Shale Gas and the American Energy Renaissance

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Abstract: Expanding natural gas shale resources will have significant implications for North American energy markets, creating new commercial energy opportunities in many sectors across Mexico and Canada as well as the United States. At the same time, a realistic assessment must place bounds on what should be expected for some of the major global problems of the day: climate change mitigation, economic recovery and energy trade and geopolitics.

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Over many decades energy markets have seen a variety of new technologies with the potential of replacing existing practices for providing conventional fossil fuels. Synthetic fuels during the 1970s, hydrogen during the 2000s and carbon capture and sequestration in today's climate-change constrained times have all captured the fancy of policymakers. And yet, each of these options has not held much promise to date in being major players in the future energy mix. But since about 2006, hydraulic fracturing combined with horizontal drilling have made substantial in-roads in altering America's energy future. The sudden appearance of a cost-effective option that required prices below conventional practices was not what many economists had expected since the oil embargos of the 1970s.

Many have called this development, combined with similar trends in finding and developing its sister source of tight oil from shale deposits, as the renaissance of U.S. fossil fuel resources. To what extent are these new shale sources a renaissance or "game changer"? This article argues that expanding natural gas shale resources have significant implications for North American energy markets, creating new commercial energy opportunities in many sectors across Mexico and Canada as well as the United States. At the same time, it suggests that a realistic assessment must place bounds on what should be expected for some of the major problems of the day: climate change mitigation, economic recovery and energy trade and geopolitics. Directionally, these trends should not hurt these goals, but they will not significantly alleviate these problems. These comments are my personal views, but they have been strongly influenced by the discussions of the Stanford Energy Modeling Forum 31 Working Group, which compared results from 8 separate cases simulated by 14 different models.[2]

Shale Gas and Economic Recovery

Some U.S. industry has responded enthusiastically to these new opportunities (e.g., see Citi GPS, 2012, and Credit Suisse, 2012). In addition to the oil and gas drilling sector and the various sectors supporting it, the chemical industry now plans major investments within North America to take advantage of lower priced natural gas, ethane and other important liquids emanating from natural gas sources. The expanded natural gas supplies have also made electric power more competitive in regions where regulations allow gas-fired plants to set electricity prices. The lower costs and increased domestic investment represent significant gains for these industries and for states like Pennsylvania, Texas and Wyoming. However, they shape aggregate economic conditions in a more muted though positive way, because natural gas expenditures represent only about 1 percent of the total U.S. economy. On average, relative to reference conditions, inflation-adjusted Gross Domestic Product in the EMF results eventually rise by .23 percent for each 10 percent reduction in natural gas prices due to expanding supplies.

Shale Gas and Climate Change Policy

Although expanding natural gas supply displaces more coal than any other fuel, future downstream U.S. carbon dioxide emissions do not decline by much in the projections discussed by the EMF group. Relative to reference conditions, downstream emissions in some model results decline by as much as 1.1 percent by 2030 for each 10 percent reduction in natural gas prices due to expanding supplies. In other model results, emissions are as much as 1.1 percent *more*, because lower natural gas prices modestly stimulate more energy consumption and faster economic growth. These mixed results suggest that the natural gas shale revolution is not a substitute for coordinated climate change policy if governments want to mitigate future greenhouse gas emissions significantly below current levels.

Shale Gas and LNG Exports

A wide natural gas price differential currently exists between North America and other major demand centers in Europe and Asia. The United States has approved several LNG export facilities, and contracts have been signed to transport surplus production across the sea to some of these centers.[3] Results from the study suggest that near-term market conditions may be a window of opportunity for a few exporting companies. Longer term, it will be more difficult to boost these export volumes unless market conditions change. Adding LNG infrastructure costs for collecting, processing, liquefying, shipping and regasifying to the wellhead cost often make U.S. export volumes uncompetitive relative to sources delivered from other supply regions like Australia, Africa and the Middle East. Regulators in these Asian and European countries may allow some of the LNG costs to be passed through to "core" customers with limited ability to purchase other supplies, but opportunities to attract more competitive, "non-core" customers appear limited. Overall, however, US producers may find a more attractive market by looking to its North American neighbors, particularly Mexico if that country expands its gas-fired power generation and fails to adopt the institutions for encouraging more domestic drilling.

