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Game Change?
The Many Faces of Today's Energy Revolution

Part III: Environmental Effects and Myopia

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Introduction

Much ado has recently been made about what has been termed the 'shale gas revolution': the boom in US unconventional gas production driven, in large part, by technological advances. The fortuitous developments in the energy sector have been discussed at length in the media, not only because of their promising economical prospects for a nation some had labeled as in decline, but also for its potential to bring about profound changes in the geopolitical landscape.

This **series of brief papers** aims to be a guide to help contextualize some of the confident claims being made in the media on today's shale gas revolution, offering a variety of factors – economic, political, security-related and environmental – to take into account in order to paint a more multidimensional view of the prospects. Both positive and negative effects stemming from the energy revolution will thus be addressed.

Part I of the series provides critical background information, offering insights on the range of energy sources involved in the revolution, the technology behind their extraction and the economical factors which have propelled the energy boom – and which could present risks of their own. **Part II** presents the geopolitical side of the story, with a detailed look at a number of countries and regions – United States, China, Russia and Europe – in turn, teasing out potential consequences of the energy revolution. **Part III**, which rounds out the series, examines the environmental effects of the energy boom on a local and global level.

This paper is the **third and final part** of the paper series. Attention is brought to the environmental side of the story: while public opposition to drilling projects often brings local environmental effects such as seismic fears and groundwater pollution into media headlines, some crucial elements are underreported. One is water scarcity and the rising competition for water usage between the extractive and other industries. Another, existentially critical, contingency is climate change: while combusting natural gas may produce lower greenhouse

gas emissions than traditional hydrocarbons, the unconventional energy heyday could reduce the sense of urgency in developing renewables, the only truly clean energy source.

Local Environmental Concerns

The arrival of the industry of shale gas or other unconventional energy extraction activity can yield immediate benefits for local communities. **Employment creation**, for instance, is high on the list: the IHS has calculated that shale gas production supported more than 600,000 US jobs (direct, indirect and induced) in 2010, while the unconventional gas industry supported 1 million jobs. By 2035, these numbers are forecasted to grow to 1,660,000 and over 2.4 million, respectively. Nevertheless, perhaps the most vociferous opposition to the extraction of unconventional resources (such as shale gas, or tar from Canada's oil sands) comes from the local population at the site of extraction, citing concerns about the environmental effects of hydraulic fracturing.

First among the worries is **water**. *Fracking* is a **water-intensive** technology[1]: in fact, the IEA estimates that the amount of water required for energy production will increase at twice the rate of energy demand from now to 2035. This increase reflects the increased share of unconventional gas in the energy mix. In areas which already experience water stress and shortages, competition may ensue between hydrocarbon extraction and other local industries, such as agriculture. In addition, if water for fracking cannot be tapped from local aquifers or other sources, it is transported in by trucks, sometimes hundreds per well – which, of course, has local impacts of its own on roads and populations along the routes.

On the other hand, **water contamination** is a recurrent fear and risk. Firstly, there is the issue of *produced water*, drilling mud, and the fracking liquids used at the well site, which often contain polluting chemicals, high levels of salt, and some radioactive elements (the latter two resurge from the rock beneath). These liquids require posterior treatment, whether in vast evaporation pools or through advanced water treatment systems. A second major concern is that water could migrate from the wells into groundwater deposits and other aquifers, contaminating drinking water with chemicals found in the fracturing liquid and hydrocarbon in various forms.

Moreover, there is a heated debate about the abovementioned chemicals: drilling firms are reluctant to disclose the **exact compositions of the chemical solutions** they add to fracking liquid, claiming the formulas are trade secrets. Environmentalists, however, claim

[1] For a more detailed look at the technologies of horizontal drilling and hydraulic fracturing, see Part I of this paper series.

the right to know what is being injected into the ground in order to analyze health risks[2]. Other local environmental concerns include the air pollution caused by particles from the wells, as well as disposal of waste rock, and **seismic events**. While the jury is still out on whether the small earthquakes that have been experienced near some natural gas drilling sites (for example in Blackpool (UK) and in Ohio (USA))[3] were caused – wholly or in part – by hydraulic fracturing, the events have led to temporary moratoria in drilling activities pending further investigation.

