit of end use energy is reduced even further. The U.S. wastes more energy than it uses. Estimates by Lawrence Livermore National Lab show aggregate U.S. energy efficiency is only about 45%, meaning 55% of all input energy is wasted, generally as waste heat. While natural gas efficiencies are generally much higher than 45%, there is still plenty of room for improvement even for natural gas.

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Natural Gas Supply

One historical concern with natural gas has been the reliability and sustainability of supply. Contrary to popular belief the U.S. isn't running out of natural gas despite the message from President Carter to that effect in the late 1970's. With just 201 trillion cubic feet (where 1 TCF = 1 quad) of remaining proven reserves in 1979, down fully a third from just 1970, it seemed a natural reaction to conclude supplies were running out. At then current consumption rates 201 TCF equated to only a 10 year remaining supply. But today U.S. proven reserves are 211 TCF, about 5% more than 30 years ago, despite the fact that in those 30 years the U.S. has produced and consumed well over 500 TCF, or 2.5 times the 1979 reserve estimates. The U.S. has now enjoyed 8 straight years of natural gas reserve growth, and 2 years of increasing production, all based on aggressive development and implementation of technology enabled by market forces. Much of this technology development has come from public private efforts between the federal government, the research community, and industry. Continued efforts to develop the new energy technologies and technologists to perpetuate this impressive progress are imperative.

Unconventional Natural Gas

How has this remarkable record been achieved? There has been a fundamental shift in resource type from conventional reservoirs to unconventional reservoirs. Visionaries knew the U.S. wasn't really running out of natural gas in 1979, it was just short on technology and innovation. It has been described that new ideas aren't really always new – they're more just stopping having old ideas. The natural gas industry had been previously finding and producing conventional reservoirs, which although sometimes hard to find were relatively easy to produce. But pioneers in the early 1980's for example around Ft. Worth, Texas knew from their drilling experience that the rocks they penetrated on the way to conventional reservoirs contained natural gas – their sensing instruments and drill cuttings clearly detected it. The trouble was they didn't know how to produce it with their conventional technologies. So they experimented, performed some research, and tried some new things. And about 18 years after first dreaming of something really unconventional, and enabled with federal research support, these pioneers figured out how to make the Barnett Shale under Ft. Worth produce gas. This exciting discovery, estimated by the United States Geological Survey (USGS) in 1996 to contain just 3 TCF of technically recoverable resources, was revised upwards in 2004 by the USGS to 26 TCF, with estimates as high as 39 TCF by Advanced Resources International in 2005. These resource numbers should continue to increase with technology developments. And there are many more Barnett Shale type possibilities; in fact they're located all across the U.S. from upstate New York to Alabama to West Texas to the Northern Rockies and California. The reality is there is plenty of safe and secure domestic natural gas, just not plenty to waste, and if developed in an environmentally responsible manner and used as efficiently as possible, these clean burning resources will last for decades.

The latest Potential Gas Committee recently increased its estimate of U.S. technically recoverable resources from 1,300 to 1,525 TCF. This equates to a 75 year supply at current consumption rates which could be further extended with additional efficiency improvements and expected resource growth. Monetized at today's commodity prices the vale of this endowment is well over $10 trillion. Extracting royalties and severance taxes from the production streams (generally between 15 and 25% and a large part of which flows to states and the U.S. government) amounts to over $2 trillion of revenue over the life of the resource which flows into the economy to be used to fund the next generation of energy technologists and energy technologies and other beneficial public needs. One other unconventional natural gas example is coal bed methane, which has been unlocked in recent years again as the result of collaborative research jointly funded by the federal government, the energy industry and private not-for-profit research organizations. Coal bed methane now accounts for approximately 10% of overall domestic gas production. As technology develops and new unconventional reservoirs are enabled, some feel the resource estimates are still too low. Dr Leigh Price, a now deceased scientist formerly with the USGS, concluded that unconventional gas resources are essentially unlimited.

