The Shale Gas Revolution: US and EU Policy and Research Agendas.

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Abstract:

The "shale gas revolution" raises a host of questions for policy makers and researchers on both sides of the Atlantic. We provide a brief overview of the regulatory environment as it relates to hydraulic fracturing for natural gas in the United States and the European Union. We then pose a set of open questions, which we believe should shape policy and research agendas surrounding shale gas wherever the development of this resource is being pursued or considered.

Keywords: shale gas | hydraulic fracturing | United States | European Union | environment | energy policy

Article:

Few natural resource topics have garnered more scrutiny in recent years in North America than the "shale gas revolution" and global spillover is on the horizon. Geologists have long been aware of the presence of large amounts of methane in subterranean shale rock layers. Indeed, much of the conventional gas resources that have been exploited for well over a century were simply pockets of shale gas that had over time migrated upward and collected in easily accessible pools (often associated with far more lucrative pools of petroleum). However, until recently, shale as a source rock for extracting natural gas was deemed uneconomical by industry because unlike conventional gas, shale gas was not collected in pools but rather tightly compressed in the tiny seams within the dense layer of rock itself. The roots of the recent revolution are twofold. The first is technological: by combining innovations in horizontal drilling with the high-pressure injection of a cocktail of water, chemicals, and sand into the horizontal layer of shale at regular intervals thereby creating larger fissures ("hydraulic fracturing" or "fracking"), the industry was able to recover large volumes of methane at an acceptable cost. Second, the sustained relatively high price of natural gas sent—and in markets outside North America, continues to send—market signals to industry that there was money to be made by applying these technologies on a widespread basis.

As a result, the forced release of shale gas, once thought a pipe dream, has turned into a piped reality: an economic boon for producers, a research bonanza, a massive headache for regulators, and a hotly debated political topic, which has pitted environmentalists against industry and those who see in shale the long-elusive goal of national energy security for the United States. “Marcellus shale,” a once obscure geological reference, has entered the dinner table lexicon. Sleepy, struggling communities scattered by happenstance atop shale layers have experienced textbook hydrocarbon booms. In the European Union (EU), meanwhile, Poland's Lublin and Baltic basin are beginning to occupy similar places in the popular lexicon as the Marcellus shale in the United States, though developments there are still at the very early stages. This viewpoint assesses what all this means for policy and research agendas on both sides of the Atlantic.

Shale Gas in the United States: Fracking against All Odds?

Over the past decade, shale gas exploitation has experienced meteoric growth in the United States. In 2010, production amounted to 5 trillion cubic feet (tcf), and projections are this number will almost triple by 2035 (U.S. Energy Information Administration [EIA], 2012a). In comparison, up to 2006 common U.S. policy wisdom was that natural gas production was on permanent decline after it peaked in 1973 (U.S. EIA, 2012a). However, recent projections need to be taken with a grain of salt. The 2012 Annual Energy Outlook spectacularly lowers the technically recoverable resources largely due to a decrease in the estimate for the Marcellus shale from 410 tcf to 141 tcf. This discrepancy can be caused by changes in the market, changes in regulation/taxation schemes, or new technical/geological insights. Whereas major changes in regulation/taxation have not been reported in Pennsylvania and new technical/geological insights are often proprietary, there is evidence for significant declines in wellhead prices for natural gas since July 2008 (U.S. EIA, 2012b). There have indeed been some reports of delayed investments in new drillings due to low wellhead prices, though other reasons cannot be eliminated at this moment. This illustrates the uncertainties that are connected with the exploration of natural gas that until recently was not economically recoverable.

Though uncertainties remain, shale gas exploitation in the United States is impacting both the domestic market and markets abroad. Domestically, wellhead prices for natural gas are expected to remain below $5 per thousand cubic feet at least through 2023. Again, such projections should be viewed with a healthy dose of skepticism since they do not anticipate a possible reorientation of the U.S. economy toward gas as a transportation fuel or large-scale liquefied natural gas (LNG) exports, which would inevitably drive up domestic prices, assuming that production figures would not change. Nevertheless, current low prices are increasingly becoming an obstacle to new investments. Relatively cheap natural gas is one of the reasons why in 2035, the share of natural gas in U.S. electricity generation is expected to rise to 27 percent, from 24 percent in 2010. In the medium term, electricity prices for consumers are expected to fall as well.

Lower prices for carbon-based electricity, in turn, can have ramifications for greenhouse gas reduction targets since the surest way to reduce consumption is to raise, not lower, prices. Climate research will need to take shale's ripple effects into account. It is safe to say that research findings on this front are still being vetted by the scientific community; much work remains to be done, though some contributions on the carbon footprint of shale versus other carbon fuel sources suggest a significant role in terms of warming potential for shale (Swart & Weaver, 2012).

