FRIEDRICH EBERT STIFTUNG

Unpacking the Shale Gas Revolution

DOMINIC MARCELLINO
February 2014

- Hydraulic fracturing and horizontal drilling, commonly called »fracking«, have opened vast deposits of oil and natural gas to development in the United States. The rapid development of these resources has already had economic and geopolitical effects, while the environmental and social impacts are becoming clearer as well. To date, the social implications have received the least attention.

- As fracking development is regionally dependent, each regional situation must be investigated separately to assess all the factors. Different regulatory systems and oversight, employment and economic impacts, royalty and fee regimes, property ownership structures, and prevailing socio-economic situations have to be considered.

- On current trends, natural gas will replace coal as America's largest source of energy in the next two decades. Increased use of natural gas has reduced greenhouse gas emissions by replacing some coal. Yet, the climate change effects remain unclear as more US coal is being sold abroad and on-going studies are assessing methane leakage from natural gas infrastructure.

- More domestic energy supply has improved the US's economic outlook and is encouraging inward investment and manufacturing. It has also strengthened the US's negotiating position in some negotiations (i.e. Iran). However, the long-term effects of increased production on geopolitics are unclear, as changed power dynamics could disrupt existing power structures requiring more US intervention.

Content

Introduction

The combination of two technological processes, hydraulic fracturing and horizontal drilling, has opened up vast tracts of oil and gas deposits found in shale formations across the United States. The terms »unconventional gas« and »unconventional oil« have changed in common parlance to »shale gas« and »shale oil« as quickly as these resources have been developed. US States that had not recently produced much oil or gas, North Dakota and Pennsylvania for example, are now significant sources. In terms of trade, US oil imports, as a percentage of domestic consumption, will fall from 40% in 2012 (down from 60% in 2006[1]) to 25% by 2019, before rising again slightly.[2] Where natural gas liquefaction facilities were being built last decade to import natural gas from abroad, these terminals are being retrofitted to export gas, as US natural gas production has surged with the advent of shale gas. Changes in the US energy markets have had ripple effects abroad, leading to the renegotiation of some long-term contract prices in Europe and more use of spot markets, while new fossil fuel production from the US, Canada, and elsewhere has allowed world markets to handle reductions in oil and gas exports from Iran without significant repercussions.

It comes as no surprise then that the rapid development of resources resulting in such marked economic and geopolitical effects also has substantial environmental and social impacts. Not all of these environmental and social impacts have been negative. For instance, shale gas production has put significant downward pressure on natural gas prices in the US, which has led to gas being used to replace coal for some electricity production and decreases greenhouse gas emissions from the utility sector. Despite this, many of the local environmental and social impacts are causes for concern (e.g. increased local air pollution, water pollution, industrial production in rural areas, social displacement, etc.) and they must be included in a comprehensive assessment of the implications of the shale gas revolution.

To move toward such an assessment, the Friedrich Ebert Stiftung, the German Embassy to the United States, and the Ecologic Institute held a conference in Washington DC on 3 December 2013 and took a group of American and German experts to Pittsburgh, Pennsylvania for an on-the-ground study tour. The following report pulls together the findings from the conference and study tour, begins an evaluation of these findings, and identifies areas needing additional attention or research. Not intended as the final word on the viability and acceptability of developing shale gas resources, this report is viewed rather as a starting point for future work.

1. The Economics of Shale Gas

Economically, the US and the rest of the world were taken by surprise by the shale gas boom.[3] In the middle of the last decade, the US was building infrastructure to import liquefied natural gas; the US will shortly be exporting natural gas. In terms of energy expenditures, the US's trade deficit has fallen and it has improved the US's balance of payments. Current natural gas prices are not only roiling the US electricity market (restraining costs and pushing gas into replacing coal), they are also improving the outlook for manufacturing and heavy industry dependent on natural gas as a feed stock. The US's overall economic competitiveness in these industries is likely to improve and encourage inward foreign direct investment in some areas. It remains unclear what the effects of US shale gas production will have on existing industrial investment and infrastructure in Germany, Europe, and elsewhere, but some new capital investments (e.g. chemicals, plastics, steel) may begin flowing to the US, if its natural gas production remains robust. Production gluts of natural gas and oil have led to increasing calls for exports.[4] Were large amounts of oil and/or gas to be exported, this would alter the economic effects of shale gas development.