Developing Innovation

The challenge today is how to create the innovation to turn these high potential resources into equivalent success stories, but maybe this time in less than 18 years. One such model now being implemented is an open innovation public private partnership created by the Energy Policy Act of 2005, managed by a consortium known as the Research Partnership to Secure Energy for America (RPSEA). RPSEA is organized as a 501 (c) 3 not for profit corporation and was selected by the Department of Energy in a competitive selection. The Energy Policy Act of 2005 established a new research program to maximize the value of domestic resources by increasing supply through reducing costs, increasing efficiency, minimizing environmental impact, and improving safety through the development of new technologies titled the "Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Program". This 10 year, $500 million dollar program, funded by lease bonuses and royalties paid by producers on federal lands, is designed to benefit consumers by developing technology to increase America's domestic energy resources.

This model contrasts historical single proprietary breakthrough type research efforts with an integrated process and interdisciplinary approach – in some ways taking ideas that may be already known and merging them into something that singularly they could never be on their own to make the whole greater than the sum of the parts. It starts with effective public policy to provide the seed funding and then leveraging it with significant cost sharing from industry. Next it requires the organization to make it happen which is the RPSEA consortium and its participants - now 130 members in 27 states and a network of about 1,000 technical and strategic experts from all constituencies, including 25 of the nation's premier research universities, five national laboratories, several private research institutions, and broad representation from industry. Ultimately the model creates the next generation of energy technologies and technologists which is the actually the resource most desperately needed - the intellectual capability. Fully engaging the academic and research community to solve actual industry problems provides incentives for the best minds to enter the research field to build this intellectual capability.

Peak Natural Gas?

One other mischaracterization is the misguided application of the peak oil theory to natural gas. There is ample public debate on peak oil, but peak oil does not imply peak natural gas. Natural gas and oil, while associated in many instances, are very much independent of each other in many more instances, not only in virtually unlimited domestic unconventional natural gas resources but also in significant stranded conventional natural gas resources globally. While U.S. oil production did peak in the early 1970's and global oil production may have or soon will peak, natural gas will provide clean burning, environmentally acceptable, and low carbon intensity energy to the American public for decades to come. Recent estimates say global peak natural gas production could occur in 2060, a full half century away. But these estimates require as input a resource estimate, and with the U.S. just now beginning significant unconventional gas development (with the rest of the world probably soon to follow using U.S. technology), growing resources estimates could push peak gas estimates out well past 2060. This illustrates a concrete example of the value of the U.S. leadership role as an example to the rest of the world, especially the developing economies of Asia, as they strive to meet growing energy demands, often times with decades old pulverized coal technology. It has been estimated that carbon emissions from non OECD countries could exceed those of the developed nations within the next five years, and these developing countries have the least capability of actually dealing with their emissions. Developing the technologies for these developing countries to exploit their unconventional gas resources is one way to deal with their rapidly expanding energy use, pollution, and carbon emissions.

Conclusion

The Energy Information Administration forecasts that natural gas and petroleum will remain essential sources of energy in this country for decades as we transition to a sustainable energy future. Whether these forecasts materialize is anyone's guess, or as Will Rogers once said "an economist's guess is as good as anyone else's." Natural gas certainly provides a

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clean and low carbon time bridge to develop a new energy portfolio of the future without having to guess. But the time for action is now. Simultaneously investing in the development of a broad portfolio of domestic energy sources will make the U.S. less dependent on precarious foreign oil supplies. And investments in R&D today will increase the energy supplies of tomorrow. This means lower prices, increased competitiveness, greater security, and all in an environmentally acceptable and sustainable manner. Natural gas can and will continue to meet its valuable share of future clean energy demands, and meet the criteria of our ancestors where effective decisions were measured seven generations out. Quoting the great Wayne Gretzky he said, "you miss 100% of the shots you don't take." The U.S. must take its shot and urgently work to proactively create its future rather than reactively just trying to predict it, in order to create the sustainable energy future that everyone desires.