U.S. LNG exports should penetrate global markets more if future U.S. natural gas supplies should become more abundant and less costly than expected by the US Energy Information Administration and other organizations. These conditions initially widen the price gap between the United States and both Europe and Asia, relative to other supply regions participating in the LNG market. When companies add the required LNG infrastructure, the US improves its competitive advantage.

Opportunities for higher US LNG exports may also exist if Asian natural gas demand should grow more strongly, but these conditions do not change the US competitive advantage relative to other supply regions. With higher Asian demands, the price gap initially rises between the Asian demand centers and all export supply regions. The US export volumes increase but so do those from other supply

regions that are closer to the Asian demand centers. The EMF scenarios assume that China adopts policies to replace coal with natural gas use in power generation in order to improve its air quality. Additionally, Korea and Japan decide to slow their construction of new nuclear plants. We developed these simulations as an interesting side case rather than as a projection that these countries would replace coal and nuclear with natural gas. Stronger Asian (China and Korea) demand increases total U.S. exports modestly by at most 1.2 Tcf above reference values in 2035. Wellhead prices in the same year are no more than 5% above reference levels.

Several models also considered the role for US exports when Russian supplies are constrained by logistical constraints on Ukrainian pipelines[4] and higher development costs for Arctic frontier supplies. Despite the removal of Russian supplies from this simulation, results indicate that the US exporters must still compete against other supply regions and that these conditions are often not favorable to the USA playing a significantly expanded role.

Shale Gas and the Clean Power Plan

The potential for US LNG exports will also depend upon what other domestic uses for natural gas develop over this period. The U.S. Environmental Protection Agency (2015) recently promulgated a Clean Power Plan to reduce carbon pollution from the power sector by 30 percent from 2005 levels. It operates at the state level and sets a fleet average target for carbon dioxide emissions within the electric power sector but ignores emissions in other sectors. The emissions rate target would have to be met on average across all existing and new fossil generators, not by each individual unit. The target allows credits for energy efficiency improvements and non-hydroelectric renewable generation that can be traded to achieve the standard.

The EMF Working Group quickly realized that this plan could produce very different market outcomes depending upon how it was implemented: which units would be covered and the amount of coordination between states that could be achieved. Reflecting this uncertainty, participants elected to

evaluate a “generic” technology performance standard (TPS) with extensions to the emissions targets beyond 2030. A common theme that emerged from the multiple models (some of which simulated across many cases) was that gas-fired generation spiked during the 2020-2030 period before the shift towards renewable and energy efficiency dampened this effect.

This increased demand for natural gas happens during a period when current investment plans call for expanding US LNG exports. Simulations indicate that US natural gas exports could be temporarily as much as 1.0 to 1.5 Tcf less due to this utility carbon policy by 2025. This finding suggests the possibility of a conflict between the nation’s goal of exporting more natural gas and its commitment to constrain carbon emissions in the electric power sector under proposed federal policies.

Global Implications

One should not view my attempts to place bounds on the natural gas renaissance as an argument that nothing has happened since 2006. Our results clearly indicate that expanding natural gas supplies has had a dramatic impact on North American energy markets. For every 10 percent reduction in natural gas prices resulting from expanded supplies, the average model result indicates that total natural gas consumption by 2035 increases by slightly more than 5 percent, total coal consumption decreases by slightly less than 5 percent, some new nuclear plants are not built and renewable energy use declines by about 2 percent. In addition, electricity sales increase by 2 percent as a result of lower electricity prices. These changes are not insignificant and suggest an important North American energy transition is underway. If exporting the hydraulic fracturing technology (with horizontal drilling) is cheaper than exporting physical natural gas volumes across the Atlantic or Pacific oceans, this development may have major global consequences. This technology transfer will not happen quickly, however, and entrepreneurs must find the right rock formations, institutions and political climate for knowledge spillovers to be economic.

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[2] This effort is the second, two-year EMF study that builds upon the previous study summarized in the Energy Modeling Forum (2013).

[3] A number of papers explain the U.S. role in future LNG global trade. For example, see Ebinger, Massy and Avasarala (2012), EIA (2012), Medlock (2012), and NERA Economic Consulting (2012, 2014).

[4] See Richter and Holz (2015) for much more depth on the issues in modeling Ukrainian pipeline constraints.