On a global scale, impacts of shale gas exploitation are even more difficult to assess. Some scholars predict that Russia's market dominance in Europe will be drastically reduced (Medlock, Jaffe, & Hartley, 2011). What we know is that the short-term effect of the U.S. shale gas boom has been that LNG from Qatar and other parts of the Middle East intended for terminals in North America instead found its way to Europe and Asia. Whereas this has enabled Europe to further diversify its supplies, it is worth bearing in mind that in this part of the world, natural gas is still predominantly a regional market, where the bulk of supplies are tied up in long-term contracts, and prices are influenced by, for instance, infrastructural limitations, available storage capacity, and national regulation.

The EIA expects the United States to become a net exporter of LNG in 2016. Yet the U.S. verdict on large-scale LNG exports is still out. So far, only one project has received an unrestricted license (U.S. Department of Energy, 2012). Eight other proposals have been put on hold due to a recently published EIA study on effects of exports on domestic prices that was incited by political concerns that exports would drive up domestic prices. The report seems to confirm what U.S. manufacturers and some politicians fear: LNG exports are expected to drive up domestic prices for natural gas and electricity (U.S. EIA, 2012c). These developments and political involvement make it extremely difficult to predict the future of shale gas, even in a country that has partly embraced it.

A Fractured Regulatory Environment

The uncertainties surrounding shale gas can also be demonstrated by examining differences in U.S. states' approach toward shale gas. “Early adopters” such as Texas, Oklahoma, and Pennsylvania have put out the welcome mat for shale gas producers, emphasizing economic development, job creation, and state income. The economic impacts can be witnessed when visiting seemingly forgotten towns that now have brand new hotels, improved main roads to accommodate intensive truck usage, and new barns and agricultural machinery decorating rural landscapes. Yet empirical evidence for the economic benefits so far remains thin. A study on the economic impacts of the Marcellus shale in Pennsylvania indicated that benefits were not as high as earlier predicted. Furthermore, only half of the benefits remained in the hands of local citizens, the other part flowing to landowners living elsewhere and the state (Kelsey, Shields, Ladlee, & Ward, 2011). On top of that, almost 40 percent of the workers were reported to be nonresidents. This is not surprising, given the specialized knowledge that is required in particular in the early phase of drilling and exploiting. We have to note that even among big-time producing states, significant differences in environmental regulation have been reported, e.g., between Texas and Colorado (Davis, 2012).

Other states, such as New York, Delaware, and Vermont, have been “contemplators,” reluctant to let the industry steer the process, with New Jersey passing and Vermont discussing an outright ban on shale gas exploitation.1 These states emphasize heavily contested environmental concerns over polluted drinking water, anthropogenic seismicity, and the overall carbon footprint of shale gas. Again, empirical evidence on these claims is not abundant. So far, the Environmental Protection Agency (EPA) reported one case of contaminated drinking water that was likely to be directly linked to shale gas exploitation in Pavillion, Wyoming (U.S. EPA, 2011a). Yet the first results of a broad study conducted by that same EPA on the potential impacts of hydraulic fracturing on drinking water resources are not expected before late 2012, with final results pending until 2014 (U.S. EPA, 2011b). Regarding the carbon footprint of shale gas, an often-quoted Cornell study concluded that shale gas has a significantly larger footprint than conventional gas due to methane emissions with flowback fluids and from drill-out of wells during well completion (Howarth, Santoro, & Ingraffea, 2011). Yet these conclusions have been disputed, notably by scholars of that same university, who pointed out that the analysis was “seriously flawed” and “overestimated the fugitive emissions associated with unconventional gas extraction” (Cathles, Brown, Taam, & Hunter, 2011). It is worth keeping in mind that “fugitive methane” is gas that escapes because of faulty application of long-used oil and gas drilling technologies (e.g., cracked well casings). More broadly speaking, human error, such as bad cementing of wells, chemical spills at the surface, or improper disposal of waste water all can have serious environmental effects. Effective regulation could have a significant impact on the potential for harmful incidents that have been linked to shale gas extraction.

The regulatory environment for shale gas is evolving rapidly, which is not unexpected given the attention shale has received in the media landscape. To give an example, several states have been adopting more stringent disclosure regulations on the chemicals used to exploit the natural gas, although this exercise is not near completion. Drilling companies in Texas have been required to disclose what chemicals they use starting last February, although the disclosure of quantities is still voluntary. In Colorado, drilling companies have to disclose both chemicals and quantities starting this April, with the option to claim the information to be proprietary and thus keeping it exclusive for the state regulator. Several states are following similar paths. More broadly speaking, whereas in the United States and Canada the industry appears to steer the process and market development and regulators and legislators are catching up, on the other side of the Atlantic, this sequence is not to be expected. Though a dozen companies are currently exploring the potential of European shale plays, it is unlikely they will operate with the same amount of freedom as their colleagues in North America have had.

