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Center for Energy Economics and Policy
Resources for the Future

A Brief Summary of RFF's Presentations at the Shale Gas Forum in Beijing

This is a brief summary of the four presentations prepared by RFF researchers for the shale gas forum to be held in Beijing on November 15, 2012. The presentations will offer forum participants a comprehensive overview of shale gas development in the U.S. by covering the history, the environmental risk, the regulation, and the economic impact of shale gas development. The project team will write three white papers after the Forum, covering these topics. Our presentations and white papers will only briefly discuss the implications of the U.S. shale gas experience for China. A thorough investigation of China's natural gas industry and regulatory regimes is required before we can say more about the shale gas development in China.

1. A RESTROSPECTIVE REVIEW OF SHALE GAS DEVELOPMENT IN THE U.S.: WHAT LED TO THE BOOM?

What factors led to the shale gas boom in the U.S.? The answers to this question are important considerations for those countries that desire to develop a shale gas industry of their own. The late 1970s is the starting point of the development of unconventional natural gas (i.e., shale gas, tight gas, and coalbed methane) in the U.S. In the mid-to-late 1970s, there were severe natural gas shortages in many U.S. States, which led the federal government to adopt fiscal policies (e.g., tax credits) and establish R&D programs to support the search for unconventional natural gas. The R&D programs include the Eastern Gas Shale Program, Western Gas Sand Program, Methane Recovery from Coalbeds Program, and the Gas Research Institute. In addition, the U.S. also gradually deregulated the wellhead price of natural gas and mandated open access to interstate natural gas pipelines. These policies and programs laid the foundation for the development of unconventional natural gas by providing economic incentives and pushing technological improvements.

Government policies, however, did not lead directly to the shale gas boom. Instead, there was a long gestation period before the boom in shale gas development. From 1981 to 2002, entrepreneur George Mitchell's natural gas firm Mitchell Energy & Development played a critical role in developing the technologies (e.g., slick water fracking) and know-hows used to crack the Barnett play. The merge of Mitchell Energy & Development with Devon Energy, which has expertise in horizontal drilling, signaled the start of the shale gas boom. Other factors that contributed to the shale gas boom include the high natural gas prices in the first decade of this century – due mainly to the declining production of conventional natural gas – which made it profitable to develop shale gas, and Wall Street financing that followed this investment

opportunity. Of course, the magnitude of the resource base was a necessary condition, and the presence of favorable infrastructure was another important contributing factor.

2. THE ENVIRONMENTAL RISKS OF SHALE GAS DEVELOPMENT

Shale gas development has become extremely controversial in the United States because the risks to health and the environment of drilling activities are not well understood. At Resources for the Future, scholars have been examining these risks from multiple perspectives in order to provide objective scholarship that can diffuse and inform impassioned debates. This presentation will draw from that project to (i) explain the project's risk matrix which lays out the 264 "impact pathways" by which shale gas development can create risks to health and the environment, (ii) report on project findings that have identified the highest priority impact pathways for further government regulatory or industry voluntary action – experts in industry, government, NGO's and academia provided this input via a detailed survey administered on the web; (iii) report on the first ever statistical analysis of the effect shale gas exploitation in Pennsylvania has on surface water quality – both directly, through spills and run-off, and indirectly, through shipments of liquid wastes to public and industrial treatment plants that then discharge to surface waters; (iv) provide information on the issue of fugitive methane in the process of shale gas development, its global warming potential, and the impact of these emissions on the carbon footprint of natural gas extracted from shale.

Key results from these studies include: (1) In contrast to the rhetoric of the debate, there is a high degree of consensus among experts on all sides about the most important risks for further mitigation; (2) statistically significant effects were found of total suspended solids from shale gas development (probably from runoff during well pad construction) on surface waters and also significant effects on surface waters of chlorides (salts) sent to waste treatment plants and discharged by them without treatment. Notably absent is evidence of systematic spills of chemicals (proxied by chlorides) reaching surface waters; (3) If methane losses reach above three percent of production, there is general agreement that replacing coal with natural gas will increase rather than diminish global warming. New information from the industry suggests that this is unlikely, but more definitive information will be available soon. The findings on surface water do not necessarily apply to China or even other states in the U.S. Methane concerns, however, are generic and the impact pathways are comprehensive.