As described in Part II of this series, **public opposition**, whether driven by environmental concerns such as the ones described above or others, has been particularly fierce in Europe. In the US, however, particularly in the state of New York, which rests on the energy-rich Marcellus Shale, local voices are also growing louder. As much environmental regulation on gas and oil extraction is determined at state and local level in the US and at national level in Europe, **the public's worries do stand to have an impact on energy production prospects** and thus, potentially and on a smaller scale, on the geopolitical outlook.

Avoiding Myopia: The Long-Term Global Picture

Moving up one degree on the ladder and in altitude, there is the global environmental picture: the greenhouse gas emissions which flow into the world's shared atmosphere upon the combustion of hydrocarbons. Advocates of shale gas often emphasize the emission benefits of natural gas, citing that it produces 50% less greenhouse gases (GHG) emissions than traditional hydrocarbons such as petroleum. While there are some doubts as to the magnitude of this stated gap (due mainly to the energy-exhaustive technologies required in the extraction of shale gas and to the short but intensive life cycle of the greenhouse gas methane – which is produced in greater quantities in the extraction and combustion of unconventional hydrocarbons), it is held fairly widely that **using natural gas instead of other 'conventional' hydrocarbons leads to lower levels of greenhouse gas emissions**.

Though this effect is positive for global warming prospects in the short term, it is not unconceivable that the boom of non-conventional hydrocarbons may have negative effects in the long-term. **The planet's reliance on fossil fuels may be extended far further** than where it could have reached under the conditions of purported 'peak oil', due to the continuing subsidization of said fuels on the oil hand, and the diminishing costs of

[2] In the USA, the debate on this matter centers on a clause in the 2005 Environmental Protection Agency's (EPA) Clean Water Act, dubbed the '(Cheney-)Halliburton Loophole', which provides particularly lenient environmental legislation on fracking. According to Paul Steven's 2012 Chatham House report, the Loophole also weakened environmental impact assessment options significantly, both ex ante and ex post (due to lack of measured baselines).

[3] Tremors of around 2.0 on the Richter scale were measured in Blackpool in the UK, which were possibly linked to the Cuadrilla shale gas operations in the area. In Ohio, some tremors reaching 4.0 on the Richter scale were registered, which were possibly linked to the subterranean injection of drilling wastewater.

hydrocarbons such as natural gas on the other. And of course, these fossil fuels will keep causing GHG emissions, regardless even of best practice scenarios such as drastically improved fuel efficiency and avoidance of flaring[4].

> Within the IEA report which has made such a media stir of late, there is a clear message which has been far less publicized than the possible realization of the American dream of energy independence and its economical and geopolitical implications. The report also stated plainly that, without further policy changes and global carbon-cutting agreements, so many greenhouse gas (GHG) emissions are likely to be "locked-in" by 2017, that **global temperatures will no longer be able to be contained to the 2°C maximum rise** agreed to in the UNFCCC (United Nations Framework Convention on Climate Change) negotiations. Moreover, the IEA wrote that "**no more than one-third of proven reserves of fossil fuels can be consumed prior to 2050 if the world is to achieve the 2°C goal**, unless the carbon capture and storage (CCS) technology is widely deployed". In the run-up to the UNFCCC's annual meeting of the parties, COP-18 in Doha, multiple international organizations published further warnings[5].

At the beginning of this century, when global oil prices were soaring, consciousness of the climate change problem was growing, certain countries had pledged to decrease their dependence on nuclear sources, and 'peak oil' was seemingly approaching, there was an international push towards renewable energy sources. However, the rise of 'new' unconventional hydrocarbons such as shale gas, propelled forward by drastically reduced extraction costs, may very well **collapse the urgency of developing other energy sources which produce zero emissions, rather than lower emissions**.