Shale Gas in the EU: Reluctant to Dive in Head First

The 2012 Annual Energy Outlook provides data on shale gas potential in the EU as well. Unlike in the United States, European shale gas development still is in its infancy. In Poland, where government enthusiasm for shale extraction is greatest and public opposition least vocal, to date, only six wells have been drilled, with a handful of private companies researching cores to establish what amount of natural gas can eventually be commercially extracted. The EIA estimates indicate that technically recoverable shale gas resources are roughly 187 tcf, with the bulk of these resources being located in the Baltic basin, in the northwest of the country. Other substantial basins in Europe are in France (with over 150 tcf of technically recoverable shale gas spread out over the country) and Scandinavia (with comparable figures) (U.S. EIA, 2011).

Similar to the United States, EU member states are not all positively disposed toward exploitation of shale gas resources. Poland is the sole “early adopter” at this moment, and its government has been actively campaigning in Brussels and other policy forums in order to diminish the chance that opposition in other quarters of the EU would undermine Poland's development of the resource. Other countries have shown enough caution to qualify as “contemplators.” Examples are the United Kingdom (where Cuadrilla, the only company actively drilling at the moment, postponed its operations due to alleged links between shale gas exploitation and increased seismic activity in the region) and the Netherlands and several German states (where local resistance has caused governments to postpone activities until further research has been conducted). In contrast to the United States, in Europe, so far, two member states have legally banned technologies used to exploit shale gas, i.e., France and Bulgaria. The French General Council on Industry, Energy and Technology published a report in April 2011 that was used in the decision-making process, though it does not clearly propose the legal ban of technologies as such. Rather, it argues that a lack of information and transparency combined with the absence of benefits of shale gas exploration for local communities, “tips against exploiting source-rock hydrocarbons” (Leteurtrois, Duraville, Pillet, & Gazeau, 2011, p. 45). In the meantime, European institutions are busy examining whether existing regulatory frameworks are sufficient to contain the initial blossoms of European shale gas ambitions, particularly in Poland, or that additional regulations need to be designed.

Moving Forward

At least in North America, widespread shale gas development is already a reality in a number of jurisdictions, e.g., Texas, Oklahoma, Louisiana, Pennsylvania, and others. As we move forward, the fundamental question for researchers and policy makers alike is whether shale gas can be developed in an environmentally responsible way with minimal impacts on subsurface and surface water, atmosphere, and geology. Therefore, the impacts of shale must also be weighed against the current energy mix. While the costs and benefits of this technology on market prices for gas have become apparent in North America and beyond, the negative externalities of shale gas are still largely not understood. There are a number of legitimate environmental concerns surrounding the extraction of a hitherto unexploited source of hydrocarbon. These can best be summed up as open questions, which in turn should shape policy and research agendas surrounding shale gas wherever the development of this resource is being pursued or considered:

1 Can hydraulic fracturing be applied in a manner that minimizes unintentional leakages of fracking fluids and/or methane into freshwater sources above and below ground to an acceptable degree? How probable is the migration of fracking fluids and/or methane from shale layers through layers of bedrock that sit atop shale layers? Are there technological fixes to the oft-cited well casing leakage problems? What are their additional costs and is regulation necessary to safeguard their application?

2 What is the impact of natural gas obtained from shale on the climate system relative to other fuel sources, including conventional and other unconventional sources of gas, coal, and petroleum? This should take into account the increasing likelihood that low-cost gas could displace oil as a transportation fuel in certain geographic contexts.

3 What are the possible effects of large-scale shale gas development on the development of renewable energy and how does this particular fuel source fit into a grand strategy of moving toward a low carbon economy? This should constitute scenarios with binding targets for renewable energy, such as the European model, and scenarios without those binding targets, comparable with some of the U.S. states.

4 To what extent will hydraulic fracturing have seismic effects that will impact humans and increase the likelihood of fractures that lead to spills and undesired migration of fluids and/or methane?

All of these suggest that policy and academic realms stand to learn from a transatlantic exchange on the subject of shale gas. If large-scale shale gas exploitation can find its way in U.S. and EU energy markets in an environmentally acceptable fashion, both sides of the Atlantic can benefit in terms of affordable and secure energy supplies. However, many questions remain as to whether this is indeed possible.

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Note

1 The House of Representatives in Vermont approved of the proposed moratorium, with the senate expected to give its verdict this spring.

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