Looking ahead, the Energy Information Administration (EIA) 2014 Annual Energy Outlook foresees continued expansion of natural gas production in the US – potentially reaching production levels 50% higher than 2012 by 2040.[5] Continually increasing production will keep price-containing pressure on natural gas in the US, provided large quantities are not exported. Assuming

1. http://www.eia.gov/oiaf/aeo/pdf/0383(2008).pdf p. 82
2. http://www.eia.gov/forecasts/aeo/er/pdf/0383er(2014).pdf
3. The same is true for shale oil. For example, US oil development is leading to the shuttering of refineries in Europe and opening the potential for US oil exports (http://www.businessweek.com/news/2014-01-07/unforseen-u-dot-s-dot-oil-boom-upends-world-markets-as-drilling-spreads).
4. http://www.startribune.com/business/238992931.html
5. http://www.eia.gov/forecasts/aeo/er/pdf/0383er(2014).pdf

limited exports, the EIA estimates that natural gas-intensive industries (e.g. bulk chemicals, metals) will maintain their recent trend of expansion for at least the next decade.[6] Expanded domestic energy production, and the replacement of imported energy with domestic supplies, will have positive macroeconomic effects as well, with manufacturing and other heavy industries benefitting from constrained natural gas prices.[7] On the electricity side, low natural gas prices have restrained wholesale and retail electricity prices, enabling the expansion of renewables in the US without noticeable price impacts. In this cost-mitigating way, natural gas could fulfil its role as a bridge fuel to a renewable future.[8]

The nationwide narrative of shale gas production – low and constrained natural gas and electricity prices, job creation, economic development, and expanded production – hide some important regional differences. The economic viability of shale gas wellheads depends in part on the geological formation from which the gas is being extracted. At current prices, some wells in Pennsylvania and elsewhere extracting gas from so-called »dry gas formations« may be operating at a loss with current prices.[9] This situation feeds into news stories about natural gas wells operating at a loss in Pennsylvania and elsewhere in order to retain natural gas leases. In Western Pennsylvania by contrast, »wet gas formations« remain profitable even at today's prices. In private conversations, an industry contact asserted that the company would turn a profit from wet gas wells at a price of under $2/m^3. An industry analyst estimated that natural gas liquids from oil production in North Dakota could be sold for around $60 a barrel.

2. Shale Gas and the Environment

Despite the rapid development of natural gas resources from shale formations in the past 7 years, the environmental effects of shale gas remain uncertain. Only in the last two years have peer-reviewed studies been published on the environmental impacts of shale gas development. Much remains uncertain; the completion and publication of a series of scientific analyses over the course of 2014 could help clarify some of the unknowns. From the regulatory perspective, shale gas development is influenced by both federal and state-level laws and regulations. An exemption from part of the Safe Drinking Water Act has allowed shale gas development to move forward without certain federal restrictions.[10] At present, the regulators of note are at the respective State-levels. While certain States (Colorado, Texas) have built-out regulatory bodies, royalty and environmental impact fee structures, etc., other States have had to start from scratch. In Pennsylvania, for example, the lack of effective regulation led in part to the creation of the Center for Sustainable Shale Development (CSSD),[11] a collaboration of industry, NGOs, and civil society to develop a responsible, voluntary structure for shale development that could serve as a temporary stand-in for comprehensive regulation. CSSD's resulting guidelines have influenced regulatory decisions in Pennsylvania and Colorado and are being considered by other countries, as they develop their own shale resources. In many areas, local communities have passed moratoria or bans on fracking, and some States have done the same.