The trends do not point in the right direction. On the one hand, **subsidies for fossil fuels** are still going strong. In fact, the IEA states that fossil fuels were subsidized by $523 billion[6] in 2011, which is almost 30% more than 2010 levels, and six times more than subsidies to renewables. This growth is contrary to the pledge made at the 2009 G20 summit, when leaders promised to phase out fossil fuel subsidies over the following ten years. On the other

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[4] With investment in improved separation and capture of gases during the initial flowback phase of each well, flaring (one of the main sources of the high GHG emissions during shale gas extraction) could be diminished drastically. (See also Part I of this series for further details on flaring and venting, which occur during the initial phases of shale gas extraction.)

[5] The World Bank has published a study showing a 20% likelihood of average global temperatures rising by more than 4°C by 2100; the World Meteorological Organization (WMO) has written that GHG emissions reached a record high in 2011, with the United Nations Environment Programme (UNEP) showing that annual GHG emissions now 14% above where they need to be in 2020; and the European Environment Agency (EEA) has provided information on the climate change damage Europe is already sustaining.

[6] This is a relatively conservative estimate: the Worldwatch Institute, for example, saw fossil fuel subsidies at over $660 billion in 2011, and estimates they will reach between $775 billion and $1 trillion in 2012.

hand, the **decreasing price of natural gas makes the naturally expensive development of renewables resources less attractive** for investors.

Collectively, the ‘cleaner’ alternatives of shale gas and its cousins may be an ominous sign for the development of renewable energy. To sum up, the combination of the decreased urgency of exploring alternative energy sources, falling hydrocarbon prices, consistently high costs of development of renewables and the continuation of fossil fuel subsidies **could mix into a toxic cocktail for global warming**.

Conclusion

Part III of this paper series has attempted to show, once more, that the current energy revolution is **not a cure-all, on national or global level**. The extraction of shale gas and other unconventional hydrocarbons can bring strong benefits to local communities, through job creation. On the other hand, however, the new technologies used by the thriving industry are hardly without risk.

A common denominator in the concerns at local level is water: both the **competition for scarce water supplies** between the extremely thirsty technology of *fracking*, and the **risk of groundwater pollution** posed by the chemicals injected while applying said technology. Seismic risks are another element of alarm, combining with the previous to strengthen the outcry in certain local communities. In a number of cases, public opinion has already led to governmental moratoria on drilling. **Local environmental concerns, therefore, are an element which cannot be ignored, and one which will certainly have to be addressed through best practices** in industry and regulation.

On the global level, the environmental perspectives are also worrying. While unconventional gas is hyped as a ‘clean’ energy source because of its lower emissions rates in comparison with fuels such as crude oil, in fact the boom in its extraction may have perverse effects on global warming. The realization that the planet’s fossil fuels reserves are much larger than previously thought and much more accessible than before (due to technological advances), could potentially remove urgency from the equation, **releasing some of the pressure to develop renewable energy sources**. **Price incentives** also come into play here: developing renewable energy is inherently expensive, and this cost is not set to fall any time soon. With natural gas prices dropping, renewable energies may simply not be economically viable. This situation is no way helped by the whopping sums of subsidies provided to fossil fuels each year, which are currently six times higher than the subsidies for renewables.

This paper series set out to hold a prism up to the current energy revolution, showing the many colors of today’s developments. Clearly, and as shown in parts I and II, the revolution

holds true transformative potential, economically and geopolitically, for the US and the rest of the world. However, it also poses many environmental risks: the planet's future path may hang in the balance. Shale and other natural gas relatives, with their benefits of lower greenhouse gas emissions, could be a promising bridge to a greener future. However, if care is not taken amidst the euphoria, they **could end up being a bridge to nowhere**.

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