3. THE REGULATOIN OF SHALE GAS DEVELOPMENT IN THE U.S.

This presentation will review the federal, state, and river basin regulations that are applicable to shale gas development. We emphasize that, though significant gaps exist in the current federal laws, regulations exist in various states that cover every aspect of shale gas development, including well design, location, spacing, operation, abandonment, water/waste management and disposal, air emissions, underground injection, wildlife impacts, surface disturbance, and worker

safety. We summarize the major existing federal water (i.e., Clean Water Act and Safe Drinking Water Act), air (Clean Air Act), land (Endangered Species Act), and safety (Occupational Safety and Health Act) regulations that are applicable to the shale gas industry. We discuss how the federal laws are implemented and enforced, and what new rules the EPA is proposing to deal specifically with the new risks posed by shale gas development. We also discuss the two river basin commissions (i.e., Delaware River Basin Commission and Susquehanna River Basin Commission) that have independent authorities to regulate shale gas development.

Most of the regulations that affect shale gas development take place at the state level due to historical reasons. RFF researchers are analyzing regulations and surveying regulators in the 31 states in the continental United States that have significant shale gas reserves or where industry has shown interest in shale gas development. This state-by-state analysis covers over 20 important regulatory elements in each state. This presentation discusses the findings on some of the regulatory elements (e.g., setback restrictions from buildings, casing and cementing depths, venting, frack fluid disclosure, pit liner, wastewater transportation, etc). The presentation will also discuss the issue of federalism (i.e. how regulatory authority is divided between state and national governments) and the arguments of various stakeholders on how to improve the regulatory structure.

4. SECTORAL IMPLICATIONS OF SHALE GAS DEVELOPMENT

The shale gas boom in the U.S. is affecting the future of electricity generation, transportation and industrial growth and competitiveness. This presentation chronicles some of these effects. In the U.S., natural gas is the most flexible of fuels, being used about equally in electricity generation, residential and commercial heating and hot water, and industrial processes and products. However, lower natural gas prices caused by the shale gas revolution in the U.S. can have only limited effects on the residential and commercial sectors because these are well built out. Likewise, the effects of lower gas prices on U.S. transportation are, for the time being minimal, because the U.S. fleet is almost entirely fueled by oil products (98 percent). Nevertheless, as the presentation makes clear, the economics have become favorable to developing a fleet of LNG-fueled heavy-duty trucks, because these trucks are currently very fuel inefficient and travel significant distances every year. Thus a favorable fuel price differential against diesel fuel can rapidly – we find within three years' time – offset the higher initial cost of an LNG-fueled truck. The paper details steps that the U.S. has taken to address the "chicken and egg problem" with refueling infrastructure (i.e., no one will buy such trucks without an infrastructure in place, but no private entities will construct the refueling stations and pipelines without trucks to demand the fuel).

Effects on the electricity generation sector, however, have already been profound. For the first time ever natural gas generated the same amount of power as did coal (during a month), and companies that were using predominantly coal and/or nuclear to generate power are not moving

rapidly into natural gas. Nevertheless, with a forecast for natural gas prices to rise (albeit to levels below such forecasts before the shale gas revolution), the U.S. Energy Information Administration does not see a huge growth in natural gas against coal, nor a downtrend in CO2 emissions (although growth slows); and it sees continued growth in renewables, although with subsidies becoming more expensive. The presentation also presents our simulations of the future electricity market using RFF's own HAIKU model, a simulation of regional electricity markets and interregional electricity trade in the continental United States. Most interesting are the comparisons between states that still regulate electricity and those where prices are set competitively. The presentation also shows that industrial use of natural gas is increasing rapidly, and talk of an industrial renaissance in the U.S. is being fueled by these low natural gas prices.