There are several important areas to be addressed by effective environmental regulation, in order to avoid serious environmental impacts. These include: groundwater and municipal water system effects; underground wastewater injection; prevalence of well failure and well-water contamination; lack of disclosure of chemicals in fracking fluids and wastewater;[12] local traffic and air pollution impacts.

Environmental NGOs are working to address and mitigate environmental and social impacts. Suggestions for industry include: increased public disclosure of fracking

6. http://www.eia.gov/forecasts/aeo/er/pdf/0383er(2014).pdf

7. http://www.eia.gov/forecasts/aeo/er/pdf/0383er(2014).pdf

8. Provided a real plan to transition away from natural gas is also implemented.

9. Dry gas formations produce exclusively methane (or nearly exclusively); wet gas formations produce other liquid natural gases (e.g.) which can also be extracted and sold, improving the economic viability of such wells. In North Dakota, for example, where methane and other natural gas liquids are produced as bi-products of already-profitable shale oil production, the economic viability of such wells is increased further.

10. In the Energy Policy Act of 2005, the U.S. Congress provided exclusions from the Safe Drinking Water Act's Underground Injection Control rules, except in cases where diesel fuel is used. The exclusions were granted for the »subsurface emplacement of fluids« for 1. storing natural gas and 2. injecting fluids from »hydraulic fracturing operations related to oil, gas, or geothermal production activities.« http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/wells_hydroreg.cfm

11. http://www.sustainableshale.org/

12. This has been justified, in part, based on extraction companies claiming that the fluid mixtures they use are trade secrets, which they cannot be compelled to divulge to competitors. Companies are required under the Safe Drinking Water Act to report to authorities the existence of diesel fuel in underground injections. The EPA is developing quid

fluid chemicals; the establishment of regulatory structures where none or weak ones exist; giving the public a voice in decision making; and the establishment of minimum federal standards to create a reasonable minimum threshold of regulation. Several groups are also assisting in the assessment and evaluation of the unknown effects and systems issues.

In addition to the local environmental impacts, increased natural gas production in the US also has national and global environmental effects. As natural gas prices have dropped since the mid 2000s from $12/m^3$ to under $4/m^3$, lower natural gas costs have encouraged electric utilities to switch a sizable amount of electricity production from coal to gas. This has resulted in lower greenhouse gas emissions from the electricity sector. If methane leakage from shale gas development can be kept very low, natural gas could also decrease GHG emissions were it to be used to replace gasoline or diesel.[13]

Even inside this good news story, there are causes for concern from an environmental perspective. Coal not burned in the US is being exported and burned elsewhere, while only recent studies are measuring full-process methane leakage to determine whether natural gas production from shale resources really have positive effects for climate protection compared to alternatives. Engineering and technical experts from the chemicals and oil and gas industry claim that the technical challenges of capturing and limiting fugitive emissions can be met. The extent to which fugitive emissions in the shale gas extraction and transportation processes are contained is imperative from a climate change perspective, as the U.S. Energy Information Administration estimates that natural gas will overtake coal as the primary source of US electricity generation within the next two decades.[14] Were methane leaks to be contained, this shift could indicate a marked reduction in greenhouse gas emissions from the U.S. electricity sector.

13. Whether these systems can meet these low thresholds remains an open research question, one that several groups are currently studying. Were leakage to be higher than currently thought, there may not be any climate benefits from replacing coal electricity with gas turbines powered by shale gas.

14. http://www.eia.gov/forecasts/aeo/er/pdf/0383er(2014).pdf

3. Geopolitics and Shale Gas

Increased use of domestic energy supplies has clear economic implications (see Section 3), but the geopolitical implications of this trend should not be overlooked either. The share of imported energy in the US's energy mix is predicted to continue its decreasing trend. In 2005, the net use of energy imports was 30%, while that figure stood at 16% in 2012; by 2040, the net use of energy could fall to 4%. Energy imports as a proportion of total energy consumption in the US may fall to as low as 9% by 2040.[15] The value of the resources under the ground in the US is immense and is already having effects on trade and US strategic interests. Vis-a-vis Russia and Iran, the changed US energy position has strengthened its negotiating position on several issues. With onshore resources now available in large quantities, offshore fossil resources in the Arctic may remain undeveloped, while its value as a transportation corridor may increase.

Yet shale resources are not only to be found in the US. Larger resources exist in Russia and Argentina, and China also has large resources. Both economic and geopolitical motivations will encourage exploration and development of shale resources around the world. From a strategic economic perspective, the US should welcome most of these developments, as increased natural gas supplies should decrease prices for many goods and improve economic conditions with a number of key strategic partners – particularly in Europe and East Asia. Without political or environmental limitations, the economic value of existing fossil fuel resources accessible with hydraulic fracturing and horizontal drilling should be sufficient to encourage large-scale development of shale resources.

To date, the impact of shale gas and shale oil expansion has been the improvement of America's negotiating position on some issues. However, continued shale development in the U.S. combined with large-scale exploitation of these resources in other countries could change the flows of natural gas globally and roil existing power dynamics and have more significant effects in places like Russia and the Middle East. Increased global competition and lower global and regional prices for oil and gas could put pressure on public budgets in traditional petrostates (i.e. Russia, Iran) and reduce their geopolitical influence and/or lead to domestic destabilization. These changes

15. http://www.eia.gov/forecasts/aeo/er/pdf/0383er(2014).pdf

would have effects on America's geopolitical strategy and its commitments in certain regions; the same would hold for America's European and other allies. Positive geopolitical effects for America from shale gas, could produce other unintended effects elsewhere.

4. Social Considerations

Many of the (potential) negative social impacts associated with shale gas extraction and production are directly related to environmental impacts. For instance, drinking water effects, both well water and district water systems, are worrisome in terms of their human health implications. Increased heavy truck traffic produces local air pollution effects, but the traffic also deteriorates rural roadways not designed for such intensive use and results in traffic patterns unusual for some areas with the associated social effects.

When assessing social impacts from shale gas extraction, several additional components to consider are: who is filling job positions; the prevailing mineral rights ownership situation; established royalty and lease payment structures; population density as well as the existing and historical socio-economic situation. In each region, the answers to these questions will differ. In Southwest Pennsylvania, where the study tour took place, community organizers offer a narrative of shale gas development with significant negative effects for the local community that exist alongside the positive economic elements. As many of the jobs associated with shale gas well-pad and related infrastructure and processing are short-term, the high-paying and highly-technical positions are being filled by an already-trained and mobile workforce primarily coming from outside the region. Oil and gas booms from the 19th and early 20th centuries resulted in many mineral rights having been sold off decades ago; therefore, many current landowners in this part of the state have to allow drilling on their land, but other than a small payment for intrusion these people do not receive any lease payments or royalties. These payments go to the mineral rights owners, many times banks or other entities. For those that retain their mineral rights, those who signed early lease agreements are receiving significantly less per acre than later agreements; fair from a legal perspective, these differences can create social tension between »winners« and apparent »losers«.[16] Southwest Pennsylvania is primarily rural with low population density. Coal mining is one of the main industries, and the social and environmental impacts have been substantial – as have the economic and employment effects. Shale gas production has intensified industrial activity and has a larger above-ground footprint than coal mining. Further, most of the residents in these areas are low income households; the extent to which industrial players can proceed with development without input from these members of the community can exasperate concerns about social and environmental justice. Lastly, in places like Pennsylvania with limited oil and gas development in recent decades, the State's regulatory regime and sufficient staffing of regulatory agencies has trailed shale gas development, which has likely increased some social impacts. As State regulatory regimes catch up, these policy-related effects should decrease.

These conditions likely do not prevail in all areas of shale gas development, and these social effects must be weighed against the positive economic and geological effects before one concludes whether intensive shale gas development is a net positive or negative for a region. When reaching such an assessment, however, these social impacts should be included in the consideration.

5. Conclusions

The development of shale gas and shale oil resources offer a variety of benefits and challenges to the US and any other country following suit. The economic effects in the US in terms of job creation, investment, lower gas and electricity prices, an improved trade balance, and strengthened industrial competitiveness are unassailable and marked. The geopolitical implications are relevant too, and they are potentially quite important; they are neither universally positive nor predictable, which should encourage some caution in terms of American exports of gas and other considerations. In this regard, it should be remembered that the development of these resources has been pushed overwhelmingly by (domestic) economic considerations with only limited restraint as yet from federal and state-level regulations and less comparative attention to international, geopolitical aspects.

16. This is even more pernicious between those landowners who retain their mineral rights and those who do not.

As the local and national environmental effects become clearer, this may change; the same holds for geopolitical implications. From the perspective of the oil and gas industry, acting responsibly to extract, transport, and develop these resources and limit or eliminate pernicious environmental impacts is compelling. However, the local-level social impacts and secrecy about elements of the fracking process has fed concerns about exploitation and disregard for citizens and environmental impacts. Recent voluntary efforts (e.g. CSSD) and new regulatory regimes may go a long way to addressing these concerns. Local, social impacts deserve additional attention.

Significant areas of uncertainty remain. A series of collaborative analyses by university researchers, NGOs, and industry will be published in 2014 investigating many of the open questions about the environmental safety and sustainability of existing shale gas development. The outcomes of these studies will help address some uncertainties and allow for a better-informed consideration of the benefits and costs of shale gas development. While the economic and geopolitical benefits have been rightly purported by industry as well as State and federal level governments, the open questions of environmental and social impacts need to be included in ongoing discussions of existing and expanded shale gas development. The short-term and immediate geopolitical gains for the US must also be weighed against longer-term geopolitical effects for US allies and competitors; there are many potential areas for concern or friction. Going forward, several issues are clearly in need of greater attention by fracking proponents in the US; these issues include: water use and the disposal of fracking fluids; the impacts of shale gas resources on the electricity sector and US climate change regulations; and local air quality and community impacts from fracking development and new infrastructure. Ongoing research projects are investigating many of the environmental impacts; to complement this work, the geopolitical and social impacts deserve additional consideration in the near future as well.

About the author

Dominic Marcellino is a Program Director at Ecologic Institute US, a private not-for-profit think tank for applied environmental research, policy analysis and consultancy with offices in Berlin, Brussels, Vienna, and Washington DC. Marcellino's work focuses on US and EU energy and climate policy; he also coordinates the Emerging Leaders in Environmental and Energy Policy Network (ELEEP) and is the Managing Editor of the Renewable Energy Law and Policy Review.

Imprint

Friedrich-Ebert-Stiftung | International Dialogue
Hiroshimastraße 28 | 10785 Berlin | Germany

Responsible:
Anne Seyfferth, Head of the Department of Western Europe/ North America

Tel.: ++49-30-269-35-7736 | Fax: ++49-30-269-35-9249
http://www.fes.de/international/wil
www.facebook.com/FESWesteuropa.Nordamerika

To order publications:
FES-WENA@fes.de

FES Office Washington, D.C.

The Washington Office of the Friedrich Ebert Foundation promotes transatlantic dialogue in the spirit of the basic values of Social Democracy. Our programs link German and European policy debates with discourses in the United States and Canada. We also facilitate »trialogue« between transatlantic partners and representatives from other regions such as the Middle East, Afghanistan, Russia, and Turkey to develop ideas and solutions for common challenges. The FES is the only German political foundation with a Liaison Officer in Ottawa, which enables us to work more effectively and consistently on programs in Canada.

Another important element of our work is building and maintaining transatlantic networks between policymakers and representatives from think tanks, universities, civil society organizations, and trade unions. Focal points of our work are conflict transformation and democracy assistance, disarmament and non-proliferation, minorities and integration, energy and climate policy, and economic and labor relations.

Friedrich Ebert Foundation
1023 15th Street, NW | Suite 801
Washington, DC 20005

Tel.: +1-202-408-5444
Fax: +1-202-408-5537
Email: fesdc@fesdc.org
http://www.fesdc.org

EFQM
Committed to excellence

ISBN 978-3-86498-822-6